UNIVERSITY OF LAGOS - NIGERIA

CONFERENCE ON AFRICAN DEVELOPMENT STRATEGIES

Theme:

Addressing Poverty in Africa:
Thinking Sustainability

CONFERENCE PROCEEDINGS

27TH - 28TH SEPTEMBER, 2023

ISBN: 978-978-62027-0-9

CONFERENCE ON
AFRICAN DEVELOPMENT STRATEGIES

UNIVERSITY OF LAGOS, NIGERIA

THEME: Addressing Poverty in Africa: Thinking Sustainability

DATE: Wednesday 27th - Thursday 28th September, 2023

TIME: 9:00am

Secretariat: +2348174380445; +2348060601893
Email: africanissues5@gmail.com
Website: www.internationalpolicybrief.org
ISBN: 978-978-62027-0-9

CONFERENCE PROGRAMME

DAY ONE: **Wednesday 27th September, 2023**

Conference Briefing via Google Meet	- 10:00am - 10:30am
Online Visual Presentation via Google Meet	- 10:30am - 1:00pm
WhatsApp Video Presentations	- 3:00pm - 4:00pm

DAY TWO: **Thursday 28th September, 2023**

Conference Briefing via Google Meet	- 10:00am - 10:30am
Online Visual Presentation via Google Meet	- 10:30am - 1:00pm
WhatsApp Video Presentations	- 3:00pm - 4:00pm

Guidelines for Manuscript Submission

Important Notice
Submitting your manuscript for assessment and publication in any of the International Journal Series means that your work has not been published elsewhere in any other journal, book or in a book chapter, be it printed online (except in the form of an abstract or an academic thesis). The editor(s) of the journal(s) have the right to edit or to alter all contribution, but authors of the submitted work will receive proof before the publication of their work.

Submission of Manuscripts
Manuscript should be submitted to the Editor in Chief, typed in English with Times New Roman font size 12, doubled space with 1" margin at all sides of A4 paper. Manuscripts should not exceed 14 pages. Articles for publication should be sent to the Editor, International Standard Research Publishing through the journal.

E-mail: africanissues5@gmail.com

Manuscript should be legibly written with clear symbols, drawings, photographs, chemical structures to ensure clarity and easy reproduction. Authors are urged to pay attentions to tables, figures and references which should be done in the correct format and appropriately cited in the main text.

Format of Paper
The paper should include: Title, author(s) name(s) (surname in full) and address (es), an abstract not exceeding 250 words, a few key words and the main paper. The main paper should have an Introduction, Materials and Methods, Results and Discussion, Tables and Figures, Plates, Conclusion, Acknowledgment, References. If the paper has more than one author, the first on the list is the Correspondence author.

References
The reference style should be APA format.

Review Process
Articles for publication will be peer reviewed by 2 or 3 reviewers to ensure accuracy. Guided by the reviewer's comment on a paper, the decision of the Board is final.

Charges
Upon acceptance of a paper for publication, the corresponding author must submit the corrected paper and pay a publication fee of 100USD only for online and hard print publication; and USD50 for only online publication. Corresponding authors shall receive one copy of the published Journal and could also download articles from the Journal's website.

Publication Ethics and Publication Malpractice Statement
Publication decisions: The editor is responsible for deciding which of the articles submitted to the journal should be published. The editor may be guided by the policies of the journal's editorial board and constrained by such legal requirements as shall then be in force regarding libel, copyright infringement and plagiarism. The editor may confer with other editors or reviewers in making this decisions.

Confidentiality: The editor and any editorial staff must not disclose any information about a submitted manuscript to anyone than the corresponding author, reviewers, potential reviewers, other editorial advisers, and the publisher, as appropriate.

Institutional website: **www.internationalpolicybrief.org**

CONTENTS

	Paper Title/Author(s)	
1	**Cultural Hydrolysis Of Sugarcane Bagasse For Bio – Ethanol Production** [1]Abdulkadir, M., [2]Kashari, O., [3]Arzika, S & [4]Ehiwario, N. J	1
2	**Determinants Of Profitability In Listed Nigerian Conglomerate Sector** [1]Ismail Abdul-khadir Musa, [2]Muhammed Nma Munirat, & [3]Kolawole Babajide	9
3	**The Role of Planning in Achieving Organization's Efficiency And Effectiveness** [1]Ademulegun Olatunji Stephen & [2]Atiku Muhammad Gwandu	28
4	**Effect of Exercise on Blood Sugar Level: A Case Study of Wukari Table Tennis Club Players** [1]Imo, Chinedu, [2]Ikwebe, Joseph, [3]Ameh, Sunday Ojonugwa, [4]Tatah, Verwiyeh Silas, [5]Shaibu, Christopher Ojomugbokenyode, [6]Abu, Michael Sunday, [7]Boyi, Richard-Harris Nsenreuti, [8]Yohanna, Emochone Roy, [9]Ugwuoke, Kenneth Chinekwu & [10]Magaji, Isaac Massemah	43
5	**Effect of Ethanolic Extracts of *Dennettia Tripetala* Seed and Fruit on Blood Sugar Level of Male Albino Rat** [1]Imo, Chinedu, [2]Ikwebe, Joseph, [3]Imo, Nkeiruka Glory, [4]Mayel, Mida Habila, [5]Ayo, Victoria Ifeoluwa, [6]Timothy, Mgbede, [7]Shadrach, Philip, [8]Muhammad, Zuhairah Ismail, & [9]Huseni, Precious Maina	50
6	**Bitter Leaf (*vernonia Amygdalina*) Extract as a Means of Extending the Shelf Life of Locally Brewed Sorghum Beer** [1]Ikwebe, Joseph, [2]Imo, Chinedu, [3]Imo, Nkeiruka Glory, [4]Mayel, Mida Habila, [5]Ayo, Victoria Ifeoluwa, [6]Timothy, Mgbede, [7]Shadrach, Philip, [8]Muhammad, Zuhairah Ismail, & [9]Adams, Christiana	57
7	**A Microbial Technology: Can a Bread Fungus (*Rhizopus stolonifer*) Play Role as Entomopathogenic against American Cockroach (*Periplaneta americana*)?** Ahmed, U. A.	66

CONTENTS

	Paper Title/Author(s)	
8	**The Impact of Management Information Systems on Organizations Performance of School of Nursing and Midwifery, Birnin Kebbi** [1]Halima Muhammad Bande, [2]Olatunji Stephen Ademulegun & [3]Olasumbo Grace Ademulegun	71
9	**Investigative Study of Effective Information System Implementation In Nigerian Tertiary Institutions: A Case Study of Selected Tertiary Institutions in Edo State.** [1]Musah A. Abubakar [2]Akhuewu D. Emoata & [3]Abas Aliu	185
10	**The Impact of Liquidity Management on Financial Peformance of Insurance Firms in Nigeria** [1]George Charisma & [2] Resident. C. F. Victor	100
11	**Production and Optimization of Sugar Apple Seed Oil, As a Sustainable and Economically Viable Alternative to Other Commercial Oils.** [1]Alheri A. [2]Ago M. A. [3]Jamila U. A. [4]Joshua Y., [5]Anyanwu S. K., [6]Nwakife N. C., [7]Makanta S. A, [8]Longbap, B. D., [9]Gani J. & [10]Aisha K. U	108
12	**Chemotherapeutic Activity of *Cassia Fiscula (linn)* Leaves Extract as Antidiarrheal and *in Vitro* Antibacterial Potential** [1]Isaac John Umaru, [2]Kerenhappuch Isaac Umaru, [3]Tyem Lawal Danjuma, [4]Asuelimen Steve Osagie, [5]Ebenezer Morayo Ale, [6]Moses Adondua Abah, [7]Mgbede Timothy & [8]Victoria Ifeoluwa Ayo	120
13	**Antibacterial Activity of Isolated Pure Compounds from Three Medicinal Plant *Barringtonia Asiatica*, *Barringtonia Racemosa* and *Leptadenia Hastata Plants*** [1]Isaac John Umaru, [2]Kerenhappuch Isaac Umaru, [3]Tyem Lawal Danjuma, [4]Asuelimen Steve Osagie, [5]Ebenezer Morayo Ale, [6]Moses Adondua Abah, [7]Mgbede Timothy & [8]Victoria Ifeoluwa Ayo	135
14	**The Jukun People of Nigeria: A Conceptual and Ethnographical Analysis of The Composition of The People** Mordakai Sule Dansonka	146

CONTENTS

Paper Title/Author(s)

15 **Evaluating The Role of Social Investment Program in Enhancing Economic Empowerment in Biu, Borno State**
[1]Ibrahim Kabiru Maji, & [2]Abdurrahman Muhammad Lele 160

Book of Proceedings

CULTURAL HYDROLYSIS OF SUGARCANE BAGASSE FOR BIO – ETHANOL PRODUCTION

[1]Abdulkadir, M., [2]Kashari, O., [3]Arzika, S & [4]Ehiwario, N. J
[1-3]Department of Science Technology, College of Science and Technology
Waziri Umaru Fed. Polytechnic, Birnin Kebbi, Kebbi State
[4]Department of Biological Sciences, Delta State University of Science and Technology, Ozoro, Delta State

Abstract
Depleted supplies of fossil fuel, regular price hikes of gasoline, and environmental damage have necessitated the search for economic and eco-benign alternative of gasoline. Ethanol is produced from food/feed-based substrates (grains, sugars, and molasses), and its application as an energy source does not seem fit for long term due to the increasing fuel, food, feed, and other needs. These concerns have enforced to explore the alternative means of cost competitive and sustainable supply of biofuel. Sugarcane bagasse could be the ideal feedstock for the second-generation ethanol production. In this research work, ethanol was produced from sugarcane bagasse and this production involves the pretreatment of the bagasse by milling, hydrolysis using Aspergillus niger, fermentation using two strains of Saccharomyces cerevisiae (Baker's and Brewer's yeast), and distillation. Four different concentrations of the bagasse (6mg/ml, 8mg/ml, 10mg/ml and 12mg/ml) were used and the amount of ethanol produced was assessed my measuring the weight of the substrates for four consecutive days because according to Martin et al. (2002) weight is a key parameter in the assessment of ethanol production because as ethanol production proceeds, weight of substrate reduces. The maximum yield of ethanol was obtained at 12g/ml in both of the two yeast (Baker's yeast and brewer's yeast) having yields of 5.2 and 6 respectively with brewer's yeast having the highest yield which proves that the higher the concentration of the substrate, the higher the ethanol yield and also proves that brewer's yeast have higher ethanol production capacity than baker's yeast.

Keywords: fossil, fuel, hikes, gasoline, Ethanol, produced, feed-based, explore, alternative, biofuel, Sugarcane-bagasse

Background to the Study

Bio-fuel has been a source of energy that human beings have used since ancient times. Increasing the use of bio-fuels for energy generation purposes is of particular interest nowadays because they allow mitigation of greenhouse gases, provide means of energy independence and may even offer new employment possibilities. Bio-fuels are being investigated as potential substitutes for current high pollutant fuels obtained from conventional sources. The quest for alternative energies has provided many ways to produce electricity, such as wind farms, hydropower, or solar cells. However, about 40% of the total energy consumption is dedicated to transports and in practice requires liquid fuels such as gasoline, diesel fuel, or kerosene. These fuels are all obtained by refining petroleum. This dependency on oil has two major drawbacks: burning fossil fuels such as oil contributes to global warming and importing oil creates a dependency on oil producing countries (Bommarius *et al*., 2008).

Also it has been estimated that the decline in worldwide crude oil production will begin before 2010. They also predicted that annual global oil production would decline from the current 25 billion barrels to approximately 5 billion barrels in 2050. Because the economy in the US and many other nations depends on oil, the consequences of inadequate oil availability could be severe. Therefore, there is a great interest in exploring alternative energy sources). Unlike fossil fuels, ethanol is a renewable energy source produced through fermentation of sugars. Ethanol is widely used as a partial gasoline replacement in the US. Fuel ethanol that is produced from corn has been used in gasohol or oxygenated fuels since the 1980s. Using ethanol-blended fuel for automobiles can significantly reduce petroleum use and exhaust greenhouse gas emission (Silverstein *et al*., 2007).

A great amount of research has been conducted on corn to achieve higher ethanol yields or to increase values of the byproducts. Seed companies have made a great effort to develop corn hybrids with higher starch contents or higher extractable starch contents to increase ethanol yields (Boussarsar *et al.,* 2009). Utilizing both starch and fiber in the grains and increasing starch loading are also the major focus to achieve high ethanol yields.

Nigeria has a population of over 150 million persons, land area of 923,768Km^2, arable land constituting about 56% and vegetation ranging from Sahel Savanna in the extreme North to Swamp Forest in the coastal South (Akande, 2007). Rising cost of fossil fuel-based petroleum products has made the product unaffordable to the rural dwellers that constitute about 70% of the population. Most parts of Nigeria are suitable for biofuels crops cultivation and so the country cannot afford to be left behind in the recent quest by even the highly industrialized nations of the world for renewable sources of energy. The use of sugarcane bagasse as feedstock exists locally and would not compete with staple food, however, it has barely been exploited for bioethanol production. Several research have been carried out on the hydrolysis of plant materials with chemicals such as H_2SO_4, NaOH e.t.c which are expensive for the production of ethanol, but little has been done on the hydrolysis of these plant materials with microorganisms (cultural hydrolysis) such as *Aspergillus niger* which is cheap and readily available. Which is why this research is carried out to produce ethanol

(biofuel) from sugarcane bagasse by hydrolyzing with *Aspergillus niger* and this study of bioethanol production from locally obtained sugarcane bagasse would provide industrialists a feedstock base to set up a bioethanol production plant in Kebbi state of Nigeria.

Sugarcane was introduced into Nigeria in the 15th century for the purpose of chewing and feeding cattle's. However, despite the realization that bioethanol will serve as perfect alternative energy source to replace the existing energy sources, product is still not available in commercial quantities in developing nations like Nigeria. This study, therefore, focuses on the production of bioethanol from the hydrolysis of sugarcane bagasse and millet that is readily available in Birnin Kebbi in large quantities as a waste and food respectively with *Aspergillus niger* which is also cheap and readily available as substrates. The use of waste biomass such as sugarcane bagasse to generate energy can reduce problems associated with waste management such as pollution, greenhouse gaseous emissions and fossil fuels use (Camargo *et al.,*2012). The study further improves the possibilities of exploiting sugarcane bagasse as potential substrates for bioethanol production of commercial interest. The aim of this research work is to produce Ethanol from the hydrolysis of sugarcane bagasse using *Aspergillus niger*. *Aspergillus niger* isolated from the soil, which will be use to hydrolyze the sample solution and the hydrolyzed sample will be fermented with *Saccharomyces cereviceae*

Methodology

Collection of Sugarcane Bagasse

The sugarcane bagasse was collected, and millet was purchased from Birnin Kebbi Central Market, Kebbi State Nigeria. It was collected in a clean polythene bag and was transported immediately to the Microbiological Laboratory of the department of Science Laboratory Technology, Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State. The sugarcane bagasse was sundried for a period of 5 days until it is completely dried and then it was grinded to powder form using a miller. After grinding, it was sieved using a sieve with a mesh size 0.2mm.

Collection of Soil Sample

The soil sample was obtained in Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State after which it was transported immediately to the Microbiological Laboratory of the department of the department of Science Laboratory Technology, Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State for the isolation of *Aspergillus Niger*.

Isolation of *Aspergillus Niger*

Isolation of *Aspergillus Niger* was performed by serial dilution. 9 test tubes were filled with 9ml distilled water each then 1g of the soil sample was measured and transferred into the first test tube labeled (10^{1}), then 1ml was picked from the first test tube using a syringe into the second test tube labeled (10^{2})and this procedure continues until the last test tube labeled (10^{9}) after which 1ml was transferred from the last test tube into the already solidified Potato Dextrose Agar medium (PDA) which was then incubated at 28°C for 48hours. Thereafter,

streptomycin was added to the PDA at 0.05mg/m to inhibit the growth of bacteria. Cultures were obtained and identified by morphological structures using lactophenol and viewed under x100 lens (Hernández-Salas, 2009)

Microbial culture Hydrolysis

20g of the sample was measured using weighing balance and poured into 300ml of distilled water in a conical flask. The same procedure was repeated for 25g, 30g and 35g then the mixtures were heated at 90°C for 15 minutes in water bath and was allowed to cool off before inoculation. After cooling, the solutions were filtered separately using double layered muslin cloth then later filtered through No 1 Whatman filter paper. After filteration, *Aspergillus Niger* was inoculated into each conical flasks and the mouth of each flask was cocked using cotton wool wrapped in aluminum foil. The flasks were kept at room temperature and shaken in an electric shaker for 4 days to produce homogenous solution (Hernández-Salas, 2009).

Quantification of Reducing Sugars

The reducing sugars were estimated by using DNS (Dinitrosalicyclic acid) reagent. The glucose standard was prepared by dissolving 0.1g of glucose into 100 cm3 of distilled water, 10cm3 portion of the first standard was pipetted and transfer into another 100 cm3 volumetric flask and made to the mark using distilled water. To each test tube 3 cm3 of DNS reagent was added. The content of each tube was placed in boiling water bath for 10 min to develop red brown colour. Then 1 cm3 of 40% potassium sodium tartrate solution was added to stabilize the colour while hot then cooled at room temperature. The absorbance was measured at 508nm with a UV-visible spectrophotometer (Ensinas *et al.,* 2009).

Fermentation using yeast (*Saccharomyces cereviceae*)

Each of the solutions were divided into 3 containers each making it 12 containers (100ml for each) and the containers were labeled A – L respectively. Four of the containers (one for each concentrations) were inoculated with *Saccharomyces cereviceae*, another four were inoculated with Baker's yeast while the last four were inoculated with Brewer's yeast and the mouth of the conical flasks were covered with cotton wool wrapped in aluminium foil. All the flasks were incubated on a shaker incubator at room temperature (28°C ± 2°C) for four days for fermentation to take place. Measurement were taken for 4 consecutive days and recorded (Ballesteros, 2004)

Distillation

5g of calcium oxide powder was added to 250ml of distillate before distillation which was carried out with a distillation apparatus set up for each of the fermented broth. The fermented liquid was transferred into round bottom flask and placed on a heating mantle fixed to a distillation column enclosed in running tap water. Another flask was fixed to the other end of the distillation column to collect distillate at78°C which is the standard temperature for ethanol production (Canilha *et al.,*2011)

Results and Discussions

Table 1: shows results for the yield of ethanol obtained after distillation of sugar cane bagasse substrate.

Types of yeast	Concentration of Substrates in (g)			
	35	30	25	20
Bk	31.32	12.04	3.01	1.20
Br	36.14	12.04	3.01	1.20

Keys:

Bk = Baker's yeast

Br = Brewer's yeast

Fig. 1: Shows the estimations of reducing sugar/ Time of fermentation

Table 2: Shows results of the changes in weight of the substrate during and after fermentation with both baker's and brewer's yeast.

Conc. of Solutions (g)	Types of Yeast							
	Baker's yeast				Brewer's yeast			
	D1	D2	D3	D4	D1	D2	D3	D4
35	131.4	130.9	130.8	128.6	143.1	142.7	142.6	141.7
30	127.9	127.1	127.0	125.6	153.3	152.6	152.5	150.7
25	103.0	102.7	102.6	101.3	109.9	109.8	108.7	108.6
20	68.80	68.67	68.62	65.22	62.00	61.80	61.20	60.51

Keys

D1 = Day 1

D2 = Day 2

D3 = Day 3

D4 = Day 4

Discussion

This research was carried out to produce ethanol from sugarcane bagasse by hydrolyzing with *Aspergillus Niger* and fermenting with two (2) *Saccharomyces cerevisiae* strains. The production of ethanol from agro-waste derived from sugarcane (sugarcane bagasse) involves the pretreatment of the agro-waste by milling, using *Aspergillus Niger* for hydrolysis to remove the lignocellulosic component to expose the simple sugars which the yeast can utilize. This hydrolysis method was followed by a four days' alcoholic fermentation brought about by two *Saccharomyces cerevisiae* strains (baker's and brewer's yeast) which utilizes the sugar content of the agro-waste as nutrients and ends up converting the sugar to ethanol under anaerobic condition. The yeast undergoes several physiological changes during the fermentation process. There is a buildup of unsaturated fatty acids and sterols at the start of fermentation, which are vital nutrients for the yeast. The yeast consumes these nutrients and depletes the amount of sugar as the fermentation progresses. Fermentation

was considered complete when the supply of sugar was almost completely converted to ethanol.

The results of the ethanol yield from four different concentrations (20g/300ml, 25g/300ml, 30g/300ml, and 35g/300ml) were shown in table1. Ethanol yields on substrates made from 20g, 25g, 30g, and 35g of sugarcane bagasse powder using Baker's yeast were 1.20, 3.01, 12.04, and 31.32, respectively while that of Brewer's yeast are 1.20, 3.01, 12.04 and 36.14 respectively. There was no significant difference in ethanol fermentation performance among the substrates made from 20g, 25g, and 30g of both yeast but there is a significant difference between the yields from the substrates made from 35g of the sugarcane bagasse. There is a maximum ethanol yield at 35g/300ml in both of the two yeast (Baker's yeast and brewer's yeast) having yields of 31.32 and 36.14 respectively with brewer's yeast having the highest yield. It was observed that at all concentrations of the substrates; the ethanol yield increased steadily reaching the peak at 96hrs (day 4) of fermentation.

The results of the changes in weight of the substrates during and after fermentation are shown on Table 2. Kinetics of ethanol production was studied using fermentation on rotary shakers. Glucose content, ethanol concentration, and weight loss, were measured during and after the fermentation process. According to Martin *et al*. (2002) during fermentation, carbondioxide escapes from the solution leading to ethanol production. Therefore, the weight loss from CO_2 evolution could be a useful indicator for ethanol yield, especially in laboratory scale fermentation tests in Erlenmeyer flasks on rotary shakers. Several researchers reported the use of weight loss from escaped CO_2 to monitor the ethanol fermentation process (Dien *et al*., 2002). Joekes *et al.* (1998) showed that weight of fermentation mashes keeps on decreasing until the last hour of fermentation, which is in agreement with the result obtained from this research on millet chaffs. Thus, the weight loss during ethanol fermentation also reveals the rate of the fermentation process. Monitoring the weight loss during a shaking-flask fermentation process can be a convenient way to predict the ethanol yield and determine the end point of the fermentation process. It is especially helpful when we evaluate new samples for ethanol yield using the shaking-flask test and do not have enough information about the chemical compositions or history of pretreatment.

Conclusion

The result of this study shows that agricultural waste such as sugarcane bagasse known to contain sugar is a good substrate for ethanol production. Therefore, the findings of this work provides evidence that ethanol can be produced from agricultural wastes rather than allowing it to contribute a nuisance to the environment. Also, pretreatment as well as hydrolysis can also be carried out using microorganisms such as *Aspergillus Niger* which is readily available and can easily be isolated from the environment as a substrate instead of acids. There is a maximum ethanol yield at 35g/300ml in both of the two yeast (Baker's yeast and brewer's yeast) having yields of 31.32 and 36.14 respectively with brewer's yeast having the highest yield which proves that the higher the concentration of the substrate, the higher the ethanol yield and also proves that brewer's yeast have higher ethanol production

capacity than baker's yeast. Finally, the result of this research work shows the relevance of weight loss in substrate as a key parameter for the assessment of fermentation rate and predicting ethanol yield.

Recommendation

Based on the results obtained from this research work, the following are recommended.

1. There should be the development of an environmentally friendly pretreatment procedure.
2. Further studies should be carried out on the use of highly effective enzyme systems for conversion of pretreated waste to fermentable sugars.
3. Other effective microorganism to convert multiple sugars to ethanol should be investigated.

References

Akande, A. (2007). Bridging East and West: Millet on the move, *Science*. 325(5943), 942–943.

Ballesteros, I. (2004). Selection of thermotolerant yeasts for simultaneous saccharification and fermentation (SSF) of cellulose to ethanol, *Applied Biochemistry and Biotechnology*. 28-29, 307-315.

Bommarius, A. S., Katona, A., Cheben, S. E., Patel, A. S., Ragauskas, A. J., Knudson, K. & Pu, Y. (2008). Cellulase kinetics as a function of cellulose pretreatment, *Metabolic Eng*. 10, 370-381.

Boussarsar, H., Rog´e, B. & Mathlouthi, M. (2009). Optimization of sugarcane bagasse conversion by hydrothermal treatment for the recovery of xylose, *Bioresource Technology*, 100(24), 6537–6542.

Camargo, F. A., Innocentini-Mei, L. H., Lemes, A. P., Moraes, S. G. & Duran, N. (2012). Processing and characterization of composites of poly(3-hydroxybutyrateco-hydroxyvalerate) and lignin from sugar cane bagasse, *J. Compos. Mater*. 46, 417-425.

Canilha, L., Santos, V. T. O. & Rocha, G. J. M. (2011). A study on the pretreatment of a sugarcane bagasse sample with dilute sulfuric acid, *Journal of Industrial Microbiology and Biotechnology*, 38, 1467–1475.

Dien, B. S., Bothast, R. J., Iten, L. B., Barrios, L. & Eckhoff, S. R. (2002). Fate of Bt protein and influence of corn hybrid on ethanol production, *Cereal Chem.* 79, 582-585

Ensinas, A.V., Modesto, M., Nebra, S. A. & Serra, L. (2009). Reduction of irreversibility generation in sugar and ethanol production from sugarcane, *Energy*, 34(5), 680–688.

Hernández-Salas, J. M. (2009). Comparative hydrolysis and fermentation of sugarcane and agave bagasse, *Bioresource Technology*. 100, 1238-1245.

Joekes, I., Moran, P. J. S., Rodrigues, J. A. R., Wendhausen, R., Tonella, E. & Cassiola, F. (1998). Characterization of *Saccharomyces cerevisiae* immobilized onto chrysolite for ethanol production, J. *Chem. Technol. Biotechnol.* 73, 54-58.

Martín, C., Galbe, M., Wahlbom, C. F., Hahn-Hägerdal, B. & Jönsson, L. J. (2002). Ethanol production from enzymatic hydrolysates of sugarcane bagasse using recombinant xylose-utilizing Saccharomyces cerevisiae, Enzyme *and Microbial Technology.* 31, 274–282.

Silverstein, R. A., Chen, Y., Sharma-Shivappa, R. R. & Boyette, M. D. J. (2007). A compares of chemical pretreatment methods for improving saccharification of cotton stalks". *Bioresour. Technol.* 98, 3000-3011.

DETERMINANTS OF PROFITABILITY IN LISTED NIGERIAN CONGLOMERATE SECTOR

[1]Ismail Abdul-khadir Musa, [2]Muhammed Nma Munirat, & [3]Kolawole Babajide
[1&2]Department of Business Admin, & Mgt, Federal Polytechnic, Nasarawa
[3]Department of Accountancy, Federal Polytechnic, Nasarawa

Abstract

This study investigates the determinants of profitability in the context of listed conglomerate firms in Nigeria, recognizing their pivotal role in the nation's economy. Given the considerable variability in the profitability of these firms over the years, the research focuses on firm size (FSZ), financial leverage (FLEV), sales growth (SGR), and firm age (AGE) as potential determinants of profitability of these firms. Three out of seven conglomerate firms are conveniently sampled due to data availability, ensuring data integrity through rigorous error checks and correction. Using a longitudinal panel data design spanning from 2013 to 2021, this study draws data from the Nigeria Exchange Group (NGX) and employs a fixed effect panel regression model to account for firm-specific effects. The findings revealed that firm size was the most significant determinants of profitability, with larger conglomerates demonstrating higher returns on assets (ROA). Conversely, financial leverage, sales growth, and firm age do not exhibit statistically significant effects on profitability. In light of these results, conglomerate firms in Nigeria are advised to explore strategies for expanding their size, whether through organic growth, mergers, acquisitions, or diversification, to potentially enhance profitability. Prudent leverage management remains crucial, but significant changes may not be necessary; prioritize retaining and building loyalty among existing customers, alongside consideration of other strategic factors such as market positioning and innovation, rather than sole reliance on age-related strategies.

Keywords: *Firm size, financial leverage, firm age, sales growth, returns on assets*

Background to the Study

Conglomerate firms in Nigeria play a pivotal role in the country's economy, contributing significantly to employment opportunities, foreign exchange earnings, and overall economic growth (CBN, 2023). However, the profitability of listed conglomerate firms in Nigeria has exhibited considerable variability over the years (Olusola et al., 2021). Gaining insights into the determinants of profitability in this sector is imperative for investors, policymakers, and managers to make well-informed decisions, improve firm performance, and bolster the country's overall economic stability. The profitability of conglomerate firms is influenced by a multitude of factors, including firm size, leverage, sales growth, and firm age (Khaksar & Kamali, 2012; Olusola et al., 2021). Firm size, measured by various indicators such as revenue, assets, or market capitalization, can significantly influence profitability. Large firms may benefit from economies of scale and have access to more resources, but they might also face challenges related to bureaucracy and inflexibility (Barnett, 2000). Small firms while more agile, might struggle to compete in terms of resources and market share (Davidsson et al., 2004).

Leverage, often represented by a firm's debt-to-equity ratio, can impact profitability by affecting interest payments and financial risk (Khaksar & Kamali, 2012). Highly leveraged firms may face higher interest expenses, which could reduce profitability. Conversely, moderate levels of leverage might optimize capital structure and enhance profitability (Modigliani & Miller, 1958). Sales growth triggers increased investment in current assets, especially in expanding production and inventory to meet rising demand. It can significantly impact profitability by boosting revenue through expanded production and increased demand (Sawa, 2009). However, challenges in managing customer accounts and extending credit can strain cash flow and jeopardize profitability. Striking a balance with a prudent expense strategy is vital to efficient financial management while awaiting accounts receivables settlement. When managed effectively, sales growth can ultimately enhance profitability (Ali et'al., 2019). The age of a firm is often associated with its experience, market penetration, and adaptability to changing business environments. Older firms may have established customer bases and supply chains, which could positively impact profitability (Barnett, 2000). On the other hand, younger firms might be more agile and innovative, potentially gaining a competitive edge (Davidsson et al., 2004).

While these factors have been widely discussed in the context of firm performance and profitability, both in Nigeria and globally, there is a notable research gap specific to manufacturing conglomerate firms in Nigeria. Existing studies in Nigeria have primarily focused on the broader determinants of firm profitability, often neglecting the nuances of the manufacturing conglomerates sub-sector (Olusola et al., 2021). Consequently, there is a lack of comprehensive research that examines the interplay between firm size, leverage, sales growth, and firm age as determinants of profitability in this specific industry.

This research aims to bridge this gap by providing empirical evidence and insights into the unique factors shaping profitability within Nigeria's conglomerate sector. Specifically, the study seeks to:

1. Examine the impact of firm size on the profitability of listed conglomerate firms in Nigeria.
2. Investigate the relationship between financial leverage and the profitability of listed conglomerate firms in Nigeria.
3. Assess the effect of sales growth on the profitability of listed conglomerate firms in Nigeria.
4. Analyze the influence of firm age on the profitability of listed conglomerate firms in Nigeria.

The findings of this study will contribute to a deeper understanding of the conglomerate sector in Nigeria, enabling stakeholders to make informed decisions that can enhance firm profitability, promote sustainable growth, and ultimately benefit the Nigerian economy.

Literature Review

Conceptual Framework

Profitability

Profitability is a key indicator of a firm's effectiveness and efficiency in achieving its financial goals, as it reflects firms' ability to manage resources and maximize shareholders' wealth (Karamoy & Tulung, 2020; Fatihudin et al., 2018). It encompasses various aspects, including managing assets, finances, equity, revenues, and expenses, to drive growth and value for shareholders (Naz et al., 2016). Stakeholders often use profitability to assess a firm's strengths and weaknesses (Baba & Nasieku, 2016; Nzuve, 2016). External evaluation of a company frequently hinges on its profitability, which affects financial statements and reports (Omondi & Muturi, 2013). Investors conduct in-depth analyses to gauge a firm's profitability, often relying on internal information from financial statements (Purwanto & Agustin, 2017). Profitability metrics, including Return on Equity (ROE), Return on Investment (ROI), Earnings per Share (EPS), Gross Operating Profit (GOP), and Return on Asset (ROA), help assess financial performance (Asadifard et al., 2023; Kabajeh et al., 2012; Chasmi & Fadaee, 2016). ROE measures earnings available to firm owners based on invested capital (Asadifard et al., 2023). ROI evaluates a company's profitability and its ability to generate profits from investor funds (Pandey, 2013). EPS indicates earnings per share and shareholder value (Laila & Akhter, 2021). GOP reflects operational efficiency (Ciptawan & Frandjuga, 2022), while ROA assesses a firm's ability to generate profits from available assets (Elali et al., 2013).

In this study, ROA was chosen as the primary measure of profitability, in line with previous research, due to its effectiveness in assessing a firm's ability to convert assets into income (Muthuri, 2020; Habib, 2023). ROA measures a firm's efficiency in managing assets to generate profits (Mehrotra, 2022).

Firm Size

Firm size is defined as the quantity and range of production capacity and ability that a firm possesses or the amount and variety of services that a firm can supply concurrently to its clients (Ramezani & Alan, 2010). Total assets are one of the most common indicators of an

organization's worth (Bashir & Asad, 2018). However, most firms use sales income, and the number of workers to determine their size (Abiodun, 2017; Wahome et al., 2015). Firm size is a major element in determining a corporation's profitability because of the notion known as economies of scale (Niresh & Velnampy, 2014). This means that larger corporations can produce products at significantly cheaper costs than smaller firms. Increased firm scale reduces marginal costs in the area of production when economies of scale are at their maximum. Larger companies have a competitive advantage due to the benefits of economies of scale, which may be obtained through large purchases of products and services. As a result, such firms may provide high-quality goods at a lower cost than their competitors.

Financial Leverage

Financial leverage involves using debt (both short-term and long-term debts) and equity to finance a company's operations, impacting both shareholders and creditors (Chesang, 2017). It could amplify returns on capital if investments funded by debt outperform interest costs (Brigham and Gapenski, 2020). Leverage is vital in assessing financial vulnerability (Alsaeed, 2016). Short-term debt (maturity < 1 year) with low interest rates is suitable for immediate funding needs (Yazdanfar & Hman, 2015). Scholars differ on its impact on profitability (Nawaz and Ahmad, 2017; Aro and Pennanen, 2017; Bendavid et al., 2017; Dombret et al., 2019). Long-term debt (maturity > 1 year) has higher costs and may lead to financial distress (Chavali & Rosario, 2018). Its relationship with profitability varies (Pontoh, 2017; Nunes and Ahmed, 2017). The equity ratio reflects leverage, with high ratios indicating lower risk (Chadha & Sharma, 2015). Equity financing is a last resort (Boadi et al., 2017), and firms seek a balanced capital structure (Coad et al., 2018).

Sales Growth

Sales growth is the increase in revenue over a period of time. It is typically measured as a percentage change in revenue from one period to the next (Kotler & Keller, 2016). Sales growth is a measure of a company's ability to increase its revenue (Lamb et al., 2018). It is important for businesses because it can lead to increased profits, market share, and shareholder value. There are many factors that can affect sales growth, including product innovation, marketing and sales, pricing, distribution, and customer service. According to Zeithaml & Bitner (2003) sales growth is a key performance indicator (KPI) that businesses use to track their financial performance. It is important to track sales growth because it can help businesses identify areas where they can improve their performance. For example, if a company's sales growth is slowing down, it may need to invest in new marketing initiatives or improve its product offerings.

Firm Age

Firm age is the number of years since the company's establishment. However, some researchers argue that listing age should be used to determine the firm's age (Ilaboya & Ohioka, 2016). There is no consensus on whether firm age is positively or negatively correlated with firm performance. Some studies have found that older firms are more profitable (Coad et al., 2018); while others have found that younger firms are more innovative (Aben-Selcuk, 2016). The relationship between firm age and profitability may be country-

specific and influenced by a variety of institutional factors (Coad et al., 2018). The optimal firm age may also vary depending on the industry (Innocent, 2018).

Empirical Review

Numerous empirical studies have investigated the determinants of firms' profitability on a global scale, focusing on factors such as firm size, financial leverage, liquidity, and sales growth across various regions.

Firm Size and Profitability

Olaniyi et al. (2022) analyzed a panel dataset of Nigerian listed financial firms spanning from 2005 to 2015 and discovered a positive correlation between firm size and profitability. Adesina et al. (2022) conducted a study on a panel dataset of Nigerian manufacturing firms from 2005 to 2015, revealing a positive relationship between firm size and profitability. Majumdar & Majumdar (2022) utilized a panel dataset of European Union firms covering the years 2008 to 2018 and found evidence supporting the idea that firm size is positively associated with profitability. Chen & Chen (2022) examined a panel dataset of U.S. firms over the period 2008 to 2018, concluding that larger firms tend to have higher profitability. Zhang et al. (2022) performed a meta-analysis of 100 studies investigating the impact of firm size on profitability. Their findings suggest a positive relationship, albeit with a modest effect size. Li et al. (2022) employed a dynamic panel data approach to explore the relationship between firm size and profitability. They observed a positive impact, but it was not linear. Inyiama and Victoria (2021) analyzed a panel dataset of Turkish manufacturing firms from 2005 to 2011 and found that firm size had a negative impact on profitability. But Akbaş & Karaduman (2020) utilized a panel dataset of Turkish manufacturing firms from 2005 to 2011 and found a positive relationship between firm size (both in terms of total assets and total sales) and profitability.

Financial Leverage and Profitability

Banal Estanol (2022), explored the relationship between profitability and financial leverage among US-listed non-financial organizations. They found a negative relationship in sectors with high product similarities and excessive mark-ups, but a positive relationship in the rest of the market. Lobisa (2022) investigated financial leverage and profitability among the top-40 firms on the Johannesburg Stock Exchange, finding a negative impact of financial leverage on profitability. Mamaro and Legotlo (2021) assessed the impact of financial leverage on the financial performance of retail firms on the Johannesburg Stock Exchange, revealing a positive association. Abubakar and Mohammed (2021) explored the impact of financial leverage on construction and natural resources firms in Nigeria, showing mixed effects on financial performance. Lawrence et al. (2021) evaluated the effect of financial leverage on deposit money banks and manufacturing companies in Nigeria, with mixed results on financial performance. Ramnoher and Seetah (2020) studied financial leverage and profitability among companies in Mauritius, finding a positive relationship. Gather et al. (2019) examined the impact of leverage on companies at the Nairobi Stock Exchange in Kenya, finding a significant positive effect on financial performance. Hongli et al. (2019) explored financial leverage's effect on manufacturing industries on the Ghana Stock

Exchange, revealing a strong positive impact on firm performance. Ahmadu et al. (2018) examined financial leverage and financial performance of conglomerate firms in Nigeria, finding varying effects of different leverage ratios. Dalci (2018), investigated financial leverage and profitability among manufacturing firms in China, finding an inverted U-shaped relationship.

Sales Growth and Profitability

A series of studies investigated the impact of sales growth on profitability across various industries and regions. Sinaga and Ane (2021) found no significant effect in Indonesian manufacturing companies. Iskandar (2021) explored sales growth's impact on firm value in Indonesian consumer goods manufacturing but reported no significant impact. Napitupulu and Napitupulu (2020) discovered that sales changes significantly affected profitability in a limited sample of six companies. Endri et al. (2020) revealed a positive impact of sales growth on profit growth in the Indonesian food and beverage sector. Fuertes-Callén and Cuellar-Fernández (2019) explored the Spanish manufacturing sector and reported a positive influence of sales growth on profitability during economic crises. Conversely, Ali et al. (2019) found a negative association between sales growth and profitability in Malaysian non-financial firms. Ogunleye et al. (2018) examined Nigerian manufacturing companies and found a positive but statistically insignificant relationship between growth rate (sales) and profitability. Finally, Odalo et al. (2016) studied Kenyan agricultural companies and revealed a positive and significant association between sales growth and financial performance.

Firm Age and Profitability

Regarding the relationship between firm age and profitability, Aribaba et al. (2022) found a positive relationship between firm age and financial performance in the Nigerian oil and gas industry. Cyril and Singla (2020), explored the impact of firm age on profitability and productivity in Indian construction firms, revealing a complex relationship. Kwaltommai et al. (2019) found a positive association between firm age and financial performance among consumer goods firms in Nigeria. Nyamiobo et al. (2018) demonstrated a significant positive effect of firm age on financial performance in firms listed on the Nairobi Securities Exchange. Pervan et al. (2017), studied the influence of firm age on profitability in Croatian food industry firms, finding a negative impact. Selcuk (2016) examined the impact of firm age on profitability in Turkish firms listed on Borsa Istanbul, revealing a negative and convex relationship. Each study had its unique methodology, findings, and limitations, contributing to our understanding of these complex relationships.

Theoretical Framework

The theories presented here provide frameworks for understanding the hypotheses surrounding the debates on the extent to which firms' profitability is determined by firm size, financial leverage, sales growth and firm age.

Pecking Order Theory

The "U-shaped" relationship between firm size and profitability is often associated with the

Pecking Order Theory, first proposed by Donaldson in 1961 and further developed by Myers and Majluf in 1984. It suggests that smaller firms may have higher profitability due to their flexibility in selecting financing sources, while larger firms may have higher profitability due to their economies of scale. The theory posits that there is an optimal size for profitability, and deviations from this size can lead to reduced profitability.

Trade-off Theory

The Trade-off Theory, proposed by Myers in 1984, suggests that firms trade off the benefits of debt (tax shields) against the costs (financial distress). Therefore, the relationship between financial leverage and profitability depends on the firm's optimal capital structure.

Penrose Growth Theory

The Penrose Growth Theory, proposed by Edith Penrose in 1959, suggests that sales growth can positively impact profitability by increasing a firm's market share, resources, and capabilities. Firms that can efficiently manage and allocate resources during growth are more likely to see improved profitability.

Life Cycle Theory of Firms

Raymond Vernon, an American economist, formulated the Life Cycle Theory of Firms in 1966, as published in the Quarterly Journal of Economics. The theory posits that firm's progress through stages (start-up, growth, maturity, and decline). For conglomerates, younger firms may initially invest heavily, yielding lower profitability but with growth prospects. As they mature, economies of scale may enhance profitability. This theory suggests that firm age can be a determinant of profitability, with younger firms potentially showing lower initial profitability but potential for growth over time.

Methodology

This study utilizes a longitudinal panel data design to investigate the determinants of profitability of selected Nigerian conglomerate firms from 2013 to 2021 (9-year period). Three firms (SCOA Nig. Plc., A,G Leventis, and Challerams Plc.) out of seven listed conglomerate firms in Nigeria were conveniently sampled due to data availability. Secondary data from the Nigeria Exchange Group (NGX), including annual financial reports, form the dataset. The balanced panel data structure enables both cross-sectional and time-series analysis. Data integrity is ensured through thorough checks and correction of errors. The fixed effect panel regression model is employed, accounting for firm-specific effects. The model assesses the influence of firm size, sales growth, financial leverage, and firm age on profitability while controlling for other covariates.

$$ROA_{it} = \beta_o + \beta_1 FSZ_{it} + \beta_3 FLEV_{it} + \beta_2 SGR_{it} + \beta_4 AGE_{it} + \mu$$

Where: ROA = Return on Asset

t = Time 1, 2, 3 ---------- 10 (2013-2022)

i = Firm 1, 2, 3 ---------- 3

μ = Error term
$\beta_{o,}$ = Intercept

FSZ_{it} = Firm size by firm $_i$ at period $_t$
$FLEV_{it}$ = Financial leverage by firm $_i$ at period $_t$
SGR_{it} = Sales growth by firm $_i$ at period $_t$
AGE_{it} = Firm age by firm $_i$ at period $_t$
$\beta_1, \beta_2, \beta_3$, and β_4 = Coefficient of independent variables

See table 1 for the measurement of variables

Table 1: Variables measurement

S/N	Variables	Type	Proxy	Measurement	Sources
1	Profitability	Dependent			
		ROA	Return on Asset	Net Income / Total shareholder equity	Abdul-Khadir et al.(2018)
2	Determinants of Profitability	Independent			
		FSZ	Firm Size	The natural logarithm of a firm's total assets	Odundo & Orwaru,(2018)
		FLEV	Financial Leverage	Debt to equity ratio = Total Debt /Total to Equity ratio	Kenn-Ndubuisi & Nweke (2019)
		SGR	Sales Growth	Liquid asset/ Total Asset	Abubakar et al. (2018)
		AGE	Firm Age	Date of Incorporation + 1 (Lead Time)	Ilaboya and Ohioka (2016)

Source: Researcher's Compilation (2023)

Results and Discussions

Descriptive Statistics

Table 2: Descriptive Statistics for ROA, FSZ, LEV and LIQ

	ROA	FSZ	FLEV	SGR	AGE
Mean	.2746	18.2723	.6781	.1994	39.1666
Median	.1006	16.76	.6998	.115	38.5
Maximum	2.38	23.329	.94	5.3645	50
Minimum	0	15.81	.0815	-.997	31
Std. Dev.	.4693	2.9840	.2039	1.0922	5.4271
N	30	30	30	30	30

Source: Researcher's Computation (2023)

The descriptive statistics provided in table 1 offer valuable insights into the variables of interest: profitability (ROA), firm size (FSZ), financial leverage (FLEV), sales growth (SGR), and firm age (AGE) for the dataset of 30 conglomerate firms. The mean ROA of 0.2746 suggests that, on average, the conglomerate firms in the sample have a return on assets of approximately 27.46%, indicating a relatively healthy level of profitability. The median value of 0.1006 is considerably lower than the mean, suggesting that there might be some firms with significantly higher ROA values, pulling the mean upwards. The minimum value of 0 implies that at least one firm in the dataset experienced no profitability during the observation period, while the maximum of 2.38 indicates a substantial variation in ROA across the firms. The standard deviation of 0.4693 reflects this variability.

The mean and median firm sizes are 18.2723 and 16.76, respectively, indicating that the average size of the conglomerate firms in the sample is relatively large. The minimum FSZ value of 15.81 and the maximum of 23.329 demonstrate a substantial range in firm sizes. The standard deviation of 2.9840 confirms the variability in this variable. The mean FLEV of 0.6781 suggests that, on average, conglomerate firms have a moderate level of financial leverage. The median value of 0.6998 is close to the mean, indicating a relatively symmetrical distribution. The minimum FLEV of 0.0815 and the maximum of 0.94 show some variability in financial leverage across firms. The standard deviation of 0.2039 is relatively small compared to the mean, suggesting that most firms have similar levels of financial leverage. The mean SGR of 0.1994 indicates that, on average, the conglomerate firms in the sample experienced positive sales growth during the observation period. The median SGR of 0.115 is slightly lower than the mean, suggesting that there might be a few firms with exceptionally high sales growth rates. The minimum SGR of -0.997 suggests that at least one firm experienced a significant decline in sales, while the maximum of 5.3645 points to substantial variation in sales growth. The standard deviation of 1.0922 confirms this variability. The mean AGE of 39.1666 indicates that, on average, conglomerate firms in the sample have been in existence for nearly 39 years. The median AGE of 38.5 is close to the mean, indicating a relatively symmetrical distribution. The minimum AGE of 31 and the maximum of 50 show some variability in firm ages. The standard deviation of 5.4271 is moderate, suggesting that while most firms have similar ages, there are some outliers.

Table 3: *Correlation Matrix*

	ROA	FSZ	FLEV	SGR	AGE
ROA	1.000				
FSZ	-0.3753	1.000			
FLEV	0.1953	-0.0211	1.000		
SGR	0.1930	0.2847	-0.0289	1.000	
AGE	-0.3753	0.8573	0.3060	0.1743	1.000

Source: Researchers' Computation (2023)

Table 2 presents the correlation among the study's variables. The correlation matrix reveals significant insights into the relationships between the variables. ROA shows a moderate inverse correlation with FSZ (-0.3753), suggesting larger firms tend to have slightly lower

profitability. ROA has weak positive correlations with FLEV (0.1953) and SGR (0.1930), indicating slightly higher profitability for firms with greater financial leverage and sales growth. A moderate inverse correlation between ROA and AGE (-0.3753) suggests older firms tend to have slightly lower profitability. FSZ is strongly positively correlated with AGE (0.8573), indicating that larger firms are generally older. FLEV shows minimal correlation with FSZ (-0.0211) and a moderate positive correlation with AGE (0.3060), suggesting older firms tend to have slightly higher financial leverage. SGR has a weak positive correlation with FSZ (0.2847) and minimal correlation with FLEV (-0.0289). AGE is strongly positively correlated with FSZ (0.8573). In summary, these correlations highlight the complex interplay among profitability, firm size, financial leverage, sales growth, and firm age in the context of listed Nigerian conglomerate firms.

Table 4: *Multicollinearity Test*

	VIF	1/VIF
FSZ	1.04	0.959405
FLEV	1.06	0.944960
SGR	1.04	0.988195
AGE	1.08	0.923275

Source: Researchers' Computation (2023)

Table 4 depicts the multicollinearity test results, based on the Variance Inflation Factor (VIF). The results indicate low levels of multicollinearity among the independent variables: firm size (FSZ), financial leverage (FLEV), sales growth (SGR), and firm age (AGE). The VIF values for all variables are close to 1, with FSZ at 1.04, FLEV at 1.06, SGR at 1.04, and AGE at 1.08. In general, VIF values below 10 are considered acceptable and indicate that multicollinearity is not a significant issue in the regression analysis. Additionally, the reciprocal of VIF (1/VIF) values for all variables are close to 1, further confirming the absence of severe multicollinearity. Lower 1/VIF values indicate higher multicollinearity, but in this case, all values are comfortably close to 1, suggesting that the independent variables are not highly correlated with each other. Overall, based on the VIF results, there is no substantial multicollinearity concern among the independent variables in the regression model, which enhances the reliability of the model's coefficient estimates and the validity of the results.

Table 5: *Model Summary*

Model	R-Square	Adjusted R-Square	Std. Error of Estimate
1	.6954	.4354	.34333

Source: Researchers' Computation (2023)

a. Dependent Variable: ROA
b. Predictors (Constant): F SZ, FLEV, SGR, AGE

From table 4 the R-Square value of 0.6954 indicates that approximately 69.54% of the variation in the dependent variable, ROA, is explained by the independent variables (FSZ, FLEV, SGR, and AGE) included in the model. In other words, this model account for a significant portion of the variability in ROA, suggesting a reasonably good fit. The Adjusted R-Square, at 0.4354, is a modified version of the R-Square that adjusts for the number of predictors in the model. It accounts for the potential over fitting that can occur when adding more predictors. While the R-Square indicates a substantial explanation of ROA, the Adjusted R-Square suggests that after adjusting for model complexity, approximately 43.54% of the variability in ROA is explained. This suggests that the model, while still reasonably good, may be somewhat less fit than the unadjusted R-Square suggests. The standard error of estimate (Std. Error of Estimate) is a measure of the model's accuracy in predicting ROA. In this case, the standard error is 0.34333. A lower standard error indicates a better fit because it means that the predicted values are closer to the actual values. Here, a relatively low standard error suggests that the model provides reasonably accurate predictions of ROA.

Table 6: *Hausman Test*

Variable	(b) fixedh	(B) randomh	(b-B)t-Differences	Prob.
ROA	0.1642	0.1475	0.17	0.000
FSZ	0.0518	0.0671	3.18	0.000
FLEV	0.1474	0.2051	1.02	0.000
SGR	-0.0095	-0.0304	-0.34	0.204
AGE	-0.0001	-0.008	-0.01	0.554

Source: Researchers' Computation (2023)

Table 6 presents the Hausman's test output. For the variables ROA, FSZ, and FLEV, the differences between the fixed and random effects coefficients are statistically significant (p-value < 0.05). This suggests that there are significant differences in the estimated coefficients between the two models. For the variable SGR, the differences between the fixed and random effects coefficients are not statistically significant (p-value > 0.05). This suggests that both models provide similar results for this variable. For the variable AGE, the differences between the fixed and random effects coefficients are also not statistically significant (p-value > 0.05). Based on the results of the Hausman test, we conclude that for the variables ROA, FSZ, and FLEV, the fixed effects model is more appropriate because it provides significantly different coefficients compared to the random effects model. For the variables SGR and AGE, either the fixed effects or random effects model can be used, as both models yield similar results, or the differences between them are not statistically significant. The choice between fixed and random effects models for SGR and AGE should be guided by the specific analytical requirements and objectives of the study. Thus, we proceed with the fixed effects model for all the variables (ROA, FSZ, and FLEV, SGR and AGE) based on the specific requirements of our analysis.

Table 7: *Panel Regression Analysis*

Variable	Coefficient	Std. Error	t-Statistics	Prob.
C	0.007	.0045	0.17	0.864
FSZ	.0518	.0163	3.18	0.005
FLEV	.1474	.1445	1.02	0.320
SGR	-.0095	.0279	-0.34	0.737
AGE	-0001	.0091	-0.01	0.988

Source: Researcher's Computation (2023)

In Table 7, a panel regression analysis was conducted to examine the relationship between key independent variables (Firm Size - FSZ, Financial Leverage - FLEV, Sales Growth - SGR, and Firm Age - AGE) and the dependent variable, profitability (Return on Assets - ROA), among listed conglomerates in Nigeria. The analysis revealed notable insights. In the absence of FSZ, FLEV, SGR, and AGE (i.e. if all variables are 0) the average profitability of the studied firms will be at 0.007. Firstly, the coefficient for Firm Size (FSZ) was found to be statistically significant ($\beta = 0.0518$, $t = 3.18$, $p = 0.005$). This signifies that firm size has a positive and significant impact on profitability (ROA). This implies that, larger conglomerates tend to exhibit higher levels of profitability. The finding is consistent with Olaniyi et al. (2022), Adesina et al. (2022), Majumdar & Majumdar (2022), Chen & Chen (2022), Zhang et al. (2022), Li et al. (2022), but inconsistent with Inyiama and Victoria (2021).The findings also aligns with the Pecking Order Theory, confirming that larger firms often have higher profitability due to economies of scale, supporting the theory's assertion that increased firm size enhances profitability, bolstering the result validity.

Conversely, the coefficient for Financial Leverage (FLEV) was not statistically significant ($\beta = 0.1474$, $t = 1.02$, $p = 0.320$), indicating that changes in financial leverage may not exert a substantial or statistically significant influence on profitability within the context of Nigerian conglomerates. The finding conforms to Banal Estanol (2022), Ramnoher and Seetah (2020), Gather et al. (2019), but not in conformity with Lobisa (2022), Mamaro and Legotlo (2021). This suggests that other factors might hold greater sway in driving profitability in these firms. The findings partly align with the Trade-off Theory, indicating that changes in financial leverage (debt) do not significantly impact profitability. This suggests firms may have reached an optimal capital structure where increased leverage no longer significantly improves profitability.

Furthermore, Sales Growth (SGR) was found to be non-significant ($\beta = -0.0095$, $t = -0.34$, $p = 0.737$) in its impact on profitability. This implies that a sole focus on increasing sales growth may not necessarily lead to improved profitability within this specific industry or region, highlighting the need for a more comprehensive approach to profitability enhancement. The result is similar to that of Ali et al. (2019), Ogunleye et al. (2020) but different from that of Endri et al. (2020), Fuertes-Callén and Cuellar-Fernández (2019), Odalo et al. (2016). The findings contradict the Penrose Growth Theory, which suggests that sales growth positively impacts profitability by enhancing market share and resources.

Lastly, Firm Age (AGE) was also deemed statistically insignificant (β = -0.0001, t = -0.01, p = 0.988) regarding its impact on profitability. This suggests that the age of the conglomerate does not distinctly determine profitability, implying that younger and older conglomerates exhibit similar levels of profitability. The result is in agreement with Pervan et al. (2017), Selcuk (2016) but different from Aribaba et al. (2022), Kwaltommai et al. (2020), Nyamiobo et al. (2020). This finding does not align with the Life Cycle Theory of Firms proposed by Raymond Vernon which suggests that firm age can be a determinant of profitability, with younger firms potentially exhibiting lower initial profitability but growth prospects as they mature.

In summary, among the variables examined, Firm Size (FSZ) emerges as a significant determinant of profitability for listed conglomerates in Nigeria. Its positive and statistically significant impact underscores the importance of size expansion in enhancing profitability. Conversely, Financial Leverage (FLEV), Sales Growth (SGR), and Firm Age (AGE) do not appear to significantly influence profitability within this specific context. These findings offer valuable insights for guiding strategic decisions, emphasizing the significance of size augmentation as a means to bolster profitability for these conglomerates.

Conclusions

Based on the results and implications of the panel regression analysis for listed conglomerates in Nigeria, we concluded that:

1) Firm size (FSZ) is a significant determinant of profitability (ROA). Larger conglomerates tend to have higher profitability.
2) Financial leverage (FLEV) is not a statistically significant factor affecting profitability.
3) Sales growth (SGR) is not found to be a significant determinant of profitability in this analysis.
4) Firm age of the conglomerate (AGE) does not significantly impact profitability according to the analysis.

Recommendations

The managements of manufacturing conglomerate firms are recommended to:

1. Consider strategies to expand the size of their conglomerate through organic growth, mergers, acquisitions, or diversification. Expanding the size of the firm may lead to improved profitability.
2. Continue to manage their leverage prudently but may not need to focus on significant changes in this regard.
3. Rather than chasing new customers for sales growth, prioritize retaining and building loyalty among existing customers. Satisfied customers are more likely to make repeat purchases and refer others, contributing to long-term profitability.
4. Concentrate on other strategic factors, such as market positioning and innovation, rather than relying solely on age-related strategies.

References

Aben-Selcuk, R. (2016). Age and innovation: Evidence from young, young-and-small, and young-and-fast-growing firms, *Research Policy, 45*(1), 231-244.

Abiodun, A. (2017). The impact of firm size on profitability: Evidence from manufacturing firms in Nigeria, *Journal of Economics and Sustainable Development, 8*(10), 115-123.

Abubakar, M. Y., & Mohammed, H. (2021). The financial leverage and financial performance of listed construction/real estate and natural resources companies in Nigeria, *International Conference on Economics, Entrepreneurship and Management (ICEEM).*

Adesina, A. O., Ogunrinola, A. O., & Akinyemi, O. (2022). The impact of firm size on profitability: Evidence from Nigerian manufacturing firms, *Journal of Finance and Accounting Studies, 10*(1), 1-15.

Ahmadu, I., Ogwumike, C., & Ojo, S. O. (2018). Financial leverage and financial performance of conglomerate firms in Nigeria, *Cogent Economics & Finance, 6*(1), 1723925.

Akbaş, E., & Karaduman, E. (2020). The effect of firm size on profitability: Evidence from the Turkish manufacturing sector, *International Journal of Business and Management, 15*(10), 133-142.

Ali, M. M. N. A. Nik, N., Ayu, N. H. & Erlane, K. G. (2019). Liquidity, growth, and profitability of non-financial public listed Malaysia: A Malaysian evidence, *International Journal of Financial Research, 10*(3).

Aribaba, J. A., Igwe, A. O., & Onah, A. C. (2022). The impact of firm age on financial performance of firms in the Nigerian oil and gas industry, *Journal of Accounting and Finance, 12*(3), 1-19.

Aro, H., & Pennanen, T. (2017). Liability driven investment in budgetary risk management, *Journal of Optimal Financial Decision, 35*(3), 121-136.

Asadifard, M., Ghorbani, A., & Rahimi, A. (2023). The impact of financial leverage on profitability: Evidence from non-financial listed firms in Iran, *Journal of Economics and Finance, 47*(1), 1-14.

Banal, E. A. (2022). The relationship between profitability and financial leverage: Evidence from US-listed nonfinancial firms. *Journal of Financial Management and Analysis, 35*(1), 1-19.

Bashir, A., & Asad, M. (2018). Moderating effect of leverage on the relationship between board size, board meetings and performance: A study on the textile sector of Pakistan. American Scientific Research *Journal for Engineering, Technology, and Sciences (ASRJETS), 39*(1), 19-29.

Barnett, W. P. (2000). The organization and control of multinational corporations. Routledge.

Bendavid, I., Herer, Y. T., & Yücesan, E. (2017). Inventory management under working capital constraints. *Journal of Simulation, 11*(1), 62-74.

Boadi, E., Agyapong, C., & Boateng, R. (2017). The impact of financial leverage on profitability: Evidence from listed banks in Ghana. *International Journal of Economics and Financial Issues, 7*(3), 166-175.

Brigham, E. F., & Gapenski, L. C. (2020). *Financial management: Theory and practice (14th ed.)*. Cengage Learning.

CBN. (2023). *Annual report & statement of accounts*, Central Bank of Nigeria.

Chadha, S., & Sharma, S. (2015). Impact of financial leverage on profitability: A study of Indian manufacturing companies. *Journal of Finance and Accounting Research, 3*(3), 1-12.

Chasmi, N. A., & Fadaee, M. (2016). Impact of financial performance and growth opportunities on success or failure of companies: Evidence from Tehran Stock Exchange, *Journal of Accounting & Marketing, 5*(2).

Chavali, G., & Rosario, M. (2018). Financial leverage and profitability: Evidence from Indian manufacturing firms. *Journal of Finance and Accounting Studies, 6*(2), 1-16.

Chen, X., & Chen, Y. (2022). The impact of firm size on profitability: Evidence from US firms. *Journal of Business Research,* 132, 102717.

Chesang, D. (2017). *Effect of financial leverage on profitability of listed agricultural firms at the Nairobi securities exchange*, (Doctoral Dissertation, Kisii University- Kenya).

Ciptawan, C., & Frandjaja, B. O. (2022). The impact of current ratio and gross profit margin towards financial distress in technology sector companies listed in Indonesia stock exchange for period 2016-2020. *Journal of Industrial Engineering & Management Research, 3*(1), 197-214.

Coad, A., Segarra, A., & Teruel, M. (2013). Like milk or wine: Does firm performance improve with age? *Structural Change and Economic Dynamics, 24*(1), 173-189.

Cyril, B. C., & Singla, P. (2020). The impact of firm age on profitability and productivity in Indian construction firms, *International Journal of Construction Management, 20*(2), 149-165.

Davidsson, P., Achtenhagen, L., & Naldi, L. (2004). *Small business research and regional development: Local and global challenges*, Springer.

Dombret, A., Gündüz, Y., & Rocholl, J. (2019). Will German banks earn their cost of capital? *Contemporary Economic Policy, 37*(1), 156-169.

Elali, M., Nour, M., & El-Masry, A. (2013). The impact of financial leverage on profitability: Evidence from Egyptian listed companies, *International Journal of Business and Management, 8*(12), 82-90.

Endri, A., Utami, R. S., & Fitriasari, I. (2020). The effect of sales growth on profit growth in Indonesian food and beverage sector, *Jurnal Ilmiah Akuntansi dan Bisnis, 25*(1), 1-13.

Fatihudin, F., Sulistyawati, I., & Nurcahyani, A. (2018). The effect of profitability, firm size, and leverage on dividend payout ratio, *International Journal of Economics and Financial Issues 8*(2), 197-204.

Fuertes-Callén, I., & Cuellar-Fernández, J. M. (2019). The impact of sales growth on profitability during economic crises: Evidence from the Spanish manufacturing sector, *Journal of Business Research, 100*, 277-283.

Gather, W., Kirira, J., & Kimani, M. (2019). The impact of leverage on profitability: Evidence from Nairobi Securities Exchange listed firms in Kenya, *Journal of Finance and Accounting Studies, 7*(4), 1-15.

Habib, M. M. (2023). The impact of profitability on firm value: Evidence from listed companies in Bangladesh, *Journal of Finance and Accounting Studies, 11*(1), 1-15.

Hongli, J., Ajorsu, E. S. & Bakpa, E. K. (2019). The effect of liquidity and financial leverage on firm performance: Evidence from listed manufacturing firms on the Ghana stock exchange, *Research Journal of Finance and Accounting, 10* (8), 91-100

Ilaboya, O. O., & Ohioka, H. N. (2016). The impact of firm age on profitability: Evidence from manufacturing firms in Nigeria, *IOSR Journal of Business and Management, 18*(1), 79-86.

Innocent, O. C., & Okafor, G. T. (2018). Firm attributes and corporate environmental performance: Evidence from quoted industrial firms on Nigerian stock exchange, *Scholars Journal of Economics, Business and Management (SJEBM), 2*(5), 854-863.

Inyiama, C. C., & Victoria, O. O. (2021). The impact of firm size on profitability: Evidence from Turkish manufacturing firms, *Journal of Economics and Sustainable Development, 12*(12), 235-246.

Iskandar, R. A. (2021). The impact of sales growth on firm value in Indonesian consumer goods manufacturing, *Journal of Economics and Sustainable Development, 12*(18), 179-190.

Kabajeh, M. A., AL Nu'aimat, F. D., & Ahmed, S. M. (2012). The relationship between the ROA, ROE and ROI ratios with Jordanian insurance public companies market share prices, *International Journal of Humanities and Social Science, 2*(11).

Ali, M. M., Hussin, N. N., & Ghani, E. K. (2019). Liquidity, growth and profitability of non-financial public listed Malaysian evidence, *International Journal of Financial Research, 10* (3). http://ijfr.sciedupress.com

Khaksar, F. R., & Kamali, A. (2012). Leverage and profitability: A review of empirical literature, *Journal of Management and Accounting Research, 24*(1), 1-21.

Kotler, P., & Keller, K. L. (2016). *Marketing management (15th ed.),* Pearson Education.

Kwaltommai, V. O., Olaleye, O. J., & Ukaga, L. O. (2019). The impact of firm age on financial performance of consumer goods firms in Nigeria, *Journal of Finance and Accounting Studies, 8*(2), 1-13.

Laila, N., & Akhter, S. (2021). *Impact of profitability on firm value*: Evidence.

Li, B., Wang, X., & Zhang, J. (2022). The impact of firm size on profitability: Evidence from a dynamic panel data approach, *Journal of Business Research,* 135, 102844.

Lobisa, N. (2022). The impact of financial leverage on profitability: Evidence from the top-40 firms on the Johannesburg stock exchange, *Danubius Journal of Economic and Management Studies, 22*(1), 119-136.

Majumdar, S. K., & Majumdar, S. (2022). The impact of firm size on profitability: Evidence from European Union firms. *Journal of Economics and Finance, 46*(1), 1-14.

Mamaro, B., & Legotlo, B. (2021). The impact of financial leverage on the financial performance of retail firms listed on the Johannesburg stock exchange, *Cogent Economics & Finance, 9*(1), 2202443.

Mehrotra, A. A. (2022). Exploring the relationship between the financial ratios and the share price: Evidence from Bahrain listed financial institutions. *Arab Economic and Business Journal 14*(2), 150-165.

Myers, S. C. (1984). The capital structure puzzle, *The Journal of Finance, 39*(3), 575-592.

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information those investors do not have, *Journal of Financial Economics, 13*(2), 187-221.

Muthori, J. G., Kiprotich, I. N., & Kipyego, L. (2020). Management of account receivables and financial performance of manufacturing firms listed on the Nairobi stock exchange, Kenya. *International Journal of Scientific and Research Publications, 10*(12).

Napitupulu, A. H., & Napitupulu, I. M. (2020). The effect of sales growth and debt to equity ratio on profitability in a limited sample of six companies. *Journal of Finance and Accounting Studies, 8*(1), 1-13.

Naz, F., Ijaz, F., & Naqvi, F. (2016). Financial performance of firms: Evidence from Pakistan cement industry, *Journal of Teaching and Education*.

Niresh, J. A., & Velnampy, T. (2014). Firm size and profitability: A study of listed manufacturing firms in Sri Lanka. *International Journal of Business and Management, 9*(4), 57-64.

Nunes, P. M., & Serrasqueiro, Z. (2017). Short-term debt and long-term debt determinants in small and medium-sized hospitality firms, *Journal of Tourism Economics, 23*(3), 543-560.

Nyamiobo, S. O., Odhiambo, J. O., & Omwenga, J. O. (2018). Does firm age matter for financial performance? Evidence from Nairobi securities exchange listed firms, *Journal of Finance and Accounting Studies, 7*(1), 1-14.

Odalo, S., Munyao, R., & Muturi, K. (2016). The relationship between sales growth and profitability of agricultural firms in Kenya. *International Journal of Economics and Financial Issues, 6*(4), 168-176.

Ogunleye, E. O., Okoye, A. E., & Ogunsanwo, O. A. (2018). The impact of sales growth on profitability: Evidence from Nigerian manufacturing companies, *Journal of Finance and Accounting Studies, 7(*2), 1-14.

Omondi, M. M. & Muturi, W. (2013). Factors affecting the financial performance of listed companies at the Nairobi securities exchange in Kenya, *Research Journal of Finance and Accounting, 4*(15).

Penrose, E. T. (1959). *The theory of the growth of the firm*, Wiley.

Selcuk, F. (2016). The impact of firm age on profitability: Evidence from Turkish firms listed on Borsa Istanbul. *Procedia Economics and Finance, 35*, 438-447.

Sha, D. (2022). Pengaruh profitability, firm size, leverage, Dan managerial ownership Terhadap earning management, *Jurnal Paradigma Akuntansi. https://doi.org/10.24912/jpa.v4i1.16685.*

Sinaga, L. A., & Ane, D. T. (2021). The effect of sales growth on profitability: Evidence from Indonesian manufacturing companies. *Jurnal Akuntansi dan Keuangan, 23*(2), 150-164.

Vernon, R. (1966). International investment and international trade in the product cycle, *The Quarterly Journal of Economics, 80*(2), 190-207. https://doi.org/10.2307/1880689.

Wahome, M. N., Memba, F. & Muturi, W. (2015). The effects of firm size and risk on capital structure decisions of insurance industry in Kenya, *International Journal of Scientific and Research Publications, 5*(8), 1-12.

Yazdanfar, D., & Öhman, P. (2015). The impact of cash conversion cycle on firm profitability: An empirical study based on Swedish data, International *Journal of Managerial Finance, 10*(4), 442–452.

Zeithaml, V. & Bitner, M. (2003). *Service marketing: Integrating customer focus across the firm*, New York: McGraw-Hill. [Google Scholar].

Zhang, T., Chen, J., & Zhao, X. (2022). The impact of firm size on profitability: A meta-analysis of 100 studies, *Journal of Business Research, 136*, 102909.

THE ROLE OF PLANNING IN ACHIEVING ORGANIZATION'S EFFICIENCY AND EFFECTIVENESS

[1]Ademulegun Olatunji Stephen & [2]Atiku Muhammad Gwandu
Directorate of Management Programmes,
Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State,
Department of Business Administration & Management,
Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State

Abstract

The role of planning in achieving organizational efficiency and effectiveness involves examining the actions of administrators/managers and their contribution to productivity and performance in achieving the organization's goals and objectives. This paper models factors contributing to planning process failure and its effect on organizational performance in public administration studies for administrators and managers. The process of planning helps managers achieve efficiency and effectiveness in organizations, leading to improved employee performance and productivity in achieving goals and objectives. Theoretical and practical implications suggest that administrators and managers should prioritize planning as a reliable tool for achieving organizational goals and objectives.

Keywords*: Effect of planning, Effectiveness and Efficiency of plans, Principles and primacy of Planning, Process of Planning*

Background to the Study

The dynamic environment continually demands for efficiency and effectiveness in organizations for their string of survival. Every organizational development is a cyclical or a step process. Every step in ensuring efficient and effective course of actions is involved with future creation actions of organization (Jeseviciute-Ufartiene, 2010). Planning is one of twelve future creation actions (Rac, 1990). Purpose of planning is to schedule tasks that impossible makes possible. Drucker (1993) maintains that plan of action must become the core of manager's time planning. Once Napoleon was told that there is no battle which goes according to plan. But the same Napoleon planed every battle till minimum details. The

manager without plan becomes victim of circumstances. On the other hand, every manager understands significance of planning in the management and development of an organization. The process of planning is connected with the process of manager's mind activity. Continual changes in the environment are the preclusion to use manager's mind activity purposefully and to orientate it into planning. Some thinks that planning is not advisable because the plan has to be reconsidered and has to be changed what has been planned before. Thus, planning has been defined as the activity by which managers analyze the present conditions to determine ways of reaching a desired future state of affairs (Owen, 1997). It can also be defined as the basic management function which involves prediction and forecasting.

Planning has been used by managers in different situations; in fact, it is involves in all aspect of management processes. For an organization to succeed, be profit oriented or for other satisfying reasons, must involve planning functions in its management. For instance, the sole proprietor who set-up a business on his own, a partnership, private or public limited companies must after conceiving the ideas of undertaken a business sit down and work out modalities on how the business should be operated, achieve the goals and objectives of the organization. This process is called planning. In recent time, most organizations have failing to accomplish their core goals and objectives due to lack of planning directed to efficiency and effectiveness of the course of actions. The lack of basic knowledge about planning necessitates the need to look at the roles of planning in achieving organization's efficiency and effectiveness.

Research Problem

Many organizations maintain poor performance and they are not efficient and effective in achieving their goals and objectives. These poor performances are due to poor planning which affect the management and workers efficiency and effectiveness in their various tasks in the organization. Poor planning are the factors that limit the productivity or performance rate and the growth of an organization greatly depend on the efficiency and effectiveness of the courses of actions given by the management. Some organizations have no proper planning process, programme analysis and coordination, greater attention is being focused on non-productive activities than productivity activities due to inappropriate planning. In most cases, the role that planning play in achieving the organization objectives is being jettisoned due to lack of knowledge these roles play in such organizations. In some cases where the administrators/managers know the significant of the role of planning in achieving the organization objectives, some fail in the basic planning process that will lead to achieving the objectives.

Research Objectives

The research aims to:

a. Determine the roles planning play in achieving organization efficiency and effectiveness in their courses of actions.
b. Examine the extent efficient and effective plans helps in the organizations.
c. Examine the factors that contribute to failure of planning process and its effects on the organization performance.

Research Hypotheses

H_1: There is significant role played by planning in helping administrators/managers to achieve organization efficiency and effectiveness in their courses of actions.

H_2: There is significant way planning help managers to attain efficiency and effectiveness in organizations.

H_3: There are factors contributing to failure of planning process which significantly affect the organization performance.

Theoretical Background

Concept of Planning in Management

Planning is the primary and most important function of management and occupies a very high position in the management process. It is the starting point of the whole management process and involves the determination of future course of action. Why an action is required, how to take an action, and when to take action are main subjects of planning for the management. Planning is a determined course of action for achieving a specific objective. It is deciding in advance what to do and how to do. It is needed at every level of management. In the absence of planning all the business activities of the organization become meaningless. The importance of planning has increased all the more in view of the increasing size of organizations and their complexities and because of uncertain and constantly changing business environment. In the absence of planning, it may not be impossible but certainly difficult to guess the uncertain events of future.

Planning is one of the basic management functions. In fact, it occupies the top position in the management process. It is the starting point of the management process as other management function can take place only through this function. Before doing a thing, it is necessary that the management formulates an idea of how to work on a particular task. Thus, planning is closely connected with creativity and innovation. It involves setting objectives and developing appropriate courses of action to achieve these objectives. Objectives are achieved by fixing time-based goals. For achieving its goals management of an organization usually works with several management plans such as business plan, production plan, maintenance plan, or marketing plan etc. Further management plans can be either short term or long term or both.

The definition of planning as given by various scholars:

Griffin (2009), defined planning as the working out in a broad outline the things that need to be done and the methods for doing them to accomplish the purpose set for the enterprise. Koontz and O'Donnel (1980) defined planning as deciding in advance what to do, how to do it, when to do it, and who is to do it. Planning bridges the gap between where we are and where we want to go. It makes it possible for things to occur which would not otherwise happen. McFarland (1979) defined planning as a concept of executive action that embodies the skill of anticipating, influencing, and controlling the nature and direction of change. Kotler (1960) defined planning as deciding in the present what to do in future. It is the process whereby companies reconcile their resources with their objectives and opportunities'.

Principles and Primacy of Planning

The focus of planning must be geared toward the achievement of organizational goals and objectives. This must follow recognized principles. Tripathi and Reddy (2008) discussed the principles as follows:

a. Determination of objectives: for any planning process to succeed, it must start with the determination of future objective, which will along the line in the future satisfy the need and other expectations from an organization.
b. Course of action: a planned action is directed toward achieving organization efficiency and effectiveness. There are situations where there are numerous alternative courses of actions, the manager is expected to select the best alternative that will solve the problem which is less costly and at the same time most effective.
c. Planning resources: for effective and efficient planning, resources requirement must be forecasted and specified. Management should always select the types of budgets that can best suit the planning needs of the organization. The availability of major resources such as personnel, raw materials and capital must be forecasted by the manager for successful planning.
d. Planning implementation: it is an important part in planning process for success in achieving organizational goals and objectives.

Primacy of planning: planning is the primary management function, the one that precedes and is the basis for the organizing, influencing, staffing, leading and controlling functions of managers. Tripath and Reddy (2008) depicted this with the figure below:

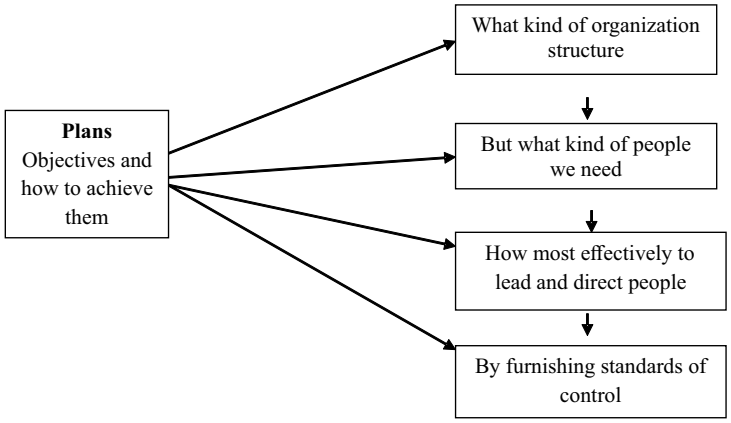


Figure: Planning precedes all managerial functions

Efficiency and Effectiveness of Plans

The efficiency and effectiveness of a plan is measured by the amount it contributes to purpose and objectives as offset by the costs and other unsought consequences required formulating and operating it (Rao, 2017). A plan can contribute to the attainment of objectives, but at too high or unnecessarily high costs (Tripathi and Reddy, 2008). This concept of efficiency implies the normal ratio of input to output but goes beyond the usual

understanding of inputs and outputs in terms of Naira, labour hours, or units of production to include such value as individual and group satisfactions. Many managers have followed plans, such as in the acquisition of certain aircraft by airlines, where costs were greater than the revenues obtainable (Tripathi and Reddy, 2008). Companies have ineffienctly attempted to attain objectives in the face of the unsought consequence of market unacceptability, as happened when a motor car manufacturer tried to capture a market by emphasizing engineering without competitive advances in style.

Plans may also become inefficient in the attainment of objectives by jeopardizing group satisfactions. The new president of a company that was losing money attempted quickly to recognize and cut expenses by wholesale and unplanned layoffs of key personnel. This result in fear, resentment, and loss of morale led to so much lower productivity as to defeat his/her laudable objective of eliminating losses and making profits. And some attempts to install management appraisal and development programs have failed because of group resentment of the methods used, regardless of the basic soundness of the programs.

Planning Process and Its Effect on Organization Objectives

The planning process involves a cycle of activities (Tripathi and Reddy, 2008). It takes into consideration short- and long-term strategies of the organization. The planning process ensures that important concerns and issues are not overlooked, that a range of perspectives is considered, that decisions are well informed, and that there is a real opportunity for participation for all the concerned personnel.

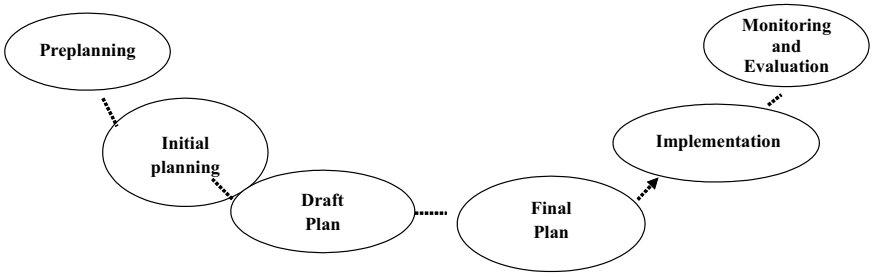


Figure 2: Basic steps in the planning process

The planning process which involves creating a road map that outlines each task the organization must accomplish to meet its overall objectives.

1. Preplanning stage – This stage consists of information gathering and getting the knowledge of earlier performance of the organization in the area for which management plan need to be prepared. With this information, the issues and opportunities are identified and analyzed.
2. Establish goals – The next step of the planning process is to identify goals of the organization in the specific area of operation for which plan is being prepared. This portion of the planning process includes a detailed overview of all the

organizational objectives to arrive at the plan goals. The goals are to be described in quantitative or qualitative terms. An example of a goal is to raise production by 10 percent over a 12-month period.

3. Identify resources – For achieving each goal, the financial, human and other resources needed are to be projected in the plan. The plan is to indicate how these resources are to be made available for the fulfillment of the plan.
4. Establish goal related tasks – Tasks and actions needed for achievements of each goal are to be clearly identified in the plan for the achievement are to be clearly fixed in the plan.
5. Prioritizing of the related tasks – Prioritizing of the goal related tasks is about identifying priority of the tasks based on their importance. The tasks deemed most important will theoretically be approached and completed first. The prioritizing process may also reflect steps necessary in completing a task or achieving a goal. The organization need to complete these steps in chronological order for achieving the goals.
6. Create assignments and timelines – As the organization prioritizes the tasks, it must establish timelines for completing the tasks and assign individuals/groups to complete them. This portion of the planning process is to consider the abilities of individuals/groups members and the time necessary to realistically complete assignments.
7. Review and the refinement of the draft plan – After the draft plan has been made it is reviewed and refined after considering the viewpoints of those who are connected with the plan for its implementation.
8. Approval and implementation of plan – Once the plan is made, it need to be approved by the management for its implementation. After its approval the plan serves as a guide for management decisions and as a reference document for everyone during its implementation.
9. Establish evaluation methods – A planning process should include a strategy for evaluating the progress toward goal completion throughout an established time period. One way to do this is through a periodic progress report from the individuals/groups handling the assignment.
10. Progress review – Once the progress report is available then the progress review is done by analyzing the fulfillment of plan against the targets. Progress review is an essential part of the planning process.
11. Identify alternative courses of action – Even the best-laid plans can sometimes be thrown off track by unanticipated events. A plan should include a contingency plan if certain aspects of the master plan prove to be unattainable. Alternative courses of action can be incorporated into each segment of the planning process, or for the plan in its entirety.

The Effect of Planning on Organization Objectives

Planning is a positive force for organizational goal attainment (Tripathi and Reddy, 2008). Many managers and chief executives of large corporation view it as important in achieving result (Rao, 2017). However, there are many factors that make planning effective (Tripathi

and Reddy, 2008), among them:

a. Effectively done planning can contribute to reduce role ambiguity and role conflict. When policy planning has been carried out, and clear role prescriptions have resulted, individuals are more likely to know what they are supposed to do and the probability that conflicting forces will push them in two directions at once considerably reduced.
b. Closely allied to the first point: effectively planning tends to limit arbitrary actions by individual superiors.
c. Because role prescriptions are the ultimate result, planning leads to a reduction of uncertainty within the organization.
d. Planning produces a greater capacity to deal with uncertainty in the environment external to a company, as well as internal uncertainty. Effective planning makes it much less likely that a company will be caught off guard and suffers accordingly. Thus positive adjustment to a sudden shift in market demand is much more likely if such a shift has been forecast and new role prescriptions established for dealing with this contingency.
e. The very process of planning tends to lead to decision making that deals with more factors and take more considerations into account. Systematic planning requires a look at a long list of variables which might influence events. Without such a systematic consideration of influences and alternatives, the likelihood that something of importance will be overlooked is very high. Thus planning by its very nature tends to force manager to take into account factors that might not otherwise be considered, and to tie plans more closely to operative goals involving both task and maintenance.
f. Planning is important in that it contribute to the performance of other management functions.

Methodology

Data Source

This research used two types of data sources to conduct the study, the primary and secondary data. The primary data used was structured questionnaires. The secondary data used were collected through the use of the Internet and Public library. Questionnaires are set of questions relating to the aims and objectives of the study to which respondents are required to answer by writing their responses. For the purpose of this study, a structured questionnaires based on personal observation and literature review, 40 questionnaires were distributed on the three areas of the hypotheses to heads of department and senior officers of 222 Batallion of Nigerian Army, Sobi cantonment randomly.

Procedure and Analysis

Inference analysis using Chi-square used to enable the researcher to either reject or accept the formulated hypotheses. The Chi-square formula is: $\mathbf{X^2 = \frac{\sum (O - E)^2}{E}}$

Where; X^2 = Chi-square, O = Observed Frequency, E = Expected Frequency, $\sum$ = Summation

To test the significance of the research, a risk level was set at 5%. This means that five out of a hundred there was a statistically significant difference. A degree of freedom for the test is also determined (df) the degree of freedom is given by (r - 1)(c – 1). Where r is the number of rows and c is the number of columns.

Decisions Rule

The rule applicable here is that where the t-value calculated is greater than the t-critical at 0.05 degree of freedom then the hypothesis will be accepted.

Results

Table 1: Respondent's data in respect significant role played by planning in helping administrators/managers to achieve organization efficiency and effectiveness in their courses of actions.

S/N	Statement	SA	D	D	SD	TOTAL
8.	Administrator/manager play significant role in accomplish organization objectives.	36	3	0	1	40
9.	There is need for the administrator/manager to forecast and document courses of actions.	37	2	1	0	40
10.	Planning needs to be effectively and efficiently implement at all levels of the organization.	2	37	0	1	40
11.	Effective and efficient planning process contributes to the accomplishment of goals and objectives.	38	1	1	0	40
12.	There should be effective and efficient planning process in utilization of resources.	6	34	0	0	40
Total		**119**	**77**	**2**	**2**	**200**
Percentage		**59.5**	**38.5**	**1.0**	**1.0**	**100.0**

KEY:

SA = Strongly Agreed, A = Agreed , D = Disagreed, SD = Strongly Disagreed

Table 2: Respondent's Data in respect to significant ways planning help managers to attain efficiency and effectiveness in organizations.

S/N	Statement	SA	D	D	SD	TOTAL
13.	Productivity/performance significantly impact organization's goals and objectives.	3	37	0	0	40
14.	Effective and efficient productivity/performance contributes to organization's goals and objectives.	36	2	1	1	40
15.	Planning is necessary for improvement of productivity or performance in an organization.	2	37	0	1	40
16.	The planning process and courses of actions must be well documented and communicated to improve productivity or performance.	38	2	0	0	40
17.	The organizational plans must not jeopardize individual or group objectives.	36	2	1	1	40
Total		**115**	**80**	**2**	**3**	**200**
Percentage		**57.5**	**40.0**	**1.0**	**1.5**	**100.0**

Table 3: Respondent's Data in Respect to factors contributing to failure of planning process which significantly affect the organization performance.

S/N	Statement	SA	D	D	SD	TOTAL
18.	Planning process significantly affect organization performance.	36	2	1	1	40
19.	Lack of basic steps in planning process contributes to failure of plans and non accomplishment of goals in an organization.	37	2	1	0	40
20.	Administrator/Manager should understand planning process to adequately perform in an organization.	36	3	0	1	40
21.	The effectiveness and efficiency of planning process contribute to the overall performance of the administrator/manager.	2	37	1	0	40
22.	Administrator/manager must militate against factors that can cause failure in the planning process.	3	36	1	0	40
Total		**114**	**80**	**4**	**2**	**200**
Percentage		**57.0**	**40.0**	**2.0**	**1.0**	**100.0**

Test of Hypotheses:

Hypothesis 1: There is significant role played by planning in helping administrators /managers to achieve organization efficiency and effectiveness in their courses of actions.

Table 4

S/N	Statement	R	O	E	(O –E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
.	Administrator/manager play significant role in accomplish organization objectives.	SA	36	10	26	676	67.6
		A	3	10	-7	49	4.9
		D	0	10	-10	100	10.0
		SD	1	10	-9	81	8.1
2.	There is need for the administrator /manager to forecast and document courses of actions.	SA	37	10	27	729	72.9
		A	2	10	-8	64	6.4
		D	1	10	-9	81	8.1
		SD	0	10	-8	100	10.0
3.	Planning needs to be effectively and efficiently implemented at all levels of the organization.	SA	2	10	-8	64	6.4
		A	37	10	27	729	72.9
		D	0	10	-10	100	10.0
		SD	1	10	-9	81	8.1
4.	Effective and efficient planning process contributes to the accomplishment of goals and objectives.	SA	38	10	28	784	78.4
		A	1	10	-9	81	8.1
		D	1	10	-9	81	8.1
		SD	0	10	-10	100	10.0
5.	There should be effective and efficient planning process in utilization of resources.	SA	6	10	-4	16	1.6
		A	34	10	24	576	57.6
		D	0	10	-9	81	8.1
		SD	0	10	-10	100	10.0
Sum			**200**	**200**	**0**	**4673**	**23.365**

From the table 4 above, the t-calculated is 23.365 while t value of X^2 with 12 degree of freedom at 5% significant level is 21.03. Following the decision rule that where t-calculated is greater than the t-table at 0.05 level of significant, then:

H_1: There is significant role played by administrators/managers in achieving organization efficiency and effectiveness in their courses of actions.

Hypothesis 2: There is significant way planning help managers to attain efficiency and effectiveness in organizations.

Table 2:

S/N	Statement	R	O	E	(O –E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
6.	Planning significantly help administrator/manager to attain efficiently and effectiveness in organizations.	SA	3	10	-7	49	4.9
		A	35	10	25	625	62.5
		D	1	10	-9	81	8.1
		SD	1	10	-9	81	8.1
7.	Planning is the foremost function that all other organization's courses of actions depend on.	SA	3	10	-7	49	4.9
		A	36	10	26	676	67.6
		D	1	10	-9	81	8.1
		SD	0	10	-10	100	10.0
8.	Planning is a veritable tool that manager can use to achieve organization goals and objective.	SA	37	10	27	729	72.9
		A	2	10	-8	64	6.4
		D	1	10	-9	81	8.1
		SD	0	10	-10	100	10.0
9.	Organization's effectiveness and efficiency greatly depend on the viability of the administrator/manager's plans.	SA	38	10	28	784	78.4
		A	2	10	-8	64	6.4
		D	0	10	-10	100	10.0
		SD	0	10	-10	100	10.0
10.	Administration/manager should focus on planning and re-planning to succeed.	SA	35	10	25	625	62.5
		A	3	10	-7	49	4.9
		D	1	10	-9	81	8.1
		SD	1	10	-10	100	10.0
Sum			**200**	**200**	**0**	**4619**	**23.095**

From the table 2 above, the t-calculated is 23.095 while t value of X^2 with 12 degree of freedom at 5% significant level is 21.03. Therefore, the formulated hypothesis is accepted

H_2: There is significant way planning help managers to attain efficiency and effectiveness in organizations.

Hypothesis 3: There are factors contributing to failure of planning process which significantly affect the organization performance.

Table 3:

S/N	Statement	R	O	E	(O –E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
11.	Planning process significantly affect organization performance.	SA	36	10	26	676	67.6
		A	2	10	-8	64	6.4
		D	1	10	-9	81	8.1
		SD	1	10	-9	81	8.1
12.	Lack of basic steps in planning process contributes to failure of plans and non - accomplishment of goals in an organization.	SA	37	10	27	729	72.9
		A	2	10	-8	64	6.4
		D	1	10	-9	81	8.1
		SD	0	10	-10	100	10.0
13.	Administrator/Manager should understand planning process to adequately perform in an organization.	SA	36	10	26	676	67.6
		A	3	10	-7	49	4.9
		D	0	10	-10	100	10.0
		SD	1	10	-9	81	8.1
14.	The effectiveness and efficiency of planning process contribute to the overall performance of the administrator/manager.	SA	2	10	-8	64	6.4
		A	37	10	27	729	72.9
		D	0	10	-10	100	10.0
		SD	1	10	-9	81	8.1
15.	Administrator/manager must militate against factors that can cause failure in the planning process.	SA	3	10	-7	49	4.9
		A	36	10	26	676	67.6
		D	1	10	-9	81	8.1
		SD	0	10	-10	100	10.0
Sum			**200**	**200**	**0**	**4662**	**23.31**

From the table 3 above, the t-calculated is 22.31 while t value of X^2 with 12 degree of freedom at 5% significant level is 21.03. Therefore, the formulated hypothesis is accepted.

H_3: There are factors contributing to failure of planning process which significantly affect the organization performance.

Discussion and Conclusion

The research revealed through the test of the hypotheses that there is significant role played by administrators/managers in achieving organization efficiency and effectiveness in their courses of actions, there are factors contributing to failure of planning process and there are

significant effects on the organization performance and there are significant way planning help managers to attain efficiency and effectiveness in organizations. The adequate knowledge of planning process, communication and documentation of the planning process can help administrator/manager and subordinates to perform excellently, improve productivities and accomplish goals and objectives.

Tripathi and Reddy (2008) observed that focus of planning must be toward achievement of the organizational goals and objectives. He opined that the principles of planning must include; determination of objectives, course of action in sets of objectives, planning resources and implementation of the plans through planning process. This research work will be of great benefit to organizations in understanding the basic steps in planning process and the significant role planning plays in achieving efficiency and effectiveness in an organization.

The research work agreed with other scholars such as Griffin (2009) who opined that planning is the process of working out in a broad outline the things that need to be done and the methods for doing them to accomplish the purpose set for the organization. The researcher thereby concluded that planning plays significantly role in achieving efficiency and effectiveness in an organization. The adequate knowledge of basic steps in planning process, communication and documentation of the planning process can help administrator/manager and subordinates to perform excellently, eliminate factors that contribute to planning failure and antecedent effects, improve employee's efficiency and effectiveness in performance and productivities on accomplishment of goals and objectives. Administrators/managers should focus on planning and use it is a veritable tool to achieve organization goals and objective.

Recommendations

The administrators or managers in organizations should use planning to achieve efficiency and effectiveness in the utilization of resources at their disposal.

1. Administrators or managers should have adequate knowledge of planning process, communication and documentation of the planning process so as to help their subordinates to perform excellently, improve productivities and accomplish the organization's goals and objectives.
2. Administrators or managers must understand factors contributing to failure of planning process and militate against them to prevent negative effects on the organization performance.

Reference

Drucker, P. F. (1993). *Innovation and entrepreneurship*, Harper Business, New York, USA

Gharajedaghi, J. (2011). *Systems thinking: Managing Chaos and complexity 3rd Ed*, San Diego: Elsevier.

Goleman, D. (2011). *Leadership: The power of emotional intelligence*, More than sound LLC, Northamton MA

Griffin R. W. (2009). *Management, 10th edition,* Southwestern Cengate learning, USA.

Jeseviciute-Ufartiene, L. (2010). Organization self-development based on mind activity expansion in management, *Management Theory and Studies for Rural Business and Infrastructure Development. Research Papers*. 5(24), 55-62.

Koontz, H. & O'Donnel, C. (1983). *Management; A global perspective international edition*, McGraw-Hill Education, USA.

Kvedaravicius, J. (2006). *Management of organizations development*, Kaunas: Vytautas Magnus University Press.

Mcfarland, D. E. (1979). *Management: Foundation and practice 5th illustrated edition*, Macmillan, New York, USA

Myers, G. D. (2009). *Psychology, 9th ed,* Worth Publishers New York, USA.

Owen, A. M. (1997). Cognitive planning in humans: neuropsychological, neuroanatomical and neuropharmacological perspectives, *Prog Neurobiol*. *53* (4),431–50.

Rac, M. (1990). *Analyzes of situation. middle of sociality, man and environment*, Moscow: Knowledge publishing.

Rao, N. (2017). Principles of management revision: An analysis of management functions, *Management Theory Review Articles*. http://nraomtr.blogspot.com/2011/12/principles-0-principles-of-management.html

Russell, L. A. (2010). *Creating the corporate future: Plan or be planned for*, New York: John Wiley & Sons, New York, USA.

Sarason, Y. & Tegarden, F. (2003). The erosion of the competitive advantage of strategic planning. *Journal of Business and Management*, 9(**1**),1-2.

Schedrovickij, G. P. (1997). *Selected Works: Philosophy, science, methodology*, Moscow: School of Cultural politics.

Steiner, G. A. (1979). *Strategic planning; What every manager must know*, The Free Press, New York, USA.

Tripathi, P. C. & Reddy, R. N. (2008). *Principles of management, 4th edition*, Tata McGraw Hill Publishing Company, New Delhi, India.

Valackiene, A. (2010). Efficient corporate communication: Decisions in crisis management, *Inzinerine Ek Onomika-Engineering Economics*, 21(**1**), 99-110

EFFECT OF EXERCISE ON BLOOD SUGAR LEVEL: A CASE STUDY OF WUKARI TABLE TENNIS CLUB PLAYERS

[1]Imo, Chinedu, [2]Ikwebe, Joseph, [3]Ameh, Sunday Ojonugwa, [4]Tatah, Verwiyeh Silas, [5]Shaibu, Christopher Ojomugbokenyode, [6]Abu, Michael Sunday, [7]Boyi, Richard-Harris Nsenreuti, [8]Yohanna, Emochone Roy, [9]Ugwuoke, Kenneth Chinekwu & [10]Magaji, Isaac Massemah

[1,2,4,5,6,7,8&9]Department of Biochemistry, Faculty of Pure and Applied Sciences, Federal University Wukari, Nigeria.

[3]Department of Sociology, Faculty of Social Sciences, Federal University Wukari, Nigeria.

[10]Wukari Study Centre, Faculty of Health Sciences, National Open University of Nigeria.

Abstract

This study investigated the effect of exercise on blood sugar level: a case study of Wukari Table Tennis Club players. A total of fifteen players of Wukari Table Tennis Club, Wukari, Taraba State, Nigeria was used for the purpose of this research. ACCU-CHEK Active (glucometer) test strips for quantitative blood glucose level were used. Blood was collected before and after the players played table tennis through finger puncture. It was placed on the test strip and slotted in the ACCU-CHEK Active and blood glucose level was displayed and read on the meter. The blood sugar level of all the table tennis players before exercise were within the normal random blood sugar level range. However, the blood sugar level of all the table tennis players after exercise were within the normal random blood sugar level range except two players. The blood sugar levels of seven players increased after the exercise, while the blood sugar levels of eight players reduced after the exercise. The mean result of blood sugar level of the table tennis players after exercise is not statistically significant ($p>0.05$) when compared to the mean result of their blood sugar level before exercise. The mean difference of the blood sugar level between before and after exercise is statistically significant ($p<0.05$) when compared to the mean result of their blood sugar level before exercise. There is a very small decrease in the mean blood sugar level of the table tennis players after exercise. The results showed that exercise may cause a decrease in blood sugar levels of some players and may also cause an increase in the blood sugar

levels of other players. Generally, exercise caused a non-significant decrease in blood sugar level of the table tennis players.

***Keywords**: Blood sugar level, Diabetes, Exercise, Hyperglycemia, Hypoglycemia.*

Background to the Study

Type 2 diabetes is a worldwide epidemic associated with obesity and a sedentary lifestyle (Hu, 2011). The estimated lifetime risk of developing diabetes for a person born in the United States in 2000 is 32.8% for males and 38.5% for females (Narayan *et al*., 2003). Diabetes increases morbidity and mortality due to heart disease, stroke, blindness, kidney failure, foot problems, and periodontal disease, and has a significant impact on quality of life. In 2010 it accounted for US$376 billion or 12% of the global health expenditure. This is approximately US$1330 per person per year (Zhang *et al*., 2010).

Treatment goals for patients with diabetes include achieving and maintaining optimal blood glucose, blood pressure, and lipid levels in order to prevent or delay the progression of chronic complications. Exercise, along with diet and weight control, is considered essential for the prevention and management of diabetes. Epidemiological studies suggest that physical activity can reduce the risk of type 2 diabetes by 30% to 50% in the general population (Bassuk and Manson, 2005). Exercise helps treat the glucose, blood pressure, and lipid abnormalities often found in people with diabetes, and assists with weight loss maintenance (Colberg *et al*., 2010). In the United States, only 39% of adults with diabetes are active compared to 58% of those without the condition (Leite *et al*., 2009).

Endurance aerobic exercise is usually performed continuously over a prolonged period of time at submaximal intensity. Most recommendations are for 150 to 210 minutes per week of moderate-intensity endurance aerobic exercise, plus some resistance exercise, spread over three to five sessions (Colberg *et al*., 2010). This time commitment is in addition to all of the other self-care activities recommended for people with diabetes, and a lack of time is often cited as a reason for not exercising (Godin *et al*., 1994). A cardiac evaluation may be required especially when vigorous physical activity is being contemplated and in the presence of additional risk factors for coronary artery disease (Nagi and Gallen, 2010). Skeletal muscle is responsible for most of the uptake of glucose after a meal, and transport of glucose into the muscle is considered the limiting step in glucose disposal (Houmard *et al*., 1991). Glucose transport occurs primarily by diffusion utilizing glucose transporter carrier proteins (GLUT). Both exercise and insulin regulate glucose transport mainly by the translocation of the GLUT4 isoform from an intracellular compartment to the plasma membrane and transverse tubules (Colberg *et al*., 2010). GLUT4 levels are considered an important determinant of insulin sensitivity (Houmard *et al*., 1991).

At rest and postprandially, glucose uptake is insulin-dependent, with the major purpose being the replenishment of muscle glycogen stores (Colberg *et al*., 2010). Insulin-stimulated GLUT4 translocation is generally impaired in type 2 diabetes (Goodyear and Kahn, 1998).

During exercise, muscle utilizes glucose made available by intramuscular glycogenolysis and by increased glucose uptake. Both aerobic and resistance exercises increase GLUT4 abundance and translocation, and hence blood glucose uptake by a pathway that is not dependent on insulin. Glucose uptake into contracting muscle is therefore normal even in the presence of type 2 diabetes. Following exercise, glucose uptake remains elevated, with the contraction-mediated pathway remaining active for several hours (Colberg *et al.*, 2010).

During moderate-intensity exercise (60% VO_{2max}) of short duration in persons without diabetes, increased glucose uptake by muscle is balanced by an equal rise in hepatic glucose production, and blood glucose levels remain unchanged (Marliss and Vranic, 2002). There is a decrease in insulin level, which sensitizes the liver to glucagon, thus increasing glucose production. Catecholamines play a role in increasing glucose production only during moderate-intensity exercise greater than 2 hours duration. With type 2 diabetes, blood glucose uptake by muscles usually increases more than hepatic production. This is also normally accompanied by a decline in plasma insulin levels, greatly reducing the risk of hypoglycemia in diabetics not using insulin or insulin secretagogues. The effects of aerobic exercise vary with duration and intensity, but following a single exercise session there is generally an increase in insulin action and hence glucose tolerance for between 24 and 72 hours (Colberg *et al.*, 2010).

Because of the rate at which people suffer diabetes, there is the need for frequent monitoring of blood sugar level. This will help detect early case of either hyperglycaemia or hypoglycaemia. Beside this, it is believed that exercise may have an influence on blood sugar level, hence, this current research will provide information on the effect of exercise on blood sugar level.

Materials and Methods

Study Population

This current project research study was conducted in March, 2022. A total of fifteen regular players of Wukari Table Tennis Club, Wukari, Taraba State, Nigeria was used for the purpose of this research.

List of materials and apparatus used

Ethanol
Glucometer (ACCU-CHEK) Active and test strip
Cotton wool
Lancet

Kits for biochemical analysis

ACCU-CHEK Active and its strips (product of Roche Diagnostics GmbH, Germany) were used for the determination of the blood sugar levels.

Determination of blood glucose level

The method of Imo *et al.* (2013) was used. ACCU-CHEK Active (glucometer) test strips for

quantitative blood glucose level were used. Blood was collected before and after the players played table tennis through finger puncture. It was placed on the test strip and slotted in the ACCU-CHEK Active and blood glucose level was displayed and read on the meter.

Statistical Analysis

Statistical analysis was carried out on the results with the use of Students-T-Distribution test using Statistical Package for Social Sciences (SPSS) version 23. The group means were compared for significance at $p<0.05$ and the group results presented as mean ± standard deviation.

Results

The results are presented below:

Table 1: Concentrations of blood sugar in Wukari table tennis club players before and after exercise

S/N	Before exercise (mg/dL)	After exercise (mg/dL)	Difference between before and after exercise (mg/dL)	Percentage difference before and after exercise (%)
1	88.2	104.4	16.2	18.4
2	117.0	149.4	32.4	27.7
3	113.4	82.8	-30.6	27.0
4	66.6	77.4	10.8	16.2
5	111.6	84.6	-27.0	24.2
6	100.8	97.2	-3.6	3.6
7	73.8	81.0	7.2	9.8
8	131.4	162.0	30.6	23.3
9	108.0	91.8	-16.2	15.0
10	84.6	93.6	9.0	10.6
11	97.2	79.2	-18.0	18.5
12	91.8	95.4	3.6	3.9
13	88.2	82.8	-5.4	6.1
14	88.2	82.8	-5.4	6.1
15	111.6	84.6	-27.0	24.2

The blood sugar level of all the table tennis players before exercise were within the normal random blood sugar level range. However, the blood sugar level of all the table tennis players after exercise were within the normal random blood sugar level range except two players. The blood sugar levels of seven players increased after the exercise, while the blood sugar levels of eight players reduced after the exercise.

Table 2: Mean concentrations of blood sugar in Wukari table tennis club players before and after exercise

Parameters	Before exercise (mg/dL)	After exercise (mg/dL)	Difference between before and after exercise (mg/dL)
Blood sugar level	98.16 ± 17.46^{a}	96.60 ± 25.26^{a}	-1.56 ± 19.86^{b}

Result represent mean ± standard deviation of result obtained (n=15).

The mean result of blood sugar level of the table tennis players after exercise is not statistically significant ($p>0.05$) when compared to the mean result of their blood sugar level before exercise. The mean difference of the blood sugar level between before and after exercise is statistically significant ($p<0.05$) when compared to the mean result of their blood sugar level before exercise. There is a very small decrease in the mean blood sugar level of the table tennis players after exercise.

Discussion

Different diseases are known to affect human health. Some of such diseased conditions include hyperglycaemia, hypoglycaemia and diabetes. Because of the rate at which people suffer hyperglycaemia, hypoglycaemia and diabetes, it is important to frequently monitor blood sugar level. This will help detect early case of either hyperglycaemia or hypoglycaemia. Beside this, it is believed that exercise may have an influence on blood sugar level.

The blood sugar level of all the table tennis players before exercise were within the normal random blood sugar level range (table 1). This showed that the players may be healthy as regards health challenges relating to blood sugar. This includes the hyperglycaemia, hypoglycaemia and diabetes which are now rampant among people in most communities. Only one player had his blood sugar level above 120 mg/dL, but less than 140 mg/dL. Upon interaction with the said player, he reported that he has been having problem of high blood sugar level. However, his blood sugar level before the exercise is considered normal since 131.4 mg/dL (table 1) is less than the 140 mg/dL maximum level set up by most Agencies and hospitals. The result of all the players showed that the table tennis game may have a way of aiding the regulation of blood sugar level in the players, apart from its other health benefits. This showed that regular exercise such as table tennis game may health human health condition. None of the players was detected to be suffering from either hyperglycaemia or hypoglycaemia.

The blood sugar level of all the table tennis players after exercise were within the normal random blood sugar level range except two players (table 1). Comparing the initial blood sugar levels of the players with their blood sugar levels after the exercise, it was observed that the blood sugar levels of seven players increased after the exercise, while the blood sugar levels of eight players reduced after the exercise. This shows that exercise may have various effects on different people. It has been reported that following exercise, glucose uptake remains elevated, with the contraction-mediated pathway remaining active for several hours (Colberg *et al*., 2010). It is possible that other factors may have an impact in the results generated. Insulin action, consumption of food and other physical exercise before getting involved in the table tennis game may contribute to the differences in the pattern of the result generated. Cellular glucose uptake was reported to be primarily regulated by insulin; a hormone produced in the pancreas (Wasserman, 2009). The highest reduction in blood sugar level recorded was by -30.6 mg/dL (from 113.4 to 82.8 mg/dL) which represent 27% of the player's initial blood sugar level, while the highest increase in blood sugar level recorded was 32.4 mg/dL (from 117 to 149.4 mg/dL) which represent 27.7% of the player's initial blood sugar level. This implies that the rate of glucose metabolism in the players which represent

individual differ. There is the need to ascertain the time and level of food consumption before random blood sugar test. A comparison of the results showed that blood sugar level reduced in more players after exercise. Different research reported that during moderate-intensity exercise (60% VO_{2max}) of short duration in persons without diabetes, increased glucose uptake by muscle is balanced by an equal rise in hepatic glucose production, and blood glucose levels remain unchanged (Marliss and Vranic, 2002).

The mean result of blood sugar level of the table tennis players after exercise (table 2) is not statistically significant ($p>0.05$) when compared to the mean result of their blood sugar level before exercise. There was a slight reduction in the mean blood sugar level of the players after the exercise. This showed that exercise have the intensity of reducing blood sugar level slightly. This reduction may be due to the fact that the body requires additional glucose during exercise than when the body is at rest. The glucose is to help in provision of energy source to the body, to sustain it during exercise which usually requires extra energy. This finding agreed with a report which stated that exercise helps treat the glucose, blood pressure, and lipid abnormalities often found in people with diabetes, and assists with weight loss maintenance (Colberg *et al*., 2010).

Conclusion

The blood sugar levels of seven players increased after the exercise, while the blood sugar levels of eight players reduced after the exercise. There is a very small decrease in the mean blood sugar level of the table tennis players after exercise. The results showed that exercise may cause a decrease in blood sugar levels of some players and may also cause an increase in the blood sugar levels of other players. Generally, exercise caused a non-significant decrease in blood sugar level of the table tennis players.

References

Bassuk, S. S. & Manson, J. E. (2005). Epidemiological evidence for the role of physical activity in reducing risk of type 2 diabetes and cardiovascular disease, *J Appl Physiol*., 99(3), 1193–1204.

Colberg, S. R., Sigal, R. J. & Fernhall, B. (2010). For American College of Sports Medicine, American Diabetes Association. Exercise and type 2 diabetes: the American College of Sports Medicine and the American Diabetes Association: joint position statement executive summary. *Diabetes Care*, 33(12), 2692–2696.

Godin, G., Desharnais, R., Valois, P., Lepage, L., Jobin, J. & Bradet, R. (1994). Differences in perceived barriers to exercise between high and low intenders: Observations among different populations, *Am J Health Promot*., 8(4), 279–285.

Goodyear, L. J. & Kahn, B. B. (1998). Exercise, glucose transport, and insulin sensitivity. *Annu Rev Med*., 49, 235–261.

Houmard, J. A., Egan, P. C. & Neufer, P. D. (1991). Elevated skeletal muscle glucose transporter levels in exercise-trained middle-aged men, *Am J Physiol*., 261(4 Pt 1), E437–E443

Hu, F. B. (2011). Globalization of diabetes: the role of diet, lifestyle, and genes. *Diabetes Care*, 34(6), 1249–1257.

Imo, C., Uhegbu, F. O., Imo, C. K., Ifeanacho, N. G., Osuocha, K. U. & Ibe, C. (2013). Acute administration of aqueous extract of *Garcinia kola* on daily blood glucose level and selected biochemical Indices in longevity Wistar Albino Rats, *International Journal of Microbiology and Mycology,* 1(2), 7-12.

Leite, S. A., Monk, A. M., Upham, P. A. & Bergenstal, R. M. (2009). Low cardiorespiratory fitness in people at risk for type 2 diabetes: early marker for insulin resistance, *Diabetol Metab Syndr*., 1(1), 8.

Marliss, E. B. & Vranic, M. (2002). Intense exercise has unique effects on both insulin release and its roles in glucoregulation: implications for diabetes. *Diabetes*, 51(Suppl 1), S271–S283.

Nagi, D. & Gallen, I. (2010). ABCD position statement on physical activity and exercise in diabetes. *Practical Diabetes International*, 27(4), 158–163a.

Narayan, K. M., Boyle, J. P., Thompson, T. J., Sorensen, S. W. & Williamson, D. F. (2003). Lifetime risk for diabetes mellitus in the United States. *JAMA*., 290(14):1884–1890.

Wasserman, D. H. (2009). Four grams of glucose. *American Journal of Physiology Endocrinology and Metabolism*, 296(1), E11–E21.

Zhang, P., Zhang, X. & Brown, J. (2010). Global healthcare expenditure on diabetes for 2010 and 2030, *Diabetes Res Clin Pract*., 87(3), 293–301.

EFFECT OF ETHANOLIC EXTRACTS OF *DENNETTIA TRIPETALA* SEED AND FRUIT ON BLOOD SUGAR LEVEL OF MALE ALBINO RAT

[1]Imo, Chinedu, [2]Ikwebe, Joseph, [3]Imo, Nkeiruka Glory, [4]Mayel, Mida Habila, [5]Ayo, Victoria Ifeoluwa, [6]Timothy, Mgbede, [7]Shadrach, Philip,
[8]Muhammad, Zuhairah Ismail, & [9]Huseni, Precious Maina
[1,2,4,5,6,7&8]Department of Biochemistry, Faculty of Pure and Applied Sciences, Federal University Wukari, Nigeria.
[3]Department of Animal Production and Health, Faculty of Agriculture and Life Sciences, Federal University Wukari, Nigeria.
[9]Department of Life Sciences, Kwararafa University, Wukari, Nigeria.

Abstract

This study evaluated the effect of ethanolic extracts of Dennettia tripetala seed and fruit on blood sugar level of male albino rat. Dennettia tripetala is used for many purposes. In traditional medicine, it is used for many medicinal purposes which includes as a remedy for cough, fever, toothache and nausea. In this study, twenty-five healthy albino rats were randomly placed into five groups with five rats in each group. Group 1 served as the control group. Group 2 received Dennettia tripetala seed extract (100 mg/kg b.w.) only. Group 3 received Dennettia tripetala seed extract (200 mg/kg b.w.) only. Group 4 received Dennettia tripetala fruit extract (100 mg/kg b.w.) only. Group 5 received Dennettia tripetala fruit extract (200 mg/kg b.w.) only. The extracts were administered to the test rats through oral route on daily basis for fourteen (14) days. The result showed that there are no significant alterations ($p>0.05$) of the blood sugar levels in all the test animals on day 4 of administration of the plant extracts when compared with the normal control. On day four, blood sugar level reduced non-significantly ($p>0.05$) in group 3 but increased non-significantly ($p>0.05$) in groups 2, 4 and 5 compared to the normal control. On day nine, blood sugar level increased non-significantly ($p>0.05$) in groups 2 and 3 but increased significantly ($p<0.05$) in groups 4 and 5 compared to the normal control. On day fourteen, the blood sugar level also increased non-significantly ($p>0.05$) in groups 2 and 3 but increased

significantly ($p<0.05$) in groups 4 and 5 when compared to the normal control. Consumption of low level of the seed of Dennettia tripetala for a short period of time may increase blood sugar level, while consumption of high level of the Dennettia tripetala seed for a short period may reduce blood sugar level. It was observed that the effect of the fruit extract on the blood sugar level of the animals at day nine and fourteen was dose-dependent, while the reverse is the case for the seed extract. A comparative analysis of the effect of the seed extract and fruit extract showed that the fruit extract have a better increasing effect on blood sugar level of the animals.

***Keywords**: Blood sugar level, Dennettia tripetala, Diabetes, Hyperglycemia, Hypoglycemia, Medicinal plant.*

Background to the Study

Different plants are used for various reasons, including in nutrition and medicine. Human beings have been reported to depend on nature for their simple requirements as being the sources for medicines, food stuffs, fragrances and flavours throughout the ages. For the large proportion of world's population, medicinal plants show a dominant role in the healthcare system, where herbal medicine has continuous history of long use (Dar *et al.*, 2017). Some plant parts are used as spices. This includes *Dennettia tripetala* seed and *Dennettia tripetala* fruit, among others.

The contribution of plants in some diversified industries is remarkable, such as fine chemicals, cosmetics, pharmaceuticals and drugs and industrial raw materials. Medicinal plants have performed a dynamic part in the development of new drug discovery. Also, they have proved their functions in coping with a number of deadly diseases, including cancer and the diseases associated with viral onslaught *viz*. Hepatitis, AIDS etc. (Dar *et al.*, 2017).

Plants have been known not to be only indispensable in health care, but also form the best hope of source for safe future medicines (Hamburger and Hostettmann, 1991). Although a good number of modern drugs exist, it is still important to discover and develop new therapeutic agents. The WHO endorses and promotes the addition of herbal drugs in national health care programs because they are reported to be easily accessible at a price within the reach of a common man and are time tested and therefore, they are considered to be safe than the modern synthetic drugs (Singh and Singh, 1981). Thus, the research of pharmacologically and biologically active agents obtained by screening natural plant extracts had led to the detection of several pharmaceutically important drugs that play a key role in the treatment of human diseases (Rastogi and Meharotra, 1990).

A promising future of medicinal plants has been reported as there are about half million plants around the world, and majority of them are yet to be investigated for their medical activities and their hidden potential of medical activities could be decisive in the treatment of present and future studies (Singh, 2015). Many varieties of modern medicines are

produced indirectly from medicinal plants, for example aspirin. Dar *et al.* (2017) documented that many food crops have medicinal effects, for example garlic. Study into medicinal values of plants helps to understand plant toxicity and protect human and animals from natural poisons. The medicinal effects of plants are known to be due to secondary metabolite production of the plants (Dar *et al.*, 2017). Medicinal plants are known resources of new drugs and many of the modern medicines are produced indirectly from plants.

Plants have been reported to possess very great potential for the treatment and management of certain disease conditions. Many plants have been used by tribal and folklore: in different countries for the treatment and management of different diseases (Imo *et al.*, 2016). Currently, many plant materials including *Syzygium aromaticum* flower bud and *Cassia tora* seed are being investigated for their potential effects in health care. For a long time, there has been a resurgence of interest in the investigation of natural materials, especially plants, as a source of potential drug. Many people consume different plant parts for several reasons. *Dennettia tripetala* seed and *Dennettia tripetala* fruit are some of the plant parts used by many as spice. Some people consume them because of the hot sensation it gives. Most people that consume *Dennettia tripetala* parts do not know if it improves or reduces blood sugar level. Though the two plant parts are consumed/used widely because of their acclaimed medicinal and nutritional importance, it is important that a research finding is conducted to ascertain the possible effects of these plant parts on blood sugar level of the consumers. Hence, this warranted research into the current study.

Materials and Methods

List of Materials and Apparatus used

Dennettia tripetala seed, *Dennettia tripetala* fruit, Ethanol, Water, Glucometer: ACCU-CHEK Active and test strip, Water bath, and Glasswares

Plant Materials and Extraction

The plant material (*Dennettia tripetala* fruit) was obtained from Umuahia, Abia State, Nigeria. The seeds of some of the fruits were removed to obtain the seed as a different sample. The *Dennettia tripetala* seed and *Dennettia tripetala* fruit were air-dried. The dried plant samples were milled to a powder. About 250g of each powder were macerated with 700 mL of ethanol (70%) by cold maceration for 48 hours and filtered. The filtrates were evaporated to dryness using water bath. The concentration of the extracts was made in water for the experiment: 50 mg/mL.

Experimental Animals

Twenty-five healthy male albino rats were used in this study. The albino rats were kept in the animal house, Department of Life Sciences, Kwararafa University Wukari, Taraba State. They were allowed to acclimatize for 14 days under standard laboratory conditions with free access to commercial rat feed and water before the experiment.

Experimental Design

The animals were randomly placed into five groups with five (5) rats in each group. Group 1 served as the control group (they were not administered any of the plant extracts). Group 2 received *Dennettia tripetala* seed extract (100 mg/kg b.w.) only. Group 3 received *Dennettia tripetala* seed extract (200 mg/kg b.w.) only. Group 4 received *Dennettia tripetala* fruit extract (100 mg/kg b.w.) only. Group 5 received *Dennettia tripetala* fruit extract (200 mg/kg b.w.) only. Groups 2, 3, 4 and 5 received the various plant part extracts once daily. The extracts were administered through oral route on daily basis for fourteen (14) days. All animals were allowed free access to feed and water *ad libitum*.

Determination of blood glucose level

The method of Imo *et al*. (2013) was used. ACCU-CHEK Active (glucometer) test strips for quantitative blood glucose level were used. Blood was collected on the 4^{th} day, 9^{th} day and 14^{th} day of administration of the plant extracts from the rats through tail puncture. It was placed on the test strip and slotted in the ACCU-CHEK Active and blood glucose level was displayed and read on the meter.

Statistical analysis

Statistical analysis was carried out on the results with the use of One-Way Analysis of Variance (ANOVA) using Statistical Package for Social Sciences (SPSS) version 23. The group means were compared for significance at $p<0.05$ and the group results presented as mean ± standard deviation.

Results

The results are presented in table 1.

Table 1: Concentrations of blood sugar in rats administered ethanolic seed extract and fruit extract of *Dennettia tripetala* (mg/dL)

Days of administration of extracts	Group 1 (Normal control)	Group 2 (Seed extract of *Dennettia tripetala*: 100 mg/kg bw)	Group 3 (Seed extract of *Dennettia tripetala*: 200 mg/kg bw)	Group 4 (Fruit extract of *Dennettia tripetala*: 100 mg/kg bw)	Group 5 (Fruit extract of *Dennettia tripetala*: 200 mg/kg bw)
Day four	80.60 ± 5.27^{a}	84.80 ± 5.81^{a}	77.20 ± 8.17^{a}	86.00 ± 6.20^{a}	85.20 ± 6.14^{a}
Day nine	78.60 ± 4.28^{a}	$86.20 \pm 3.90^{a,b}$	$83.60 \pm 6.88^{a,b}$	$89.40 \pm 6.58^{b,c}$	94.20 ± 5.63^{c}
Day fourteen	84.00 ± 3.61^{a}	$89.00 \pm 3.54^{a,b}$	$88.80 \pm 4.44^{a,b}$	92.00 ± 3.00^{b}	98.60 ± 3.51^{c}

Result represent mean ± standard deviation of group serum result obtained (n=5).

Mean in the same row, having different letters of the alphabet are statistically significant ($p<0.05$). There are no significant alterations ($p>0.05$) of the blood sugar levels in all the test animals on day 4 of administration of the plant extracts when compared with the normal control. On day four, blood sugar level reduced non-significantly ($p>0.05$) in group 3 but increased non-significantly ($p>0.05$) in groups 2, 4 and 5 compared to the normal control. On day nine, blood sugar level increased non-significantly ($p>0.05$) in groups 2 and 3 but increased significantly ($p<0.05$) in groups 4 and 5 compared to the normal control. On day

fourteen, the blood sugar level also increased non-significantly ($p>0.05$) in groups 2 and 3 but increased significantly ($p<0.05$) in groups 4 and 5 when compared to the normal control.

Discussion

Different diseases are known to affect human health. Some of such diseased conditions include hyperglycaemia, hypoglycaemia and diabetes. Because of the rate at which people suffer hyperglycaemia, hypoglycaemia and diabetes, it is important to frequently monitor blood sugar level. This will help detect early case of either hyperglycaemia or hypoglycaemia. Beside this, it is believed that stress due to office work or duties may have an influence on blood sugar level of people who work in various offices.

The blood sugar level of all the test animals increased except the blood sugar level of the animals administered high dose of seed extract of *Dennettia tripetala* when compared to the normal control animals (table 1). Although this alteration (increase and decrease of blood sugar levels), is not significant, the result showed that consumption of the fruit of *Dennettia tripetala* for a period of four days may slightly increase the blood sugar level. Consumption of low level of the seed for a short period of time may also increase blood sugar level, while consumption of high level of the *Dennettia tripetala* seed for a short period may reduce blood sugar level. This shows that the constituents of seed of *Dennettia tripetala* may have different mechanisms of actions on blood sugar level if it is consumed for a short time (four days) as used in this study. It was observed that lose dose of the two different plant extracts had a better increasing effect on blood sugar than the high dose. This observation may be due to the different actions of the chemical constituents of the plant extracts which may have possible different mechanisms of action on processes involved in glucose metabolism. Glucose can be transported from the intestines or liver to other tissues in the animal body via the bloodstream. It has been reported that cellular glucose uptake is primarily regulated by insulin, a hormone produced in the pancreas (Wasserman, 2009).

Following the administration of the various doses of the plant extracts at day nine, blood sugar level of the animals increased non-significantly ($p>0.05$) in groups 2 and 3 administered low dose and high dose of the seed extracts respectively but increased significantly ($p<0.05$) in groups 4 and 5 animals administered the fruit extract of *Dennettia tripetala* when compared to the normal control. This result showed that if the number of days of consumption of fruit extract of *Dennettia tripetala* is increased up to nine days as in this study, it may cause a significant increase in blood sugar level of the consumers. This means that individuals who have high blood pressure related challenge may be required not to consume fruit of *Dennettia tripetala* for a longer period. The effect of the seed extracts also caused an elevation of the blood sugar level of the test animals, but the increase is not statistically significant ($p>0.05$) when compared with the normal control. There are two types of mutually antagonistic metabolic hormones affecting blood glucose levels: Catabolic hormones (such as glucagon, cortisol and catecholamines) which increase blood glucose; (Lehninger *et al*., 2017) and one anabolic hormone (insulin), which decreases blood glucose. It is possible that some of the chemical constituents of the plant extracts may be encouraging the action of any of the catabolic hormones. Some phytochemicals reported to

be present in the fruits of *D. tripetala* according to Egharevba and Idah (2015) are tannins, alkaloids, steroids, terpenes, flavonoids, balsams (resin) and phenol. It has been reported that these bioactive compounds are the basis for therapeutic potentials of medicinal plants (Khadijah, 2015). It was observed that the effect of the fruit extract on the blood sugar level of the animals at day nine was dose-dependent, while the reverse is the case for the seed extract. A comparative analysis of the effect of the seed extract and fruit extract showed that the fruit extract have a better increasing effect on the blood sugar level of the animals.

The effects of administration of the various doses of the two plant extracts at day fourteen showed similar pattern of effect on blood sugar level when compared to the effect recorded at day nine. This means that the longer the administration of the extracts, it is possible that there will be increase in the effects observed. This result showed that consumption of seeds and fruits of *Dennettia tripetala* may have the potency of increasing blood sugar level. Fruit extract of *Dennettia tripetala* may increase blood sugar level more that seed extract of *Dennettia tripetala*

Conclusion

The result of this study showed that the blood sugar level of all the test animals increased except the blood sugar level of the animals administered high dose of seed extract of *Dennettia tripetala* on day four. Consumption of low level of the seed of *Dennettia tripetala* for a short period of time may increase blood sugar level, while consumption of high level of the *Dennettia tripetala* seed for a short period may reduce blood sugar level. Individuals who have high blood pressure related challenge may be required not to consume fruit of *Dennettia tripetala* for a longer period. It was observed that the effect of the fruit extract on the blood sugar level of the animals at day nine and fourteen was dose-dependent, while the reverse is the case for the seed extract. A comparative analysis of the effect of the seed extract and fruit extract showed that the fruit extract have a better increasing effect on blood sugar level of the animals.

References

Dar, R. A., Shahnawaz, M. & Qazi, P. H. (2017). Natural product medicines: A literature update, *J Phytopharmacol*, 6(6), 349-351.

Egharevba, H. O. & Idah, E. A. (2015). Major compounds from the essential oil of the fruit and comparative phytochemical studies of the fruits and leaves of *Dennettia tripetala* Barker F. Found in North Central Nigeria, *International Journal of Pharmacognosy and Phytochemical Research*, 7(6), 1262-1266.

Hamburger, M. & Hostettmann, K. (1991). Bioactivity in plants: the link between phytochemistry and medicine, *Phytochemistry*, 30, 3864-3874.

Imo, C., Arowora, K. A., Awache, I. & Abdullahi, Z. R. (2016). Haematological effects of ethanolic leaf, seed and fruit extracts of datura metel on Male Albino rats, *FUW Trends in Science & Technology Journal*, 1(2)509-512.

Imo, C., Uhegbu, F. O., Imo, C. K., Ifeanacho, N. G., Osuocha, K. U. & Ibe, C. (2013). Acute administration of aqueous extract of *Garcinia kola* on daily blood glucose level and selected biochemical Indices in longevity wistar albino rats, *International Journal of Microbiology and Mycology,* 1(2) 7-12.

Khadijah, S. (2015). Anthelmintic efficacy of crude methanol extract of *Dennetia tripetalag*, Baker Fruits with its Various Chemical Fractions in Mice Experimentally infected with heligmosomoidesbakeri. A Thesis Submitted to Ahmadu Bello University, Zaria, Nigeria, 65-70.

Lehninger, A., Nelson, D. & Cox, M. (2017). *Lehininger principles of biochemistry,* New York: W.H. Freedom, 930-934.

Rastogi, P. R. & Meharotra, B. N. (1990). *In compendium of Indian medicinal plants*. I, 339, a) (1993) III: 194. PID, CSIR, New Delhi, India.

Singh, P. & Singh, C. L. (1981). Chemical investigations of clerodendraon fragrans. *Journal of Indian Chemical Society*, 58, 626-627.

Singh, R. (2015). Medicinal plants: A review, *Journal of Plant Sciences*, 3(1-1) 50-55.

Wasserman, D. H. (2009). Four grams of glucose. *American Journal of Physiology Endocrinology and Metabolism*, 296(1), E11–E21.

BITTER LEAF (*VERNONIA AMYGDALINA*) EXTRACT AS A MEANS OF EXTENDING THE SHELF LIFE OF LOCALLY BREWED SORGHUM BEER

[1]Ikwebe, Joseph, [2]Imo, Chinedu, [3]Imo, Nkeiruka Glory, [4]Mayel, Mida Habila, [5]Ayo, Victoria Ifeoluwa, [6]Timothy, Mgbede, [7]Shadrach, Philip, [8]Muhammad, Zuhairah Ismail, & [9]Adams, Christiana

[1,2,4,5,6,7,8&9]Department of Biochemistry, Faculty of Pure and Applied Sciences, Federal University Wukari, Nigeria

[3]Department of Animal Production and Health, Faculty of Agriculture and Life Sciences, Federal University Wukari, Nigeria

Abstract

Burukutu is a traditional alcoholic beverage that is mostly brewed in the northern regions of Nigeria. Although widely consumed and used during many festivities and during work sometimes in the farm, poor shelf-life limits its economic potential as an income generating venture for most women. The study was carried out to improve the shelf-life of this beverage through the addition of Vernonia amygdalina leaf extract. The study investigated the shelf-life of untreated burukutu and burukutu treated with bitter leaf extract. Microbiological (fungi and coliform growth) and physical (pH) assessments, as well as sugar and alcohol levels, and organoleptic parameters were measured. The burukutu samples with bitter leaf extracts had low pH values in burukutu during the storage which some coliforms cannot survive. There was no consumer acceptability of untreated burukutu when stored for 7 days. However, the bitter leaf treated burukutu was less acceptable to consumers during storage. Based on the findings of this research it can be concluded that the addition of bitter leaf extract can help increase the shelf-life of burukutu to 7 days. However, burukutu with bitter leaf extract was not acceptable to consumers. Additional research is suggested on other antimicrobial plants since it is proven that consumers did not like burukutu with the bitter leaf extract due to its bitter flavour.

Keywords*: Alcoholic beverage, Burukutu, pH, Shelf-life, Vernonia amygdalina.*

Background to the Study

The word beer derives from the Latin word *bibere* meaning to drink (Okafor, 2007).Beer is the world's oldest and most widely consumed alcoholic beverage and the third most popular drink overall after water and tea. Grossman (1995) defined beer as a general name given to beverages resulting from the germination of a malt or cereal grain. The process of making beer is called brewing. It is produced by the breaking down and fermenting of starches mainly derived from cereal grains most commonly malted barley, although wheat, maize (corn), and rice are widely used (Gutcho, 1976). In Nigeria today, barley has been replaced by some locally grown cereals such as sorghum or guinea corn, millet and maize as the principal raw materials. African local beers are known by different names in different part of the world; burukutu, otika and pito in Nigeria.

Burukutu, among indigenes of the middle belt region of Nigeria, is a local brew made from fermented sorghum and other protein enriched grains. The age long drink, also known as BKT, serves as a source of alcohol for those who lack the financial means to patronize more refined exotic brew like beer and other foreign or imported drinks. It is produced mainly from the grains of guinea corn (*Sorghum vulgare and Sorghum bicolor*). The process of production of burukutu involves malting, mashing, fermentation and maturation. The production process of these indigenous drinks involves fermentation at its initial production stage and comes out as an alcoholic drink. The microorganisms associated with fermentation include *Saccharomyces cerevisiae*, *Saccharomyces* and *Chavelieria*. Sorghum is a large variable genus with many cultivars. The method employed in brewing sorghum beer here involves, malting, mashing, worth boiling with hops.

The problem faced by the producers of local beer (*burukutu*) is that the beer has a very short shelf-life and therefore, it gets spoiled very easily. A means of extending the shelf-life of this local beer has to be established in other to improve the product and also make it of a good standard. The significance of this research work is that bitter leaf (*Vernonia amigdalina*) extract can be used extend the shelf-life of local beer (*burukutu*) and also standardize the product thereby, improving the quality of this product. The use of bitter leaf is going to be of great importance to the producers of local beer (*burukutu*) as their product will have a better bitter flavour as well as an extended shelf-life.

Materials and Methods

Procurement and Pretreatment of Raw Bitter Leaf

The raw bitter leaf used in this study was sourced freshly from Wukari main market in Taraba state all in Nigeria respectively at two different periods. The leaves were thoroughly rinsed and screened to remove foreign bodies. They were then dried at room temperature (35 ^{o}C) for five days to eliminate moisture. The dried leaves were therefore crushed and pounded using a mortar and a pestle into smaller particles. The size reduction was done in order to increase the surface area for contact with the solvent because the particle of a soluble material is surrounded by a matrix of insoluble matter and thus, the size reduction will allow the solvent to penetrate and diffuse into the particle to allow the extract to diffuse out accordingly.

Experimental Procedure for Preparation of Bitter Leaf Extracts (Direct Extraction)
In the process, 20 grams of the granulated sample of smaller particle was measured into a conical flask which contained 200 mL of distilled water. The mixture was rigorously agitated by shaking the flask. The mixture was allowed to stay for 2 days for proper extraction. After which it was filtered and ready for use.

Local Brewing of Sorghum Beer
During the brewing process, the hop that was extracted from bitter leaf was added. Here, two samples of sorghum beer were prepared; sample A contains bitter leaf extract while sample B has no content of bitter leaf extract. These samples were observed for five days, and analysis was carried out on each of the samples for the first day to the fifth day. The two biochemical tests carried out on each of the two samples are: Alcoholic content test and Glucose content test. Since fermentation has to do with conversion of glucose to alcohol, these two biochemical tests were carried out daily for accurate results.

The procedure for the production of local beer is shown below:
Two moods sorghum (guinea corn) was measured and divided into two different samples (A and B) two moods each sample, then the samples were divided into four equal parts, one each of sample A and B and labelled Ai and Bi was soaked in water and removed from water after four hours then allowed to germinate for four days after which sample Ai and Bi were wet milled using milling machine. After milling, two litres of water were added to each samples Ai and Bi and was then filtered using filter pieces. The two samples were then boiled and allowed to cool till the next day; this is the first fermentation that takes place.

On the same day, samples Aii and Bii were soaked in water (steeping) and removed from water after four hours and allowed for germination in three days. Samples Aii and Bii were boiled separately for three hours. During the second boiling process, bitter leaf extract was added to sample Aii, after which both samples were allowed to cool while stirring it continuously until it cools. Sample Ai was then mixed with sample Aii and sample Bi mixed with Bii giving sample C and D respectively. Both sample C and D were allowed to ferment overnight. The next morning, an alcohol containing bitter leaf extract and another without bitter leaf extract were ready for analysis.

Alcoholic Content Test
Using an Alcoholmeter, the alcoholic content of the sorghum beer with and without bitter leaf extract were tested and recorded as observations were made as well. This process was repeated for five days and observations were also made each day and recorded respectively. 500 mL of the local beer was measured into the measuring cylinder and the calibrated alcoholmeter was dropped inside and the reading was taken both for sample C and D respectively.

Glucose Content Test
Glucose meter was used in this test, to obtain the glucose level of this alcoholic beverage, this process is repeated each day for five days as observations were made to be able to derive the

difference in the results gotten. A drop of the alcohol sample on the strip which was inserted into the digital glucose meter and result displays on the screen of the glucose meter as the reading was taken immediately, this process is done both for sample C and D respectively.

Microbial Analysis to Detect the Growth of Microbes on the Locally Brewed Sorghum Beer

For microbial analysis, colony count of microbes was used in this analysis, serial dilution of the sample (C and D). Samples were measured into two bottles and labelled C and D. About 9 mL of distilled water was measured into 5 different test tubes and labelled 1-5. Exactly 1 mL of sample C was measured into tube 1 using a string and the string disposed.1 mL from tube 1 into tube 2 and the string disposed. Also, 1 mL from tube 2 was added into tube 3 and the string disposed. One mL from tube 3 was added into tube 4 and the string disposed. Then 1 mL from tube 4 into tube 5 and the string disposed, and 1 mL from tube 5 was discarded.

Test tubes 4 and 5 were used for pouring plate culture. Four Petri dishes were used for incubation and were labelled as C4, C5, D4, and D5. 1 mL each from tubes 4 and 5 both for sample C and D were poured into Petri dishes respectively, using one string for each of the sample. The culture media (nutrient agar) was poured on each of the four Petri dishes well spread. The four Petri dishes were incubated in the incubator for 24 hrs, and finally, the microbes that grew on the dishes were counted and recorded. This process was repeated for five days and results from C and D were compared and noted.

Determination of the pH level of the Locally Brewed Sorghum Beer (Burukutu)

The pH of the samples C and D were determined respectively using the pH meter and results were recorded, observed, compared and the differences between the results were noted. A pH meter was dipped into the alcohol and the result displayed on the digital pH meter and was recorded. This was carried out on sample C and D respectively.

Results

The results are presented in the tables below.

Table 1: Analysis of burukutu sample without bitter leaf (sample C)

Day	Alcoholic content (%)	Glucose content (mmol/L)	pH
1	0.00	0.90	3.35
2	2.00	0.80	2.45
3	4.00	0.70	2.00
4	5.00	-	1.45
5	5.00	-	1.09
6	5.00	-	1.05
7	5.00	-	1.01

Table 2: Analysis on burukutu sample with bitter leaf extract (sample D)

Day	Alcoholic content (%)	Glucose content (mmol/L)	pH
1	0.00	0.70	3.35
2	2.00	0.60	2.45
3	3.00	-	2.00
4	4.00	-	1.45
5	5.00	-	1.09
6	6.00	-	1.05
7	6.00	-	1.01

From table 1 and 2 above, the alcoholic content of the burukutu increased as the glucose content decreases, and the concentration of lactic acid also increases (pH) due to fermentation.

Table 3: Microbial count for sample C

Day	Samples	Microbial count
1	C4	6
	C 5	8
	D 4	3
	D5	4
2	4 C	17
	C 5	20
	D4	10
	D5	6
3	C4	35
	C5	28
	D4	15
	D5	12
4	C 4	40
	C 5	29
	D4	17
	D5	15
5	C4	45
	C5	35
	D4	21
	D5	17
6	C4	45
	C5	40
	D4	30
	D5	25
7	C4	50
	C5	47
	D4	32
	D5	28

Table 3 showed that the sample of burukutu treated with bitter leaf extract has less microbial count than the untreated sample showing the antimicrobial effect of bitter leaf.

Discussion

Bitter leaf burukutu exhibited antimicrobial activity, which is a characteristic of bitter leaf extract, hence contributed to the reduction of coliforms in burukutu at zero day compared to the high coliform load in untreated burukutu. The heat shock from bitter leaf burukutu reduced coliform load in samples prior to storage. The lowest reduction of microbial load in pasteurized bitter leaf burukutu can be attributed to the cocktail of treatment, hence can enhanced microbial stability in burukutu during 5 days of storage. However, the reduction of coliform load in untreated burukutu during storage would be as a result of spontaneous microbial activity; this include accumulation of lactic acid and acetic acids during storage produced by bacteria, which are detrimental to some sensitive bacteria (Fadahunsi *et al.,* 2013) as well as the lowering of pH values in burukutu during the storage which some coliforms cannot survive (Ray and Bhunia, 2013), hence explaining the drastic reduction of coliform population in untreated burukutu samples. Similar inference could be made for the reduction of coliform in various treatments applied to the sorghum beer (burukutu). Unlike coliform, the mould population did not reduce very significantly in bitter leaf burukutu. This implied that, antimicrobial activity of bitter leaf varied with the type of microbe which confirms the findings made by some researchers, on the inhibitory effect of *Vernonia amygdalina* leaf extract on some selected fungal strains (Bukar *et al.,* 2010; Devendra *et al.,* 2011), but bitter leaf extract treatment can reduce mould population to acceptable levels. This corroborates with previous report that pasteurization is capable of inactivating microbial activity in traditionally brewed sorghum beers (Osseyi *et al.,* 2011).

The significant reduction of the number of fungi growth in the untreated burukutu during storage might have resulted from the exhaustion of nutrients in the products, thus reducing the overall food availability for the microorganisms as reported by other researchers (Fadahunsi *et al.,* 2013). Also, the growth of fungi might have been impeded by unfavourable conditions as stated in the case of coliforms. Generally, the addition of bitter leaf extract might have been the major contributing factor, influencing the overall reduction of microbial growth in bitter leaf burukutu. In order to improve the shelf life of sorghum beer, the addition of *Vernonia amygdalina* to sorghum beer were employed in comparison with traditionally brewed sorghum beer (burukutu).

The pH values for all burukutu samples (untreated burukutu, treated burukutu) were within the stipulated pH range for sorghum beer of 2 to 4 as indicated in previous study of increasing shelf of burukutu and microbial assessment of burukutu during storage (Fadahunsi *et al.,* 2013). However, each treatment lacked stability with respect to pH (3.2 to 3.5) value, which can be attributed to activities of microbes with the burukutu samples during the period of storage. Microbial activities were much more in untreated burukutu which led to a lower pH value compared to bitter leaf burukutu which had higher pH values. The lower pH can also be attributed to organic acid produced by some microorganisms (bacteria, moulds and yeast) that were isolated in the burukutu treated samples and also suggested by Fadahunsi *et al*. (2013). The high pH in bitter leaf burukutu, signifies low microbial activity in the treated burukutu sample. Bitter leaf burukutu suggested that *Vernonia amygdalina* inclusion only could minimize microbial activity to some extent when

compared to untreated burukutu. This implies that untreated burukutu would be less acidic compared to treated burukutu, since it been reported that the souring in sorghum beer is owned to the presence of lactic acid bacteria or acetic acid bacteria (Lyumugabe *et al.,* 2012). Levels of extract (% mass saccharose) in sorghum beer (burukutu) brewing were determined by fermentation period and yeast cells activities in burukutu brewing. The decline of the extract (%) was expected because sugar was converted into alcohol. The extract (%) showed a decline in all the treatments. This implied that fermentation was still on-going, hence the presence of some microbes and yeast cell as revealed in the microbiology of the burukutu sampled. The decline of the extract (%) which showed a reduction in sugar content in pito for 7 days storage corroborates with earlier report of Demuyakor and Ohta (1993), thus the glucose content in burukutu reduced during storage since it served as carbon source for energy by the microorganisms present.

Despite *Vernonia amygdalina* leaves is known to contain carbohydrate (Mustapha and Babura, 2009), conversion rate into fermentable sugars may be low because of *Saccharomyces cerevisiae* inability to convert starch/complex carbohydrate to simple sugars and later to alcohol as well as the large proportion of carbohydrate in malted sorghum prior to fermentation (Lyumugabe *et al.,* 2010). In additon, *Vernonia amygdalina,* extract might have influenced *S. cerevisiae* activity, hence translating into the low percentages of glucose in the burukuru at the initial stage of storage when treated with bitter leaf extract. Untreated burukutu encountered high microbial activity hence resulting in the rapid decline of the amount of glucose for 5 days of storage. This period could be described as lag periods/phase as sugar usage was almost negligible. The decline in extract (%) in untreated burukutu from day 1 to 5 might be due to microbial build up hence sugar utilization increased. It was expected that, the amount of the sugar utilized should be equivalent to alcohol produced but this was not observed. Stability of alcohol level observed for a week (seven days) in treated burukutu could be attributed to treatment shock on microbes and change in the physico-chemical properties of the medium (burukutu), and hence sugar utilization as a carbon source by microbes and yeast cell was not efficient for the first 2 days. Unlike untreated burukutu, it was characterized by alcohol reduction from day 1 to 3. This implied that alcohol reducing microbes were associated with each sample. The reduction of alcohol produced more acids contributing to the sourness of burukutu during storage hence the low pH recorded for each sample during storage. The reduction of alcohol in all samples during storage would be linked to alcohol degrading microbes. Similar inference could be made for untreated burukutu.

The significant reduction of alcohol in the untreated burukutu led to early spoilage. This observation indicated that for the efficient conversion of sugar to alcohol involves other factors (Lin *et al.,* 2012). The stability of alcohol level in untreated burukutu might have resulted from inadequate carbon source for the microorganisms present and also the low pH of the medium might not have been appropriate for some microbial activity. This study suggests that treatment of local beer (burukutu) is capable of maintaining the alcohol content in the burukutu during storage for seven days of storage. The undesirable sensory characteristics of sorghum burukutu are as a result of microbial presence and activity

(metabolic processes) that leads to the sorghum beer spoilage. The presence of coliforms and moulds in the burukutu samples may have resulted from unhygienic practices during and after the brewing process of the burukutu, causing the relatively high increase of coliform and mould growth at the initial stage of storage in the untreated burukutu. The high coliform and fungi count in the fresh burukutu might have led to the present coliform in the burukutu samples after the addition of bitter leaf extract. The intensity of the sourness is a reflection of the product acidity. The right degree of sourness is considered as part of the general characteristics of a good burukutu (Demuyakor, 1994); if it becomes very sour it is an indication of deterioration. Also, the untreated burukutu was very sour after seven days of storage indicating the impact of the decrease of pH level during storage.

Treated burukutu was mostly liked up to 7 days of storage. The untreated burukutu was further not preferred after 3 days of storage. The reason may be attributed to off flavours which alter the quality of the beer causing it to deteriorate (Rodrigues *et al.,* 2011). Also, the burukutu treated with bitter leaf extract which was less liked throughout the storage period shows that consumers are not familiar with the product, and this confirms that some consumers find it very difficult to change.

Conclusion

The addition of bitter leaf extract had reduced the fungi and coliform growth in the treated burukutu sample than the untreated burukutu. The physical composition, that is, pH, glucose and alcohol levels were significantly influenced by the addition of *Vernonia amygdalina* leaf extract: The untreated burukutu had lower pH than the treated burukutu sample during storage comparatively causing the untreated burukutu to be very sour than the treated burukutu sample. Also, the treated burukutu had higher glucose and low alcohol content during storage. Although burukutu with the bitter leaf did improve the shelf life, organoleptically, it was less liked by the assessors. Based on the findings of this study, the research concludes that the shelf life of burukutu can be improved through the addition of *Vernonia amygdalina* leaf extract for 7 days, however burukutu samples that contained the bitter leaf extract was less favoured by consumers.

References

Barcellos, M. D., Aguiar, L. K., Ferreira, G. C. & Vieira, L. M. (2009). Willingness to try innovative food products: A comparison between British and Brazilian consumers, *Braz. Adm. Rev.,* 6(1), 50-61.

Bukar, A., Uba, A. & Oyeyi, T. (2010). Antimicrobial profile of moringa oleifera Lam. extracts against some food–borne microorganisms, *Bayero J. Pure Appl. Sci.*, 3(1), 43-48.

Demuyakor, B. (1994). Exploitation of Ghanaian raw materials in tropical beer brewing, Doctor of Philosophy, Hiroshima University.

Demuyakor, B. & Ohta, Y. (1993). Characteristics of single and mixed culture fermentation of pito beer, *J. Sci. Food Agric*. 62(4), 401-408.

Devendra, B., Srinivas, N., Prasad, Talluri, V. & Latha, P. S. (2011). Antimicrobial activity of *Moringa oleifera* Lam. leaf extract against selected bacterial and fungal strains, *Int. J. Pharm. Biol. Sci.,* 2(3), 1-4.

Fadahunsi, I. F., Ogunbanwo, S. T. & Fawole, A. O. (2013). Microbiological and nutritional assessment of burukutu and pito (indigenously fermented alcoholic beverages in West Africa) during storage, *Nat. Sci*., 11(4), 98-103.

Grossman, H. (1995). *Beer. encyclopedia Americana12*, 132-138 U.S.

Gutcho, M. (1976). Alcoholic beverages processes. London, U.K: Noyes press.

Lin, Y., Zhang, W. L. C., Sakakibara, K., Tanaka, S. & Kong, H. (2012). Factors affecting ethanol fermentation using Saccharomyces cerevisiae by4742. *Biomass Bioenergy*, 47, 395-401.

Lyumugabe, F., Gros, J., Nzungize, J., Bajyana, E. & Thonart, P. (2012). Characteristics of African traditional beers brewed with sorghum malt: A review, *Biotechnol. Agron. Soc. Environ*., 16(4), 510-526.

Lyumugabe, L., Kamaliza, G., Bajyana, E. & Thonart, P. H. (2010). Microbiological and physico-chemical characteristics of Rwandese traditional beer "Ikigage, *African Journal of Biotechnology* 9, 42, 41-4246.

Mustapha, Y. & Babura, S. (2009). Determination of carbohydrate and β-carotene content of some vegetables consumed in Kano metropolis, Nigeria, *Bayero J. Pure Appl. Sci*., 2(1), 119-121.

Okafor, N. (2007). *Modern industrial microbiology and biotechnology*, Enfield (NH): Science Publishers.

Osseyi, E., Tagba, P., Karou, S., Ketevi, A. & Lamboni, C. (2011). Stabilization of the traditional sorghum beer, "tchoukoutou" using rustic winemaking method, *Adv. J. Food Sci. Technol.*, 3(4), 254-258.

Ray, B. & Bhunia, A. (2013). *Fundamental food microbiology*, CRC Press. 27-29.

A MICROBIAL TECHNOLOGY: CAN A BREAD FUNGUS (*Rhizopus Stolonifer*) PLAY ROLE AS ENTOMOPATHOGENIC AGAINST AMERICAN COCKROACH (*Periplaneta americana*)?

Ahmed, U. A.
Department of Biological Science, Sule Lamido University, P.M.B 048, Kafin Hausa, Jigawa State, Nigeria

Abstract

Biological control has become an alternative for controlling cockroaches. Only a few studies have reported fungal pathogenicity to cockroaches. Isolates of Metarhizium specie and Beauveria bassinia have been put into trial. A bread fungus (Rhizopus stolonifer) is chiefly obtainable and it has never been tried against cockroaches. Therefore, this study has tried entomopathogenicity of R. stolonifer and found it successful in playing role as entomopathogenic against cockroaches. It is recommended that this same fungus could be tried for another annoying insect pests and vectors.

Keywords*: Bread, Cockroach, Entomopathogenic, Fungus, Microbial*

Background to the Study

In recycling of nutrients, cockroaches eat almost everything, including garbage and dead plants, and animals wastes. They also play role in composting; they are natural composters. They play a huge role in the process of decaying organic matter to produce soil rich nutrients. However, cockroaches are arthropod transmitters of diseases, acting both as mechanical vectors and as reservoirs of pathogen agents (Pubmed, 2020). According to the World Health Organization (W.H.O), cockroaches have been known to play role as carriers of intestinal diseases, such as dysentery, diarrhoea, cholera, gastroenteritis, giardiasis and salmonellosis and other diseases such as campylobacteriosis, leprosy and listeriosis.

Hamu *et al*. (2014) reported that several evidence showed that cockroaches are carriers of medically important parasites and protozoa and most recently Maji and Ahmed (2023) reported eight species of parasites were found associated with American cockroach (*Periplaneta americana*), namely *Ascaris lumbricoides*, *Ancylostoma duodenale*, *Necator americana*, *Wucheraria bancrofti*, *Taenia* species, *Entamoeba histolytica*, *Schistosoma* species and *Strongyloides stercoralis*.

Cockroaches are considered as one of the most successful group of animals because of their adaptability in several environmental conditions. Thirty per cent of 3500 identified species of cockroaches are adapted to human habitation and are able to breed all year round in favourable environmental conditions. In this study, bread fungus, *Rhizopus stolonifer* was tried for entomopathogenicity against cockroach. Bread is a staple food prepared from a dough of flour (usually wheat) and water, usually by baking (Wikipedia, 2021). Bread, baked food product made of flour or meal that is moistened, kneaded, and sometimes fermented and it is a major food since prehistoric times (Britanica, 2023).

Bread contains carbohydrates and gluten, sometimes seen as unhealthy. However, for most people, wholegrain bread is an excellent source of nutrition (Medical, 2021). A yeast called *Saccharomyces cerevisiae* is mixed with sugar, flour, and warm water to make bread. The yeast uses the sugar, and the sugars present in the flour as its food. It breaks them down to provide the yeast with energy for growth. *Rhizopus stolonifer* is commonly known as black bread mould. It is a member of zygomycota and is considered the most important species in the genus *Rhizopus*. It is one of the most common fungi in the world and has a global distribution. And unlike the known entomopathogenic fungi, that are not chiefly obtainable, and we observed, there was a high level of pesticide resistance among cockroaches. With these reasons, we therefore, felt that biological control has become the option in control of cockroaches.

Materials and Method

Isolation of *Rhizopus Stolonifer*

A loaf of bread was exposed to a humid and moist environment and allowed for three days. Spores of *R. stolonifer* are commonly found in air and in the environment. The spores rested on the loaf and germinated. Saprophytism was established on the loaf by the fungus and toxic metabolites, leading to spoilage of the loaf were also expected to be established.

Exposure of American Cockroach (*Periplaneta americana*) to *Rhizopus Stolonifer*

The cockroach was kept in a netted cage and supplied with dry biscuit and water. The contaminated loaf of bread was put into the cage and impliedly the cockroach was exposed to the fungus. The cockroach was allowed in the cage for three days. Usually entomopathogenic fungi invade their hosts by attaching their spores on the cuticle of the insect and this followed by germination of spores on the cuticle of the insect and subsequent penetration of rhizoids into the insect's body.

Results/Observations

Growth of the *Rhizopus Stolonifer* on the Loaf of Bread

Three days after exposure of the bread, the following observations were made: bread mould spores landed on the surface of the loaf. Mould hyphae grew over the surface and inside of the loaf. The mould grew and presented long and hairy filaments called hyphae, produced sporangia (that bear sporangiospores), stolon, spores, and rhizoids. The mould's colour ranges from black to blue green. The mould dominated the loaf. Other major fungi, of the

genera of *Alternaria*, *Aspergillus*, *Fusarium*, and *Penicillium* that are also responsible for contamination of bread were not observed.

The Entomopathogenicity of *Rhizopus Stlonifer*

Three days after exposure of the cockroach to the mould, the mould attached its spores to the cuticle (epicuticle and procuticle) of the cockroach. The spores germinated all over the body of the cockroach and this made it dormant. One day later, the spores germinated, rhizoids developed and found their way inside the cockroach, hyphal bodies disseminated through the haemoceole and invaded muscle tissues. The cockroach died and the mould undergone to facultative feeding and this was preceded by hyphal development towards integument and the mould became well established thereby producing mass of spores.

Discussion

Saranraj and Geetha (2012) reported various genera of moulds involved in spoilage of bread, namely *Rhizopus*, *Mucor*, *Penicillium*, *Eurotium*, *Aspergillus*, and *Monilla*. This report has contradicted with our finding in that we only encountered *Rhizopus*. This could be attributed to level of humidity and of the environment that the two studies were conducted. Likely, the conditions aforementioned for our study had suited only *Rhizopus* but not others. It may also be attributed to the ingredients in the bread. Like the quantity of sugar among other things. Possibly, the quantity of sugar is relatively important in determining the kind of mould to grow on bread.

Under specific conditions, some fungi can produce toxic metabolites referred to as myco toxins, leading to food contamination and damage. The major toxin-producing moulds include genera of *Aspergillus*, *Fusarium*, *Penicillium*, and *Alternaria* (Khodei and Pandey, 2022). This is not in agreement with our findings. We reported only *Rhizopus* while they reported others. May be the specific condition they set their experiment is not the same as ours. Spores of *Rhizopus* are found in air and environment and they finally get to settle on specific suitable niche, such as bread. Bread mould spores landed on the surface of the loaf of bread we used, and this is similar to what was reported in Science Direct (2023) that spores are found in the environment as resting spores and as they get in contact with bread, they germinate. In three days, mould hyphae grew all over the bread surface and inside.

After three days of exposure of the bread, growth of the mould was observed as hairy filaments. The structure along with the function of the *Rhizopus* or the common bread mould: the structures include sporangium, spores, stolon, and rhizoids (Byjus, 2023). Bread mould is a fungus that grows in the form of multicellular cells composed of long hairy filaments called hyphae (Quora, 2023). *Rhizopus stolonifer* produces sporangia that bear sporangiospores (sexual and asexual), non-green, unicellular or multicellular, eukaryotic, hetertrophic and saprophytic organism. Has the presence of cell wall which is made up of chitin. Most of them made up of thread-like hyphae rather than cells. common bread moulds are fuzzy and can appear black or blue-green and certain species of them can kill bacterial infections (Sciecing, 2018).

Enthomopathoges, which can be bacterial, viral or fungal are pathogens that kill or seriously disable insects. They play a vital role in natural regulation of insects (Sandhu, 2012). Entomopathogen: an organism (generally bacterium, viruses, protozoa or fungus) causing disease in insects (Entnemdept, 2021). There are spore-forming entomopathogenic bacteria such as *Bacillus* species, *Paeribacillus* specie, and *Clostaridium* species, and non-spore forming ones that belong to the genera *Pseudomonas*, *Serrata*, *Yersinia*, *Photorhabdus*, and *Xenorhabdus* (Ucan, 2017). Entomopathogens are pathogenic to insect pests. There are several types of naturally occurring entomopathogens, viz, fungus, bacterium, virus, and nematodes (Springeropen, 2021).

Three days after exposure of *Periplaneta americana* to *Rhizopus stolonifer*, the spores of *R. stolonifer* got attached to the cuticle of the *P. americana* and this is in agreement with what was reported in Sciencedirect (2023) that entomopathogens are found in environment as resting spores. Insects become infected by these fungi when they come in contact with spores on the surface of plants, in the soil, in air as windborne particles or on bodies of dead insects. The mould initiated hyphal development outwards the integument, built massive amount of spores on the fourth day of exposure. The mechanism of action of entomopathogenic fungi is, once inside the insect, they develop as hypal bodies that disseminate through the haemocele and invade diverse muscle tissues, and fatty bodies (Scielo, 2021). Spores of hypocrealean entomopathogenic fungi are able to infect insects, via attachment to the insect's epicuticle. The cockroach died and the mould undergone to facultative feeding and produced a mass of spores. This was similarly reported in Vicapedia (2023) that the mode pf action of insect pathogenic fungi kills the insect by different ways such as by causing starvation to toxin production. These insects' pathogenic fungi produce many toxins and extracellular enzymes such as proteases and chitinases which aid penetration of the host's physical defences.

With this study, we realized that *R. stolonifer* is very chief and easily obtainable entomopathothogenic fungus unlike other known entomopathogenic fungi (*Beauveria bassinia*, *Metarhizium robertsii*, *Isaria fumosorosea*, *Entomophthora muscae*, *Pandora neoaphidis*, *Nomurea rileyi*, and *Paecilomyces lilacinus*). Moreover, bread mould is one of the most frequently encountered members of the kingdom fungi, appearing not only on bread but on a variety of other foods (Minley, 2023).

Conclusion

This study has ascertained that bread mould (*Rhizopus stolonifer*) can easily be isolated from air using bread and can parasitize American cockroach (*Periplaneta americana*) and hence can be used in biocontrol anmd stands as "Entomopathogenic fungus."

Recommendations

This study was restricted to *Periplaneta americana*, a cockroach, other insect pests and vectors are recommended to be subjected same for the trial. We tried *Rhizopus stolonifer*, other fungi can be put into this kind of trials.

References

1. Britanica, 2023: www. Britanica.com

2. Byjus, 2023: byjus.com

3. Entnemdept, 2021: entnemdept.uf/edu.org

4. Hamu, H., Serkadis, D., Endalaw, Z., Belay, B., Zeleke, M. & Delenasaw, Y. (2014). Isolation of Intestinal Parsites of Public Health Importance from cockroaches (*Blatela germinica*) in Jimma town, South Western Ethiopia. *Journal of Parasitology Research*, 2014

5. Khodei, M. & Pandey, R. J. (2022). Food contaminants of common Human Food. www.foodprot.com

6. Maji, A. & Ahmed, U. A. (2023). Identification of parasites of Public Health Important from the body of Cockroach (*Periplaneta americana*) in Kafin Hausa Area of Jigawa State, Nigeria, *African Journal of Advanced Sciences and Technology Research*, 10(1) www.afropolitanjournals.com

7. Medical, 2023: www.medicalnewstoday.com

8. Milne, 2023: milnepublishing.geneseo.edu

9. Pubmed.ncbi.nlm.nih.gov

10. Quora, 2023: quora.com

11. Sandhu, 2012: www.sciencedirect.com

12. Saranraj, R. & Geetha, P.U. 2012: www. Sciencedirect.com

13. Sciencing, 2018: sciencing.com

14. Scielo, 2021: ve. Scielo.org

15. Springeropen, 2021: ejbpc.springeropen.com

16. Ucan, 2017: ucanr.edu

17. Vikaspedia, 2023: vikaspedia.in

18. Wikipedia, 2021: wikipedia.com

THE IMPACT OF MANAGEMENT INFORMATION SYSTEMS ON ORGANIZATIONS PERFORMANCE OF SCHOOL OF NURSING AND MIDWIFERY, BIRNIN KEBBI

[1]Halima Muhammad Bande, [2]Olatunji Stephen Ademulegun &
[3]Olasumbo Grace Ademulegun
[1]Bursary Department, School of Nursing and Midwifery, Birnin Kebbi, Kebbi State
[2]Directorate of Management Programmes,
Waziri Umaru Federal Polytechnic, Birnin Kebbi, Kebbi State,
[3]St. Thomas Aquinas College, Hospital Road, Akure, Ondo State

Abstract

The study investigates the impact of MIS on organizations performance from the academic point of view at the School of Nursing and Midwifery, Birnin Kebbi. The target population for the study comprised all the staff in the institution using management information systems for their performance. A simple random sample was used in distribution of 85 questionnaires, the response rate was 94.12% (80 usable responses); statistical tools were used to test the hypothesis such as: Pearson correlation coefficient and simple regression. The key findings indicated that, there is a significant and positive relationship between MIS and organizations performance, which implies that the higher the management information systems, the higher the organizations performance. Also the findings showed that the management information systems had a significant impact on organizations performance. At the last part the study, the researchers suggest some useful recommendations for School of Nursing and Midwifery, Birnin Kebbi Management.

Keywords: *Management Information Systems, Organizations Performance, School of Nursing and Midwifery, Birnin Kebbi*

Background to the Study

A continuing stream of IT innovation, combined with new business practices and superb management decisions, is transforming the way we run organization, the way revenues are generated, and the way costs are being saved. The growth of organization – wide information systems that provide extraordinarily rich data to managers on students, parents, and employees, means that managers no longer operate in a fog of confusion but instead have online, nearly instant access to the important information they need to make accurate and timely decisions that influence organization performance. Information Technology is a powerful force in today's global society. The advent of computers and Information Technology (IT) has been the single massive drive influencing organizations during past few decades. Information Technology is revolutionizing all the living ways. No doubt, it has given a new meaning to the word "Convenience" (Shaukat, *et al.*, 2008). Information Technology has drastically changed the organization landscapes, and word "IT" has become the "Catchword" of the modern life today.

Information Technology has become, within a very short time, one of the basic building blocks of modern educational society. The effective use of IT is an essential element of competing in a fast-paced, knowledge-based economy. The rapid growth of the personal computer industry, substantial decreases in computer unit cost, and simultaneous increases in computer capabilities have made vast amount of information readily available to individuals in organizations (Long and Long, 1999; Salhieh and Abu-Doleh, 2007). The goal of every Management Information Systems (MIS), in any organization is to improve job performance, and this performance efficiency is only achieved when IT is accepted and used warmly by the concern employees in organizations (Venkatesh and Davis, 2000).

Statement of the Problem

The essential benefits that can get from merging MIS in education institutions has made most of the employees in School of Nursing, Birnin Kebbi embraces the uses information systems in different ways for over a decade now. The staff recognized the critical contribution of MIS to their performance, this necessitated the core problem of this study to answer this question; "to what extant MIS has an influence on organizations performance?"

Objectives of the Study

Contemplating the study problem, and its ultimate purpose, the following specific objectives could be generated:

1. What is the relationship between MIS and organizations performance from academic institution people?
2. What is the impact of MIS on organizations performance from academic institution people?

Research Hypotheses

This study has two main hypotheses:

H_1: There is a significant relationship between Management Information Systems and organizations performance.

H_2: Management Information Systems have a significant impact on organizations performance.

Concept of Management Information Systems (MIS)

In the midst of a swiftly moving river of technology and organization innovations, this is transforming the global organization landscape. An entirely new IT organizational culture is emerging with profound implications for the conduct of organization. It can be seen every day by observing how organization employees work using high-speed internet connections for e-mail and information gathering, portable computers connected to wireless networks, and hybrid devices to an increasingly mobile and global workforce. We have all come to expect use of computer and IT devices for performance of institution processes, we expect our colleagues to be available by e-mail and cell phone, and we expect to be able to communicate with the students, parents, and employees any time of day or night over the internet, so information technology will make difference to you as a manager and an employee throughout your career, and this well reinforce institution performance and improvement on quality products produced. This is why information systems are so important.

A system is a collection of interrelated components that function together to achieve some outcomes (Satzinger et al, 2002). An information system is a collection of interrelated components that collect, process, store, organize, retrieve, manage and provide information to support business activities, decision making, and performance in an organization (Laudon and Laudon, 2007; O'Brien, 2003). In this meaning, it differs from information technology that refers to the products, methods, inventions, and standards that are used for the purpose of producing information (Kroenke, 2007). Information systems play an important role in helping managers to analyze problems, visualize complex subjects, and create new products (Laudon and Laudon, 2008).

Components of Information Systems

The five fundamental components of an information system are: computer hardware, software, data, procedures, and people. These five components are present in every information system from the simplest to the most complex. These five components are symmetrical. The outmost components, hardware and people, are both actors; they can take actions. The software and procedure components are both sets of instructions: software is instructions for hardware, and procedures are instructions for people. Finally, data is the bridge between the computer side and human side (Kroenke, 2007).

Major Types of Information Systems

The main categories of information systems serve different organizational levels: Operational level systems that support operational managers by keeping track of the elementary activities and transactions of the organization. Management level systems serve the monitoring, controlling, decision-making, and administrative activities of middle managers. Strategic-level systems help senior management tackle and address strategic issues and long-term trends, both in the firm and in the external environment. Laudon &

Laudon (2008) divides systems to four major specific types that correspond to each organizational level:

1. Transaction processing systems which is a computerized system that performs and records the daily routine transactions necessary to conduct business.
2. Management information systems that serve the management level system of the organization, providing managers with reports and often online access to organization's current performance and historical records.
3. Decision support systems. They also serve the management level system of the organization, and help managers make decisions that are unique, rapidly changing, and not easily specified in advance.
4. Executive support systems. Senior managers use support systems to help them make decisions, they serve the strategic level of the organization. They address non routine decisions requiring judgment, evaluation, and insight because there is no agreed-on procedure for arriving at a solution.

For the purpose of this study management information systems defined as a computer-based information systems, that makes information (in different types) available to users with similar needs. The information provided by management information systems describes the organization or one of its major systems in terms of what has happened in the past, what is happening now, and what is likely to happen in the future.

Organizations Performance

Performance is a measure of results achieved by individual, group, and organization. Organization performance is defined as a continuous and action oriented with focus on improving performance by using objective, standards, appraisal, and feedback (Ababneh, 2008). Organizations performance comprises the actual output or results of an organization achievement as measured against its intended goals and objectives. Organizations adopt performance measurement because it creates accountability, provides feedback to operations, and result in more effective planning, budgeting and evaluation (Ammons, 2001).

The performance as stated by Hunger and Wheelen (2007), is an end result of an activity, and an organizational performance is accumulated end results of all the organization's work processes and activities. Managers measure and control organization performance because it leads to better assessment for management, to increase the ability to provide customer value, to improve measures of organizational knowledge, and measure of organizational performance do have an impact on an organization's reputation. When the performance of the organization is assessed, the past management decisions that shaped investments, operations and financing are measured to know whether all resources were used effectively, whether the profitability of the business met or even exceeded expectations, and whether financing choice were made prudently (Shaukat *et al*., 2008). Organizational performance is conducted to support decisions concerning whether program or project should be continued, improved, expanded, or curtailed (Rossi *et al*., 1999). The traditional approach to performance measurement is based on productivity measures, including such measures as

service inputs and outputs' (Holmes *et al.*,2006). In recent years, many organizations have attempted to manage organizational performance using the balanced scorecard methodology where performance is tracked and measured in multiple dimensions such as: financial performance (e.g. shareholder return)-customer service-social responsibility (e.g. corporate citizenship, community outreach) - employee stewardship. As this study focuses on measurement of efficiency and effectiveness part of organizations performance, therefore, these concepts are elaborated in detail.

McClenahen (2000), defines effectiveness "extent to which an organization realizes its goal". Oz (2002) defines effectiveness, as the degree to which a goal is achieve. According to Robbins and Coulter (2003) "Effectiveness is doing the right things" to achieve organization goal.

Measuring Impact of Information System on Organizations Performance

As Walrad and Moss (1993) state that efficiency and effectiveness do not means the same thing. Often one can have one, or the other, but not both (Unless one is lucky or one want to spend a lot of money). Being efficient means that one spends less time on something, one spends less money on something or one spends less efforts (or number of workers) on something. Being effective means that one does his job well. In other words, the output (finished product) is of high quality. It is a rare and delightful occasion where a solution to a problem is both efficient and effective; one usually has to decide which he prefers, because one usually cannot have both.

In an IT context when we measure the effectiveness, we basically measuring the capacity of the outputs of information systems or an IT application to fulfill the requirements of the company, and to achieve its goals. In the same IT context efficiency is the measurement that how cheaply can you get things done, and are the people to whom you provide IT services (the stakeholders) satisfied with the level of services being delivered? And does it reduce the operational expenses? Various studies have been undertaken to measure the impact of IT on management performance (efficiency and effectiveness) of organizations using different performance indicators, which are considered key factors. These variables capture all activity levels, performance measures and common to all units, and cover the range of resources used. These variables include income, student's satisfaction, parents/government links, institution's image, job interest of employees, stakeholders' confidence, and interoffice links. Many researchers have investigated the impact of IT on the performance of educational institutes and found positive impact. While other researchers have seen the increase/decrease in above qualitative factors after implementation of IT, they have concluded that IT has ultimately increased institution image, job interest of employees, stakeholders' confidence, interoffice link etc. (Shaukat *et al.*,2008). The use of IT in academic institution in Kebbi State has not been explored to relate the MIS and the organizations' performances. Also, the education organizations in Kebbi State have not be able to measure the impact of MIS on their performance which necessitate this study.

Review of Previous Studies

Study of Chapmana and Kihnb (2008), aimed to measure the effect of Information systems resources and capabilities on firm performance. The literature has demonstrated the complex relationship between information system integration approaches. In the study, they begin their analysis by focusing on just one aspect of information system integration, namely in terms of data architecture, commonly referred to as the single database concept. They argue that whilst this particular aspect of integration should be related to perceived system success, the variety of ways in which information might be drawn on in practice means, it provides no strong basis for predicting a link to business unit performance. They used Two types of bureaucracy: Enabling and coercive. They argue that the level of information system integration fosters the four design characteristics that make up an enabling approach to management control. Each of these in turn is related to both perceived system success and business unit performance.

Ravichandran and Lertwongsatien (2005), draw on the resource-based theory to examine how information systems (IS) resources and capabilities affect firm performance. A basic premise is that a firm's performance can be explained by how effective the firm is in using information technology (IT) to support and enhance its core competencies. In contrast to past studies that have implicitly assumed that IS assets could have direct effects on firm performance, this study draws from the resource complimentarily arguments and posits that it is the targeted use of IS assets that is likely to be rent-yielding. They develop the theoretical underpinnings of this premise and propose a model that interrelates IS resources, IS capabilities, IT support for core competencies, and firm performance. The model is empirically tested using data collected from 129 firms in the United States. The results provide strong support for the research model and suggest that variation in firm performance is explained by the extent to which IT is used to support and enhance a firm's core competencies. The results also support the proposition that an organization's ability to use IT to support its core competencies is dependent on IS functional capabilities, which, in turn, are dependent on the nature of human, technology, and relationship resources of the IS department. Garg *et al*., (2005) analyzed data of one hundred studies met their inclusion criteria about decision support systems in hospitals. The number and methodological quality of studies improved over time. They found that DSS improved practitioner performance in 62 (64%) of the 97 studies assessing this outcome, including 4 (40%) of 10 diagnostic systems, 16 (76%) of 21 reminder systems, 23 (62%) of 37 disease management systems, and 19 (66%) of 29 drug-dosing or prescribing systems. Fifty-two trials assessed 1 or more patient outcomes, of which 7 trials (13%) reported improvements. Improved practitioner performance was associated with DSSs that automatically prompted users compared with requiring users to activate the system (success in 73% of trials vs. 47%; P = .02) and studies in which the authors also developed the CDSS software compared with studies in which the authors were not the developers (74% success vs. 28%; respectively, P = .001). Conclusions Many DSSs improve practitioner performance. To date, the impact of MIS on job performance in Kebbi State higher institutions remain understudied.

Methodology

Population and Sample

The target population for this study comprised all the departments of School of Nursing and Midwifery, Birnin Kebbi deans and departments heads, individuals whom they represent both academic and managerial positions. There are 107 staff who are in these categories and whom they are closely related to MIS. Using Taro Yamane formula (5% Significance Level), a sample size of 85 was used for the study. A random sampling was used to distribute the 85 questionnaires and 80 questionnaires were returned which represents the response rate was 94.12% (80 usable responses).

Data Collection

Secondary data was collected based on the findings of published papers, articles, books, prior studies, and the World Wide Web. The primary data collection was carried out using a self designed questionnaire, this adopted instrument comprises three sections, the first section covers the demographic information (Gender, Age, Academic Rank, Experience, and Current Position). The second section contains (16) items measuring Management Information Systems, the third section measures organizations performance through (16) items also, Five Likert scales were used to score the responses.

Data Analysis Methods

Statistical Package for Social Sciences (SPSS) was used to analyze the data. Descriptive techniques such as; frequencies, percentages, means, standard deviation (Std.), and coefficient of variation (CV) were used to describe the variables. Spearman correlation and simple regression analysis were used to test hypothesis of the study.

Statistics Analysis and Hypothesis Testing

Demographic Profile

The sample was divided between males (56%) and females (44%), 78.67% of the respondents were between 30 and less than 50 years of age; 24% were Chief/Principal lecturers, 37.33% Senior lecturers, and 38.67% were other lecturers; 33.33% of the respondents were between 5 and less than 10 years of experience; and 6.67% of the respondents were in dean position, while 16% were HODs. Table (1) shows a detailed descriptive statistics of the respondent's demographics (gender, age, academic rank, experience, and current position).

Table 1: Demographic Profile of the Study (N = 75)

Demographic Variables		Frequency	Percentage (%)
Gender	Male	42	56
	Female	33	44
Age	Less than 30	4	5.33
	30 – Less than 40	24	32
	40 – Less than 50	35	46.67
	50 and above	12	16
Academic Rank	Chief /Principal Lecturer	18	24
	Senior Lecturers	28	37.33
	Other Lecturers	29	38.67
Experience	Less than 5 years	15	20
	5 – Less than 10 years	25	33.33
	More than 10 years	35	46.67
Current Position	Dean	5	6.67
	HODs	12	16
	Others	58	77.33

Research Results Description

The mean, standard deviation, and coefficient of variation (CV) of the research questions related to management information systems factors (independent variable) and the level of performance,
(dependent variable) are summarized in table (2) and (3).

Management Information Systems Factors

Table 2 below shows the results that represent management information systems factors.

Technological Factors

Examination of the mean value listed in table (2) reveals that, the most important items in technological factors as indicated by the respondents were: providing updated software for implementing the organizations work (4.43), the commitment for providing personal computers for all employees (4.43). the interest in computerizing works and operations (4.37), the contribution of management information systems in getting the required information in suitable time (4.31), using the available website to communicate with external environment (4.27), developing and continuously updating database that support organizations activities (4.24), The results also shows that the less important items in technological factors in terms of mean value were: availability and accessibility of knowledge base (3.14), electronic communication with students and employees between each other (2.86), and the interested in data and networks security (2.42). The standard deviation for technological factors lies between (0.42-0.80), while the coefficient of variation lies between (0.14-0.26).

Table 2: The Results of the Management Information Systems Factors

Item	Mean	Std.	CV
Technological Factors	**3.83**	**0.64**	**0.17**
1. The interest in computerizing works and operations.	4.37	0.80	0.18
2. Developing and continuously updating database that support organizations activities.	4.24	0.59	0.14
3. Providing updated software for implementing the organizations work.	4.43	0.64	0.14
4. Availability and accessibility of knowledge base.	3.14	0.55	0.18
5. The contribution of management information systems in getting the required information in suitable time.	4.31	0.65	0.15
6. The commitment for providing personal computers for all employees	4.43	0.61	0.14
7. Electronic communication with students and employees between each other.	2.86	0.74	0.26
8. Using the available website to communicate with external environment.	4.27	0.80	0.19
9. The interested in data, and networks security.	2.42	0.42	0.17
Structural factors	**3.64**	**0.73**	**0.20**
10. The organizational structure simplifies the exchange of knowledge and information.	2.86	0.68	0.24
11. The organizations structural and cultural environment encourages the use of management information systems.	4.47	0.65	0.15
12. High management believable in the management information systems importance.	4.45	0.83	0.19
13. The procedures and roles that simplify the work of management information systems	2.77	0.77	0.28
People	**2.88**	**0.63**	**0.22**
14. Organizations commitment to train and qualify employees to use management information systems.	4.53	0.82	0.18

Structural Factors

Based on mean values the results show that the most important items were: the organizational structure and cultural environment that encourage the use of management information systems (4.47), and high management believable in the management information systems importance (4.45). The results also show that the less important items in structural factors were: the organizational structure that simplify the exchange of knowledge and information (2.86), and the procedures and rules that simplify the work of management information systems (2.77). The standard deviation lies between (0.65-0.83), while the coefficient of variation lies between (0.15-0.28).

People

The mean values in the same table show that the most important item in people factors was: organizations commitment to train and qualify employees to use management information systems (4.53). While the less important items were: adopting computer usage capability as a criteria in employment selection process (2.17), and having specialists in management information systems (1.94). The standard deviation lies between (0.46-0.82), while the coefficient of variation lies between (0.18-0.31). In comparison between three groups of management information systems factors, it is obvious that the most important factors were: the technological factors (3.83) that represent the information technology (IT) side for the management information systems, this may be because management information systems are mostly depend on IT components (software, hardware, database, networks, etc) to work effectively. The second group was: structural factors (3.64) which represent the most important element in internal environment for all the organizations, which could be used to support the process of transformation from manual to electronic (computer based management information systems). Finally, the results indicated that the people factors were the less important factors (2.88) except the organizations commitment to train and qualify employees to use management information systems, interpreted by top management commitment to the importance of training and qualifying employees to use MIS as indicated earlier.

Organizations Performance

Table (3) shows the results that represent to what extent MIS factors improve organizations performance, and it appeared as follow:

Table 3: The Results of Performance Factors

Item	Mean	Std.	CV
Technological Factors	**4.10**	**0.65**	**0.16**
1. Introduce the support and information for the student.	4.43	0.55	0.12
2. Speed the achieving required works.	4.35	0.61	0.14
3. Increasing the degree of authority delegation.	2.88	0.58	0.20
4. Accelerate the process of deliver the products and services to customers.	4.46	0.62	0.14
5. Increasing the innovation degree for the employees.	4.37	0.67	0.15
6. Increasing the dependence on teamwork.	3.32	0.72	0.22
7. Discovering new methods of academic delivery	4.28	0.67	0.16
8. Identifying study orientation and student needs	4.45	0.81	0.18
Performance Efficiency	**4.10**	**0.75**	**0.18**
9. Inventory minimization.	4.55	0.87	0.19
10. Productivity improvement.	4.53	0.75	0.17
11. Cost minimization, and quality improvement	3.36	0.63	0.19
12. Resources controlling.	4.53	0.87	0.19
13. Managerial levels minimization.	3.27	0.66	0.20
14. Operating cost controlling.	3.29	0.69	0.21
15. Introduced services quality improvement.	4.50	0.74	0.16
16. Work flexibility maximization.	4.48 0	0.78	0.17

Performance Effectiveness

Based on mean value the results show that the most important items were: accelerate the process of deliver the products and services to customers (4.46), identifying market orientation and customer needs (4.45), introduce the support and information for the students (4.43), increasing the innovation degree for the employees (4.37), speed in achieving the required works (4.35), and discovering new markets or market segments (4.28). The less important items in terms of mean value were increasing the dependence on teamwork (3.32) and increasing the degree of delegation authority (2.88). The standard deviation lies between (0.55-0.72), while the coefficient of variation lies between (0.12-0.22).

Performance Efficiency

Examination of the mean value listed in Table (3) reveals that the most important items were: inventory minimization (4.55), productivity improvement (4.53), resources controlling (4.53), introduced services quality improvement (4.5), and work flexibility maximization (4.48). the less important items were cost minimization, and quality improvement (3.36), controlling operating cost (3.29), and managerial levels minimization (3.27). The standard deviation lies between (0.63-0.87), while the coefficient of variation lies between (0.16-0.21).

Hypotheses Testing

H_1: There is a significant correlation between management information systems and organizations performance.

Table 4 indicates to the Correlation of MIS factors and Organizations performance.

Table 4: Correlation of the MIS Factors and Organizations Performance (OP)

Correction

		MIS	Organization Performance
MIS	Pearson Correlation	1.000	.827
	Sig. (2-tailed)		.06
	N	80	80
Organization Performance	Pearson Correlation	.827	1.000
	Sig. (2-tailed)	.06	
	N	80	80

This output indicates that there is a positive significant correlation as it yielded a P-value of 0.06 At 5% level of significance i.e. $\alpha = 0.05$ between MIS factors and organizations performance, which implies that the higher the management information systems, the higher the organizations performance at ($r = 0.827$).

H_2: There is a significant impact of MIS on organizations performance.

Table 5: Regression for MIS Performance

Model Summary

Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate
	.828[a]	.729	.725	.44875

a. Predict; (Constant). MIS

Coefficients[b]

Model		Unstandardized Coefficient		Standardized Coefficient		
		B	Std. Error	Beta	t	Sig
1.	Constant	2.476	.369		6.636	0.000
	MIS	.345	.081	.421	4.231	0.000

Table (5) shows that MIS explains (72.9%) of the variation in the organization's performance (as indicated by the R-Square value), and significant at ($P > 0.01$), in addition, the value of Beta (=0.421, $P \leq 0.05$). This is enough to establish a cause – effect relationship between MIS and organizations performance, so second hypothesis is accepted.

Conclusion

Management information system variables (technological factors, organizational factors, and people) are provided in high percentages with a mean (3.64, 3.83) receptively but the abundance of people traits are low with a mean equal (2.88) compared with the expected mean which is (3). The results indicate that the effectiveness level for the information systems was high, so the mean was (3.45). The level of organizations Performance (Performance Effectiveness and Performance efficiency) was high with a mean equal (4.1). There is significant statistical relationship between the information system variables and the organizations Performance at the confidence ($P > 0.05$). The study revealed that information systems have a significant statistical impact on organizations, Performance and explains (73%) of the variation in the organizations performance.

Recommendations

Consequence to the findings, this study recommends the following:

1. School of Nursing and Midwifery, Birnin Kebbi should develop strategy for using management information systems to improve its performance, and this will be beneficial in utilizing more of its available capabilities.
2. The Management at the top level of the institution should adopt knowledge-sharing philosophy so as to contribute to highly performance development by embracing a common network among each others.
3. School of Nursing and Midwifery, Birnin Kebbi to offer more scholarships or at least

to offer more flexible work schedule for both academic and/ or non-academic staff that show willingness to develop themselves for better performance.

4. School of Nursing and Midwifery, Birnin Kebbi Management should develop an internal database to ensure distribution of actual, accurate, reliable, relevant, and completeness information among employees, which can lead to more performance effectiveness and efficiency.

References:

Ammons, D. (2001), *Municipal benchmark*, 2nd ed., Oaks: Sage Publication, Thousand.

Chapmana, C. S., & Kihnb, L. A. (2008). *Effect of information systems resources and capabilities on firm performance: A resource-based perspective,* Available online http://doi.acm.org/10.1145/641865.641866.

Earl, M., Edwards, B., & Feeny, D. (1996). *Configuring the is function in complex organizations, information management, the organizational dimension*, Edited by Earl, M., NY: Oxford University Press, Oxford, 201-230.

Garg, A. X., Adhikari, N. K. J., McDonald, H., Rosas-Arellano, M. P., Devereaux, P. J., Beyene, J., Sam, J., & Haynes, R. B. (2005). Effects of computerized clinical decision support systems on practitioner performance and patient outcomes, *The Journal of the American Medical Association*, 293 (10).

Holmes, J., Pineres, S., & Kiel, D. (2006). Reforming government agencies internationally: Is there a role for the balanced scorecard?" *International Journal of Public Administration*, 29, 1125-1145.

Hunger, J. D., & Wheelen, T. L. (2007). *Essentials of strategic management*, 4th ed., Prentice-Hall, Inc., Upper Saddle River, New Jersey.

Kroenk, D. (2007). *Using MIS*. prentice-Hall, Inc., Upper Saddle River, New Jersey.

Laudon, K. C., & Laudon, J. P. (2008). *Management information systems: Managing the digital firm 11th ed.,* Prentice-Hall, Inc., Upper Saddle River, New Jersey.

Laudon, K. C., & Laudon, J. P. (2007). *Essentials of business information systems 7th ed.,* Prentice-Hall, Inc., Upper Saddle River, New Jersey.

Long, L., & Long, N. (1999). *Computers*, prentice-hall, Inc., Upper Saddle River, New Jersey.
McClenahen, J.S. (2000). *Unstoppable improvement*, Industrial Week, 85-95.

O'Brien, J. A. (2003). *Introduction to management information systems: Essentials for the e-business enterprise*, 11th ed., McGraw-Hill Companies, Inc., Irwin.

Oz, E. (2002). *Management information systems*, 3rd ed., Course technology-reprinted by Thomson Asia Ltd., Singapore, 267-271, 166-204, 210-224, 353-391.

Ravichandran, A. C. & Lertwongsatien, C. L., (2005). The resource-based theory to examine how information systems (IS) resources and capabilities affect firm performance, *Journal of Management Information Systems*, 21(4), 237 – 276.

Robbins, S. P., & Coulter, M. (2003). *Management*, 7th ed., Prentice-Hall, Inc., Upper Saddle River, New Jersey.

Rossi, P., Freeman, H., & Lipsey, M. (1999). *Evaluation: A systematic approach*, 11th ed., Sage Publication, London.

Salhieh, L. M., & Abu-Duleh, J. (2007). Investigating IT use and satisfaction among commercial Banks: A management challenge, *Jordan Journal of Business Administration*, 3 (2),

Satzinger, J. W., Jackson, R. B., & Burd, S. D. (2002). *System analysis and design in a changing world* 2nd ed., Course Technology- Thomson Learning.

Sekaran, U. (2003). *Research methods for business: A skill-buildings approach* 4th ed., John Wiley & Sons Inc., New York.

Shaukat, M., Zafarullah, M., & Abdul-Wajid, R. (2008). Impact of information technology on organizational performance: A comparative quantitative analysis of Pakistan's Banking and manufacturing sectors, *Oxford Business and Economics Conference Program*, ISBN: 978-0-9742114-7.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model, *Journal of Management Sciences*, 186-204.

Walrad, C., & Moss, E. (1993). Measurement: The key to application development quality, *IBM Systems Journal*, 32 (3), 445-460.

INVESTIGATIVE STUDY OF EFFECTIVE INFORMATION SYSTEM IMPLEMENTATION IN NIGERIAN TERTIARY INSTITUTIONS: A CASE STUDY OF SELECTED TERTIARY INSTITUTIONS IN EDO STATE.

[1]Musah A. Abubakar [2]Akhuewu D. Emoata & [3]Abas Aliu
[1,2&3]Department of Computer Science,
School of information & Communication Technology
Auchi Polytechnic, Auchi

Abstract

Information Systems (IS) are embedded in the core of almost every business function in modern organizations; however, the field of education is not an exception to this phenomenon. Tertiary Institutions around the world are investing considerable amount of money to create and Implement Information Systems strategies that meet their students' and staff institutional needs. While Tertiary Institutions encourage their stakeholders to implement one or more of these new technologies for their planning and delivery of services, various other factors inhibit the effective implementation of Information System strategies. This paper, optimistically, will establish the availability of Information System resources in Nigeria Tertiary Institutions and explore the effective implementation of Information System in Nigeria Tertiary Institutions. Four (4) Tertiary Institutions were selected for the survey: these are Ambrose Alli University Ekpoma (AAU); Auchi Polytechnic (AP); Edo University Iyamho (EUI); and University of Benin, Benin City (UNIBEN).

Keywords: *Information System (IS), Tertiary Institutions, Implementation, resources*

Background to the Study

These days, various tertiary Institutions work with large amounts of data, and data are basic facts or values which are organized in a database. Many people think of data as synonymous with information; According to the Cambridge International Advanced Subsidiary (CIAS) & Advance Level Information Technology - 9626 examination, a division of Cambridge

assessment 2017; the concept of data as it is used in the computing syllabus is commonly referred to as 'raw' data, which is a collection of text, numbers and symbols with no meaning.

Introna, (1992). Viewed the meaning of information as a concept that is related to human communication and technological systems and concluded that Information usually implies data that is organized and meaningful to the person receiving it; it can also be defined in terms of its surprise value, however, it tells the recipient something he did not know.

Zorkoczy (1981), defines information as the meaning that a human expresses by, or extracts from representations of facts and ideas, by means of the known conventions of the representations used; Information actually consists of data that has been organized to help answers questions and to solve problems.

Stonecash (1981), defines information by stating that "information is simply symbols (data, text, images, voices, etc.) that convey meaning through their relative ordering, timing, shape, context, etc. ... information is the raw material for making decisions for creating knowledge and fuelling the modern organization".

The Concept of Information System

According to Sebastian K. Boell (2015) Information systems (IS) involve a variety of information technology (IT) tools such as computers, software, databases, communication systems, the Internet, Mobile devices and much more, to perform specific tasks, interact with and inform various actors in different organizational or social contexts.

Jessup, Leonard & Joseph, Valacich (2008), Defined Information Systems as an academic study of systems with a specific reference to information and the complementary networks of hardware and software that people and organizations use to collect, filter, process, create and also distribute data, of general interest to the field of Information Systems (IS) are therefore all aspects of the development, deployment, implementation, uses and impact of IS in organizations and society.

Sebastian, and Dubravka (2015), is of the opinion that Information Systems can be defined in terms of two perspectives: one relating to its function, and the other relating to its structure. From a functional perspective; An Information Systems is a technologically implemented medium for the purpose of recording, storing, and disseminating linguistic expressions as well as for the supporting of inference making. From a structural perspective, an information system consists of a collection of people, processes, data, models, technology and partly formalized language, forming a cohesive structure which serves some organizational purpose or function.

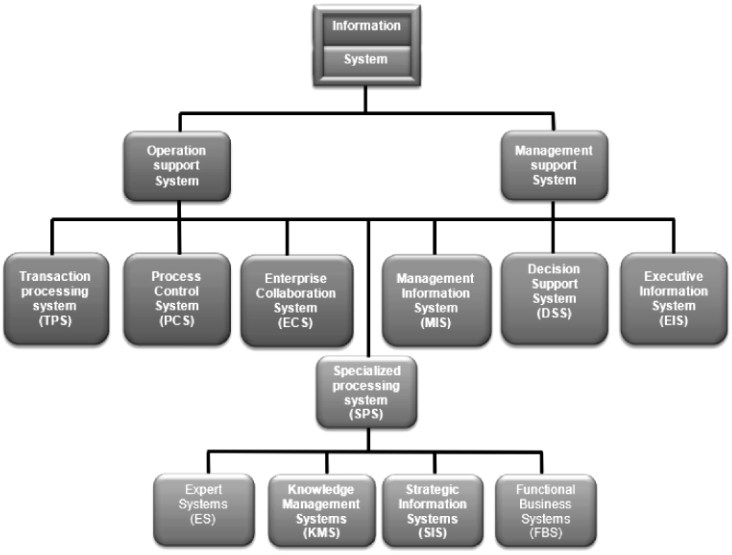
Laudon and Laudon (2013), termed information system as a set of interrelated components that collect, retrieve, process, store, and distribute information to support decision making and control in an organization. Information Systems can also be used to analyze problems, visualize complex subjects, and create new products. In the implementation of information

system, three activities are required to produce the information the organizations need to make decisions, control operations, analyze problems, and create new products or services. These activities are input, processing, and output. Input captures or collects raw data from within the organization or from its external environment. Processing converts this raw input into a more meaningful form. Output transfers the processed information to the people who will use it or to the activities for which it will be used. Information Systems also require feedback, which is output that is returned to appropriate members of the organization to help them evaluate and refine the input or correct the input stage. Environmental actors, such as staff, students, stockholders, contractors, competitors, and regulatory agencies, interact with the institution and its Information Systems.

Types of Information System

O'Brien & Marakas (2007), are of the opinion that the applications of information systems that are implemented in today's business world can be classified in several different ways. They stressed that, several types of information systems can be classified as either Operations Support System or Management Support System. While Operations Support System is the support of business operation such as Transaction Processing Systems, Process Control Systems and Enterprise Collaboration Systems; Management Support System is the support of managerial decision making such as Management Information System, Decision Support System and Executive Information Systems.

According to Patterson (2005), there are several categories of Information Systems, Data Processing System is a type of Management Support System and therefore Data Processing System, Management Information System, Decision Support Systems and Executive Information System are in the same classification.



Source: updated from O'Brien & Marakas (2007)

Fig 1.1: Types of information system

Information System is divided into two major categories namely:

A. Operation Support System.
B. Management Support System.

(A) Operation Support System

The operations support systems focus on the operations of the enterprise. The basic objective of these systems is to improve the operational efficiency of the enterprise. As these systems are concerned primarily with operations, they use internal data primarily for managers at the lower levels. Similarly, operation support system also helps to efficiently process business transaction, control industrial process support enterprise communication and update corporate database. The operations support systems may be further classified into the following categories:

i. Transaction Processing System (TPS)
ii. Process Control System (PCS)
iii. Enterprise Collaboration System (ECS)

Transaction Processing Systems

According to Laudon and Laudon (2013), Transaction processing systems (TPS) are the basic business systems that serve the operational level of the organization. A transaction processing system is a computerized system that performs and records the daily routine transactions necessary to the conduct of the business. And at the lowest level of the organizational hierarchy, we find the transaction processing systems that support the day-to-day activities of the business.

Transaction Processing Systems (TPS)

The TPS serves the people in the operational level of an organization, it collects and stores information about transactions, and controls some aspects of transactions. A sale of item in the store is an example of a transaction. Similarly, it is generally use to process sales, purchase, inventory and other organizational database; these database then provide the data resources that can be processed and used by Decision Support System and Executive Information System.

Transaction Processing System processed transaction into two ways:

i. Batch Processing
ii. Real Time Processing

In Batch Processing, data is accumulated over a period time and processed periodically; while in Real Time Processing data is immediately processed after a transaction occurs, for example: Sales and Inventory Processing

Process Control System (PCS)

It is a category of Operation Support System in which decision about a physical production process are automatically made by computer through routine decisions that control operational process, for example: A petroleum refining center uses electronic sensors which

are linked to the computers to continuously monitor chemical processes and make instant adjustments that control the refined process.

Enterprise Collaboration System (ECS)
Enterprise Collaboration System (ECS) is the type of Information System that uses a variety of Information Technology to help the people to work together. Enterprise Collaboration System helps to collaborate and communicate ideas, share resources and co-ordinate work effort of an organization. The aim of an Enterprise Collaboration System is to use the information technology to enhance productivity and creativity of organization and work group in an organization. for example: E-mail, chat, video conferencing etc.

(B) Management Support System (MSS)
Management Support System (MSS) generally deals with providing information and support for effective decision making. It refers to computer technology and system theory to data processing in an organization. It helps in designing system frameworks for organizing information system application. It helps in management decision making and processing of data generated by business operation.

The various Management Support Systems:

i. Management Information System (MIS)
ii. Decision Support System (DSS)
iii. Executive Information System (EIS)

Management Information System (MIS)
MIS is a form of MSS that provides managerial end-user with information product that support their day-to-day decisions. It provides a variety of information in the form of report and display to management that contain information specified in advance by manager. Information is generally provided on demand or periodically to the managers. For example: Sales manager may use their network computer, net web browser to get instant display of the sales, result of their product and access their daily sales report.

Decision Support System (DSS)
Decision support systems are computer-based information systems that provide interactive information support to managers and business professionals during the decision-making process. It provides managerial end-users with information in an interactive manner i.e., analytical modeling, data retrieval, information presentation capability. For example: Product pricing, Risk Analysis

Executive Information System (EIS)
Executive Information System is an Information System that provides Strategic information tailored to the needs of executives and other decision makers (top management). It provides top management with immediate and easy access to select information about key factors that are critical to organizational strategic objectives. For example: The top-level executives

may use the touch screen to instantly view text and graphics that display the key areas of the organization.

Other Classifications of Information System

Several other categories of information systems fall under ***Specialized Processing System*** and can support both operations support system and management support system.

i. Expert Systems (ES)
ii. Knowledge Management Systems (KMS)
iii. Strategic Information Systems (SIS)
iv. Functional Business Systems (FBS)

Expert Systems

Knowledge-based systems that provide expert advice and act as expert consultants to users. Examples: credit application advisor, process monitor, and diagnostic maintenance systems.

Knowledge Management Systems

Knowledge-based systems that support the creation, organization, and dissemination of knowledge within the enterprise. Examples: Intranet access to best business practices, Sales Paper Strategies, and Customer Problem Resolution Systems.

Strategic Information Systems

Support operations or management processes that provide a firm with strategic products, services, and capabilities for competitive advantage. Examples: online stock trading, shipment tracking, and e-commerce Web systems.

Functional Business Systems

Support a variety of operational and managerial applications of the basic business functions of a company. Examples: information systems that support applications in accounting, finance, marketing, operations management, and human resource management.

The Components of Information Systems

Patterson (2012), defined information System as a group of interrelated components that work to carry out input, processing, storage, output and control actions in order to convert data into information that can be used to support forecasting, planning, control, coordination, decision making and operational activities in an organization. Every business organization in this era needs an information system (IS) to keep track of all business activities, right from business planning, till the product delivery via manufacturing and quality cycles.

According to O'Brien & Marakas (2007), information system (IS) can be any organized combination of people, hardware, software, communications networks, data resources, and policies and procedures that stores, retrieves, transforms, and disseminates information in an organization. People rely on modern information systems to communicate with one

another using a variety of physical devices (hardware), information processing instructions and procedures (software), communications channels (networks) and stored data (data resources)

According to Erik Gregersen (2007), the components of Information System are usually described as hardware, software, network, Databases, people and procedur**e**. The first three, fitting under the technology category, are generally what most individuals think of when asked to define information systems. But the last two, people and process, are really what separate the idea of information systems from more technical fields, such as computer science.

Computer Hardware
These are the physical technology that works with information. They are physically handy and available. They includes: computers, printers, image scanner, speaker, compact disc, iPads, flash drives, router, etc.; Hardware can be as small as a smartphone that fits in a pocket or as large as a supercomputer that fills a building. With the rise of the Internet of things, in which anything from home appliances to cars to clothes will be able to receive and transmit data, sensors that interact with computers are permeating the human environment.

Computer Software
Software is a set of instructions that tells the hardware what to do. Software is not tangible, i.e. it cannot be touched. There are several categories of software, with the two main categories being system software, which makes the hardware usable, and application software, which does something useful for the computer users. Software can be divided into two types: system software and application software. The primary piece of system software is the operating system operating system, such as windows or iOS, which manages the hardware's operation. Application software is designed for specific tasks, such as handling a spreadsheet, creating a document, or designing a web page.

Network
This component connects the hardware together to form a network. Connections can be through wires, such as Ethernet cables or fibre optics, or wireless, such as through Wi-Fi A network can be designed to tie together computers in a specific area, such as an office or a school, through a Local Area Network (LAN). If computers are more dispersed, the network is called a Wide Area Network (WAN). The internet itself can be considered a network of networks.

Databases and Data Warehouses
This component is where the "material" that the other components work with resides. A database is a place where data is collected and from which it can be retrieved by querying it using one or more specific criteria. A data warehouse contains all of the data in whatever form that an organization needs. Databases and data warehouses have assumed even greater importance in information systems with the emergence of "big data," a term for the truly massive amounts of data that can be collected and analyzed.

Human Resources and Procedures

The final, and possibly most important, component of information systems is the human element: the people that are needed to run the system and the procedures they follow so that the knowledge in the huge databases and data warehouses can be turned into learning that can interpret what has happened in the past and guide future action. In order to fully understand information systems, students must understand how all of these components work together towards bringing value to a University system.

Data

Data is a collection of facts; like software, data is also intangible. Pieces of data are not really very useful, but they are when aggregated, indexed, and organized together into a database. Data are powerful tool in any organisation; University system collects all kinds of data and uses it to make decisions. These decisions can then be analyzed as to their full effectiveness in order to improve the university system.

Communication

Besides the components of hardware, software, and data, which have long been considered the core technology of information systems, it has been suggested that one other component known as communication should be added. An information system can exist without the ability to communicate the first personal computers were stand-alone machines that did not access the Internet. However, in today's hyper-connected world, it is an extremely rare computer that does not connect to another device or to a network. Technically, the networking communication component is made up of hardware and software, but it is such a core feature of today's information systems that it has become its own category.

Literature Review

A number of researchers have worked on information system in Nigerian Tertiary Institutions, using different theories and tools to establish their exploration; according to. Nakpodia (2010), in his work, he examined information systems in Nigerian education as it affects data storage devices and data bank. He believes that the power to process information rapidly makes the data bank a versatile Centre for planning and research.

Nakpodia (2010), further observed that information system which is also known as computer-based information system, is important in Nigerian educational systems at all levels because of its transaction process systems, knowledge management systems and information technologies designed to enable individual persons to perform task for which the human brain is not well suited. In addition, the organization of a data system with national coverage is very complex.

Roheet, et al (2016), examined the role of Information Systems in a University system and discovered that the University can be better handled by developing and using an automated application (Information System) which can improve the functioning of the university. They further discuss the need of a central repository to update and maintain a document

management system so that stakeholders can access and make use of the information for their specific purpose from time to time. They concluded that it is imperative that the university obtain and maintain accurate and timely information about faculty professional activities.

An Evaluation of ICT Infrastructure and Application in Nigeria Universities Analysis of findings on Research Question 1 has revealed that, ICT infrastructure utilized in most Nigeria universities are computers, the internet and telephone and that the internet resources of email, the web and websites are the ICT services utilized in most Nigeria Universities. This is an indication that Nigeria universities are still low in provision and utilization of ICT facilities.

Blerta (2013) examined Higher Education Information Systems with respect to the latest trends and issues and observed that there is very little information available on information systems strategies and technologies in HEI's or on information strategies. He stressed further that It is important to understand that the accessibility, reliability, consistency, and relevance of data underpinning information systems are crucial to its use and effectiveness in a university setting.

Methodology

This research paper focuses on exploring the effective implementation of information system using selected Institutions in Edo States. For this purpose, this study attempt to answer the following research questions:

(a) Are there available Information Systems resources in Nigeria Tertiary Institutions?
(b) To what extent is Information system implemented in Nigeria Tertiary Institutions?
(c) What are the least utilized Information System facilities in Nigeria Tertiary Institutions?

A descriptive survey approach is more appropriate for this study since it focuses on people, facts about people, their benefits, opinions, attitudes, motivation and behaviour. A descriptive survey was considered most appropriate for this study because it sought the relationship among factors regarding the Investigative Study of Effective Information System Implementation in Nigerian Tertiary Institutions.

The study was carried out in the South-South regions of Nigeria. These areas were chosen because they have a good number of Tertiary Institutions for such study. The population of the study comprised students, lecturers and administrators in these Tertiary Institutions. The students, lecturers and administrators of the Tertiary Institutions were chosen because they are in the best position to provide the required information on the Investigative Study of Effective Information System Implementation in Nigerian Tertiary Institutions.

A total of 240 respondents were randomly selected from a total of 4 Tertiary Institutions; each institution is represented by, 20 lecturers, 20 administrators and 20 students. A

questionnaire was developed and used as the research instrument for this study. The questionnaire has three sections. Section A was used to collect general information about the respondents; Section B has 20 items (1-20) intended to elicit information on the availability and relevant information system resources in Nigeria Tertiary Institutions (Research question 1) Section C has 10 items (21-30) which sought information on the level of effective implementation of information system in Nigeria institution; While Section D has 10 items (31-40) required information on the challenges of effective implementation of information system strategies in Nigeria Institution (Research Question 3). The items were structured on a five-point Likert rating scale with response options of: Strongly Agreed (SA), Agreed (A), Undecided (U), Disagree (D), Strongly Disagree (SD).

The instrument (questionnaire) was validated by two experts from the Economic/Statistics Department of University of Abuja, FCT of Nigeria; they examined the questionnaire items for clarity and suitability for use in collecting data for the study. The observations and suggestions of these experts improved the instrument. The reliability was determined by a pilot test for the instrument which was administered to 10 respondents comprises of 5 students, 3 lecturers and 2 administrators from an institution outside the zones used for the study. The instrument was administered in the various Tertiary Institutions and 218 copies of the questionnaire, out of 240 copies administered were retrieved and used for the study and the return rate was 90.8%. The research questions were analyzed using a simple mean statistic. This indicates that in each of the response items, the mean score of the item is computed and interpreted based on its boundary limits (Table 1.0 and Table 2.0).

In other words, for research question 1, a mean score on an item statement that was equal to or greater that 0.50 (>0.50) was accepted as available; while a mean that was equal to or less than 0.49 (<0.49) was acceptable as unavailable (Table 1).

Table 1: Response options with points and boundary limit

Response option	Points	Boundary limit
Available	1	0.50 - 1.00
Unavailable	0	0.00 - 0.49

Similarly, the decision rules for the research question 2 and 3 are: a mean score on the item statements that was greater than or equal to 3.50 (≥ 3.50) was taken as Agree while a mean that was less than or equal to 3.49 (≥ 3.49) was taken as Disagree (Table 2).

Table 2: Response categories with points and boundary limit

Response option	**Points**	**Boundary limit**
Strongly Agree	5	4.50 - 5.00
Agree	4	3.50 -4.49
Neutral	3	2.50 -3.49
Disagree	2	1.50 - 2.49
Strongly Disagree	1	0.50 - 1.49

Results for Data Analysis

Figure 2: Showing mean score analysis on availability of information system resources.

B	Availability of Information system resources	Available	Unavailable	Mean(X)	Decision
1	Institutional eBooks/eBook reader	51	167	0.23	UNAVAILABLE
2	Bespoke/collaboration software to facilitate students learning	64	154	0.29	UNAVAILABLE
3	Broadcast lecture delivery	24	194	0.11	UNAVAILABLE
4	Teleconferencing/videoconferencing	8	210	0.04	UNAVAILABLE
5	Online/E-learning course delivery	87	131	0.40	UNAVAILABLE
6	Laptops /Desktop computers/accessories	215	3	0.99	AVAILABLE
7	Interactive whiteboard for lecture and presentations	211	7	0.97	AVAILABLE
8	Use of Projectors for classroom lecture	214	4	0.98	AVAILABLE
9	Intranet/extranet facilities	3	215	0.01	UNAVAILABLE
10	Private Internet facilities	120	98	0.55	AVAILABLE
11	E-library services	20	198	0.09	UNAVAILABLE
12	Use of telephone (fixed mobile) service within the institution	70	148	0.32	UNAVAILABLE
13	Use of Institutional website for online forum	96	122	0.44	UNAVAILABLE
14	Institutional Web portal	201	17	0.92	AVAILABLE
15	Campus Area Network	84	134	0.39	UNAVAILABL
16	Lightings/Fans /AC in all offices	206	12	0.94	AVAILABLE

Looking at the reality of the available data, regarding research question 1, explicitly, "are there

Figure **2: Level of information system implementation in Nigeria Institution**

S/N	Level of Information system implementation in Nigerian Institution.	SA(5)	A(4)	U(3)	D(2)	SD(1)	Mean (x)	Decision
1	My institution use Intranet/extranet services	3	20	2	71	122	1.67	Disagree
2	My institution use E-library services	3	2	12	34	167	1.35	Strongly Disagree
3	we use Teleconferencing /Videoconferencing for lectures, seminars, etc.	9	12	0	104	93	1.81	Disagree
4	We use telephone (fixed mobile) service for communication within the institution	2	11	0	88	117	1.59	Disagree
5	We use of Institution's website for online forum	4	11	9	127	67	1.89	Disagree
6	My Institution use a Web portal for staff and students activities	86	123	0	3	6	4.28	Agree
7	my school use Internet facilities	89	110	0	3	16	4.16	Agree
8	we use E-Mail services in my school	15	174	8	17	4	3.82	Agree
9	Staff/Students can access their details on the school portal	47	162	6	0	3	4.15	Agree
10	There exist a master database for both staff and students activities	2	9	2	71	134	1.50	Disagree
							2.62	

adequate Information system resources in Nigeria institution?", responses and results are presented in Table 1, which depicts that a mean value of **0.48** which is less than 0.50 (<0.50) was accepted as unavailable. This specifies therefore, that Information system resources are inadequate in Nigeria Tertiary Institutions.
Source: Author's Computation (2020)

The findings on Research Question 2 which bothered on to what extent is Information system implemented in Nigeria Tertiary Institutions. In table 2, it was established that among the information system resources available in Nigeria Tertiary Institutions, the lowest mean score were observed for Institutional eBooks/eBooks reader, Bespoke/collaboration software, Broadcast lecture delivery, Teleconferencing/videoconferencing,Online/E-learning course delivery, Intranet/extranet facilities, E-library services, among others; this account for a total *Mean* value of **2.62**, which is an indication that there is a low level of information system implementation in Nigeria Tertiary Institutions.

Examining the findings on the least utilized Information System facilities in Nigeria Tertiary Institutions (Research Question3), Figure 4.3 show that Institutional eBooks/eBook reader, Bespoke/Collaboration software to facilitate students learning, Broadcast lecture delivery, Teleconferencing/Videoconferencing, Online/E-learning course delivery, Intranet/extranet facilities, E-library services, telephone (fixed mobile) service within the

institution, Institutional website for online forum, Campus Area Network, Wide Area Network, and Surveillance devices rank the least utilized facilities with *Mean* values of 0.39, 0.36, 0.39, 0.44, 0.32, 0.09, 0.01, 0.40, 0.04, 0.11, 0.29, and 0.23 respectively.

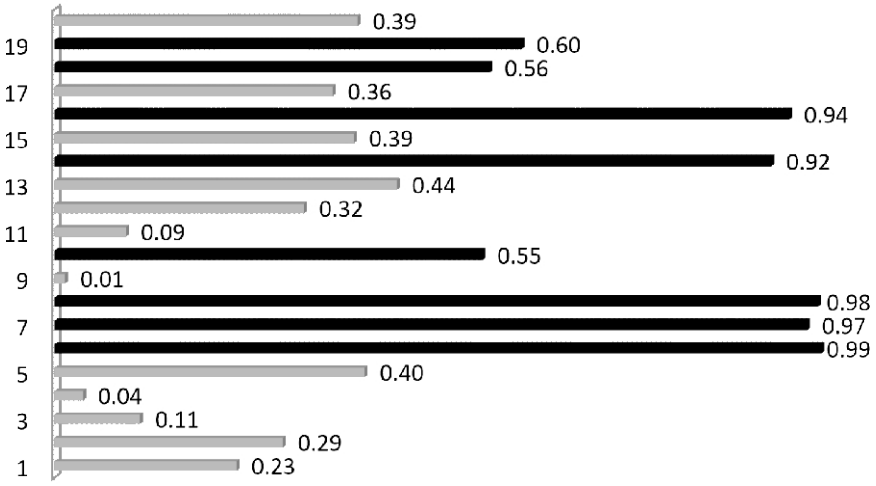


Figure 3: **The least utilized Information System facilities in Nigeria Tertiary Institutions.**

Conclusion

It is important to note that the implementation of Information Systems are powerful tools in the hands of many Institutions around the globe, and if deployed appropriately can bring dramatic change in the way Tertiary Institutions perform and achieve their various objectives; however, The benefits of IS facilities in Nigeria Tertiary Institutions are quite enormous and the levels to which an institution can provide and utilize these IS facilities define the status of the institution;

Unfortunately, there is indication that IS facilities is lacking in Nigeria Tertiary Institutions and the level of implementation is low. The main IS facilities and services that are least utilized in Nigeria Tertiary Institutions were identified to include Institutional eBooks/eBooks reader, bespoke/collaboration software, Broadcast lecture delivery, Teleconferencing/Videoconferencing facilities, Online/E-learning course delivery, Intranet/Extranet facilities, E-library services, and the use Facsimile Machine

Recommendations

It is recommended that necessary actions should be taken for adequate provision of other important IS facilities identified to be lacking including:

1. Use of Intranet/Extranet services – These services will help us to connect computers and other workstations within and outside the Institution for easy sharing of resources and information.
2. The use of E-library services – The Electronic Library System provides the latest functions as well as allowing books to be displayed on screen as if they were printed

books. The system makes advances in retrieving books and papers.

3. The use Teleconferencing/Videoconferencing for lectures, seminars, etc.

References

Blerta, A. C. (2013). *Higher education information systems: An overview of the latest trends and Issues*, retrieved from https://www.researchgate.net/publication/271699883_ Higher Education Information Systems.

Cambridge International Examinations, *A division of Cambridge assessment*, retreived from: www.cambridgeinternational.org

Erik, G. (2007). *Five components of information system*, retrieved from

Introna, L. D, (1992). *Data, information and meaning*, retrieved from https://repository.up.ac.za/bitstream/handle/2263/27367/03chapter3.pdf

Jessup, L. M., & Joseph, S. V., (2008). *Information systems today (3rd ed.)*. Pearson Publishing. Glossary 416

Laudon, K. C. & Laudon, J. P. (2013). *Management information systems: Managing the digital firm. 12th edition*, Pearson Education Inc., Upper Saddle River, NJ 07458.

Nakpodia, E. D, (2010) An information system in Nigerian education: A study of data storage, *International Journal of Library and Information Science 2*(6), 102-107, retrieved from http://www.academicjournals.org/ijlis ISSN 2141 - 2537 ©2010 Academic Journals"

O'Brien, J. A., & Marakas, G. M. (2007). *Management information systems-10th ed*, by McGraw-Hill/Irwin, a business unit of The McGraw-Hill Companies.

Patterson, A. (2005). *Information systems – Using Information in learning and teaching*, Scotland.

Roheet, B. Ashish, K. & Shubham, G. (2016). Role of information systems in an university Setup – A case study, *International Journal of Computer Science and Electronics Engineering (IJCSEE) 4*(3) (2016) ISSN 2320–4028 (Online)

Sebastian, K. B., Dubravka, C. (2015). *What is an information system*?, https://www.researchgate.net/publication Conference Paper, March 2015

Stonecash, J. C. (1981). The IRM showdown, *Infosystem, 28.* 10, 42-8.

Zorkoczy, E. (1981). *The importance of information systems*, retrieved from https://www.ukessays.com/essays/information-systems/the-importance-of-information-systems.php

THE IMPACT OF LIQUIDITY MANAGEMENT ON FINANCIAL PEFORMACE OF INSURANCE FIRMS IN NIGERIA

[1]George Charisma & [2] Resident. C. F. Victor
[1&2]Department of Accounting, School of Management Science,
Federal Polytechnic Ekowe, Bayelsa state, Nigeria

Abstract

This study examines the impact of liquidity management on financial performance of insurance firms in Nigeria. Ex post facto research design and Secondary sources of data was used for the study. Liquidity management is the independent variable while, Financial Performance as the dependent variable which also has its sub-variables. The underpinning theory for the study is liquidity Preference Theory. Data were collected from the annual reports of the listed insurance firms in Nigerian stock exchange market (NSE) from 2012 to 2022. Regression model involving ordinary least square method was used to test hypotheses formulated to examine the impact of liquidity management on financial performance variables... The finding reveals that there is a significant impact of liquidity management on policy sales growth and also there is a significant impact of liquidity management on average cost per claim (ACPC). It is therefore recommended among other things that boards and corporate managers of insurance firms in Nigeria should take interest in liquidity management of their entity as a priority in order to achieve improve financial performance. Also, managers in this sector should identify and monitor key business drivers within the framework of analysis to enhance Financial Performance

Keyword: *Liquidity Management, Return on Surplus, Policy Sales Growth, Revenue Per Policyholder, Average Cost Per Claim*

Background to the Study

Liquidity is a financial capacity for a company to meet it cash and collateral responsibilities with absence of incurring unacceptable losses. According to Owolabi, & Obida, 2012,

"Liquidity is the capacity of a company to meet demands for funds thereby ensuring that such organization maintain adequate cash and liquid assets to satisfy the demand of client for loans and savings withdrawals and then meet its expected expenses. Basically, the liquidity management role is to prospectively evaluate the needs for funds to meet obligation and ensure the availability of cash or collateral to fulfill those need at the right time by coordinating the different sources of funds accessible to the organization under normal and stressed conditions. It depends on the day-to-day assessment of the liquidity conditions in the insurance companies, so as to measure its liquidity needs and thus the volume of liquidity to allot or withdraw from the market. Management of liquidity involves a day-to-day evaluation and detailed estimation of the size and timing of cash inflows and outflows over the coming days and weeks to lessen the risk that savers will be unable to access their deposits in the moment they demand them. Thus, liquidity is lifeblood of a business organization. Biety (2003), assert that the objective of liquidity management is to gear organizations towards a financial position that enables them to meet their financial obligations as they occur.

According to liquidity plays a crucial role in the successful functioning of an organization. A company should ensure that it doesn't suffer from lack-of or excess liquidity to meet its short-term obligations (Bhunia , 2010),. A study of liquidity is of major significance to both the internal and the external analysts simply because of its close relationship with daily operations of a business. Liquidity requirement of an organization relies on the peculiar nature of the organization and there is no particular rule on measuring the optimal level of liquidity that an organization can maintain so as to ensure positive impact on its profitability.

Objectives of The Study

The major objective of the study is to examine the impact of liquidity management and financial performance of Insurance firms in Nigeria with the following specific objectives.

1. Examine the use of liquidity management on average cost per claim of insurance firms in Nigeria
2. Ascertain the impact of liquidity management on policy sales growth of insurance firms in Nigeria.

Review of Related Literature

Liquidity Management (LM)

Liquidity is the capacity of a financial institution to get together with its money and insurance commitments without bringing about inadmissible misfortunes. Sufficient liquidity is dependent upon the limit of a firm to competently meet its expected incomes and security needs without antagonistically influencing either its consistently activities or the budgetary circumstance of the firm. In this way, liquidity the board is characterized as the providing or withdrawal from the market the aggregate of liquidity predictable with the ideal degree of momentary financing costs or save cash. Additionally, it is the limit of a firm to satisfy needs for reserves in order to guarantee that the firm keep up satisfactory money and fluid advantages for the fulfilment of customer interest for credits and investment funds

withdrawals and afterward meet its normal costs, (Ebhodaghe, 2012),

According to Adekanye (2014), investigation of liquidity is essentially worries both the inward and outer budgetary investigators basically due to its cozy relationship with the everyday activities of a business substance. Liquidity prerequisite of a business endeavour is dependent on the impossible to miss nature of the venture and there's no sure guideline to find out the ideal degree of liquidity that a business undertaking can keep up in order to guarantee positive effect on its monetary presentation. One should endeavour neither to expand nor lessen the liquidity proportions; one should endeavour to advance them dependent on the goal, which in the event of a benefit making organization is undoubtedly the amplification of benefit on capital utilized. The lesser the liquidity proportions are, the more defenceless the business substance is to pressure from loan bosses or speculators which it unfit to meet and the other way around. In this way, a business element should look to have as merger working capital as is reliable with not being unduly powerless to pressure from lenders or speculators.

Liquidity Buffer (LQB)

Bech and Keister (2012), the liquidity support is the short finish of the counterbalancing limit. Liquidity cushion is characterized as the overflow liquidity accessible through and through to be utilized in liquidity stress circumstances in a given specified time typically momentary period. Likewise, liquidity cradle is the accessibility of liquidity, which forestalls the need to take any phenomenal measures. The cradle size is resolved dependent on the subsidizing hole under pressure conditions over indicated time skylines (the "endurance periods"). The time of endurance and the related liquidity cradle shouldn't go past or supplant different estimates taken to deal with the net subsidizing hole and financing sources, and the organization's emphasis ought to be on enduring admirably past the pressure time frame. In this way, the time of endurance should just be the period where an organization can keep working with no compelling reason to create extra assets but then meet every one of its instalments due under the accepted pressure situations, (De Haan & end, 2013)

Liquidity support is found out in three measurements which are: the seriousness and highlights of the pressure situations, the time skyline fixed as the endurance time frame, and the highlights of the benefits in the cushion.

Risk Monitoring and Reporting (RMR)

According to Hussain, and Al-Ajmi, (2012), hazard observing exercises set up as a regular occurrence the hazard checking technique by assembling data through computerized or manual methodology, alarming or giving an account of data essential to expected focuses on chance observing and giving contributions to continuous hazard evaluation and reaction forms. Depending on hazard suspicions, requirements, needs, and resistance levels, the arrangement of hazard observing practices really executed at any one time might be not quite the same as what is recorded in the hazard checking procedure. Hussai, and Al-Ajmi, (2012) proposed that, associations ought to consider chance observing from a hierarchical

point of view and to organize checking rehearses over the three levels so as to help the achievement of the general hazard the board objectives and evade future duplication of executed observing exercises.

Financial Performance (FP)

"Performance" begins from the old French word known as 'Parfournir', implying that, to bring through, to do, to do or to deliver. Execution is viewed as a demonstration of performing, executing, achieving, and satisfying of the given errands or assignments that should be assessed against characterized sets of exactness, cash, totality and timing. In fund, execution is the estimations of the organization's strategies, exercises and operational outcomes in budgetary terms. It is utilized to check an organization's prosperity, consistence and budgetary position. Profit for value is another proportion of monetary execution. It quantifies the pace of profit for the venture of the proprietors' normal stock (Thompson and Strickland, 1996).

Revenue Per Policyholder (RPP)

Revenue per policyholder is an essentially key exhibition pointer (KPI) that quantifies the measure of income produced by an insurance agency, per policyholder adjusted. This measurement is significant basically in light of the fact that a low or slacking, esteem for the key execution marker could be because of a few variables which are poor organization and online deals, shoddy in-power client assistance (which prompts low standard for dependability), or an absence of sound speculation practices could all add to underneath normal income age. An organization should hope to improve its dissemination technique and speculation exercises to amplify organization income.

Average Cost Per Claim (ACC)

The average cost per claim gauges how much an association pays out for each guarantee recorded by its clients. With this KPI (similarly as with other protection KPIs), it's very fundamental to order dependent on the kind of guarantee, since each sort of guarantee will be diverse in cost. The point of this KPI is to help an association to appropriately assess the hazard related with each sort of approach and modify strategy evaluating as needs be.

At the point when the case sums paid or acquired are isolated by the pertinent number of cases, a normal expense for each guaranteed result. This normal expense can be evaluated, similarly just like the case sums themselves. At that point, set up with a different projection for the quantity of cases, it'll yield the new gauge for a definitive misfortune. The scientist can likewise survey the development of the case numbers and normal expenses as the mishap years create, and search for noteworthy patterns or discontinuities. A full perspective on the business would thus be able to be accomplished, maybe prompting change of the holding figures, or demonstrating where further examination is required.

One significant point with respect to average expense per guaranteed techniques is that there are the opportunities for some varieties. The scientist ought to ask, what amounts go into making the normal, what is the premise of projection, and what guarantee numbers are

utilized for the possible multiplier of the anticipated normal? It is significant to be clear with regards to the specific definitions being utilized, the expression "Normal Cost per Claim Method" all alone is fairly deficient.

Return on Surplus (ROS)

Bingham and Russell (2012) characterized return on policyholder surplus as the proportion of an insurance agency's overall gain to its policyholder excess. This is just determined by partitioning an insurance agency's after-charge salary and benefits by its policyholder excess, with the policyholder surplus subbing for the insurance agency's advantages. Despite the fact that, it is identified with the arrival on value (ROE) estimation utilized in different parts and is an estimation of an insurance agency's money related quality. It is commonly communicated as a rate. The arrival on policyholder surplus uncovered how much benefit an insurance agency can acquire comparative with the measure of income it makes from guaranteeing protection arrangements and contributing continues, with policyholder surplus speaking to how much a safety net provider's advantages surpass its liabilities.

Policy Sales Growth (PSG)

It is determined by separating the contrast between the present time frame's business income and the past period's business income, and afterward partitioning that distinction by the past period's business income. This measurement is significant in light of the fact that higher arrangement development approaches higher deals. This key execution marker is intended to give an organization a perspective on the master plan, and regardless of whether the organization screen a brief timeframe outline, it's critical to contrast current qualities with chronicled standards. Utilize this protection key execution marker to decide whether an association is hitting deals targets, (Wikipedia, 2015).

Theoretical Framework

Liquidity Preference Theory

Keynes (1936) was the principal man to build up the idea of liquidity in his book The General Theory of Employment, Interest and Money to clarify assurance of the financing cost by the flexibly and interest for cash. Liquidity inclination is characterized as the interest in cash, which is considered as liquidity. The idea that financial specialists request a premium for protections with a long development, include more serious hazard, essentially on the grounds that they'd like to hold money, which includes less hazard. The more fluid a venture is, the simpler it is to sell quickly for its full worth, just in light of the fact that loan costs are not unsurprising for the time being, the premium on short-versus medium-term protections will be more noteworthy than the premium on medium-versus long haul protections. For example, a three-year treasury note may pay 1% premium, a 10-year treasury note may pay 3% premium and a 30-year treasury bond may pay 4% premium.

Methodology

Research Design

This research employs ex post facto research which was adopted to investigate the impact of

liquidity management on financial performance of insurance firms in Nigeria. The population of the study is the companies' insurance listed in Nigeria. The sampling technique used in the judgemental sampling technique. The Source of Data collection Was through Secondary sources from the annual reports of listed insurance companies 2012 to 2022.

Method of Data Analysis

The study intended to examine the impact of liquidity management on financial performance of insurance firms in Nigeria. To fulfil this purpose, regression analysis was employed in examining the impact of liquidity management on financial performance.

Model Specification

This study adopted the following regression models to examine the impact of liquidity management on financial performance.

$PSG = a_0 + b_1CRT + b_2LQB + b_3ATR + b_4RMR + \mu$ ..... Model 1

$FINANCIAL\ PERFORMANCE = b_o + b_5LMT_{it} + \mu_{it}$..... Model 2

Where:

β_o is the intercept for each model

$\beta_{1-}\ \beta_5$ are the coefficients of the explanatory variables

μ_{it} are the error terms that absorbs the influence of omitted variables in the proxies used.

Table

liquidity management and policy sales growth					
Model One $PSG = a_0 + b_1CRT + b_2LQB + b_3ATR + b_4RMR + \mu$		Coefficients	Standard Error	t-statistic	Prob.
	CRT	1.217020	5.577340	0.218208	0.8277
	LQB	4.380153	1.957511	2.237614	0.0276
	ATR	0.257350	13.84946	0.018582	0.9852
	RMR	2.322254	7.070799	0.328429	0.7433
	C	22.33213	8.245850	2.708287	0.0080
Dependent Variable: PSG					
R^2 =0.570416, F =4.446706, p = 0.024691< 0.05		PSG = 22.33 + 1.21CRT + 4.38LIB + 0.25ATR + 2.32RMR			

Source: Author's computation using E-views 9

Result Interpretation

The model result shows that there is a significant impact of liquidity management and revenue per policyholder. also, the coefficient of determination gives 0.570416, which suggests that 57.04% difference on policy sales growth can be ascribed to liquidity management, while 42. 96% reasons for changes in policy sales growth can be ascribed to other factors not considered in this regression model. The result is significant on the fact of f-statistics since P < 0.05. This indicates that there is a significant impact of liquidity management on the policy sales growth. Therefore, H_o will be rejected instead H_1 will be accepted.

Conclusion

The need to examine the impact of liquidity management on financial performance of insurance firms in Nigeria cannot be overlooked, because all the insurance companies attempt to survive. The research work was able to create a relationship between liquidity management and financial performance in Nigeria using insurance firms listed in Nigeria Stock Exchange from the period 2012-2022. The study noted that liquidity management influences revenue per policyholder, average cost per claim, return on surplus and policy sales growth of insurance firms in Nigeria.

Recommendations

1. Based on the outcome of the study, its hereby recommends that boards and managers of insurance firms in Nigeria should take interest in liquidity management of their companies in order to realise enhanced financial performance. Insurance companies should adopt optimum liquidity model for maximum policy sales growth as the research observed that liquidity management positively impacts policy sales growth.
2. Insurance managers should identify and monitor key business drivers (e.g. current ratio and risk monitoring and reporting) within the framework of analysis

References

Anyanwu, J. C. (2013). *Monetary economic system in Nigeria*, Quodro Impressions Ltd.

Adekanye, F. (2014). *Element of banking in Nigeria*, Lagos F & A Publishers.

Bech, M. & Keister, T. (2012). On the liquidity coverage ratio and monetary policy implementation, *BIS Quarterly Review, 49–61*

Biety, M. (2003*). Liquidity and asset liability management in saving services for the poor, an operational guide, ed*, Madeline Horesechland, Washington D.C. Pact publication.

Brealey, R. A. (2012). *Principles of corporate finance*, Tata McGraw-Hill Education.

Ebhodaghe, J. U. (2002). *Safe and sound banking practices in Nigeria: selected essays*, Lagos page Publisher's Services Ltd.

De-Haan, L. & Van-Den, J. W. E. (2013). Bank liquidity, the maturity ladder, and regulation. *Journal of Banking & Finance, 37, 3930–3950.*

Bhunia, A. (2010). A trend analysis of liquidity management efficiency in selected private sector Indian steel industry. *International Journal of research in commerce and management, 1(5), 213.*

Bingham, R. E. (2012). Surplus-concepts, measures of return, and its determination. *Insurer Financial Solvency (Casualty Actuarial Society 1992 Discussion Paper Program),* I, 179-230.

Ebhodaghe, J. U. (2012). *Safe and sound banking practices in Nigeria: selected essays*, Lagos page Publisher's Services Ltd.

Hussain, H., Al-Ajmi, J. (2012). Risk management practices of conventional and Islamic banks in Bahrain. *The Journal of Risk Finance, 13(3), 215-239.*

Myers, S. C., & Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics, 10(5) 187-221.*

Owolabi, S. A., & Obida, S. S. (2012). Liquidity management and corporate profitability: Case study of selected manufacturing companies listed on the Nigerian stock exchange, *Business Management Dynamics, 2(2), 10-25.*

Panigrahi, A. K. (2013). Liquidity management of Indian cement companies–a comparative study, *IOSR Journal of Business and Management (IOSR-JBM) 49-61.*

Roth, R. J., Jr. (2012). Analysis of surplus and rate of return without using leverage ratios, *Insurer Financial Solvency (Casualty Actuarial Society 2012 Discussion Paper Program),* I, 439-464.

Wambu, T. M. (2013). *The relationship between profitability and liquidity of commercial banks in Kenya*. Unpublished MBA Project, University of Nairobi.

PRODUCTION AND OPTIMIZATION OF SUGAR APPLE SEED OIL, AS A SUSTAINABLE AND ECONOMICALLY VIABLE ALTERNATIVE TO OTHER COMMERCIAL OILS.

[1]Alheri A. [2]Ago M. A. [3]Jamila U. A. [4]Joshua Y., [5]Anyanwu S. K., [6]Nwakife N. C., [7]Makanta S. A, [8]Longbap, B. D., [9]Gani J. & [10]Aisha K. U

[1,5,6&7]Department of Chemistry Federal University of Technology Minna, Niger State, Nigeria.
[2,4,8&9]Department of Chemical Sciences, Federal University Wukari, Taraba State, Nigeria.
[1,2,3,4&9]Department of Chemistry, Modibbo Adama University, Yola Adamawa State Nigeria.
[10]School of Science and Technology Adamawa Sate Polytechnic Yola. Adamawa State.

Abstract

There is growing interest in natural products and their potential therapeutic applications in various industries, such as the cosmetic, pharmaceutical, and food industries. Sugar apple seed oil has been shown to possess various therapeutic properties. The following where determined in this study peroxide value, free fatty acids (FFA)/Acid, saponification value, specific gravity/density, iodine value, unsaponifiable matter, gas chromatography-mass spectrometry (GC-Ms), Fourier transform infrared (FTIR). The extraction yield of sugar apple seed oil was found to be 54.6%. The peroxide value was 0.375 mol/kg. The free fatty acid content of the oil was found to be 7.57 mg/g. The acid value was 3.785 mg/g. The saponification value of the seed oil was found to be 210.375 mg/g. The specific gravity of sugar apple seed oil was found to be 0.907 kg/m3, and the density was found to be 0.925 kg/m^3. The iodine value of the oil was 0.355 g/100g. The unsaponifiable matter of sugar apple seed oil was found to be 0.05%. The GC-MS analysis of sugar apple seed oil revealed the presence of several compounds, including n-hexadecanoic acid, limonene, octadecadienoic acid, octadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester, and n-decanoic acid. N-hexadecanoic acid. From the FTIR peaks identified in sugar apple seed oil at the peak at 700 cm^1 is attributed to the presence of the out-of-plane bending of C-H of aromatics, indicating the presence of aromatic compounds in the oil. Therefore, the results obtained for sugar apple seed oil indicate that it is of good quality and falls within the permissible limits.

Keywords*: Extraction, Sugar apple, seed, Oil*

Background to the Study

Sugar apple (Annona squamosal), belonging to family Annonaceae is commonly found in India and cultivated in Thailand and originates from the West Indies and south America. Sugar apple has been commercially cultivated in Africa, South America, Australia, India, Mexico, in the south and the United States, the Philippines, and Thailand (Pinto *et al.,* 2005) It is mainly grown in gardens for its fruits and ornamental value. It is known as custard apple, sugar apple, sweet après in English, sharifa in hindi, sitaphalam in telugu in India, corossolier, cailleux, pommier cannelle in French (Crane *et al.,* 2016). Its commonly called Gwanda masar in Hausa Language and kribobo in nupe tribe of Nigeria as cited by Muhammad, A. (2018).

One potential research problem for sugar apple seed oil could be, investigating its potential uses and benefits in various industries, such as the cosmetic, pharmaceutical, and food industries. Despite the fact that sugar apple seed has been shown to possess various therapeutic properties, such as antioxidant, antimicrobial, and anti-inflammatory activities, there is limited research available on its potential uses and applications (Mariod *et al.,* 2017). sugar apple is a widely cultivated fruit that has been traditionally used for medicinal purposes in many cultures. It is also known for its nutritional and antioxidant properties. However, there is limited research available on the potential benefits of its seed oil. Secondly, there is growing interest in natural products and their potential therapeutic applications in various industries, such as the cosmetic, pharmaceutical, and food industries. Sugar apple seed oil has been shown to possess various therapeutic properties, including antioxidant, antimicrobial, and anti-inflammatory activities. Investigating its potential uses and applications could contribute to the development of new products with potential health benefits (Parham *et al.,* 2020).

Ushie *et al.,* (2023) studied the physico-chemical content and nutritional value present in the extract of Citrullus colocynthis using the best readily available method. The result shows that the Citrullus colocynthis seed contained 4.93% moisture, 12. 06% crude protein, 4.35% ash and 45.83% crude fibre, 8.16% lipid and 24.67% carbohydrate. The oil was liquid at room temperature with physico-chemical characteristics like iodine value of 11.33, acid value of 3.86(mg KOH/g of oil), saponification value of 171.09 and specific gravity of 0.92.

Physicochemical parameters are used to measure the quality and purity of oils. Some important physicochemical parameters of oils include. These parameters can be used to determine the shelf life, stability, and nutritional value of oils. (Ahmad *et al.* 2017). The aim of the research project is to investigate the potential uses and benefits of sugar apple seed oil, optimize the extraction and purification methods, and explore its potential as a sustainable and economically viable alternative to other commercial oils.

Materials and Methods

Solvent Selection

Chemical used were of analytical grade. methanol, petroleum ether, conc. H_2SO_4, ethanol, barium chloride, potassium iodide, glacial acetic acid, chloroform, water, sodium

thiosulphate, starch, diethyl ether, alcohol, phenophthalein, NaOH, potassium hydroxide.

Plant Collection

Seeds of sugar apple was obtained from Niger state, Nigeria in the month of October. The seeds were sun dried and thereafter crushed into powder with a mortar and pestle.

Apparatus and Materials

The apparatus and materials needed for the extraction of oil using Soxhlet apparatus are: Soxhlet extractor, round bottom flask, condenser, heating mantle, extraction thimble, solvent used for oil extraction include hexane, ethanol, and petroleum ether, analytical balance, glass wool. filter paper, rotary evaporator: desiccator

Extraction

Sugar apple seeds was dried, crushed and grounded to powder with a mortar, which was then sieved with a sieve of 850 micrometer, thereafter the powder which is obtained was wrapped with filter paper in small portions. And then placed in a round bottom flask before filling with petroleum ether and attached to a Soxhlet apparatus to extract oil from the seed kernels. While doing the extraction, the solvent is used in the ratio of 15 ml/g of seed's powder, and extraction time was 5hr, 6hr for two petroleum ether, and one methanol solvent respectively. The temperature was maintained near about 65-70 degrees Celsius by regulating the magnetic cum heater and stirrer. After extraction, the sample is distilled to remove the petroleum ether. distillation is carried out through the Soxhlet apparatus after the sample wrapped in the filter paper is removed. after distillation the oil extracted remains in the Soxhlet apparatus. and lastly the oil separated is analyzed for peroxide value, acid value, specific gravity, density and saponification value, iodine value, unsaponifiable matter.

Determination of the Peroxide Value

One gram of the oil weigh was into a clean dry boiling tube and while still liquid add 1g powdered potassium iodide and 20ml of solvent mixture (2 vol glacial acetic acid + 1 vol chloroform). the tube was place in a boiling water so that the liquid boil within 30 seconds and allow to boil vigorously for not more than 30 second. the contents were quickly poured into a flask containing 20ml of potassium iodide solution (5%), wash out the tube twice with 25ml water and titrate with 0.002m sodium thiosulphate solution using starch. a blank was performed at the same time.

$$\text{Peroxide value} = \frac{\text{sample} - \text{blank} \times 0.025 \times 100}{1}$$

Determination of the Free Fatty Acids (FFA)/Acid

To determine the free fatty acid, 25ml was mixed with diethyl ether with 25ml alcohol and 1ml phenolphthalein (1%) and care-fully neutralize with 0.1m NaOH. 1-10g of the oil was dissolved in the mixed neutral solvent and titrated with aqueous 0.1m NaOH shaking constantly until a pink color which persist for 15 seconds.

$$\text{Acid value} = \frac{\text{titre(ml)} \times 56.1}{\text{wt of sample use}}$$

Determination of the Saponification Value

To determine the saponification value, 2g of the oil was weigh into a conical flask and add exactly 25ml of the alcoholic potassium hydroxide solution. a reflux condenser was attached and the flask was heated in boiling water for 1hr shaking frequently. 1ml of phenolphthalein (1%) solution was added and titrated hot. The excess alkali with 0.5m hydrochloric acid (titration = aml)

$$\text{Saponification value} = \frac{(b\text{-}a) \times 28.05}{\text{wt(g) of sample}}$$

Determination of the Specific Gravity/Density

To determine the specific gravity/density, 50ml pyrometer bottle was thoroughly washed with detergent water and petroleum ether, dry and weigh. the bottle was filled with water and weigh. after drying the bottle, the oil sample was filled and weighed

$$\text{Specific gravity (S.V)} = \frac{\text{weight of x ml of oil}}{\text{wt of x ml of water}}$$

$$\text{Density} = \frac{\text{weight of oil}}{\text{volume of oil}}$$

Determination of the Iodine Value

the oil was poured into a small beaker and added a small rod and weigh out a suitable quantity of the sample by difference into a dry glass-Stoppard bottle of about 250ml capacity. The approximate weigh in g of the oil to be taken can be calculated by dividing 20 by the highest expected iodine value. 10ml of carbon tetrachloride was added to the oil or melted fat and dissolved. 20ml of wijis solution was added, and the stopper (previously moistened with potassium iodine solution) and was allowed to stand in the dark for 30 minutes. 13ml of potassium iodide solution (10) was added, with 100ml water mixed and titrated with 0.1 thiosulphate solution using starch as indicator just before the end point (titration = aml) blank was carried out at the same time, commencing with 10 ml of carbon tetrachloride (titration = bml)

$$\text{Iodine value (I.V)} = \frac{(b\text{-}a) \times 1.269}{\text{wt(g) of sample}}$$

Note: if (b-a) is greater than 6/2 the test must be repeated using a smaller amount of the sample.

Determination of the Unsaponifiable Matter

The term “unsaponifiable matter” is applied to the substances non-volatile at 100-105 °C

obtained by extraction with an organic solvent from the substance to be examined after it has been saponified. The result is calculated as per cent m/m.

$$\text{Unsaponifiable matter} = \frac{(A-B) \times 100}{W}$$

Where, A = weight, in g, of the residue, B = weight, in g, of the fatty acids in the extract, V = volume, in ml, of NaOH solution, N = normality of NaOH solution, and W = weight, in g, of the material taken for the test.

Gas Chromatography-Mass Spectrometry (Gc-Ms) Determination

The samples were subjected to chromatographic analysis using a Varian 3800/4000 gas chromatograph mass spectrometer equipped with an Agilent equipped with a splitter split/splitless. With a BP5 (30 m × 0.25 mm × 0.25 microns) capillary column. Nitrogen was used as a gas carrier. 1.0 µL volumes were injected using a splitless mode at an injector temperature of 2700C. The oven temperature was ramped from 80 to 2000C (1 minute hold) at a rate of 50C/min. The oven temperature was held at 2800C for 6 minutes following each analysis. The total run time for each sample was approximately 45 minutes. The GC-MS interface temperature was set to 2800C. Mass spectrometry mode was used during analytical scanning from 30–1000 atomic mass unit (amu) for the oil sample. The ion source temperature was set to 2500C. The blank was first injected and was followed by the sample injection. Organic compounds in the samples were identified in Wiley's NIST 08 Mass Spectral Library, if the obtained comparison scores were higher than 95%. Otherwise, fragmentation peaks of the compounds were evaluated, and the compounds were identified using the memory background for the identification of the compounds that appeared in GCMS chromatograms. Contents of individual compound in the extract were given in percent of the total compound in the sample. The chromatograms obtained from the total ion count (TIC) were integrated without any correction for co-eluting peaks and the results were expressed as total abundance. All the peaks were identified based on mass spectral matching (≥ 90%) from both the NIST and Wiley libraries. Only compounds with 90% or greater spectral matching accuracy are reported. No response factors were calculated.

Fourier Transform Infrared (FTIR) Determination

In the FTIR analysis procedure, samples are subjected to contact with infrared (IR) radiation. The IR radiations then have impacts on the atomic vibrations of a molecule in the sample, resulting the specific absorption and/or transmission of energy. This makes the FTIR useful for determining specific molecular vibrations contained in the sample (Kirk and Othmer, 1953). the power was Turn on and the Instrument was allowed to warm-up time of 10-15 minutes. the computer (attached to the system) was turn on. After initialization from the computer double 'MicroLab PC window' icon was click on and waited for it to open. The Start button was clicked to initiate the sampling operation. And to select the method i.e. absorbance or transmittance. the crystal was clean with organic solvent and next was clicked to check the crystal and collecting background. the sample of about 10-15mg was placed. for solids sample it was close and press to make a pellet on top of the crystal, if it's liquid sample

it will remain open to smear on top of the crystal and click next. the sample alignment was check for blue line from red to green region for proper sampling and was put in the sample identity for coding. next was click for sampling. and it was right clicked to pick the peaks and select peaks for labeling by dragging to acquire the wavenumbers as well as transmittance or absorbance.

Results and Discussion

Extracted yield of sugar apple seed oil

Figure 1 shows the chart for the percentage yield of the extract. Sugar apple seed oil is a potential source of edible oil with several physicochemical properties that make it suitable for various applications. The following is a discussion of the physicochemical properties of sugar apple seed oil. The extraction yield of sugar apple seed oil was found to be 54.6%. The yield is a significant factor in determining the commercial viability of the oil. The extraction yield of sugar apple seed oil (54.6%) is within the range reported by (Göhl *et al.* 2019). Of (52.5%), oil yield.

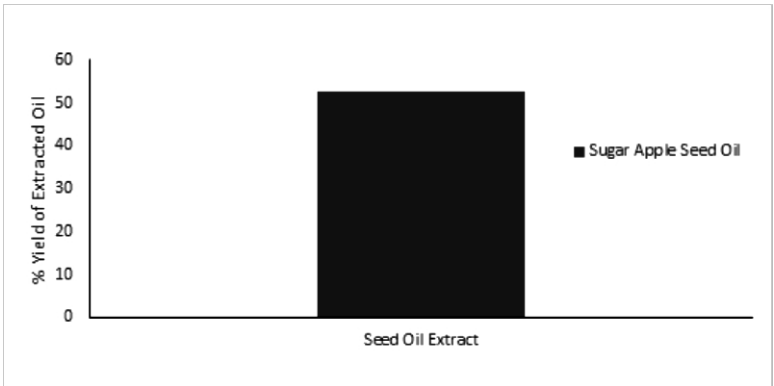


Figure 1. Extracted yield of sugar apple seed oil

Proximate Characterization of the Oil

The peroxide value of sugar apple seed oil was found to be 0.375 mmol/kg as shown on Table 1. This value represents the amount of peroxide present in the oil and is an indication of the oil's oxidative stability. A high peroxide value indicates that the oil is susceptible to oxidation and rancidity. The peroxide value falls within the range reported by (Mansor *et al.* 2016; Diaz-de-Cerio *et al* 2016). From Table 1, the free fatty acid content of sugar apple seed oil was found to be 7.57 mg/g. This value indicates the amount of free fatty acids present in the oil and is an indication of the oil's quality. A high free fatty acid content is an indication of poor-quality oil. The free fatty acid content is an important parameter to evaluate the quality of vegetable oils. In a study by (Göhl *et al.* 2019). the free fatty acid content falls within the range reported in the work.

The acid value of sugar apple seed oil was found to be 3.785 mg/g as shown on Table 1. This value indicates the number of acidic compounds present in the oil and is an indication of the oil's quality. A high acid value is an indication of poor-quality oil. The acid value of different

oils can vary depending on their chemical composition and processing methods. For example, the acid value reported by (Göhl *et al.* 2019). Is also with the range obtained in his work. On the other hand, the acid value of used frying oil was reported to be as high as 10 to 50 mg/g (Echarte *et al.* 2019).

The saponification value of sugar apple seed oil was found to be 210.375 mg/g as shown on Table 1. This value represents the amount of potassium hydroxide required to saponify the oil and is an indication of the oil's fatty acid composition. The saponification value of oils can vary widely depending on their fatty acid composition. For instance, oils with high levels of unsaturated fatty acids typically have higher saponification values compared to oils with high levels of saturated fatty acids (Salimon *et al* 2011). In comparison to other sugar apple seed oils, the saponification value of sugar apple seed oil (210.375 mg/g) is of close range of (191.5 mg/g) (Mansor *et al* 2016). The specific gravity of sugar apple seed oil was found to be 0.907 kg/m3, and the density was found to be 0.925 kg/m3 as shown on Table 1. These values indicate the oil's weight and volume, respectively. According to a study by Diaz-de-Cerio *et al.* (2016), the specific gravity of sugar apple seed oil was found to be 0.92, while the density was found to be 0.925 g/cm3.

The iodine value of sugar apple seed oil was found to be 0.355 g/100g as shown on Table 1. This value represents the degree of unsaturation of the oil and is an indication of its fatty acid composition. The iodine value of sugar apple seed oil is relatively low compared to other vegetable oils, which typically have iodine values ranging from 50 to 200. This suggests that the oil has a low degree of unsaturation and is less susceptible to oxidation. Which also is within the range reported by (Göhl *et al.* 2019). The unsaponifiable matter of sugar apple seed oil was found to be 0.05% as shown on Table 1. This value represents the amount of non-saponifiable compounds present in the oil, such as sterols, tocopherols, and hydrocarbons. The unsaponifiable matter content in oils can vary greatly and is dependent on the oil source and extraction method. The unsaponifiable matter obtained in this work fall within the range reported by (Göhl *et al.* 2019; Mansor *et al* 2016).

According to FAO/WHO, the permissible limits for peroxide value in edible oils are 10 meq O2/kg oil, free fatty acids are 2.0%, and acid value is 4.0 mg KOH/g. Therefore, the results obtained for sugar apple seed oil indicate that it is of good quality and falls within the permissible limits. Other studies have also reported similar permissible limits for peroxide value, free fatty acids, and acid value in edible oils. For instance, in a study on the quality evaluation of some commercial vegetable oils, the permissible limits for peroxide value were found to be between 5-10 meq O2/kg oil, for free fatty acids between 1.5-5%, and for acid value between 0.5-5 mg KOH/g (Duru and Ekere, 2015). In another study on the quality evaluation of sunflower oil, the permissible limits for peroxide value, free fatty acids, and acid value were reported to be 15 meq O2/kg oil, 0.1%, and 1.0 mg KOH/g, respectively (Knothe *et al.* 2010).

Table 1: Result on the proximate characterization of the oil

S/N	Parameters	Results	WHO/FAO Limits
1	acid value(mg)	3.785mg	0.6 – 3.0 mg
2	density(kg/m^3)	0.925kg/m^3	No limit
3	free fatty acid(mg)	7.57mg	0.5-5.0%
4	iodine value(g)	0.355g	120 g I2/100g
5	peroxide value(mmol)	0.375mmol	10 meq O2/kg.
6	saponification value(mg)	210.375mg	No Limit
7	specific gravity(kg/m^3)	0.907kg/m^3	No Limit
8	unsaponifiable matter (%)	0.05%	No Limit

GC-MS Analysis of Sugar Apple Seed

The results from Figure 2, the GC-MS analysis of sugar apple seed oil revealed the presence of several compounds, including n-hexadecanoic acid, limonene, octadecadienoic acid, octadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester, and n-decanoic acid. N-hexadecanoic acid, also known as palmitic acid, is a saturated fatty acid that is commonly found in plant oils. The high percentage of n-hexadecanoic acid in sugar apple seed oil indicates that it is a significant component of this oil. This finding is consistent with previous studies on the fatty acid composition of seed oils from various plants, which have also shown high levels of n-hexadecanoic acid. Limonene is a terpene that is commonly found in citrus fruits and is known for its distinctive aroma. It has been reported to have various biological activities, including antioxidant and anti-inflammatory properties (Ribeiro *et al*. 2019). The presence of limonene in sugar apple seed oil suggests that it may also possess some of these beneficial properties. Octadecadienoic acid, also known as linoleic acid, is an essential polyunsaturated fatty acid that is required for various biological processes in the body. It is commonly found in plant oils, including seed oils (Chakraborty *et al.,* 2023). The presence of octadecadienoic acid in sugar apple seed oil indicates that it is a good source of this essential fatty acid. Octadecanoic acid, also known as stearic acid, is a saturated fatty acid that is commonly found in animal fats and some plant oils. Its presence in sugar apple seed oil indicates that it contains a mixture of both saturated and unsaturated fatty acids, which is typical of many plant oils. 2-hydroxy-1-(hydroxymethyl) ethyl ester is a compound that is not commonly found in plant oils, and little is known about its biological activity. Further studies are needed to determine the potential health benefits of this compound. N-Decanoic acid is a medium-chain saturated fatty acid that is commonly found in plant and animal fats. It has been reported to have various biological activities, including antimicrobial and antifungal properties (Lin *et al.* 2011). The presence of n-decanoic acid in sugar apple seed oil suggests that it may also possess some of these beneficial properties.

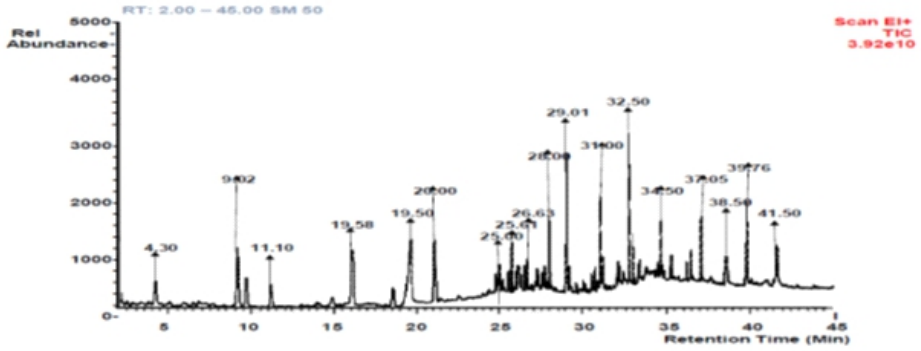


Figure 2: GCMS spectrum regions of sugar apple seed oil

Table 2: Results of gems peaks identified in sugar apple seed oil

Peak #	RT	Compound Detected	Mol. Formula	MW	Peak Area %	Comp. wt%	m
1	4.30	Hexanoic acid	$C_6H_{12}O_2$	116	1.83	2.84	41, 60, 116
2	9.02	Octanoic acid	$C_8H_{16}O_2$	144	4.60	5.26	43, 60, 144
3	11.18	Pyrazine, 2,5 -dimethyl-	$C_6H_8N_2$	108	0.99	1.73	42, 81, 108
4	15.98	β-Myrcene	$C_{10}H_{16}$	136	4.86	2.22	41, 93, 136
5	19.50	β-Pinene	$C_{10}H_{16}$	136	4.31	1.21	43, 93, 136
6	17.32	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	$C_{19}H_{38}O_4$	330	6.16	6.90	43, 98, 330
7	25.00	α-Pinene	$C_{10}H_{16}$	136	7.33	1.31	41, 69, 154
8	25.61	Decanal	$C_{10}H_{20}O$	156	4.28	5.92	43, 57, 156
9	26.63	n-Decanoic acid	$C_{10}H_{20}O_2$	172	5.53	6.65	41, 60, 172
10	28.00	Undecanoic acid	$C_{11}H_{22}O_2$	186	5.19	6.58	43, 60, 186
11	29.01	Limonene	$C_{10}H_{16}$	136	9.78	14.31	68, 93, 136
12	31.00	Octadecanoic acid	$C_{18}H_{36}O_2$	284	7.34	8.20	43, 73, 284
13	32.50	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	13.14	15.95	43, 73, 256
14	34.50	2,6-Octadienal, 3,7 -dimethyl-, (E)-	$C_{10}H_{16}O$	152	7.97	3.41	41, 69, 152
15	38.50	Butane, 1 -(2,2-dichloro-1-methylcyclopropyl)-3-methyl-	$C_9H_{16}C_{l2}$	195	2.75	2.74	43, 58, 185
16	39.76	9,12-Octadecadienoic acid (Z,Z)-	$C_{18}H_{32}O_2$	280	6.72	8.95	41, 67, 280

FTIR Peaks identified in sugar apple seed oil

From the FTIR peaks identified in sugar apple seed oil as shown on Figure 3 at the wavenumbers of 700, 961.7, 1110.7, 1155.5, 1230.0, 1379.1, 1401.1, 1744.4, 2855.1, and 2922.2 cm^{-1} correspond to specific functional groups present in the oil. The peak at 700 cm^{1} is attributed

to the presence of the out-of-plane bending of C-H of aromatics, indicating the presence of aromatic compounds in the oil. The peak at 961.7 cm^{-1} is assigned to the deformation of C-H out-of-plane in trans-alkenes. The peak at 1110.7 cm^{-1} corresponds to the stretching vibration of C-O-C ether linkage. The peak at 1155.5 cm^{-1} is due to the stretching of the C-O-C ether linkage. Table 3 Shows the organic compounds present in sugar apple seed oil. The peak at 1230.0 cm^{-1} corresponds to the C-O stretching of esters. The peak at 1379.1 cm^{-1} is attributed to the deformation of C-H in plane of CH3. The peak at 1401.1 cm^{-1} corresponds to the asymmetric stretching of CH_3. The peak at 1744.4 cm^{-1} is attributed to the stretching of C=O bond in esters, indicating the presence of fatty acid esters. The peaks at 2855.1 and 2922.2 cm^{-1} correspond to the symmetric and asymmetric stretching vibrations of CH_2, indicating the presence of fatty acids in the oil. Overall, the FTIR analysis of sugar apple seed oil indicates the presence of various functional groups that are characteristic of fatty acids and esters, as well as aromatic and ether compounds.

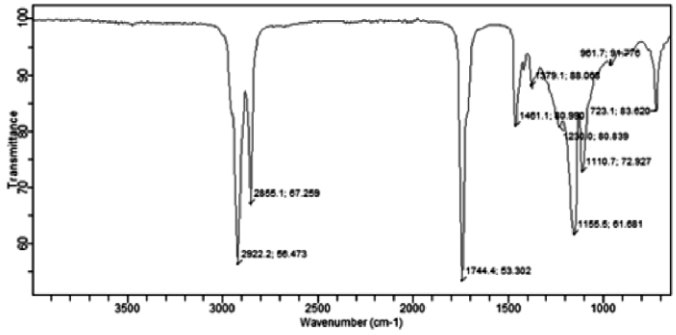


Figure 3: FTIR Peaks identified in sugar apple seed oil
Table 3: results of ftir peaks identified in sugar apple seed oil

S/N	**Wavenumber, cm^{-1}**	**Bond**	**Functional Group**
1	700	C-H	ALKYNE
2	961.7	O-H	CARBOXYLIC ACIDS
3	1110.5	=C–H	ALYNE
4	1155.5	C–N	ALIPHATIC AMINES
5	1230.0	C–N	ALIPHATIC AMINES
6	1379.1	C–H	ALKANES
7	1401.1	C–H	ALKANES
8	1744.4	C=O	ESTERS, SATURATED ALIPHATIC
9	2855.1	C–H	ALKANES
10	2922.2	C–H	ALKANES

Conclusion

Based on the discussion, several conclusions can be drawn: the physicochemical properties of sugar apple seed oil suggest that it has potential for various applications, but some parameters exceed the FAO/WHO permissible limits for edible oils. The extraction yield of 54.6% suggests a relatively efficient extraction process, while the low peroxide value indicates that the oil is fresh and has not undergone significant oxidative degradation. However, the high levels of free fatty acid and acid value suggest that the oil may require

further processing or refinement before it can be used as an edible oil.

The sample analyzed using GCMS contains sixteen different compounds, including n-Hexadecanoic acid, Limone, Octadecadienoic acid (Z,Z), Octadecanoic acid, and n-Decanoic acid, with varying composition weights. The FTIR results suggest that the sample contains several functional groups and bonds, such as C-C-H, O-H, =C-N, C-N, C-H, C=O, and C-H. However, the specific compound(s) present in the sample cannot be determined without further information and analysis. Both GCMS and FTIR are powerful analytical techniques used to identify and quantify the components and functional groups of a sample, but additional analytical techniques may be required to confirm the identity of the compounds. Careful interpretation and analysis of analytical results are necessary to draw accurate and meaningful conclusions about the sample being analyzed.

References

Ahmad, M. S., Anjum, F. M., Zahoor, T., Nawaz, H., Dilshad, S. M. R., Hussain, S., Ali, A. (2017). Chemistry and uses of edible oils, *In Advances in Food Science and Technology* (1-30). Springer, Cham.

Chakraborty, A. & Deb, J. & Saha, M. & Chatterjee, S. (2023). *Apple seeds: Phytochemistry, medicinal property and toxicology. 1038*-1045. 10.13040/IJPSR.0975-8232.14(3).1038-45.

Crane, J. H., Balerdi, C. F., Maguire, I., & Schaffer, B. (2016). *Sugar apple growing in the Florida home landscape*. UF/IFAS Extension, University of Florida.

Díaz-de-Cerio, E., Verardo, V., Gómez-Caravaca, A. M., Fernández-Gutiérrez, A., Segura-Carretero, A. (2016). Determination of the phenolic composition and antioxidant activity of crude extracts and fractions from Annona cherimola Mill. and Annona squamosa L. using liquid chromatography-tandem mass spectrometry and in vitro assays, *Journal of Agricultural and Food Chemistry, 64*(2), 311-322.

Duru, M. & Ekere, N. R. (2015). Quality evaluation of some commercial vegetable oils marketed in Nigeria, *Journal of Food Science and Quality Management, 38*, 35-40.

Echarte, M., Pazos, M., Moyano, P., Medina, I., & Gallardo, J. M. (2019). Influence of household frying on fatty acid profile, polar compounds and total antioxidant capacity of different vegetable oils, *European Journal of Lipid Science and Technology, 121(*8), 1800391. https://doi.org/10.1002/ejlt.201800391

Göhl, I., Nöbel, S., Abu-Tarboush, H. M., Alu'datt, M. H. (2019). Sugar apple (An¬nona squamosa L.) seed oil: A review of its potential applications, *Trends in Food Science & Technology, 86*, 25-32.

Knothe, G., Dunn, R. O., & Bagby, M. O. (2010). Biodiesel: The use of vegetable oils and their derivatives as alternative diesel fuels, ACS Symposium Series, 1039, 19-47.

Lin, Y. H., Chen, Y. C., Huang, W. J., & Liu, Y. C. (2011). The identification and analysis of the components in camellia oil by FTIR and GC-MS, *Journal of Food and Drug Analysis, 19*(1), 36-43.

Mansor, T. S. T., Che, M. Y.B., Mat, H. D., & Baharin, B. S. (2016). Characterization of Annona squamosa L. seed oil: Its potential as a new dietary source of fatty acids, *Journal of Food Science and Technology, 53*(9), 3608-3615.

Mariod, A. Mirghani, M. & Hussein, I. (2017). Annona squamosa L. *Sugar apple seed oil.* 10.1016/B978-0-12-809435-8.00025-1.

Muhammad, A. (2018). Indigenous names and uses of some plants in Niger State, Nigeria, *Journal of Applied Life Sciences International, 16(*4), 1-8.

Parham, S., Kharazi, A. Z., Bakhsheshi-Rad, H. R., Nur, H., Ismail, A. F., Sharif, S., RamaKrishna, S., & Berto, F. (2020). Antioxidant, Antimicrobial and Antiviral Properties of Herbal Materials. *Antioxidants (Basel, Switzerland)*, *9*(12), 1309. https://doi.org/10.3390/antiox9121309

Pinto, A. C. Q., Cordeiro, M. C. R., & Silva, J. M. (2005). Annona species (Annonaceae) as sources of commercial fruits in Brazil, *Economic Botany, 59*(4), 358-370.

Ribeiro, P. R. A., Silva, E. K., Silva, M. R. A., Borges, L., Lima, I. S., & Andrade, J. K. S. (2019). Chemical characterization, antioxidant and antimicrobial activity of the seed oil of Annona squamosa L. (sugar apple). *Anais da Academia Brasileira de Ciências, 91*(1), e20180313. https://doi.org/10.1590/0001-3765201920180313

Salimon, J., Salih, N., & Yousif, E. (2011). Physicochemical properties of Malaysian rubber (Hevea brasiliensis) seed oil as a new source of edible oil, *Molecules, 16(*4), 3084-3094.

Ushie, O. A., Longbap, B. D., Nkom, P. Y., Ago, M. A., Gani, J. & Jijingi, S. T. (2023). Proximate and physicochemical analyses of Citrullus Colocynthis (Bitter Apple) Seed, *Tropical Journal of Science and Technology, 4*(1), 83 – 90.

CHEMOTHERAPEUTIC ACTIVITY OF *CASSIA FISCULA (LINN)* LEAVES EXTRACT AS ANTIDIARRHEAL AND *IN VITRO* ANTIBACTERIAL POTENTIAL

[1]Isaac John Umaru, [2]Kerenhappuch Isaac Umaru, [3]Tyem Lawal Danjuma, [4]Asuelimen Steve Osagie, [5]Ebenezer Morayo Ale, [6]Moses Adondua Abah, [7]Mgbede Timothy & [8]Victoria Ifeoluwa Ayo

[1,4,5,6,7&8]Department of Biochemistry, Faculty of Pure and Applied Science, Federal University Wukari, Nigeria.

[2&3]Department of Medical Biochemistry, College of Health Sciences, Federal University Wukari, Nigeria.

Abstract

The crude extract of Cassia fiscula (Linn) Leaves with various solvents of hexane, dichloromethane, hlorofor, and methanol was tested for antidiarrheal and in Vitro antibacterial potential and exhibited significant results against diarrhea and microorganism. For the bacterial test, the agar ethod was used against the standard bacteria Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram –ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve) while for the evaluation of antidiarrheal activity, castor oil and the mechanism of sulphate-induced diarrhea methods was used on the albino rats at a dose of 50 mg/kg, 100 mg/kg, 250 mg/kg, 500 mg/kg, 1000 mg/kg, and 2000 mg/kg, (body weight, bw) orally. The result of methanol extract of Cassia fiscula (Linn) Leaves presented signifiantly at p<0.001 decrease the frequency of defeation and wet stools in dose depended on the manner of reeiving magnesium sulphate (2g/kg/bw) and castor oil (1.0 mL per rat). The extract also showed significant growth inhibition on the selected bacterial in an onentration-dependent manner, with lower inhibition observed at 50 µg/mL of 7.32 ± 0.04mm, 6.26 ± 0.14mm, 5.47 ± 0.13mm, 8.45 ± 0.14mm, and 7.50 ± 0.22 mm for the bacterial respectively while higher inhibition was observed at 1000 µg/mL of 12.59 ± 0.18mm, 11.86 ± 0.08mm, 10.59 ± 0.12mm, 15.58 ± 0.09mm, 15.60 ± 0.10mm respectively when compared to the control chloramphenicol between 18.00 ± 1.11-21.10 ± 0.22mm. These findings show significant results that Cassia fiscula (Linn) Leaf were effective as an antidiarrheal and antibacterial agent.

Keywords: *Chemotherapeutic, Cassia fiscula (Linn), Extract, Antidiarrheal, In Vitro, Antibacterial*

Background to the Study

The search for new drugs worldwide has become a necessary tool due to so many health challenges arising from resistant species of diseases, causative agents, and the discovery of different species and trends of microorganism (bacteria and viruses). These have therefore turned researchers to plant sources for active phytochemicals that could combat these new trends in health challenges, thus plants hold the key to the discovery and development of new pharmaceutical and biological resources that will champion the course of health and well-being of huen (Wakawa & Hauwa, 2013). These various plants on which human and animal's life depend on for food contain thousands of phytochemicals and allelochemicals (Rosenthal *et al.,* 1979) which constitute antinutritional or beneficial factors to the consumer. It was therefore observed from the research work that the medicinal value of these plants/medicinal plants lies in some chemical substance that produce a definite physiological action on the human body (Costa et al., 2016).

Many of the world population are versed in the use of available plants and herbs in their environment in the treatment of different diseases. The use of medicinal plants in the world traditional medicine has been in practice for a long time, and the practice is now becoming increasingly popular, especially as an alternative or as a compliment to modern medicine (Umaru et al., 2018)

The use of traditional medicine at the primary health care level is widespread and plant-based treatments are being recommended for curing various diseases by traditional medical practitioners all over the world. The phytochemicals present in plant parts, fruits, and vegetables are gaining attention day-by-day for their active role in the treatment of various human diseases. More than 400 plant species have been reported to have hypoglycaemic activity (Ranade et al., 2017). However, the search for a new antidiabetic drug from natural plants is still attractive and perhaps with safer effects on diabetes mellitus.

Cassia fiscula (Linn) (Fabaceae) is an evergreen plant. It is a wild native species of plant from Africa and a small medium sized tree (of about 4 to 10 m tall) with a white bark. It has leaf and long brown fruit about 30 to 50 cm. The plant has been used in traditional folk medicine for the treatment of piles and headache and to increase appetite. A member of Leguminosae family it is widely used for its medicinal properties, its main property being that of a mild laxative suitable for children and pregnant women and was reported to contain a substantial number of phytochemicals (Bahorun et al., 2005) ence, in the present study, we evaluated the chemotherapy activity of *Cassia fiscula (Linn) l*eaves extract and *In Vitro* antibacterial potential

Figure 1: Showing the *Cassia fiscula (Linn)* tree, flowers and leaves.

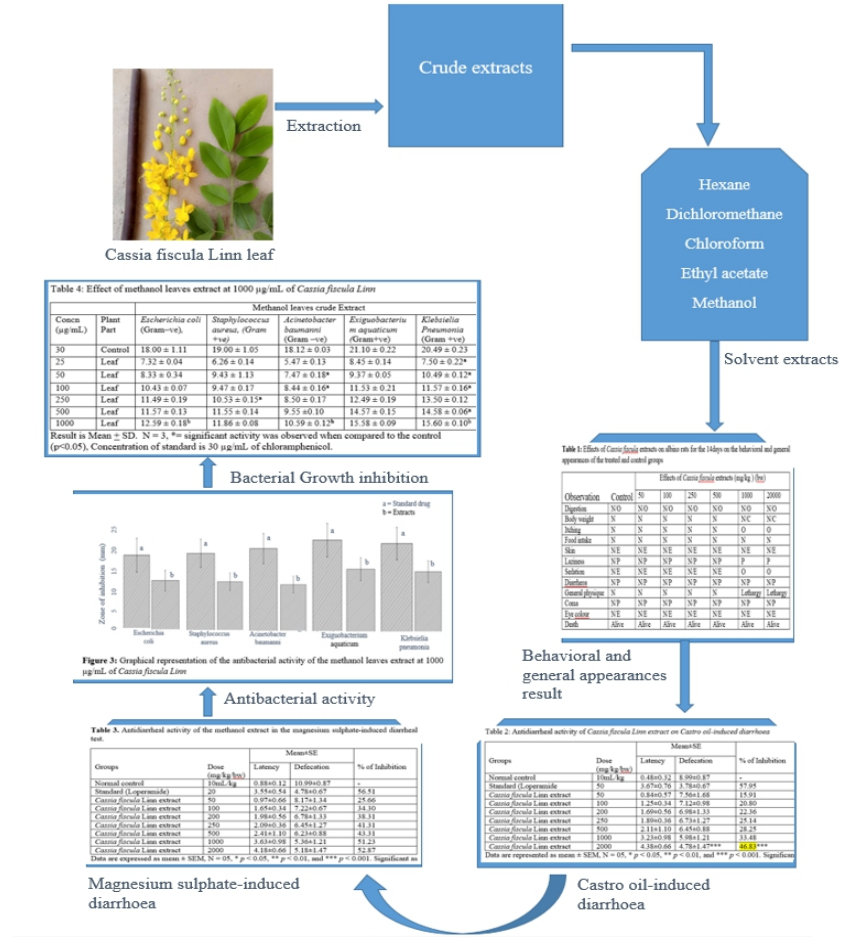


Figure 1: Graphical abstract of chemotherapeutic activity of *Cassia fiscula (Linn)* Leaves extract as antidiarrheal and *In Vitro* antibacterial potential

Materials and Methods

Collection, Identification, and Extraction of Plant Material

The whole plant of *Cassia fiscula (Linn)* was collected in June 2020 from the local area of Michika and was identified by the Department of Botany, University of Mubi. The plant was washed with running water, and the roots were separated and dried in a shady place for 3 weeks. The leaves after drying were grounded into a coarse powder with the grinding machine. The ground materials (powder) were kept in airtight bottles until further use. After that, 1000 g of the ground roots were subjected to maceration for the process of extraction using methanol as a solvent. The powdered sample was soaked for 14 days with constant stirring and fitted with a filter paper. The resultant extract was then concentrated under reduced pressure via a rotary evaporator and placed in a clean hood for evaporation until dryness. The dried crude extract was kept in the refrigerator at a temperature of 5 °C for further use.

Drugs, Chemicals, and Instruments

The chemicals used in the present study were loperamide (Sigma Aldrich, Steinheim, Germany), magnesium sulphate (Sigma Aldrich), castor oil, methanol (BDH Chemicals, London, England), agar (Liofilchem, Roseto degli Abruzzi, Italy), and metabolic cages.

Test Microorganism

Escherichia coli (Gram–ve), *Staphylococcus aureus* (Gram +ve), *Acinetobacter baumanni* (Gram –ve), *Exiguobacterium aquaticum* (Gram+ve), and *Klebsielia Pneumonia* (Gram +ve) were used for antibacterial studies.

Test Animals

A male and female albino rat having a normal weight range from 20–30 g (Batiha et al., 2019), were employed in this study that was procured from the National Institute VOM-Jos Plateau. The animals were kept in plastic cages at the animal house under standard environmental conditions (23-25 °C). The night before the experiment, the animals fasted overnight, and further treatments were according to the rules and protocols, Scientific Procedures Issue involving the animals were used as sanctioned by the official bodies (Ethical Committee) of the University.

Acute Toxicity Study

Organisation for Economic Co-operation and Development (OECD) guideline 423 was used for determining the acute toxicity study with some modifications (Jonsson et al., 2013), for instance, different doses of the extracts (50, 100, 250, 500, 1000 and 2000 mg/kg (body weight, b.w) was employed for the animals. The animals were distributed into seven groups consisting of five animals each. Group I was the control; groups II, III, IV, V, VI, and VII received a single dose of methanol extract of *Cassia fiscula (Linn)* 50, 100, 250, 500, 1000 and 2000 mg/kg (b.w) orally, respectively. Before administering the test drug, each rat was weighed, and the dose for it was determined based on its weight. The treated animals were monitored for any mortality and toxic effects within the first 4 h, after 3 days, and then twice daily for 14 days. Behavioural changes and other parameters such as body weight, urination,

Figure 1: Graphical abstract of chemotherapeutic activity of *Cassia fiscula (Linn)* Leaves extract as antidiarrheal and *In Vitro* antibacterial potential

Materials and Methods

Collection, Identification, and Extraction of Plant Material

The whole plant of *Cassia fiscula (Linn)* was collected in June 2020 from the local area of Michika and was identified by the Department of Botany, University of Mubi. The plant was washed with running water, and the roots were separated and dried in a shady place for 3 weeks. The leaves after drying were grounded into a coarse powder with the grinding machine. The ground materials (powder) were kept in airtight bottles until further use. After that, 1000 g of the ground roots were subjected to maceration for the process of extraction using methanol as a solvent. The powdered sample was soaked for 14 days with constant stirring and fitted with a filter paper. The resultant extract was then concentrated under reduced pressure via a rotary evaporator and placed in a clean hood for evaporation until dryness. The dried crude extract was kept in the refrigerator at a temperature of 5 °C for further use.

Drugs, Chemicals, and Instruments

The chemicals used in the present study were loperamide (Sigma Aldrich, Steinheim, Germany), magnesium sulphate (Sigma Aldrich), castor oil, methanol (BDH Chemicals, London, England), agar (Liofilchem, Roseto degli Abruzzi, Italy), and metabolic cages.

Test Microorganism

Escherichia coli (Gram–ve), *Staphylococcus aureus* (Gram +ve), *Acinetobacter baumanni* (Gram –ve), *Exiguobacterium aquaticum* (Gram+ve), and *Klebsielia Pneumonia* (Gram +ve) were used for antibacterial studies.

Test Animals

A male and female albino rat having a normal weight range from 20–30 g (Batiha et al., 2019), were employed in this study that was procured from the National Institute VOM-Jos Plateau. The animals were kept in plastic cages at the animal house under standard environmental conditions (23-25 °C). The night before the experiment, the animals fasted overnight, and further treatments were according to the rules and protocols, Scientific Procedures Issue involving the animals were used as sanctioned by the official bodies (Ethical Committee) of the University.

Acute Toxicity Study

Organisation for Economic Co-operation and Development (OECD) guideline 423 was used for determining the acute toxicity study with some modifications (Jonsson et al., 2013), for instance, different doses of the extracts (50, 100, 250, 500, 1000 and 2000 mg/kg (body weight, b.w) was employed for the animals. The animals were distributed into seven groups consisting of five animals each. Group I was the control; groups II, III, IV, V, VI, and VII received a single dose of methanol extract of *Cassia fiscula (Linn)* 50, 100, 250, 500, 1000 and 2000 mg/kg (b.w) orally, respectively. Before administering the test drug, each rat was weighed, and the dose for it was determined based on its weight. The treated animals were

monitored for any mortality and toxic effects within the first 4 h, after 3 days, and then twice daily for 14 days. Behavioural changes and other parameters such as body weight, urination, water intake, respiration, food intake, tremors, convulsions, temperature, constipation, and changes in skin and eye colour were also monitored.

Dose Selection

Six different doses of methanol extract of *Cassia fiscula* were selected according to 1/10th of the maximum toxic dose and were diluted in normal saline.

Experimental Design

Castor Oil-Induced Diarrhoea

The antidiarrheal activity was performed on albino rats with castor oil-induced diarrhoea with some modifications in the protocols (Birru et al., 2016). Animals were randomly assigned into seven groups of five animals each. Group I was the control and received normal saline, while group II was the standard that received (loperamide) at a dose rate of 50 mg/kg (b.w). Groups III and VIII were the tested groups that received the methanol extract at a dose rate of 50, 100, 250, 500, 1000, and 2000 mg/kg (body weight, b.w), respectively. After the treatment of the respective drugs, each animal was put in separate cages and laid with papers for collecting the faecal mass. Diarrhoea was induced by oral administration of castor oil (1mL/rat). The methanol extract and loperamide were given 1h before the oral administration of the castor oil; the time were taken for the first fae excretion, and the total number of faecal outputs within 6 h of administration was recorded. The inhibition of defecation was calculated using the following equation:

$$\text{Percentage inhibition} = \left[\frac{M_O - M}{M_O} \times 100\right] \qquad \text{Eqn 1}$$

Where Mo = mean defecation of control and M = mean defecation of the experimental group. Loperamide, the standard drug used, slows intestinal motility and alters the bowel water and electrolyte movement. It is a potent opiate receptor agonist in the gut wall where it inhibits the release of acetylcholine and prostaglandins, thereby reducing propulsive peristalsis and increasing the intestinal transit time. The drug has also been reported to increase the activity of the anal sphincter (Abe et al., 2019). It thus, antagonizes the diarrheal activity induced by castor oil (Karim & Adaikan, 1977).

Magnesium Sulphate-Induced Diarrhoea

The effect of *Cassia fiscula* on magnesium sulphate-induced diarrhoea was also determined in albino rats (Uddin et al., 2005). After overnight fasting, the animals were distributed into seven groups of 5 animals each. Group I, the control, received only normal saline. Group II, the standard, received loperamide at a dose rate of 20 mg/kg (b.w), while groups III and VIII, which were the test groups, received a methanol extract of *Cassia fiscula* at a dose rate of 50, 100, 250, 500, 1000 and 2000 mg/kg (b.w). Sixty minutes after treatment of the respective drug, the animal groups were treated orally with magnesium sulphate at a dose rate of 2 g/kg (b.w). The frequency of defecation and faeal material was again noted for up to 4 h. The rats

were in transparent (clear) cages with preweighed plastic dishes for fae collection at the bottom of all cages. The weights of the plastic dishes were recorded and compared with those of the control before and after defecation.

Test Microorganisms and Growth Conditions

Five standard bacterial strains: *Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram–ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve)* were used for antibacterial studies. The agar nutrient medium was used for the growth of bacterial strains and was allowed to stand for a period of 24 h at 37 °C. Nutrient agar was added to a conical flask that already contained distilled water. The nutrient agar powder and distilled water were mixed in (proper ratio). The aqueous solution was made by incorporating an amount of 20 mg of agar nutrient in 1000 mL of distilled water with constant shaking for 6 min. The solution was then sterilized in an autoclave and transferred to Petri dishes for the inoculation of bacterial strains.

Well Diffusion Method

The antibacterial activity of *Cassia fiscula* was determined individually by the agar diffusion method (Umaru et al., 2020). Twenty millilitres of molten nutrient agar were poured into each of the Petri dishes and allowed to solidify. Overnight, a bacterial broth, standardized to 0.5 McFarland, was spread on the dry nutrient agar and spread using a spreader pre-sterilized in ethanol and flamed. With the aid of a sterile fork borer, eight 6-mm holes, about 5 cm apart, were made in the nutrient agar. Six of the wells were filled with 200 µL of the *Cassia fiscula* plant extract dissolved in sterile distilled water, one well with water only (negative control), and the last with 1% standard antibiotic, chloramphenicol.

The positive control was dispensed into the wells in triplicate. The antibacterial activities were determined after incubation for a 24 h period at 37 °C as the diameter of the inhibition zone. The zones of inhibition observed with the extract were compared with that of the standard antibiotic, chloramphenicol. The experiment was done in triplicate. The measured chloramphenicol inhibition zones' diameters were subsequently matched with the respective standard zones' diameters (Jean, 2014) for *Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram –ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve)* (Melvin, 1995). The *Cassia fiscula* zone of inhibition from 9-14 mm in diameter was taken as a positive antibacterial activity based on the growth inhibition standard as reported by Karima et al., (2013) and Mothana et al., (2010).

Determination of Minimum Inhibitory Concentration (MIC)

Solutions of *Cassia fiscula* extract at varied concentrations of 1.0 mg/mL, 2.0 mg/mL, 3.0 mg/mL, 4.0 mg/mL, and 5.0 mg/mL were introduced to molten agar plates and incubated for 24 h at 37 °C. The plates were then inoculated with the specific bacterial strains, incubated at 37 °C for 24 h, and the minimum inhibitory concentration (MIC) of the extract was determined against the selected bacterial strains. The MIC of the extract against the bacterial strains was found to be 0.5 mg/mL, which shows that the activity increased with

Where Mo = mean defecation of control and M = mean defecation of the experimental group. Loperamide, the standard drug used, slows intestinal motility and alters the bowel water and electrolyte movement. It is a potent opiate receptor agonist in the gut wall where it inhibits the release of acetylcholine and prostaglandins, thereby reducing propulsive peristalsis and increasing the intestinal transit time. The drug has also been reported to increase the activity of the anal sphincter (Abe et al., 2019). It thus, antagonizes the diarrheal activity induced by castor oil (Karim & Adaikan, 1977).

Magnesium Sulphate-Induced Diarrhoea

The effect of *Cassia fiscula* on magnesium sulphate-induced diarrhoea was also determined in albino rats (Uddin et al., 2005). After overnight fasting, the animals were distributed into seven groups of 5 animals each. Group I, the control, received only normal saline. Group II, the standard, received loperamide at a dose rate of 20 mg/kg (b.w), while groups III and VIII, which were the test groups, received a methanol extract of *Cassia fiscula* at a dose rate of 50, 100, 250, 500, 1000 and 2000 mg/kg (b.w). Sixty minutes after treatment of the respective drug, the animal groups were treated orally with magnesium sulphate at a dose rate of 2 g/kg (b.w). The frequency of defecation and faeal material was again noted for up to 4 h. The rats were in transparent (clear) cages with preweighed plastic dishes for fae collection at the bottom of all cages. The weights of the plastic dishes were recorded and compared with those of the control before and after defecation.

Test Microorganisms and Growth Conditions

Five standard bacterial strains: *Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram–ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve)* were used for antibacterial studies. The agar nutrient medium was used for the growth of bacterial strains and was allowed to stand for a period of 24 h at 37 °C. Nutrient agar was added to a conical flask that already contained distilled water. The nutrient agar powder and distilled water were mixed in (proper ratio). The aqueous solution was made by incorporating an amount of 20 mg of agar nutrient in 1000 mL of distilled water with constant shaking for 6 min. The solution was then sterilized in an autoclave and transferred to Petri dishes for the inoculation of bacterial strains.

Well Diffusion Method

The antibacterial activity of *Cassia fiscula* was determined individually by the agar diffusion method (Umaru et al., 2020). Twenty millilitres of molten nutrient agar were poured into each of the Petri dishes and allowed to solidify. Overnight, a bacterial broth, standardized to 0.5 McFarland, was spread on the dry nutrient agar and spread using a spreader pre-sterilized in ethanol and flamed. With the aid of a sterile fork borer, eight 6-mm holes, about 5 cm apart, were made in the nutrient agar. Six of the wells were filled with 200 µL of the *Cassia fiscula* plant extract dissolved in sterile distilled water, one well with water only (negative control), and the last with 1% standard antibiotic, chloramphenicol.

The positive control was dispensed into the wells in triplicate. The antibacterial activities were determined after incubation for a 24 h period at 37 °C as the diameter of the inhibition

zone. The zones of inhibition observed with the extract were compared with that of the standard antibiotic, chloramphenicol. The experiment was done in triplicate. The measured chloramphenicol inhibition zones' diameters were subsequently matched with the respective standard zones' diameters (Jean, 2014) for *Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram –ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve)* (Melvin, 1995). The *Cassia fiscula* zone of inhibition from 9-14 mm in diameter was taken as a positive antibacterial activity based on the growth inhibition standard as reported by Karima et al., (2013) and Mothana et al., (2010).

Determination of Minimum Inhibitory Concentration (MIC)

Solutions of *Cassia fiscula* extract at varied concentrations of 1.0 mg/mL, 2.0 mg/mL, 3.0 mg/mL, 4.0 mg/mL, and 5.0 mg/mL were introduced to molten agar plates and incubated for 24 h at 37 °C. The plates were then inoculated with the specific bacterial strains, incubated at 37 °C for 24 h, and the minimum inhibitory concentration (MIC) of the extract was determined against the selected bacterial strains. The MIC of the extract against the bacterial strains was found to be 0.5 mg/mL, which shows that the activity increased with the increase in concentration (Andrews, 2001).

Data Analysis

All experiments were conducted in triplicate and data were presented as mean ± SEM; values were considered significantly different at 95% confidence, i.e., $p < 0.05$. One-way ANOVA test followed by Turkey's multiple comparisons was employed for the antidiarrheal studies (Beshbishy et al., 2019).

$$\text{Percentage} = \left[\frac{A_0 - A_1}{A_0} \times 100\right] \qquad \text{Eqn}$$

Where A_0 is the defecation of the control, while A_1 is the defecation in presence of the sample.

Results and Discussion

Acute Toxicity Study

During the toxicity test, the result showed no mortality, and any treatment-related toxic effects were observed after the administration of *Cassia fiscula* extracts of 50, 100, 250, 500, 1000, and 2000 mg/kg (b.w) up to limited dose to the albino rats. The general observation of the tested groups did not show any visual changes in breathing, food intake, water consumption, behaviour, skin, and temperature during the fourteen days of the study. Hence, the tested drug was considered nontoxic even at a high dose level of 2000 mg/kg (b.w). However, laziness, itching, and sedation were found for the first 12 h, which became normal on the 7th day after receiving *Cassia fiscula* when compared with the control group. The parameters that were analysed during the 14 days of the study are shown in Table 1.

Table 1: Effects of *Cassia Fiscula* extract on Albino rats for 14days on the behavioral and General Appearance of the Treated and control Groups

		Effects of *Cassia fiscula* extracts (mg/kg) (bw)					
Observation	Control	50	100	250	500	1000	2000
Digestion	N/O	N/O	N/O	N/O	N/O	N/O	N/O
Body weight	N	N	N	N	N	N/C	N/C
Itching	N	N	N	N	N	O	O
Food intake	N	N	N	N	N	N	N
Skin	N/E	N/E	N/E	N/E	N/E	N/E	N/E
Laziness	N/P	N/P	N/P	N/P	N/P	P	P
Sedation	N/E	N/E	N/E	N/E	N/E	O	O
Diarrhea	N/P	N/P	N/P	N/P	N/P	N/P	N/P
General physique	N	N	N	N	N	Lethargy	Lethargy
Coma	N/P	N/P	N/P	N/P	N/P	N/P	N/P
Eye colour	N/E	N/E	N/E	N/E	N/E	N/E	N/E
Death	Alive	Alive	Alive	Alive	Alive	Alive	Alive

N/O: not observed, O: observed, N/P: not present, N/E: no effect, N: normal, N.C: no change, and P:
Present. b.w: body weight.

Castor Oil-Induced Diarrhoea

The antidiarrheal activity of the methanol extract of *Cassia fiscula* and standard drugs in castor oil-induced diarrhoea are given in Table 2. A significant decrease ($p < 0.001$) in the mean number of defecations was noted in the methanol extract and loperamide-receiving groups while compared to control. The attenuation in the mean number of defecations with *Cassia fiscula* at a dose rate of 50 mg/kg (b.w) was ($p<0.05$) was 7.56±1.68mg/kg. Similarly, the attenuation in the mean number of defecations in the animal group that received a *Cassia fiscula* extract at the dose rate of 1000 mg/kg (b.w) and 2000 mg/kg (b.w) was 5.98±1.21, 4.78±1.47 respectively which seemed to be more significant ($p < 0.01$) as a match to the control group. Furthermore, the mean number of defecations with loperamide at the dose of 50 mg/kg (b.w) was more significant ($p < 0.001$) at 3.78±0.67 mg/kg. The results indicate that the percentage of attenuation in the mean number of defecations by the extracts of both lower and higher doses were 15.91%, 33.48%, and 46.83% respectively. Additionally, the percentage of attenuation in the mean number of defecations with loperamide was 57.95%. The latent period for *Cassia fiscula* increased significantly ($p<0.001$) opared to the control group.

Table 2: Antidiarrheal activity of *Cassia Fiscula Linn extract on Castor oil-induced diarrhoea*

Groups	Dose (mg/kg/bw)	Mean±SE		% of Inhibition
		Latency	Defecation	
Normal control	10mL/kg	0.48±0.32	8.99±0.87	-
Standard (Loperamide	50	3.67±0.76	3.78±0.67***	57.95
Cassia fiscula Linn extract	50	0.84±0.57	7.56±1.68*	15.91
Cassia fiscula Linn extract	100	1.25±0.34	7.12±0.98	20.80
Cassia fiscula Linn extract	200	1.69±0.56	6.98±1.33	22.36
Cassia fiscula Linn extract	250	1.89±0.36	6.73±1.27**	25.14
Cassia fiscula Linn extract	500	2.11±1.10	6.45±0.88**	28.25
Cassia fiscula Linn extract	1000	3.23±0.98	5.98±1.21	33.48
Cassia fiscula Linn extract	2000	4.38±0.66	4.78±1.47***	46.83***

Data are represented as mean ± SEM, N = 05, * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$. Significant when compared with control. The statistical test employed was a one-way ANOVA test followed by a Turkey's multiple comparisons.

Magnesium Sulphate-Induced Diarrhoea

The antidiarrheal activity of the *Cassia fiscula Linn* extract was also evaluated by the magnesium sulphate-induced diarrhoea method. The results presented in Table 3 show that the groups that received *Cassia fiscula Linn* extract at the dose rates of 50, 50, 100, 200, 250, 500, 1000, and 2000 mg/kg (b.w) produced significant and dose-dependent ($p < 0.01$) attenuation in the total number of stools and wet stools opared to the control. The mean number of defecations with the *Cassia fiscula Linn* extract at a dose rate of 50 mg/kg (b.w) which is the lowest was 8.17±1.34, while the mean number of defecations with 1000 mg/kg (b.w) and 2000 mg/kg (b.w) were 5.36±1.21, and 5.18±1.47 compared to the control group. The mean number of defecations produced by the standard drug was 4.78±0.67. The percentage of inhibition of defecation with the methanol extract at dose 50. 1000 and 2000 mg/kg (b.w) were 25.66%, 51.23, and 52.87%, respectively, while those of the loperamide standard, at dose 50 mg/kg (b.w), was 56.51%.

Table 3. Antidiarrheal activity of the Methanol extract in the Magnesium Sulphate-induced Diarrheal Test.

Groups	Dose (mg/kg/bw)	Mean±SE		% of Inhibition
		Latency	Defecation	
Normal control	10mL/kg	0.88±0.12	10.99±0.87	-
Standard (Loperamide)	20	3.55±0.54	4.78±0.67	56.51
Cassia fiscula Linn extract	50	0.97±0.66	8.17±1.34	25.66
Cassia fiscula Linn extract	100	1.65±0.34	7.22±0.67*	34.30
Cassia fiscula Linn extract	200	1.98±0.56	6.78±1.33	38.31
Cassia fiscula Linn extract	250	2.09±0.36	6.45±1.27	41.31
Cassia fiscula Linn extract	500	2.41±1.10	6.23±0.88**	43.31
Cassia fiscula Linn extract	1000	3.63±0.98	5.36±1.21***	51.23
Cassia fiscula Linn extract	2000	4.18±0.66	5.18±1.47***	52.87

Data are expressed as mean ± SEM, N = 05, * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$. Significant as matched to the control. The statistical test employed was a one-way ANOVA test followed by a Turkey's multiple comparison test.

Well Diffusion Method

The antimicrobial activity *of Cassia fiscula Linn leaves extract* was determined as a zone of inhibition against *Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram –ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve)* growth. This was compared with chloramphenicol as a positive standard in which *Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram –ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve) were* susceptible to chloramphenicol with zones of inhibition (mm) that were 12.59 ± 0.18, 11.86 ± 0.08, 10.59 ± 0.12, 15.58 ± 0.09, and 15.60 ± 0.10, respectively (Figure 1). The results revealed that the methanol extract has a significant antibacterial potential against all bacterial strains, and the zones of inhibition (mm) were observed at 1000 µg/mL in all bacterial species ranging from 9.55 ±0.10 mm-15.60 ± 0.10 mm is considered as susceptible.

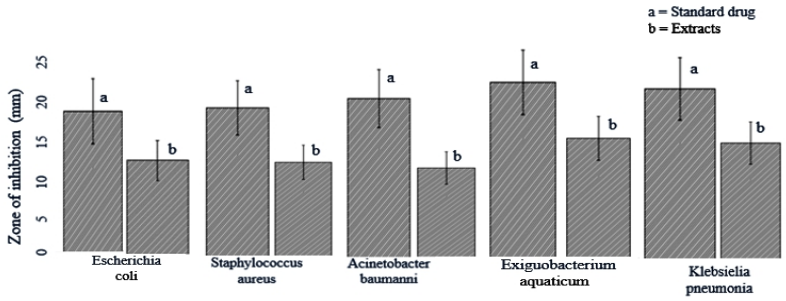


Figure 3: Graphical representation of the antibacterial activity of the methanol leaf extract at 1000 µg/mL of *Cassia fiscula Linn*

Table 4: Effect of methanol leaf extract at 1000 µg/mL of *Cassia fiscula Linn*

		Methanol leaves crude Extract				
Concn (µg/mL)	**Plant Part**	***Escherichia coli* (Gram–ve),**	***Staphylococcus aureus, (Gram +ve)***	***Acinetobacter baumanni* (Gram –ve)**	***Exiguobacterium aquaticum* (Gram+ve)**	***Klebsielia Pneumonia* (Gram +ve)**
30	Control	18.00 ± 1.11	19.00 ± 1.05	18.12 ± 0.03	21.10 ± 0.22	20.49 ± 0.23
25	Leaf	7.32 ± 0.04	6.26 ± 0.14	5.47 ± 0.13	8.45 ± 0.14	7.50 ± 0.22[a]
50	Leaf	8.33 ± 0.34	9.43 ± 1.13	7.47 ± 0.18[a]	9.37 ± 0.05	10.49 ± 0.12[a]
100	Leaf	10.43 ± 0.07	9.47 ± 0.17	8.44 ± 0.16[a]	11.53 ± 0.21	11.57 ± 0.16[a]
250	Leaf	11.49 ± 0.19	10.53 ± 0.15[a]	8.50 ± 0.17	12.49 ± 0.19	13.50 ± 0.12
500	Leaf	11.57 ± 0.13	11.55 ± 0.14	9.55 ±0.10	14.57 ± 0.15	14.58 ± 0.06[a]
1000	Leaf	12.59 ± 0.18[b]	11.86 ± 0.08	10.59 ± 0.12[b]	15.58 ± 0.09	15.60 ± 0.10[b]

Result is Mean $\pm$ SD. N = 3, *= significant activity was observed when compared to the control ($p<0.05$), Concentration of standard is 30 µg/mL of chloramphenicol.

In this study performed with recognized and validated criteria and measurement scales for the diagnosis and assessment of chemotherapeutic activity of *Cassia fiscula (Linn)* Leaves

extract and *In Vitro* antibacterial potential of different concentration of five solvents. The result showed a dose-dependent antidiarrheal effect in the castor oil-induced diarrhea method. The effect of *Cassia fiscula Linn* as antidiarrheal was intimately analogous to loperamide which is normally used as antidiarrheal medication. The use of *Cassia fiscula Linn* extract as an antidiarrheal was found to counteract the increase in electrolyte secretion perhaps due to the anti-electrolyte permeability action. It was reported by Rode et al (2013) and Yacob et al., (2016) on the effects of plant extracts which attributed to the antidiarrheal activities because of their anti-electrolyte permeability actions. In this study, we tend to postulate that the methanol extract of *Cassia fiscula Linn* extrat shows a significant inhibition in the accumulation of intestinal fluids and intestinal contents, this is possible because of the presence of chemical constituents such as saponins, triterpenoids, flavonoids, tannins, alkaloids, and reducing sugars.

For the evaluation of the antibacterial potential of the plant extract, the leaves of *Cassia fiscula* showed a significant growth inhibition of Escherichia coli (Gram–ve), Staphylococcus aureus (Gram +ve), Acinetobacter baumanni (Gram –ve), Exiguobacterium aquaticum (Gram+ve), and Klebsielia Pneumonia (Gram +ve). Lower inhibition was observed at 25 µg/mL with 7.32 ± 0.04, 6.26 ± 0.14, 5.47 ± 0.13, 8.45 ± 0.14, and 7.50 ± 0.22 mm, respectively. While higher inhibition was observed at 1000 µg/mL with growth inhibition of 12.59 ± 0.18, 11.86 ± 0.08, 10.59 ± 0.12, 15.58 ± 0.09, and 15.60 ± 0.10 respectively for the selected bacterial. However, the extracts overall showed better antibacterial ativity opared to chloramphenicol which is the standard antibiotic; that may be due to the purity of the chemical constituents.

Conclusion

The results of this observation suggest that the tested leaf extracts of *Cassia fiscula* could be of interest with the potential against diarrhoea in castor oil and magnesium-induced diarrhoea, as an alternative source, efforts should be made towards deploying *Cassia fiscula* leaf extract as an antidiarrheal and antimicrobial agent.

Acknowledgement

The authors extend his appreciation to Prof Fasihuddin B. Ahmed for his support and encouragement in research.

References

Abe, T., Kunimoto, M., Hachiro, Y., Ohara, K. & Murakami, M. (2019). Clinical efficacy of Japanese herbal medicine daikenchuto in the management of faecal incontinence: A single-center, observational study, *J. Anus. Rectum. Colon*. *3*, 160–166.

Andrews, J. M. (2001). Determination of minimum inhibitory concentrations, *J. Antimicrob. Chemother*. 48, 5–16.

Bahorun, T., Neergheen, V. S., & Aruoma, O. I. (2005). Phytochemical constituents of Cassia fistula, *African journal of Biotechnology*, *4*(13).

Batiha, G. E. S. Beshbishy, A. M. Tayebwa, D. S., Adeyemi, O. S., Shaheen, H., Yokoyama, N. & Igarashi, I. (2019). The effects of *trans*-chalcone and chalcone 4 hydrate on the growth of *Babesia* and *Theileria*, *PLoS Negl. Trop. Dis*. *13*, e0007030.

Beshbishy, A. M., Batiha, G. E., Yokoyama, N. & Igarashi, I. (2019). Ellagic acid microspheres restrict the growth of *Babesia* and *Theileria* in vitro and *Babesia microti* in vivo, *Parasit Vectors*. 12, 269.

Birru, E. M., Asrie, A. B., Adinew, G. M. & Tsegaw, A. (2016). Antidiarrheal activity of crude methanolic root extract of Idigofera spicata Forssk. (Fabaceae). *BMC Complement. Altern. Med*. *16*, 272.

Costa, J. H. C., Von-Keyserlingk, M. A. G., & Weary, D. M. (2016). Invited review: Effects of group housing of dairy calves on behaviour, cognition, performance, and health, *Journal of Dairy Science*, *99*(4), 2453-2467.

Jean B. P. (2014). Performance standards for antimicrobial susceptibility testing; twenty-fourth informational supplement, *Clinical & Laboratory Standards Institute*: Wayne, PA, USA. 34.

Jonsson, M., Jestoi, M., Nathanail, A.V. Kokkonen, U. M., Anttila, M., Koivisto, P., Karhunen, P. & Peltonen, K. (2013). Application of OECD guideline 423 in assessing the acute oral toxicity of moniliformin, *Food Chem. Toxicol*. *53*, 27–32.

Karim, S. & Adaikan, P. (1977). The effect of loperamide on prostaglandin induced diarrhoea in rat and man, *Prostaglandins 13*, 321–331.

Karima, S., Farida, S., Mihoub, Z. M. (2013). Antimicrobial activity of an Algerian medicinal plant: *Carthamus caeruleus* L. *Pharmacogn. Commun.* 3, doi: 10.5530/pc. 4.10.

Melvin P. Weinstein. (1995). *National committee for clinical laboratory standards*. In *Performance standards for antimicrobial disk susceptibility tests*. Clinical & Laboratory Standards Institute: Wayne, PA, USA, 15.

Mothana, R. A., Abdo, S. A., Hasson, S., Althawab, F. M., Alaghbari, S. A., & Lindequist, U. (2010). Antimicrobial, antioxidant and cytotoxic activities and phytochemical screening of some Yemeni medicinal plants, *Evid. Based Complement. Alternat. Med*. 7, 323–330.

Rajagopal, P. L., Premaletha, K., Kiron, S. S., & Sreejith, K. R. (2013). Phytochemical and pharmacological review on Cassia fistula linn.- The Golden Shower, *International Journal of Pharmaceutical, Chemical & Biological Sciences*, *3*(3).

Ranade, A. M., Vignesh, A., & Gayathri, M. (2017). A brief review on medicinal plants from South India, endophytes and their antidiabetic properties, *Int J Cur Res Rev*| *9*(20), 1.

Rode, M. S., Kalaskar, M. G., Gond, N. Y. & Surana, S. J. (2013). Evaluation of antidiarrheal activity of diospyros malabarica bark extract, *Bangladesh. J. Pharmaco*. 8, 49–53.

Rosenthal, G. A. & Janzen, D. D. (1979). *Herbivores; Their interaction with plant secondary metabolites*. Academic Press, New York. P718.

Uddin, S. J., Shilpi, J. A., Alam, S. M., Alamgir, M., Rahman, M. T. & Sarker, S. D. (2005). Antidiarrheal activity of the methanol extract of the barks of *Xylocarpusmoluccensis* in castor oil-and magnesium sulphate-induced diarrhea models in mice, *J. Ethnopharmacol. 101*, 139–143.

Umaru, I. J., Ahmed, F. B., Umaru, K. I., & Omalayo, A. O. (2020). Extraction and biological activity of Barringtonia asiatica Stem-Bark extracts on some selected fungi, Bacteria's, cytotoxicity and antioxidant potentials. *Indian Journal of Pure and Applied Biosciences*. 8(1), 6-15.

Umaru, I. J., Badruddin, F. A., & Wakawa, H. Y. (2018). Antifungal potential of *Leptadenia hastata* against Some Pathogenic Fung, *American Journal of Biochemistry and Biotechnology*, 14(1), 57-60.

Wakawa, H., & Hauwa, M. (2013). Protective effect of *erythrina senegalensis* (DC) leaf extract on carbon tetrachloride-induced liver injury in rats. *Asian Journal of Biological Sciences*, *6*(4), 234-238.

Yacob, T., Shibeshi, W. & Nedi, T. (2016). Antidiarrheal activity of 80% methanol extract of the aerial part of Ajuga remota Benth (Lamiaceae) in mice, *BMC Complement. Altern. Med*, 16, 303.

ANTIBACTERIAL ACTIVITY OF ISOLATED PURE COMPOUNDS FROM THREE MEDICINAL PLANT *BARRINGTONIA ASIATICA*, *BARRINGTONIA RACEMOSA* AND *LEPTADENIA HASTATA PLANTS*

[1]Isaac John Umaru, [2]Kerenhappuch Isaac Umaru, [3]Tyem Lawal Danjuma, [4]Asuelimen Steve Osagie, [5]Ebenezer Morayo Ale, [6]Moses Adondua Abah, [7]Mgbede Timothy & [8]Victoria Ifeoluwa Ayo

[1,4,5,6,7&8]Department of Biochemistry, Faculty of Pure and Applied Science, Federal University Wukari, Nigeria.

[2&3]Department of Medical Biochemistry, College of Health Sciences, Federal University Wukari, Nigeria.

Abstract

*Phytochemicals were isolated from the leaves, stem-bark and roots extracts of Leptadenia hastata, Barringtonia asiatica and Barringtonia racemosa after the extraction from five solvents (hexane, dichloromethane, chloroform ethyl acetate and methanol). The chemical compounds isolated include Benzyl alcohol (**1**), 3-Pyridine carboxylate (**2**), 2-Methoxy-4-vinylphenol (**3**), Methyl biphenyl-4-carboxylate (**4**) were from dichloromethane crude leaf extract of Leptadenia hastata, Methyl salicylate (**5**) from root crude extract of Leptadenia hastata. Cyclohexanol-5-methyl-2-(1 methyl ethyl) (**6**), Phytol (**7**), and Tetracosane (**8**) from Dichloromethane Leaf extract of Barringtonia asiatica, 1-Docosanol (**9**), Hexadecanoic acid (**10**) and Squalene (**11**) from Dichloromethane Leaf extract of Barringtonia racemosa. Methods: Antibacterial assay was evaluated using Agar disc diffusion method through determining the zone growth rate inhibition of the crude extract of Leptadenia hastata, Barringtonia asiatica and Barringtonia racemosa against Gram positive and Gram-negative bacteria; Staphylococcus aureus (ST), Klebsielia pneumonia (KP), Salmonella typhi (ST) and Escherichia coli (EC) and compared to the standard drug Tetracycline expressed at p>0.05. Results: The result showed a significant potential on the selected bacteria with the isolated compound from Leptadenia hastata. Barringtonia asiatica and Barringtonia racemosa extract to have exhibit antibacterial activity from 25 ppm to 1000 ppm against all the selected bacteria with little variations.*

Key words: *Antibacterial, Activity, Compound, Medicinal, Plant, Activity.*

Background to the Study

Numerous efforts by researchers have been directed towards the provision of empirical proof to back the use of tropical plants in traditional medicinal practice (Umaru *et al.*, 2019). Focus on medicinal plant research has increased worldwide and evidence abounds in the immense potentials of medicinal plants used in various traditional systems. Various medicinal plants have been studied using different scientific approaches and results from these studies have revealed the potentials of medicinal plants in pharmacology (Somova *et al.,* 2003; Umaru et al., 2020). These medicinal plants are of great importance to the health of the individuals and communities to larger extend, and nutritional benefits are derived from these plants since they are commonly used as vegetables. The use of these medicinal plants in most communities is commonly referred to as traditional medicine (Wakawa *et al.*, 2018).

The World Health Organization (WHO) defines traditional medicine as practices, knowledge and belief systems which use minerals, plants and animal-based remedies, spiritual therapies and exercises to prevent, treat and maintain wellbeing (WHO, 2018). The practice is widely accepted and practiced due to some major factors including;
The trend is aggravated by the poor socio-economic situations of the communities (mostly in sub Saharan regions and third world countries and areas that have suffered political instability) and ignorance (basically due to believe that the practice is mostly associated with their traditional believes and norms).

The exorbitant cost of most western drugs and treatments, and its affordability as compared to the availability and accessibility of these medicinal plants. Most often, knowledge of traditional medicine is only inherited orally, thereby facing the danger of being lost in favor of modern medicine. They believe in the manifestation of life forces or spirits in every creation, and that these spirits constitute the heart of all life forms, natural events or non-living things, this gives herbal medicine a vital role in health care delivery systems especially in remote areas where clinics and hospitals are sparsely located (Ogbe, 2009; Busia 2005)

It is a cultural phenomenon, dynamic and adaptive, like language and other cultural manifestations. However, *Leptadenia hastata, Barringtonia asiatica* and *Barringtonia racemosa* are widely distributed throughout the world. The plants parts are used in various applications especially for medicinal purposes. They are significant element of the world cultural heritage and they resort for treating health problems. This knowledge is passed down from generation to the next generation with or without little written information was available on the active, safety and effectiveness of this medicine (Sarkiyayi *et al.*, 2015). They are distributed from Africa to Bangladesh, Sri Lanka, India, China, Taiwan, and Japan as well as Malaysia (Kabir *et al.*, 2014). This is to provide sufficient information on the health beneficial properties of the plants and their specific usage of their isolate. The identification of these plants and their biochemical to obtain information on their biological activities. This work is designed to explore the medicinal property of the isolated compounds from the leaves stem bark, and roots extracts of *Leptadenia hastata*, *Barringtonia asiatica* and *Barringtonia racemosa* with the view of evaluating some acclaimed traditional medicinal

uses. The objective is to extract isolate and identify secondary metabolites in the plant parts and evaluate the antimicrobial assay of the isolated compounds. Thus, the research focused on the extraction of the crude extracts, purification and identification of secondary metabolites of *Leptadenia hastata*, *Barringtonia asiatica* and *Barringtonia racemosa*. The studies also focused on their biological activity to support the medicinal and health claims related to them.

Material and Methods

Extraction and Identification of Secondary Metabolites

Sample Preparation

Dried plant materials (leaves, stem bark and roots) were ground into fine powder form using laboratory pestle and mortar and electric grinder. The finely ground powdered samples were packed into clean, dry sample containers and were labelled appropriately and kept for use. Extraction was then carried out by the conventional solvent extraction method described by Fasihuddin et al. (2010). This was achieved by soaking the ground plant material in solvents in the order of increasing polarity. A total of 2 kg of the dried and ground powdered sample was extracted using cold soaking method with hexane. The sample were soaked in the hexane with the ratio of 1:3 in 5 liters Erlenmeyer flasks at room temperature for 5-7 days. The resulting hexane solution was then filtered using Whatman filter paper No 4 and the residue was then re-extracted with fresh hexane for another 72hrs and filtered. Both extracts were combined and concentrated with a rotary evaporator (Heidolph Laborota 4000 efficient) under reduced pressure below 50 °C to obtain the hexane crude extract. The residue was re-extracted using similar procedure with DCM, followed chloroform, ethyl acetate and methanol to obtain respective crude extracts. The dry weight and yield of each crude extracts were determined.

Isolation and Purification

Column Chromatography

Fractionation using column chromatography was done according to procedure described by Umaru *et al*. (2020) with slight modifications. Approximately 100 g of silica gel 60 (0.063 – 0.020 mm) (700 – 230 mesh ASTM) was placed in a beaker and hexane (1:2 wt/vol) was added and stirred until slurry was formed. The slurry was poured through a funnel into a glass column (4 cm x 50 cm). The packed column was covered with a cork and allow standing for 24 h before use. Approximately 10 g of sample was placed in a beaker and 9 g of silica was added and mixed until a uniform mixture is obtained. The mixture was then loaded into the column. Approximately 200 ml of each solvent system was used as eluting solvent. Fractions of 10 ml was collected in test tubes. A total of 5 solvent systems (Hexane, DCM, $CHCl_3$, EA and methanol) were used in different combinations and ratios.

Chromatotron

The chromatotron is a preparative, centrifugally accelerated, radial, thin-layer chromatograph designed by the authors of the Compendium of Organic Synthetic Methods. The sample to be separated is applied, as a solution, near the center of a spinning disk coated with a thin layer of sorbent. Elution by solvent forms circular bands of the

separated components which are spun off from the edge of the rotor together with solvent. A novel collection system brings the eluate to a single output tube.

Vacuum-Liquid Chromatography

Vacuum liquid chromatography is a separation technique that involves step gradient elution of compounds in which the flow of compounds is activated by vacuum. Silica gel is packed in a hard cake column (under applied vacuum that gives a compressed packing) to obtain a uniform packing. Hexane is the poured into the column and eluted under pressure then the column is allowed to dry. Sample is dissolved in a suitable solvent and then mixed with silica (in a 1:3 ratio) and allowed to dry. It is then loaded into the pre-packed column, ensuring a uniform packing, and a filter paper is placed on the sample. Successive addition of eluting solvent is done, and band of fractions are collected into several conical flasks.

Thin Layer Chromatography (TLC)

The eluents collected from column chromatography, vacuum chromatography and chromatotron were subjected to thin layer chromatography (TLC) analysis. TLC was carried out using the method described by Ahluwalia *et al*. (2005). A glass capillary tube was used to apply samples on the TLC plates (with size 6.6 x 20 cm, 5 x 20 cm) repeatedly with a spot of about 0.3 mm in diameter. The TLC plate was then placed in a rectangular glass developing chamber with its lower marked edge (1cm from the base) dipped into a developing solvent below the mark where the samples were spotted. The plates were allowed to develop to the level of upper mark (4 cm from the base) and the removed and dried. The TLC plates were then viewed directly for colored compounds, it was also viewed under UV box for UV fluorescent compound and stained with vanillin for compound that are neither visible nor UV fluorescence. Fractions containing similar characteristics were combined and dried.

Chemical Structure Elucidation (Instrument Analysis).

Gas chromatography – Mass spectrometry (GC-MS) analysis of extractives

Gas chromatography (GC) analysis of fractions that were obtained from TLC as single spot was performed using a Shimadzu GC-Mass Spectrometry model QP2010 plus, equipped with a BPX-5 column (5% phenyl polysylphenlenesiloxane) of 30 m in length, film thickness of 0.25 µm and internal diameter of 0.25 mm. the operating method was based on the method described by Kalaiselvan *et al*. (2012). Ionization energy of 70 eV was used in the electron ionization energy system of the GC-MS for detection and carrier gas, helium (99.999%) at a constant flow rate of 1 mL per min was used, 1 µL of purified sample was injected into the GC-MS using a syringe and sample was analysed using split mode with ration of 25:1. Injection temperature was set at 260 °C and the oven temperature was programmed from 60 °C with an increase of 10 °C per min, isothermal for 5 min, to 280 °C, ending with 10 min isothermal at 280 °C at 70 eV. Mass spectra was taken at a scan interval o 0.5 sec and fragments from 45 to 450 Da. By matching its average peak area to the total areas, the relative percentage quantity of each component was acquired. Compound identification was obtained by matching the retention times of the compounds and the mass spectral obtained from the library data of the corresponding compound.

Fourier Transform Infra-Red Spectrometry (FT-IR)

Fourier Transformed Infra-Red (FTIR) was performed using FTIR spectroscopy (thermos scientific, Nicolet iS10 SMART iTR) to detect the chemical bonds (functional groups) of the compounds. The operating system was based on the method described by Shalini and Sampathkumar (2012). The liquid samples were introduced into the machine and scan range was set from 400 to 4000 cm^{-1} with a resolution of 4 cm^{-1}. Characteristic of the chemical bonds was read by spectrum produced through transmittance of wavelength of light. The chemical bond in a molecule were detected by interpreting the infra-red transmittance spectrum and the functional groups of the compounds were identified based on the Table of characteristic IR absorptions published in Organic Chemistry (Janice, 2008).

Nuclear Magnetic Resonance (NMR)

Nuclear Magnetic Resonance (NMR) spectrometry was performed using JEOL JNM-ECA 500 Spectrometer. The operating system was based on the method described by Efdi *et al.* (2010). Sample was dissolved in 0.8 mL chloroform D1 ($CDCl_3$) or Acetone D6 and placed into NMR tube to a sample depth of 4 cm and the ^{1}H and ^{13}C spectra were measured at 500 MHz. Chemical shifts were reported as δ units (ppm) with tetramethysilane (TMS) as internal standard and coupling constants (J) in Hz. Integration of the ^{1}H-NMR and ^{13}C-NMR data was performed by using DELTA version 5.0.4 software by JEOL. The Identification of each ^{1}H-NMR and ^{13}C-NMR detected was based on the Table of characteristic NMR absorptions that published in Organic Chemistry (Janice, 2008) and with the guide of the possible proposed structure given by NIST library.

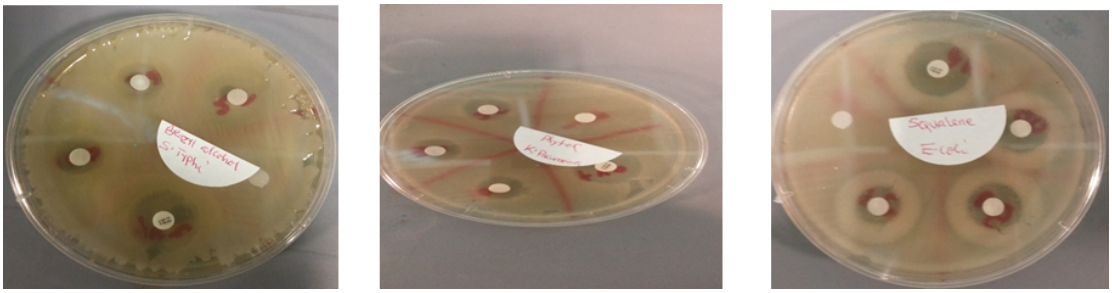
Antibacterial Assay (Determination of zone of inhibition)

Antibacterial activity of the isolated compounds was determined against three pathogenic bacterial strains EC= Escherichia coli, KP= Klebsiella pneumonia, ST= Salmonella typhi using agar disk diffusion method as reported by various authors (Prashanth *et al.,* 2006; Boyan *et al.*, 2005). The extract was dissolved using dimethyl sulfoxide (DMSO) and sterilized by filtration and stored at 4 °C until use. Standard antibiotics (Tetracycline) was used for comparison of the zone of inhibition of the pure strains of the bacteria. The isolated compounds were then screen for their antibacterial activity against the bacterial strains. Set of three dilutions for antibacterial activity (25 µg/mL, 50 µg/mL, 100 µg/mL) of the isolated compounds and standard drug (Tetracycline (30µg) was used for the study. Sterile plates containing Mueller-Hinton agar were seeded with indicator bacterial strains and control experiment using Tetracycline as standard drug were kept for 3 hrs at 37 °C. They were then incubated for 18 to 24 hrs at 37 °C, and the zones of growth inhibition around the disks were measured in mm. The antibacterial activity of the test organisms on the plant extracts were determined by measuring the diameter of the inhibitory zones on the surface of the agar around the disk, and the values <9 mm were considered as not active against the microorganism for antibacterial activity. The experiment was carried out in triplicate and the mean values of the diameter of zones of inhibition was calculated using statistical software SPSS 22.

Table 1: Antibacterial activity of isolated pure compounds

Conc. (µg/mL)		Isolated pure compounds antibacterial activity (mm)														
	B	**Control Tetracycline (30µg)**	**Benzyl alcohol (1)**	**Pyridine carboxylic acid (2)**	**2-Methoxy-4-vinyl phenol (3)**	**Phytol (4)**	**Tetracosane (5)**	**Squalene (6)**	**1-Docosanol (7)**	**Methyl biphenyl-4-Carboxylate (8)**	**Hexadecanoic acid (9)**	**Methyl salicylate (10)**	**Cinnamic acid (11)**	**Pyragallol (12)**	**Caryophyllene (13)**
25 µg/mL	*EC*	18.30±1.6	12.20±0.43	11.30±0.16	**10.4±0.05**	**10.6 ±0.43**	8.30 ±0.15	11.0 ±0.28	12.3 ±0.16	**6.30 ±0.16**	**9.00 ±0.00**	**9.40 ±0.16**	15.98±0.67	18.83±0.56	**18.28±0.8**
	KP	20.80 ±2.2	11.3 ±0.16	**0.00 ±0.00**	10.7 ±0.16	12.3±0.16	**0.00 ±0.00**	12.4±0.16	**10.10±0.03**	10.30 ±0.16	12.0 ±0.28	10.30±0.16	**15.49±0.33**	17.66±0.44	19.00±0.8
	ST	26.1 ±3.40	12.3 ±0.16	15.3 ±0.16	8.20±0.02	**0.00 ±0.00**	14.30±0.16	**8.70 ±0.16**	13.0 ±0.28	10.50 ±0.14	11.0 ±0.28	12.30±0.16	19.00±0.8	**13.00±0.80**	18.33±1.60
50 µg/mL	*EC*	18.3±0.30	11.4 ±0.10	11.0 ±0.29	14.7±0.04	11.7 ±0.16	9.00±0.29	12.3 ±0.16	15.4 ±0.15	8.30 ±0.16	10.7 ±0.18	11.30±0.16	17.98±0.67	18.64±0.89	19.33±0.3
	KP	20.8 ±2.20	14.2±0.08*	14.3 ±0.16	15.2±0.02	16.3±0.16*	13.0 ±0.07	13.3 ±0.16	10.30±0.16	11.0 ±0.28	17.3 ±0.16	11.1 ±0.05	17.32±0.58	**24.99±0.67**	20.00±0.8
	ST	26.1 ±3.40	15.4±0.15*	18.3±0.16*	15.2±0.02	13.3±0.16	11.0 ±0.28	11.0 ±0.28	12.2 ±0.06	6.50 ±0.14	15.3±0.16	12.3 ±0.16	**20.00± 0.8**	18.83±0.20	19.50±1.42
100 µg/mL	*EC*	18.32±1.6	13.2±0.06	12.4 ±0.16	16.9±0.05	11.9 ±0.28*	10.7 ±0.18	**14.4 ±0.16***	16.1 ±0.26	**14.3 ±0.16***	13.3 ±0.16	**14.8±0.19***	19.98±0.67	**24.31±0.89**	**22.75±0.3***
	KP	20.8 ±2.20	15.3±0.16	18.3±0.16*	**19.7±0.04***	14.5 ±0.14	**17.0±0.28***	12.1 ±0.24	16.3 ±0.16	12.7±0.33	16.0±0.28*	11.7 ±0.16	21.98±0.66	**27.66±0.44**	21.66±0.8
	ST	26.1 ±3.40	20.5±0.14*	**20.73±0.2***	14.7±0.04	**17.00±0.0***	13.4 ±0.15	12.3±0.16	**18.7±0.16***	14.3 ±0.07	**18.3 ±0.16***	13.3±0.15*	23.67±0.3*	20.8±0.30	22.00±0.8

Higher inhibition =*, B=Bacteria, *EC= Escherichia coli, KP= Klebsiella pneumonia, ST= Salmonella typhi*



a **b** **c**

Figure 1: Antibacterial activity of some isolated pure compounds, a. Benzyl alcohol (**1**) against *S. typhii*. b. Phytol (**2**) against *K. peumonia* and c. Squalene (**3**) against *E. coli* at 100 µg/mL, 50 µg/mL and 25 µg/mL.

Discussion

The *in vitro* antibacterial activity of isolated pure compounds of *Leptadenia hastata*, *Barringtonia asiatica* and *Barringtonia racemosa* extracts was carried out for 24 hrs culture for three selected bacteria. The bacteria used were *Salmonella typhi, Escherichia coli* and *Klebsielia pneumonea*. All the test organisms were obtained from stock cultures at Virology Laboratory, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak. Circular discs of 6 mm diameter were cut from Whatman No 1 filter paper and used throughout the test. The sensitivity of each test microorganism to the pure compounds was determined using the disc diffusion technique. The standard used was tetracycline. The growth inhibition was considered and compared based on the inhibition rate as reported and < 9 mm inhibition is considered inactive (Jan Hudzicki, 2009). The growth inhibitory concentration of the pure compounds was significantly active on all the selected pathogen.

Greater antibacterial activity was shown against *Salmonella typhi*, *Escherichia coli*, and *Klebsielia pneumonea* suggesting that the isolated compounds of *Leptadenia hastata*, *Barringtonia asiatica* and *Barringtonia racemosa* could be used in the treatment of bacteraemia infections (Table 1).

Table 1 shows the mean value of zone of inhibition of the antibacterial activity of the isolated compounds from *Leptadenia hastata*, *Barringtonia asiatica* and *Barringtonia racemosa* against the three selected bacteria. Significant activity was observed in all the fractions at 25 µg/mL, 50 µg/mL and 100 µg/mL for all the bacteria except for pyridine carboxylic acid (**2**), phytol (**4**) and tetracosane (**5**) where there was no growth inhibition observed on *Klebsielia pneumonia,* and *Salmonella typhi* at 25 µg/mL. Strong growth inhibition of benzyl alcohol (**1**) activity was observed *on Salmonella typhi* at all the concentration. Higher inhibition was observed at concentration of 100 µg/mL with inhibition zone of 20.5 ±0.14 mm and weaker inhibition zone was observed against *Klebsiellia pneumonia* with inhibition zone of 11.3 ±0.16 mm at 25 µg/mL as shown in Table 104 and Figure 138. This agrees with the report of Yano *et al*. (2016) that benzyl alcohol (**1**) reduce the number bacteria by inactivate the membrane protein of the pathogen.

Salmonella typhi was observed to be inhibited strongly by pyridine carboxylic acid (**2**) at 50 µg/mL and 100 µg/mL with inhibition zone of 18.3 ±0.16 mm and 20.73±0.20 mm, respectively. There was no inhibition observed on *Klebsielia pneumonia* at 25 µg/mL. Weaker inhibition was observed on *Escherichia coli* of 11.30 ±0.16 mm at 25 µg/mL. It was reported that pyridine carboxylic acid showed antibacterial activity against *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Bacillus pumilus* (Ali Shahhat *et al*., 2014). 2-Methoxy-4-vinylphenol (**3**) exhibited strong inhibition on *Klebsielia pneumonia* at 100 µg/mL with inhibition zone of 19.7±0.04 mm. Weaker growth inhibition was observed at 25 µg/mL of 8.20±0.02 mm against *Salmonella typhi* when compared to the control tetracycline of 26.1±3.40 mm. 2-Methoxy-4-vinylphenol (**3**) demonstrated an antibacterial activity by inhibiting the growth *in vitro* of bacterial germs (Ammar *et al*., 2012).

Phytol (**4**) showed a significant inhibition on all the bacteria. Higher growth inhibition was observed at 100 µg/mL on *Salmonella typhi* with inhibition zone of 17.0±0.00 mm, followed by 16.3±0.16 mm on *Klebsielia pneumonia* at 50 µg/mL as shown (Table 104). Lower inhibition was observed on *Escherichia coli* of 10.6 ±0.43 mm at 25 µg/mL. There was no growth inhibition by phytol (**4**) at 25 µg/mL on *Salmonella typhi*. Phytol (**4**) showed significant activity against bacteria and fungi as reported by Ghaneian *et al*. (2015). From the study it was observed that tetracosane (**5**) showed significant inhibition on all the bacterial as shown in the Table 104 except for *Klebsielia pneumonia* where zero inhibition was observed at 25 µg/mL. Higher growth inhibition was observed at 100 µg/mL of 17.0 ±0.28 mm on *Klebsielia pneumonia* and lower inhibition on *Escherichia coli* of 8.30 ±0.15 mm at 25 µg/mL when compared to the tetracycline which showed inhibition of 26.1 ±3.40 mm.

Squalene (**6**) is one of the pure compounds isolated from leaf extract of *Barringtonia racemosa* tested against the selected bacteria. The result shows a bactericidal activity of

squalene (**6**) against the growth of the test organisms (Figure 1). Higher inhibition was observed at 100 µg/mL on *Escherichia coli* with inhibition zone of 14.4 ±.16 mm. Lower inhibition was observed on *Salmonella typhi* with inhibition zone of 8.70 ±0.16 mm at 25 µg/mL when compared to the control. It is less effective when compared to the standard of inhibition where inhibition < 9 mm is considered inactive (Jan Hudzicki, 2009).

The result obtained for 1-docosanol (**7**) showed higher antibacterial activity with inhibition zone of 18.7±0.16 mm for *Salmonella typhi* at 100 µg/mL. Weaker inhibition was observed on *Klebsielia pneumonia* at 25 µg/mL of 10.10 ±0.03 mm compared to the control. 1-Docosanol was reported to display antimicrobial, anti-carcinogenic and antitumor activity (Figueiredo *et al*., 2014). Methyl biphenyl-4-carboxylate (**8**) was observed to inhibit all the selected bacteria. Higher inhibition was observed on *Escherichia coli* and *Salmonella typhi* with inhibition zone of 14.3 ±0.16 mm and 14.3 ±0.07 mm at 100 µg/mL. Low growth inhibition was observed on *Escherichia coli* at 25 µg/mL with inhibition zone of 6.30 ±0.16 mm and at 50 µg/mL of 8.30 ±0.16 mm.

Hexadecanoic acid (**9**) obtained from the crude root extract of *Barringtonia racemosa* showed bactericidal activity on all the selected bacteria *Escherichia coli*, *Klebsielia pneumonia*, *Salmonella Typhi*. Higher zone of inhibition was observed on *Salmonella typhi* at 100 µg/mL of 18.3 ±.16 mm, followed by *Klebsielia pneumonia* of 16.0±0.28 mm at 100 µg/mL and weaker inhibition on *Escherichia coli* at 25 µg/mL of 9.00±0.00 mm. Hexadecanoic acid (**9**) was reported to be used in treatment of infectious diseases commonly associated with microorganisms (Bulama *et al*., 2014).

Methyl salicylate (**10**) from the dichloromethane root crude extract of *Leptadenia hastata* exhibited significant antibacterial activity against the test organism at 25 µg/mL 50 µg/mL and 100 µg/mL Significant inhibition growth was observed against *Escherichia coli* and *Salmonella Typhi* at 100 µg/mL. With inhibition zone of 14.8 ±0.19 mm and 13.3±0.15 mm. Weaker inhibition was observed on *Escherichia coli* with inhibition zone of 9.40 ±0.16 mm at 25 µg/mL. This study agreed with the report by Monte *et al*. (2014) who reported that methyl salicylate has a significant antibacterial activity against *Escherichia coli* and *Staphylococcus aureus*.

Cinnamic acid (**11**), pyrogallol (**12**) and caryophyllene (**13**) obtained from *Barringtonia asiatica* stem bark showed higher antibacterial activity on all the selected bacteria at 100 µg/mL. Cinnamic acid (**11**) exhibited high growth of inhibition zone of 23.67±0.31 mm on *Salmonella typhi*. Pyrogallol (**12**) showed high inhibition of 27.66±0.44 mm on *Klebsiella pneumonia* and caryophyllene (**13**) exhibited high inhibition of 22.75±0.30 mm against *Escherichia coli*.

Conclusion

The antibacterial studies revealed the activity of crude extract of *Leptadenia hastata*, *Barringtonia asiatica* and *Barringtonia racemosa* on bacteria. Finding from this study showed that *Leptadenia hastata* extract showed higher zone of inhibition and higher

bactericidal activity compared to the two *Barringtonia* species. The isolated pure compounds gave significant growth inhibition on the selected pathogens. Among the isolated compound pyrogallol (**12**) was observed to give the highest inhibition against *Klebsiella pneumonia*. This is clear significance of this plant isolate that medicinal plant have chemical constituents which qualify the assumption of the potency of herbal plants of its medicinal value. However, therefore, research in this area should be focused on the optimization of chemical constituents' combinations and applications to obtain effective antimicrobial activity at sufficiently low concentrations. It could be concluded that adverse effects of herbal medicines as well as their interactions with other prescription drugs should be known to the consumers and physicians. Herbal remedies under conventional therapy are known to show many benefits to humans, which is true but one should be fully familiar with their side effects at normal and large doses considering the fact that this plants are full of numerous chemical constituents.

Conflict of Interest

We declare that we have no conflict of interest

Acknowledgement

This research work was supported by TEDFund Nigeria and ZAMALA, University of Malaysia Sarawak for post graduate study

References

Ali Shahhat, I. M., Ghazal, G. M., & Mohamed G. S. (2014). Effect of ascorbic acid and niacin on protein, oil fatty acids and antibacterial activity of Lupinus termis seeds, *International Journal of Pharmacognosy and Phytochemical Research, 6(*4), 866-873.

Ammara, I., Ennouria, M., Khemakhem, B., Yanguid, T., & Attia. H. (2012). Variation in chemical composition and biological activities of two species of Opuntia flowers at four stages of flowering, *Industrial Crops and Products, 37,* 34– 40.

Boyan, B., James, H. & Judicael, P. (2005). Principles of accessing bacterial susceptibility to antibiotics using agar diffusion method, *Journal of Antimicrobial Chemotherapy, 6,* 1295-1301.

Bulama, J., Dangoggo, S., Halilu, M., Tsaf, A. I., & Hassan, S. (2014). Isolation and characterization of palmitic acid from ethyl acetate extract of root bark of Terminalia glaucescens, *Journal of Chemical Mater Research, 6*, 140-143.

Busia, K. (2005). Medical provision in Africa – past and present, *Phytotherapy Research, 19*(11), 919-923.

Efdi, M., Fujita, S., Inuzuka, T. & Koketsu, M. (2010). Chemical studies on *Goniothalamus tapis* Miq, *Natural Product Research, 24*(7), 657-662.

Fasihuddin, B. A., Sallehuddin, N. K. N. M., & Assim, Z. (2010). Chemical constituents and antiviral study of *Goniothalamus velutinus*. *Malaysian Journal of Fundamental and Applied Sciences*, 6(1), 73-76.

Figueiredo, C. R., Matsuo, A. L., Massaoka, M. H., Girola, N., Azevedo, R. A., Rabaça, A. N., & Rodrigues, E. G. (2014). Antitumor activity of kielmeyera coriacea leaf constituents in experimental melanoma, tested in vitro and in vivo in syngeneic mice, *Advanced Pharmaceutical Bulletin, 4(Suppl* 1), 429-436.

Ghaneian, M. N., Ehrampoush, M. H., Jebali, A., Hekmatimoghaddam, S., & Mahmoudi, M. (2015). Antimicrobial activity, toxicity and stability of phytol as a novel surface disinfectant, *Environmental Health Engineering and Management Journal, 2*(1), 13-16.

Jan, H. (2016). Kirby-Bauer disk diffusion susceptibility test protocol, *American Society of Microbiology*, 2(1), 1-23.

Janice, G. S. (2008). *Key concepts - Mass spectrometry, infrared spectroscopy and nuclear magnetic resonance spectroscopy. Organic Chemistry 2nd edition.* New York, McGraw-Hill. pp. 485-525.

Kabir, M. Z., Rahman, S. M., Islam, M. R., Paul, P. K., Rahman, S., Jahan, R., & Rahmatullah, M. (2013). A review on a mangrove species from the Sunderbans, Bangladesh: Barringtonia racemosa (L.) Roxb. Am. *Eurasian Journal Sustainable Agriculture, 7*, 356-372.

Kalaiselvan, A., Gokulakrishnan, K., & Anand, T. (2012). Gas chromatography mass spectrum analysis of bioactive components of the ethanol extract of *Andrographis paniculate, Journal of Pharmaceutical and Biomedical Science*, 20(15), 1-3.

Ogbe, F. M. D., Eruogun, O. L., & Uwagboe, M. (2009). Plants used for female reproductive health care in Oredo local government area, Nigeria, *Scientific Research and Essays*, *4*(3), 120-130.

Prashanth, V. K., Chauhan, N. S., Padh, H. & Rajani, M. (2006). Search for antibacterial and antifungal agents from selected Indian medicinal plants, *Journal of Ethnopharmacology*, *107*(2), 182-188.

Sarkiyayi, S., Umaru, H. A., & Onche H. O. (2015). Anti-Inflammatory and analgesic effect of *Leptadenia hastata* on Albino rats, *American Journal of Biochemistry*, 5(2), 35-41.

Shalini, S., & Sampathkumar, P. (2012). Phytochemical screening and antimicrobial activity of plant extracts for disease management. *International Journal of Current Science,* 1(1), 209-218.

Somova, L. I., Shode, F. O., Ramnanan, P. & Nadar, A. (2003). Antihypertensive, antiatherosclerotic and antioxidant activity of triterpenoids isolated from *Olea europaea, subspecies africana* leaves. *Journal of Ethnopharmacology*, *84*(2-3), 299-305.

Umaru, I. J., Ahmed, F. B., Abdulrashid, M., & Ahmed, M. A., (2020). Extraction, isolation, characterization of caryophyllene from *Barringtonia asiatica* stem-bark extracts and Biological activity, *International Journal of Pharmacy and Biomedical Research,* 7 (1), 1-15.

Umaru, I. J., Fasihuddin A. B., & Hauwa A. U. (2019). Phytochemical screening of essential oils and antibacterial activity and antioxidant properties of *Barringtonia asiatica* (L) leaf extract. *Hindawi Biochemistry Research International Volume* 2019, Article ID 7143989, 6.

Umaru, I. J., Fasihuddin, B. A, & Hauwa, A. U. (2020). Extraction, Isolation, Characterization of the chemical constituents' compound from *Leptadenia hastata*. *International Journal of Mordern Phermaceutical Research*, 4 (1), 94-114.

Wakawa, H. Y., Ahmad, F. B., & Bin, Z. (2017). Antibacterial activity of leaves and root extracts of *Abrus precatorius*. *Journal of Medicinal Plants*, 5(6), 96-99.

World Health Organization. (2006). *The world health report 2006: Working together for health*. World Health Organization

THE JUKUN PEOPLE OF NIGERIA: A CONCEPTUAL AND ETHNOGRAPHICAL ANALYSIS OF THE COMPOSITION OF THE PEOPLE

Mordakai Sule Dansonka PhD
Department of History and Diplomatic Studies,
Federal University Wukari

Abstract

Most often, the study of the Jukun people of Nigeria revolved around the group domiciled in Wukari presenting those beyond as groups under their influence. It is this perspective that has been critically examined in this chapter on the basis of presenting the composite groups known as the Jukun. An account of the etymology of the word Jukun is carefully unfolded to give the veracity of the degree of the ethnic affinity of the group. The chapter gleans through the account of the compositions of the Jukun people of Nigeria and repositions it based on the historical processes that produced it. Adopting a historical method of data collection, oral interview inclusive, what has emerged from the analysis is that like other ethnic groups in Nigeria, Jukun was being named by their neighbour and they are not essentially define in kinship term, but on fundamental identity base on their mode of existence and cultural affinity. Jukun is a generic term which connotes cluster of groups of people with similarity in social and political institutions. The group is identified by common religious and cultural traits and the recognition of the supremacy of the Jukun paramount ruler the Aku Uka of Wukari.

Keywords: *Jukun, Ethnic group, culture, affinity and trait*

Background to the Study

History and Overview of the area of study

The area dominated by the Jukun is identified by its historical context and as such lack's homogeneous definite characteristic which other regions such as the North and South-East hold. It is located within the Guinea Savannah region of Nigeria. The significance of outlying the geographical and historical context of the area of study is to put into focus the relevant position of the Jukun in the area. The area commonly known as Middle Benue region stretches on both sides of the middle course of the river Benue from just below Lau in Taraba

State where the river Lamurde in Adamawa State joins the Benue. The western boundary runs down to Umaisha at the Confluence of the Rivers Niger and Benue. It is an area with many physical features and several heterogeneous ethnic groups. It is located between Latitudes7.0 ° and9.30 ° North and Latitudes 9.0 ° and 11.30 ° East of Meridian[1]. The region covers an area of 75,000 square kilometers. The territorial estimation of the Middle Benue region in the Nigeria State comprises Taraba, Benue, Nasarawa, Plateau and Kogi States.

The distinguishing feature of the region that gave it coherence as a historical unit was that most of the people were subjected to Jukun political and cultural influences and with the outbreak of the Jihad they were exposed to Islamic influences[2]. The Middle Benue region comprises about fourth – seventh of the area of the Northern Nigeria and covers approximately 414, 00 square kilometers[3]. The river Benue which flows from north – east to south-west passes through the Middle Benue region. The river Benue places the Jukun capital town Wukari just above thirty-five kilometers west of river Benue at Ibi town of Taraba State.

According to Charles Kingsley Meek the people of the Middle Benue region are Bantu speaking Bafun, with giant delichocephatic, Sudanese Jen, short thick-set Munshi [Tiv] and massive frame Jukun. Others include low-statures Vere and bluish looking Mumuye as well as less prognathous Bachama[4]. Tesem Makar refers to the people of the Middle Benue region as predominantly non-Muslim groups which include Jukun, Kuteb and Chamba in Wukari Division, Tiv, Itulor, Iyodor in Tiv Division, Alago, Migili or Koro, Gwandara, Eggon in Lafia Division, Gwari, Toto, Alago, Mada, Igbira in Nasarawa Division all in the Benue Plateau State.[5] Unarguably, the Middle Benue region is an area of heterogeneous ethnic groups that had direct dealings with one another and B.T. Bingel on the other hand maintained that "The Jukun have settled in the Middle Benue Basin for very long,... as far back as the 14th Century or beyond"[6] It is pertinent to indicate that this chapter is focus on identifying the identity of the Jukun.

Conceptualizing the Jukun people

The significance of onomastic in understanding the traditions of origin in historical study cannot be overemphasized. It represents one of the reference keys that language offers for detecting historical contacts, convergences and influences.[7] Many contemporary studies on the Jukun people used the terms Jukun and Kwararafa interchangeably thereby insinuating

[1]Hamman Mahmoud, *The Middle Benue region and the Sokoto Jihad 1812 – 1869: The Impact of the Establishment of the Emirate of Muri* (Kaduna: Ahmadu Bello University, Zaria), 2007, 1

[2]Hamman Mahmoud, 'The Political Economy of the Middle Benue Basin before the Jihad, C.1500 – 1812' in History Research at Ahmadu Bello University, the Post Graduate Seminar Paper of the Department of History, A.B.U, Zaria, vol.9, 1984/1985, p.1 and 33

[3]Asemanya Joshua A the *Jukun of Abinsi A Socio – Political History* (Makurdi: Aboki Publishers), 2018, 4

[4]Meek Charles Kingsley, *The Northern Tribe of Nigeria: An Ethnographical Account of Northern Province of Nigeria* together with the report on the 1921 Decennial Census Volume I (London: Oxford University press), 1925, 29

[5]Makar Tesem, 'The Relationship between the Sokoto Caliphate and the Non- Muslim Peoples of the Middle Benue region' in Usman, Y. B. (ed). *Studies in the History of the Sokoto Caliphate: The Sokoto Seminar Papers, Lagos*, Third Press International, 1979, pp.450 - 4576.

[6]Bingel, B.T, "Historical Demography of Nigerian Middle Belt A.D. 1400 – 1900: An Explanation of the role of Historical and Environmental factors in Shaping the population of Niger Province" (PhD Thesis: Department of History, Ahmadu Bello University, Zaria, 1991), 221

[7]Wazari Ibrahim Maina'The significance of Onomastic in Understanding Bole Oral Traditions of Origin and Interpreting their Migratory Proces: A Case Study of Toponyms, Anthroponyms and Hydronyms' in *Issues in History and International Studies, Essays in Honour of Professor David Sarah Momoh Koroma*, eds J.P. Dada & Armstrong Matiu Adejo (Makurdi: Aboki Publishers 2007) ,221

that it is one and the same. This is typical of some of the perception of Jukun history which is based on concepts which were not closely examined. The problem with some of the concepts associated with history is that once you accept them without examination, you get confused and junk on the study. It is imperative in this study to examine the relationship of these terms Jukun and Kwararafa and other terminology related to the study of Jukun history.

The word Jukun has its etymology. The word Jukun is an expression 'PaJukun' which is translated to mean people or human kind. Traditions among the Jukun people say that during their contact with the Hausa people, the latter demanded to know who they were. In response the Jukun said they are 'PaJukun' translated to mean human kind and 'PaJukun' later became corrupted as Jukun. Indeed, as Alubo has argued, ethnic group is a process of naming self, naming others, as well as being named by others.[8] A Jukun refers to himself and his kindred as PaJukun while other persons outside his group bore different identity.

Jukun is a generic term which connotes cluster of some groups of people. Furthermore, Sukuji classified the cluster which became known collectively as Jukun into two main groups namely the Kwararafa group and the Jibu group. The Kwararafa group comprises the Wapan and Kona. The Jibu group composes the Jibu, Kpanzon, Ichen, Yukuben, Tigon and Ndola.[9] There are thirty-seven (37) dialects that made up the cluster called Jukun.[10] It is imperative to state that, language as a fundamental instrument of communication is functionally linked to the geographical location the people lived and the differences in the Jukun dialects arose as a result of different location of the settlements of the groups.

Thus, Jukun as an ethnic group refers to people who share a common socio-cultural and political institution and spoke seemingly related language. However, the Jukun speak one form of the Jukun language known as *dandan* either of Wukari or Takum areas. There are physical symbols of common identity such as facial marks and particular peculiar clothing items associated with the Jukun.

J.H Greenberg's classification of African languages as shown below would shape our understanding of the Jukun people of Nigeria, the study classified African languages as follows:

(1) Niger-Congo Family
Kwa-sub –family
Alago
Igala

[8]Alubo Ogoh, *Ethnic Conflicts and Citizenship Crises in Central Nigeria* (Ibadan: Programme on Ethnic and Federal Studies, 2005),.5
[9]Sukuji Bako *The History of Jukun and Kwararafa Kingdom (*Kaduna: Merry – Time Association press and publishers, 1995), 35
[10]Jukun Language Development Project, Wukari, Amune press, 1982. P.43

Idoma

(2) Benue –Congo Family

a) Plateau Group
Yergam [Tarok]
Basher

b) Bantiod Group
Mambilla
Ndoro [Ndola]
Tiv
Yututure
Njwande
Abong
Bantu
Wurkum

c) Jukunoid Group
Jukun
Kporo
Ashuku
Ichen
Kpan [Ekpan or Kpanzun]
Yukuben
Kuteb

(3) Adamawa- Eastern Sub-family
Verre
Jen
Mumuye
Chamba

(4) Chadic family
Hausa
Bachama
Batta
Ankwe

Source: Greenberg, J.H, The Languages in Africa, The Hague, 1963, pp.45 -55

The area of my focus in the above language classification is the group named the Benue – Congo Family called Jukunoid. Whatever might be the reason for the classification one important ingredient is that members of this group are linguistically related. In other words, they all speak similarly related language. Greenberg was correct in his study by tracing the similarity in the languages spoken by the members of the group. My contention here is that

the unlike the other language groups classified by Greenberg, the Jukuniod group are all Jukun clans that speak different varieties of the Jukun languages. As stated above, most of the speakers of these different dialects of the Jukun language also speak the *dandan* Jukun dialects of Wukari or Takum areas.

Charles Kingsley Meek who carried out an ethnographical study of the Jukun speaking people of Nigeria states that all the members of the Jukunoid groups mentioned above claimed the same origin that is referring to the migration to Nigeria area through the Lake Chad. In addition, the various Jukun groups maintained that prior to their migration out of a central location i.e Kwararafa, all the various Jukun groups were known as Jukun and it was only after they emigrated out that they became influenced by their new environments and profession. They began to bear names that depict either their environment or profession. The complex historical reality to stress is that at Kwararafa the group was known as Jukun and it was after the great dispersal at Kwararafa and later Wukari that each became influenced by their new environment. The gist of the matter is that the Wapan, Kpanzun, Wanu, Wurbo, Kyanton (Ichen), Yukuben and others are a professional or historical phenomenon appellation of the group collectively known as Jukun.

Essentially, the definition of the Jukun as an ethnic group is subsumed to Yusufu Bala Usman's postulation that groups in most parts of Nigeria before colonial rule were not defined in kinship term but on fundamental identity tied up with their mode of existence.[11] It should be emphasized that the Jukun as an ethnic group is not essentially define in kinship term but on fundamental identity base on their mode of existence and cultural affinity. The Jukun comprised a large number of different and divergent speech communities who are socio-culturally and politically related.

At present the Jukun do not live as a corporate whole under one leadership, but scattered within the Central Nigeria area. In Plateau State the Jukun are in significant number in Wase Local Government Area where they are known as Jukun Wase. The people of Ajekamai close to Yelwa-Shendam in Shendam Local Government Area also are Jukun. In Nasarawa State the Jukun are predominantly found Akyekura, Wamba, Akiri and Awe towns. In Benue State the Jukun occupied Abinsi town in Guma Local Government Area, Adi town near Katsina-Ala and in Makurdi town around the North Bank area. Pindiga and its environs in Gombe State is dominated by the Jukun.

A larger percentage of the Jukun are found in Taraba State of Nigeria. Following the disintegration of the Jukun Empire Kwararafa, the people scattered in different groups and consequently established several settlements. They thereafter bore a professional or historical phenomenon appellation of their group or clan, hence the name Kpanzun, Ichen,

[11]Usaman Yusufu Bala, *Beyond Fairy Tales: Selected Historical Writings of Dr. YusufuBala Usman,* Zaria, (Abdullahi Smith Centre for Historical Research, 2008)58 - 59

Yukuben, Jibu, Wapan, Wanu and others. All the Jukun have cultural relevance to the institution of the Aku Uka (Jukun Supreme ruler) as the supreme spiritual and administrative leader. The King of the Jukun title Aku Uka resides in Wukari. This could explain why the concept of the Jukun is more related to those within the Wukari area. Historically, Wukari is the Successor State of the erstwhile Kwararafa Empire and no doubt about is the nucleus of the contemporary Jukunland. However, proportionally the people are scattered within the central Nigeria area and beyond with similarity in socio-cultural and political activities. The table below shows the Jukun clans and their settlements.

S/NO	CLAN	SETTLEMENTS
1	Wapan	Wukari, Dampar, Wase, Tsokundi,
2	Wanu	Abinsi, Ibi, Makurdi, Gbajimba and Tella
3	Kpanzu/Ekpan	Takum, Donga, Kumbo, Nyita, Nyite, Kente, Sondi,
4	Jibu	Serti, Bali, Takum
5	Wurbo	Gassol, Ibi, Bakundi
6	Ichen	Maraba, Didan, Maigoge, Bissaula, Gatere, Tukura, Gayama etc
7	Yukuben	Shibon, Yukuben, Barki Lisa, Lukpo, Bete, Lufu, Kapyaetc
8	Kona	Jalingo, Ardo –Kola
9	Pindiga/Gwana	Pindiga in Gombe State

Source: Akoga, N.B, Apa-Jukun History in the Benue Valley, A Portrait of Socio-Political History of Ibi from 19th to 20th Centuries, Makurdi, Oracle Business, 2012, pp.48 – 49 and Field work by the author.

Ethnographical Analysis of the Jukun

Jukun of Wukari

The Jukun of Wukari are of Wapan clan. Traditionally, Wapan males were usually seen with *apu* (a plaited hair on the upper back of the head, the front being shaved) and a loin cloth tie round just above the navel and below the chest leaving the rest of the body bare and the females dress in similar manner except that the breasts are covered. This is the main differentiating feature between the Wapan and other Jukun groups. Wukari town founded after Kwararafa broke up around the last quarter of the 17th century[12] is the main settlement of the Wapan. The administration of Wukari by the Aku Uka was structured in such a way that each of the senior officials namely Abon Acio, Abon Ziken, Kinda Acio and Kinda Ziken was responsible for the control of one or more outlying villages with which he kept in constant by means of messengers. These officials handle all matters relating to their respective areas of jurisdiction except when they felt that it was necessary to refer particular matter to the Aku Uka.[13]

[12]Hamman Mahmoud, *The Middle Benue Region and Sokoto Jihad 1812 - 1869: …* 55
[13]Charles Kingsley Meek, A *Sudanese Kingdom…* p.344

The Jukun of Dampar related closely with those of Wukari. Dampar is situated on the bank of river Benue and it is bordered on the south by both Wase and Langtang Local Government Areas of Plateau State, on the North- East by Karim- Lamido Local Government Area of Taraba State. Traditions among the people of the town believe that the town was founded after the disintegration of Kwararafa in the middle of the 15th century.[14] The tradition collected in Dampar claim that the town was founded by Ajiku the son of Agbukenjo the last king that ruled in Kwararafa.

It should be noted that, the process of selection of the Kings in Dampar is similar to what was obtainable in Wukari and other Jukun settlements of the Middle Benue region. The King was selected by the Kingmakers based on the tradition and custom of the people and the selection was done by the kingmakers headed by Kaundu Ashio an equivalent of *Abon Achuwo* in Wukari who is the head of the four-man kingmakers.

However, the remarkable thing about the selection of the king was that, the name of the new King so selected will be forwarded to the Aku Uka at Wukari for conformation and blessing. The Aku Uka after the confirming the new King would send a delegate headed by the *Abon Achuwo* to Dampar to announce his confirmation and represent him at the installation ceremony at Byeku. The submission of the name of a new king to the Aku Uka was recognition of the fact that the symbol of the authority of the Jukun Empire is embedded in the person of the Aku Uka.

Wase – Tofa is a Jukun dominated settlement about five (5) kilometers away from Wase town the Headquarters of Wase Local Government of Plateau State. It is located in the western part of Wase town. Oral tradition collected in Wase-Tofa claim that the Jukun of Wase -Tofa, Dampar and Mavo have same ancestral origin.[15] The traditional religion and other socio-political activities of the people resemble those of the Jukun of Wukari.

The Jukun of Ibi belongs to Wurbo clan. Wurbo is a Jukun word meaning meat got through bow. They were professional hunters skilled in the use of bow and arrow to hunt animals. Therefore, they were identified as the people who used bow and arrow to obtain meat.

Ibi located on the bank of the river Benue was founded by Jukun who originally called it *Nubi* (translated to mean water bank).[16] During the expansion of the territories of the Emirates of Bauchi, Gombe and Muri to Jukunland, Ibi was one of the towns that were subdued by the Jihadists. The town and its aborigines submitted to a slave of the Emir of Gombe named Bula. Later Bula revolted against his master and offered his services to the Emir of Muri Hammadu.[17] The emirates were interested in Ibi because it was located at a strategic position where goods from the other Jukun communities passed to the Hausa States. Many of the

[14]Zaku A. Gambo, *A Short History of Dampar*, np, 1990, p.vii
[15]Interview with Abakza, 54, civil servant, Wukari, 22/1/2020 and Haruna Pate, 56, at Wukari on 23/2/2020
[16]Interview with Samuel Tsovini Adda, 78, politician and adviser to the AkuUka, at Wukari on 12/8/2021
[17]Hamman Mahmoud *The Middle Benue region and the Sokoto Jihad*... p.130

resources from the Middle Benue region reached the Hausaland through Ibi. The Jukun Wurbo embraced Islam in large number and so inter-married with the Hausa and the Fulani people and gradually, speaks more of the Hausa language than Jukun language.

Jukun Yukuben

These groups of Jukun occupy large expand of the hills south-west of Takum Local Government Area of Taraba State. They spread from Sabon-Gida Yukuben to Bete which share border with Benue State and the Southern stretch of the area share border with Cameroun Republic. The groups under the leadership of Abe left Kwararafa during the time of the dispersal of people from Bye Pi the capital of the Kwararafa Empire.[18] It is important to mention that Abe, Aten and Katakpa feature prominently in the oral and documented history of the Jukun people, especially, their roles during the disintegration of the Kingdom.[19]

According to their traditions, Abe led these sections of the Jukun out of Bye Pi the deserted capital of Kwararafa and settled in few places before finally settling at their present abode The migrating group under Abe was called *jinjinbu Abe* (children of Abe). The mountainous area of South-western Takum Local Government Area became the habitat of the *jinjinbu Abe*.[20] It is the adulteration of the word *jinjinbu Abe* that became Yukuben as it is known today. As the *jinjinbu Abe* (Yukuben)began to spread and increased in number, prominent individuals emerged among them and assumed the position of leaders of groups. The leaders that emerged accompanied by their supporters left the group to form separate settlements on other hills farther away from the group. The leaders began to move farther away from one another possibly in search of fresh hunting fields. In the course of dispersing on the hilly countries of the south-western Takum, the groups were known by their leader's name. The towns founded by *jinjinbu Abe* scatter on the hills south-west of Takum Local Government Area are: Bete, Kapya, Lufu, Bibi, Lukpo, Gamga, Shibon, Nyayirim, Sabon-Gida Yukuben, Fete and others all in Takum Local Government Area. Their relation with the Jukun of Wukari is the acknowledgement of the supremacy of the Aku Uka of Wukari and their political organization is similar with that of the Jukun of Wukari. For instance, in Bete town the political ethos of the people revolves around a centralized institution headed by Ukoh Bede. However, he did not possess supreme power similar to the Aku Uka of Wukari. This is because it is only the Aku Uka of Wukari who is the custodian of the instruments that is seen as the representative of the gods among the people. Notwithstanding all other Jukun Chiefs posses' power capable of commanding respect and heading strong political oligarchy. Like the Aku Uka of Wukari, the King of Bete was followed by four powerful title holders who also served as the King makers.

[18]Oral Interview with Enoch Dauda Angaro, civil servant age 58 in Bete on 4/5/2020
[19]Meek Kingsley Meek, A *Sudanes Kingdom*...48
[20]Interview with Enoch Dauda Angaro....

A remarkable tie between the Jukun Yukuben and their kindred in the area can be gleaned in the cultural milieu via an annual festival known a *shin bossum* a festival for masquerade such as Agashi, Akuma, Ashama, Agabi. Agabi masquerade is said to be attached with fertility and barren woman who touches it has the tendency of bearing children. The masquerade appears in the public once in every four years. It should be noted that Agabi masquerade is common among the Jukun of the Middle Benue region but differs in the regalia. This may be due partly to the geography and the vegetation of the localities. In places where there was availability of palm trees, fresh palm fronts were used to dress masquerades.

Jukun -Ichen

Jukun Ichen is another cluster group that formed the Jukun ethnic group. They called themselves Etkwe but they were known by the Wapan as Kyeton. The Jukun Ichen people spread across the hills in present Donga and Kurmi Local Governments areas of Taraba State. They settled in isolated communities between whom there was no cohesion other than the bond of reverence for a common religious center at Nyivu.

Jukun of Ashuku and Nama

These communities are in Kurmi Local Government of Taraba State and the inhabitants are Jukun people. The chieftaincies in Ashuku and Nama were established by members of the royal families of Wukari. The Chiefs of these communities bore the Jukun title 'Ku' on their selection were confirmed and received magic or spiritual power to rule by the Aku of Wukari. The power confer by the Aku Uka was considered to have fertility, wealth, influence and control over nature.[21] The symbol of the power received from Wukari was an ivory bracelet embodying the power associated with royalty. The people of Ashuku and Nama have the Jukun cult of *Aku-hwa* Scholar like Elijah I Akombo refers to the phenomenon of the emergence of Jukun settlements of Ashuku and Nama as mere area of sphere of Jukun influence. It is illogical to dismiss the phenomenon that led to the establishment of chieftaincy institution and the emergence of a centralized polity as mere spread of influence. Ashuku and Nama were communities whose chieftaincies institutions were formed by person of Wukari royal house. The royal members left Wukari with the aim of establishing a State. Generally, a State or centralized community presupposes an existence of a polity with subject people who may or may not ethnically distinct from the ruler and with centralized administrative machinery through which authority is exercised. In Ashuku and Nama the rulers were from the group of the Jukun immigrants and they exercised authority over the surrounding people mainly.

The Jukun of Ashuku and Nama retained to large extent some essential parts of Jukunculture. For instance, their inheritance follows paternal principle just like the Jukun of Wukari and other places while the other ethnic group in their area it was matrilineal.

[21]Meek Charles Kingsley, *Tribal Studies in Northern Nigeria*, p.552

Jukun of Takum

The Jukun of Takum mainly belongs to Kpanzun clan. It is not clear how the term Kpanzun became a name of this group of the Jukun of Takum town and area, what is certain is that the Jukun people who migrated to Takum area possibly soon after the collapse of Kwararafa. Ashumanu Tsoho was said to lead some group of Jukun people out of Bye-Pi the capital of Kwararafa and moved to Mbarikam hills. From Mbarikam hills, they moved to Pejiji or Kunatata hills which had more fertile plains.[22]

The Jukun cults known as *Aku –hwa* and *Achu –nyade* were adopted and became an important practice of the Jukun of Takum area.[23] The Jukun constituted themselves into a structure body of leadership with the title *Kuru-kpate*. The *Kuru-kpante* in his position as the head of the Jukun people of Takum recognized the suzerainty of the Aku Uka of Wukari from whom he received the support to exercise authority in his domain.

Traditional Political Institution as a Nexus of the Jukun of Nigeria

All the Jukun of Nigeria acknowledged the Aku Uka of Wukari as a supreme leader. This is because the symbol of power that held the group together during the hay day of Kwararafa Empire was transferred to Wukari. In addition, Wukari was a Successor State of Kwararfa for that reason the various Jukun Chieftaincies that emerged after the collapse of Kwararafa acknowledged the religious and political headship of the Aku Uka of Wukari. By implication, the traditional political institution in Wukari seems to be the epicenter of the Jukun traditional institution.

The traditional administration of the Jukun of Wukari is theocratic in nature. At the head of the administration is a personage of a divine attribute known as Aku Uka. The Jukun compound word, Aku Uka literally interpreted to mean King the great. Aku is a Jukun word for King while Uka means great, therefore referring to Aku as the great king of all the Jukun. There could be other Akus in other Jukun communities but the one in Wukari is the great and exalted above all. However, there is another version which posits that Uka is the original name of the town which was corrupted as Wukari and as such Aku Uka reasonably means the King of Uka. Going by this semantics, it is a tautology as appears in many official documents to address the paramount ruler of the Jukun as the Aku Uka of Wukari. To retain the appellation the Aku Uka of Wukari the first version that says Uka means great is more tenable.

In spite of the variation in the political arrangement of the various Jukun communities which occurred partly due to environmental factor, a major common feature of the Jukun

[22]Documented separate Oral testimonies by Manu Kuru Mana Ikon Abongaby, Dahsuma Vten Mamman and Manu Adi Shiddi in respond to an interview on 8/8/1983.
[23]Saddi U. Mgbe, Know *the Story of the Kuteb*, n.p, 1973, p.6

traditional administration system is the supreme and unchallenged attribute of the King. The King of all the Jukun communities wielded ultimate political, religious and judicial authorities over the people. The Jukun practice a theocratic form of government, that is, a State governed directly by gods or through a sacerdotal class.[24] The Jukun people believe that obeying the king is obeying the gods because he is an intermediary between the people and the gods.

The Aku Uka of Wukari was seen not only as the representative of the gods, but also source of the Jukun existence through whom sufficient rainfall and bountiful harvest is secured. His decision has a divine authority and there is no appeal.[25] The Aku Uka by tradition is not accountable to any person. Ordinarily any divine kingship with unlimited power is liable to producing a despotic ruler, but in the case of the Aku Uka he was surrounded by taboos which were meant to define and restrict his powers. On the account of the taboos the Aku Uka was compelled to give due consideration to the advice of his councilors who form a patrician caste headed by Abon Achuwo.[26]

In his capacity as the Aku Uka and the supreme head, he exercised some power over other semi-independent Jukun Chieftaincies of Nigeria. Before the advent of the British and the introduction of colonial rule, all the rulers of the outlying groups such as Kona in present Jalingo area of Taraba State, Gwana in Plateau State, Awe and Akiri In present Nasarawa State and others recognized the supremacy of the Aku Uka of Wukari by sending him annual gifts such as horse, iron currency, potash and others. The gifts were a token of respect to the Aku Uka and he in return recompensed with items of more value. In most cases the Aku Uka retaliated by giving the rulers seed-corn which was believed to endowed with magical properties capable of causing bumper harvest.

The various Jukun Chieftaincies locally select their head, but the appointment received formal confirmation from the Aku Uka. This was to enable the nominee receive the sacred seed-corn and acquire the secret of the daily rituals and charms which would ensure his safety and the prosperity of himself and his people provided he observed the royal taboos. The belief in the potency of the Jukun magic bond the people together in one centralized politic.

However, the Aku Uka could order the deposition or execution of a Chief who misgoverned his Chiefdom by showing contempt for religion. The Aku Uka is likened to the Pope of Rome and the heads of the subordinate Chiefdoms to the Cardinals and Bishops.[27] Through the medium of religion the Jukun built a powerful centralized State headed by a theocratic

[24]Meek Charles Kingsley, *A Sudanese Kingdom...* p.332

[26]Atando Dauda Agbu, 'History of Leisure and Entertainment among the Jukun people of the Lower Benue valley of Nigeria, 1850 – 2000', Unpublished PhD Thesis, Department of History, Benue State University, Makurdi, 2017, p.79

[27]Meek Charse kkik. *K, A Sudanese Kingdom...* 343

personage believed to possessed superior magical power and through which they exercised control over many other ethnic groups.

Conclusion

The Jukun as seen above, like most African societies of the pre-colonial era, was a Mosaic of lineage groups, clans, villages and Chiefdoms with loose allegiance to the supreme king the Aku Uka of Wukari. The paper is an attempt to re-enforce the view that Jukun is a composite of clans of people who due to migrations were separated from one another. It was after the disintegration of Kwararafa Empire that the various groups that migrated began to bear the name that depicts either their environment or profession. At the outset of British colonial rule, the administrators and ethnographers endeavoured to classify the Jukun people, trying to create out of the Jukun what they called 'tribe'. The Jukun supreme king the Aku Uka was the sole authority and the embodiment of the culture of the people. The theory of pure tribe implying that prior to European invasion of Africa many ethnic groups were virtual strangers to one another is not tenable in the face of this study.

References

Abubakar, B, Z, *History and the Challenges to the Institution of the Aku Uka in the 21st Century*, (Jos: ltd), 2007

Abubakar, S, "Peoples of the Upper Benue Basin and the Bauchi Plateau before 1800" in Ikime Obaro (ed) *Groundwork of Nigerian History* (Ibadan: Heinemann), 1980

Adamu Anyeza Danjuma, The *Jukun and Their King* (Jos: Plateau Publishing Company Limited), 1983

Ahmed, P, et tal, *The Cross and the gods* (Jos: Capro Research Office), 1988

Akinwumi Olayemi, &Abereoran Joseph, *Shaped by Destiny: A Biography of Dr. Shekarau Angyu Masa – Ibi, The AkuUka of Wukari* (Ilorin: UniIorin Alumni Association), 1996

Asemanya Joshua.A, *The Jukun of Abinsi: A Socio – Political History* (Makurdi: Aboki Publisher), 2018

Documented separate Oral testimonies by Manu Kuru Mana Ikon Abongaby, Dahsuma Vten Mamman and Manu Adi Shiddi in Akoga Nuhu.B, Apa *Jukun History in the Benue Valley: A Portrait of Socio – Political History of Ibi from the 19th to 21st Century (*Makurdi: Oracle limited), 2012 respond to an interview on 8/8/1983.

Elijah Akombo, I, *The Genesis of the Tiv – Jukun Rivalry in Former Wukari Federation: Interrogating the Colonial Factor* (Jalingo: Macro Net Publisher), 2014

Erim O Erim *Idoma Nationality 1600 – 1900: Problems in Studying the Origins and Development of Ethnicity* (Enugu: Fourth Dimension publishers), 1981

Fari Abubakar A 'The Jukun Empire: A Reconsideration" in Maiduguri Journal of Historical Studies, Vol.1, No.1(2003)

Greenberg Joseph. H, *Languages of Africa*, Bloomington, Indiana University, 1970

Hamman Mahmoud. *The Middle Benue Region and the Sokoto Jihad 1882 – 1869: The Impact of the Establishment of the Emirate of Muri* (Kaduna: Ahmadu Belio University press), 2007

Hassan Emmanuel Lawson, 'Exploring non-conventional Evidence in the Study of Jukun Origins, migration, and Identity' in *United in Differences Disunited in Agreement: An Analysis of Peoples, Tradition, Culture, and Endless Conflict Among the Jukun of Central Nigeria*'(ed), Ukaogo Victor (Makurdi: Academic press, 2015).

Hoku A.M and Ahmadu Beavens Ajiduku, *A Conceptual Overview of the History and Culture of the Jukun People of Wukari*, 2016

Isichei Elizabeth, A *History of Nigeria* (New York: Longman, 1983)

Meek Charles Kingsley, *A Sudanese Kingdom, An Ethnographical Study of the Jukun Speaking Peoples of Nigeria* (New York: Negro University Press, 1931)

Okonkwo, U. U, &Zhema, S, Jukun – *AroRelations: A Reconsideration of Hamitic Hypothesis* (Wukari: Centre for Taraba State History and Archaeology Project, 2017)

Omagu Donald O, *A Wind of Change: Bekwarra in an age of Globalization* (Makurdi: Aboki publisher, 2012)

Oral Interview with Enoch Dauda Angaro, civil servant age 58 in Bete on 4/5/2020

Interview with Abakza, 54, civil servant, Wukari, 22/1/2020 and Haruna Pate, 56, at Wukari on 23/2/2020

Interview with Samuel Tsovini Adda, 78, politician and adviser to the AkuUka, at Wukari on 12/8/2021

Smith Edgar H, *Nigerian Harvest, A Reformed witness to Christ in Nigeria, West Africa in the twentieth century, including a detailed history of the missionary ministry of Christian Reformed Church in the Benue Province from 1940 – 1970* (Michigan: Baker Book House, 1972)

Sukuji Bako. *The History of Jukun and Kwararafa Kingdom* (Kaduna: Merry – Time Association Press, 1995)

Zaku, A. G, *A Short History of Dampar*, np, 1990

EVALUATING THE ROLE OF SOCIAL INVESTMENT PROGRAM IN ENHANCING ECONOMIC EMPOWERMENT IN BIU, BORNO STATE

[1]Ibrahim Kabiru Maji, & [2]Abdurrahman Muhammad Lele
Department of Economics,
Nigerian Army University Biu

Abstract

This study evaluates the role of social investment programs in enhancing economic empowerment in Biu Town, with a focus on initiatives aimed at poverty alleviation and community development. The study specific objectives examine the awareness of social investment programme on economic empowerment; evaluate the implementation of social investment programme, assess the impact of social investment programme in alleviating poverty. Survey research approach was conducted with purposive sampling technique in selecting the target respondents. 350 questionnaires were administered randomly to the beneficiaries and 322 questionnaires were retrieved. Frequency and percentage are used to for descriptive statistics while linear regression is used for hypothesis testing. The result revealed the presence of significant relationship between awareness of social investment programme and economic empowerment. This suggests that the social investment programme can play an important role in reducing poverty in Biu. Policy recommendation was provided also provided.

Keywords: *Evaluating, Role, Social Investment Program, Economic Empowerment*

Introduction

Social investment programs (SIPs) are designed to address poverty, unemployment, and social inequality by providing vulnerable groups with resources, skills, and financial support. These programs have proven to be effective tools for enhancing economic empowerment, particularly at the grass root level. Initiatives such as conditional cash transfers, microfinance, and skill acquisition schemes have played significant roles in

reducing poverty by targeting the most disadvantaged groups in society. According to the World Bank (2020), social protection programs, when well-designed, can significantly improve economic mobility, decrease income inequality, and provide safety nets for the poor in times of crisis.

In Nigeria, the government's Social Investment Programs (SIPs) have been pivotal in addressing poverty and unemployment, particularly through initiatives like the N-Power programme, the National Home-Grown School Feeding Programme, and the Government Enterprise and Empowerment Programme (GEEP). These interventions have had considerable impacts on economic empowerment at the grassroots level. A report by the Nigerian Bureau of Statistics (2022) indicates that over 12 million Nigerians have benefited from these programs, with notable improvements in skill acquisition and job creation. In Biu Town, the introduction of these SIPs has contributed to poverty reduction by supporting small-scale enterprises and enhancing income-generating opportunities, thus fostering sustainable economic growth in the community.

Despite the implementation of various social investment programs aimed at poverty alleviation in Nigeria, many local governments, including Biu, continue to experience high levels of poverty and economic stagnation. While program such as N-Power has been designed to enhance economic empowerment, their overall effectiveness in reducing poverty and fostering sustainable development remains questionable in certain communities. Inadequate infrastructure, limited access to financial resources, and poor program implementation have hindered the full potential of these initiatives (Olawale & Akinlo, 2021). Therefore, it is crucial to examine how these programs are impacting economic empowerment in Biu, to identify gaps and recommend measures for more effective poverty reduction strategies.

This study will contribute to the existing literature by providing a localized assessment of the effectiveness of social investment programs in enhancing economic empowerment in Biu. It will offer insights into the specific challenges and successes of these initiatives within the community, identifying gaps in program implementation and suggesting policy recommendations for improving their impact on poverty alleviation. Additionally, the findings will serve as a valuable resource for policymakers and development practitioners looking to tailor social programs to better meet the needs of marginalized populations.

Methodology

The study design

This study used a quantitative approach to assess the impact of social investment programs on economic empowerment in Biu. Quantitative data was collected through structured questionnaires administered to a representative sample of program beneficiaries, focusing on income levels, employment status, and business growth before and after participation in the programs. The population of the study was 1,644. This comprised of the one thousand one hundred and fifty-one (1151) National Conditional cash Transfer beneficiaries (NCCT), three hundred and eighty-five (385) N-power volunteers and the one hundred and eight

(108) cooks under National home-grown school feeding programme (NHGSF). On the other hand, Orodho (2014) maintained that sampling is the process of selecting a subset of cases in order to draw conclusions about the entire set. Sample size was obtained from the population using Simple Random Sampling procedure by employing the Taro Yamane's formula to determine the size.

n = N/ 1+N (e)2

Where:
n = Sample size, *N* = Total Population, *e* = Margin of error (it could be 0.10, 0.05 or 0.01)
n = 1644/ 1+1644 (0.05)2
n = 1644/ 1+1644 (0.0025)
n = 1644 / 1+4.11; n = 1644/5.11; n = 321.72; thus, n = 322 (approximately)
A total number of three hundred and twenty-two (322) questionnaire copies were distributed.

Study location and Instrument of data collection
Biu is a town located in the southern part of Borno State, northeastern Nigeria. It is the largest town in the Biu Local Government Area and sits at an elevation of about 626 meters (2,054 feet) on the Biu Plateau. The town is known for its unique topography, which consists of rocky hills and grasslands, contributing to its scenic landscape. Biu serves as a key administrative and economic center for the surrounding rural communities, with farming and livestock rearing being the main economic activities.

Questionnaire was used as the primary instrument for data collection in this study, designed to gather quantitative data from beneficiaries of social investment programs in Biu. It consists of closed-ended questions that allow for easy quantification and statistical analysis. The structured format enables the collection of consistent information regarding participants' demographics, program participation history, perceived impacts on income, employment status, and overall economic empowerment (Dillman et al., 2014). To ensure the reliability and validity of the questionnaire, a pilot test was conducted with a small subset of participants before the main data collection. This help refine the questions, ensuring clarity and relevance. The finalized questionnaire was administered through face-to-face interviews.

In this study, the chi-square test was employed to analyze the relationships between various demographic factors (e.g., age, gender, and education level) and the awareness of social investment programs. Via categorizing responses and computing the chi-square statistic, it would be ascertained whether specific demographic groups experience different levels of economic empowerment as a result of their participation in these programs. A significance level (usually set at $p < 0.05$) is used to determine the statistical significance of the results. This method did not only aid in understanding the impact of social investment programs but also provides insights into how different factors may influence beneficiaries' experiences.

Results and discussion

After analyzing the demographic information of the respondents which include gender, age, marital status, educational level and occupation, the awareness level of respondents was obtained and analyzed in Table 1. The collected information from respondent was on the basis of a Likert scale response ranging from strongly agree to strongly disagree (SA – SD (see table 1)). Regarding awareness of government social investment program item (1) there are 118 respondents representing 36.6%,115 representing 35.7%, 40 representing 12.4% and 9 respondents representing 2.8% respectively of the scale of strongly agree to strongly disagree. Moreover, regarding awareness of social investment program through the local government officers, 93 (28.9%) of the respondents strongly agree, 23 (7.1%) strongly disagree while the remaining percentage either agree, undecided or disagree. Other awareness information retrieved from the respondents as presented in Table 1 are social investment benefits directly from the federal government, awareness of social investment program through the media and the amount received from the social investment program.

Table 1: Awareness of social investment programme

S/N	ITEMS	SA	A	U	D	SD
1	You are aware of government social investment since 2016	118 (36.6)	115 (35.7)	40 (12.4)	40 (12.4)	9 (2.8)
2	your awareness on social investment is through your LGA desk officer	93 (28.9)	105 (31.4)	50 (15.5)	55 (17.1)	23 (7.1)
3	The social investment programme is from government	142 (44.1)	122 (37.9)	28 (8.7)	23 (7.1)	7 (2.2)
4	You are informed about social investment programme through media	121 (37.6)	144 (44.7)	25 (7.8)	20 (6.2)	12 (3.7)
5	You received social intervention of up to N30 thousand	79 (24.5)	137 (42.5)	51 (15.8)	35 (10.9)	20 (6.2)

Source: Field survey, 2022

Table 2 presents the result of social investment and economic empowerment with emphasis on beneficiaries' income, productivity, employability and access to health facilities. Regarding the question on social investment and increase in income, 103 (32%) of the beneficiaries strongly agree that the intervention has increased their income, 108 (33.5%) agree, 35 (10.9%) are neutral, 44 (13.7%) disagree and 32 (9.9%) strongly disagree. For the case of social investment and productivity, 101 (31.4%) strongly, 122 (37.9%) agree, 46 (14.3%) are indifferent, 35 (10.9%) disagree while 18 (5.6%) strongly disagree. The respondents' response on social investment and increase in employment is also presented in Table 2. 79 (24.5%) strongly agree, 12 (3.7%) strongly disagree while the remaining percentage are spread in between agree, undecided and disagree. Moreover, question on the role of social investment in improving access to health facilities has also been assessed. Out of the 322 respondents, 118 (36.6%) strongly agree that social investment has increase their access to health facilities, 14 (4.3%) strongly disagree while the remaining percentage are spread between undecided, agree and disagree.

Table 2: Social investment and economic empowerment

S/N	ITEMS	SA	A	U	D	SD
1	Social investment programme has increased your income	103 (32.0)	108 (33.5)	35 (10.9)	44 (13.7)	32 (9.9)
2	Social investment programme has increased your productivity	101 (31.4)	122 (37.9)	46 (14.3)	35 (10.9)	18 (5.6)
3	Social investment programme has increased your employability	79 (24.5)	137 (42.5)	51 (15.8)	35 (10.9)	20 (6.2)
4	Social investment programme has increased your access to health facilities	118 (36.6)	118 (36.6)	44 (13.7)	28 (8.7)	14 (4.3)

Source: Field survey, 2022

Have assessed the awareness and economic empowerment of social investment, the study proceeds to conduct hypothesis test using regression analysis and the result is presented in Table 3. The result of the relationship between social investment and economic empowerment reveals that there exist a positive and significant relationship between social investment and economic empowerment in Biu. This implies that social investment programs of government will go a long way in a reducing poverty and increasing social and economic inclusiveness in the study area. Thus, it was concluded that government social investment intervention can be leverage as a mechanism of reducing poverty in the state as a whole.

Table 3: Regression results

Model	Unstandardized Coefficients		Standardized Coefficients	T-statistics	Significance
	B	Std error	Beta		
Constant	4.594	0.335		13.727	0.000
Economic empowerment	0.328	0.034	0.471	9.564	0.000

Conclusion

This study examines the role of social investment program in enhancing economic empowerment in Biu Town, with a focus on initiatives aimed at poverty alleviation and community development. The study specific looked at the awareness of social investment programme on economic empowerment and evaluate the implementation of social investment programme along with assessment of the impact of social investment programme in alleviating poverty. Survey research method was used with purposive sampling technique in selecting the respondents. 322 out of the 350 questionnaires administered randomly to the beneficiaries were retrieved. Frequency and percentage are used to for descriptive statistics while linear regression is used for hypothesis testing. The result shows the presence of significant positive impact of social investment programme and economic empowerment. This suggests that the social investment programme can play an important role in reducing poverty in Biu. The study recommends increase social

investment programs to further reduce the number of people that are economically vulnerable in the state.

References

Aliyu, A. (2002), Restructuring of the Poverty Alleviation Activities of 116 the Federal Government of Nigeria National Poverty Eradication Programme Abuja.

Anger, B. (2000), Poverty Eradication, Millennium development Goals & sustainable Development in Nigeria. Journal of sustainable Development, 3(4), 138-141.

Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method (4th ed.). John Wiley & Sons.

Field, A. P. (2018). Discovering Statistics Using IBM SPSS Statistics (5th ed.). Sage Publications.

Nigerian Bureau of Statistics. (2022). National Social Investment Programme Report. Retrieved from NBS Website.

Olawale, F. & Akinlo, A. E. (2021). The Impact of Social Investment Programs on Poverty Alleviation in Nigeria: A Critical Review. Journal of African Economies, 30(2), 237-253.

Ogwumike, F.O. (2001) Approach of Poverty and Poverty reduction stratrirs in Nigeria. Central Bank of Nigeria Economic and Financial Review 39(4), 45-71.

Taherdoost, H. (2016). Sampling Methods in Research Methodology: How to Choose a Sampling Technique for Research. International Journal of Academic Research in Management, 5(2), 18-27.