UNIVERSITY OF LAGOS - NIGERIA

CONFERENCE ON AFRICAN DEVELOPMENT STRATEGIES

Theme:

Addressing Poverty in Africa:
Thinking Sustainability

CONFERENCE PROCEEDINGS

27TH - 28TH SEPTEMBER, 2023

CONFERENCE ON
AFRICAN DEVELOPMENT STRATEGIES

UNIVERSITY OF LAGOS, NIGERIA

THEME: Addressing Poverty in Africa: Thinking Sustainability

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

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Book of Proceedings

CONFERENCE ON AFRICAN DEVELOPMENT STRATEGIES
University of Lagos - Nigeria
Wednesday 27th - Thursday 28th September, 2023

CULTURAL HYDROLYSIS OF SUGARCANE BAGASSE FOR BIO – ETHANOL PRODUCTION

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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.

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PRODUCTION OF CATALYST USING *COCONUT* SHELL AS A SUBSTRATE FOR BIODIESEL PRODUCTION

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Abstract

Catalyst is a substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change. In this study, the effect of temperature on the percentage yield of catalyst produced, the effect of pH, Fourier Transform Infrared analysis, morphology, ash content, moisture of catalyst produced from *Coconut* shell was studied. The spectra for *Coconut* shell catalyst, shows different spectra at different wavelengths of 3339.7cm^{-1}, 2885cm^{-1}, 1684cm^{-1}, 1581.8cm^{-1}, 1151.7cm^{-1}, and 745.5cm^{-1}. 3339.7cm^{-1}associated to O-H stretching vibration of OH functional groups. Gradual decrease with increase in the concentration of K_2CO_3, optimum yield was observed at 1:6 with total yield of 84.60%. The effect of activation temperature increases the ash content of the catalyst from 500 to 700°C leading to a gradual increase in ash content from 5.4 to 9.6. Moisture content of the catalyst produced at different activation temperatures and impregnation ratios was found to decrease with increase in activation temperatures and increase with increase in impregnation ratio. Catalyst produced at higher activation temperature 700 to 900°C show a lower moisture content of 5.4 and 3.2% respectively. This work concludes that, Heterogenous catalyst can be produced from *Coconut* shell which is an agricultural waste and can be further used as catalyst for biodiesel.

Keywords: *Activation, catalyst, Coco nucifera, shell, waste*

Background to the Study

Coconut is mainly composed of lignin, cellulose and hemicelluloses (Borel et al., 2021). Increasing the rate of cellulose breakdown improves the porous structure of biochar (Li et al., 2020), whereas increasing the rate of lignin breakdown contributes to the formation of biochar with a high specific area, high FC content and fine aromatic structure (Jiang et al.,

2020). The composition of lignin, cellulose and hemicellulose in a *Coconut* shell influences the characteristics of *Coconut* shell. Kamaluddeen *et al.* (2022) studied the production of solid catalyst from carbonaceous materials. This requires careful approach so that the physical or mechanical properties of all intermediates are not destroyed. Filtration, drying, calcination, and forming rather than the batch method are recommended.

Dass *et al.* (2018) studied the morphology of catalyst produced from *Coconut* fruit shells by physical activation at 900°C. Cavities were visible on the surface of the catalyst of different sizes. The different pores suggest that these could be sites that may adsorb reactants during catalysis (Jiang & Xiao, 2020). Also, the size of the pore could be related to the different functional groups that may be present (Lee *et al.,* 2019). The nature of functional group on catalyst surface has been related to the nature of reaction that would proceed in heterogeneous catalysis (Charlotte and Bert, 2022). This work focuses on producing a heterogenous catalyst from *Coconut* shell and evaluation of heterogenous catalyst produced by physical activation from *coconut* shell.

Materials and Methods

Equipment/Apparatus

The following instruments were used for the purpose of the research which include Oven, Hot plate, muffle furnace, weighing balance, crucible, water bath glass reactor, thermometer, separating funnel, distillatory, sieve, magnetic stirrer, viscometer.

Methods

The *Coconut* shells were collected from coconut sellers in Wukari LGA, Taraba State. The *Coconut* shell was washed with tap water, sun-dried for two days and crushed to small particle size. A 500g of crushed *Coconut* shell was washed with distilled water till the wash water became colorless. It was then dried at 110°C in an oven for 8 hours to get rid of moisture and other volatiles.

Physical Activation: A 100g of pre-treated *Coconut* shell was carbonized in a crucible and at 1000°C for 2 hours. After carbonizing for 2 hours, the sample was kept in a desiccator to cool. It was ground and sieved with a 300µm sieve and Storage in airtight bottle to avoid long contact with oxygen.

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Determination of the percentage yield of Catalyst produced by physical activation ($K_2CO_3cm^3$) of *Coconut* shell.

The total yield (%) of *Coconut* shell produced by physical activation was determined after sample processing in terms of raw material mass. The dried weight, of the pre-treated and carbonized samples was determined using Metler balance and the carbon yield and calculated as

$$Y\% = \frac{W\ x\ 100}{W^{\circ}} - - - - Eq\ 1$$

Where Y = Carbon yield (%); W = final weight of catalyst prepared; W° = initial weight of the sample used in the carbonization and activation processes (Verla *et al.*, 2012).

Determination of pH of catalyst produced by physical activation of *Coconut* shell.
The pH was determined according to ASTM D3838-80 1.0g of each of the catalysts produced by physical activation of *Coconut* shell was weighed and transferred into separate 250 ml beaker and 100 ml of distilled water was added and stirred for 1 hour. The samples were allowed to stabilize and then the pH was measured using a hand-held pH meter, (Jenway 430 Model).

Determination of percentage Ash content of the produced catalyst
Ash content determination was done according to the ASTM D2866-94 method. 2g of each of *Coconut* shell catalyst was placed into separate porcelain crucible which was weighed and transferred into a preheated muffle furnace set at a temperature of 1000°C. The furnace was allowed to be burned for an hour after which the crucible and its content was transferred to a desiccator and allowed to cool. The crucible and content were reweighed, and the weight lost was recorded as the ash content of the catalyst (W_{ash}) and the % ash content (dry basis) was calculated from the equation (Verla *et al.*, 2012).
W°= initial weight of AC, W_{ash} = weight loss

$$Ash = \frac{Wash\ X\ 100}{W^{\circ}} - - - - - Eq\ 2$$

Moisture (%) of catalyst produced.
Moisture content was determined according to ASTM D2867-99. From the Catalyst produced, 1g was weighed and dried in an oven set at 110°C. The drying sample was constantly weighed at a 10 minutes' interval until a constant weight ($W_{p)}$ was obtained. The crucible and its content were retrieved and cooled in desiccator. The difference in weight was recorded and the moisture content (MC) was calculated from the equation as loss in weight on drying divided by initial weight of activated carbon multiplied by 100. (Donni *et al.*, 2005).

$$MC = \frac{Wf - Wi\ X\ 100}{Wo} - - - - Eq\ 3$$

Where Wf = weight of Carbon retrieved from the oven, Wi = weight of crucible and AC and W_o = initial dry weight of the AC sample

The Morphological studies of the Catalyst: Oven dried porous sample was mounted on an adhesive carbon tape attached to an aluminium-stub and subsequently sputter coated with platinum for 5 min in a JFC-1100 sputter coater. SEM magnification was selected at 370, 500, 1000 and 1500 (Guo *et al.,* 2010). Scanning Electron Microscope (SEM) operating at 25 kV was used to study the morphology.

Fourier Transform Infrared Analysis of Catalyst.
Catalyst was analyzed was using a PERKIN-ELMER spectrum One FT-IR spectrophotometer. Each sample was ground to fine powder and oven dried at 11°C for 2

hours and turned into pellet hydrolytically. The pellet was analyzed immediately, and the spectra produced was recorded. A pellet prepared with an equivalent quantity of pure KBr powder was used as control (Sugumaran *et al.,* 2012).

Results and Discussions

Effect of Temperature (°C) On the Yield (%) of *Coconut* Shell Catalyst.

Figure 1: shows the effect of temperature on the yield (%) of the carbonized *Coconut* shell when the temperature was varied from 500 to 900 °C at between constant concentration of catalyst and time, the result shows that the yield of catalyst decreases gradually as the temperature increases from 500 to 700°C and there was a decrease in catalyst yield from 700 to 900°C also. The optimum yield of the *Coconut* shell Catalyst observed at 500°C was 84.60%.

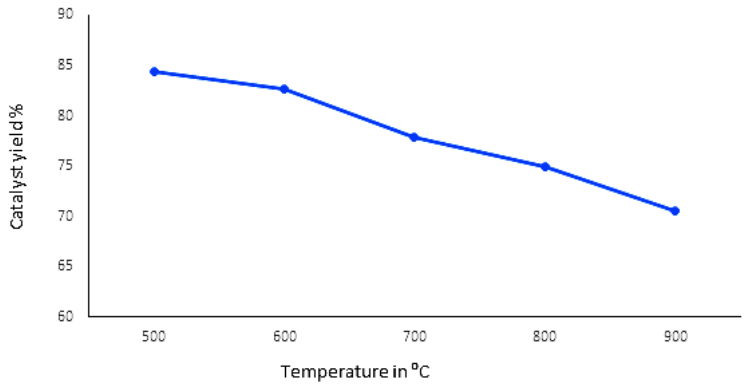

Figure 1: Effect of temperature on catalyst yield at constant impregnation ratio (gdm^3) and time

Impregnation ratio K_2CO_3 (gdm^{-3}) on the yield of Coconut shell Catalyst.

Figure 2: The impregnation ratio was varied from 3:2 to 3:10 of K_2CO_3 and the *Coconut* shell. As the impregnation ratio was increased at constant temperature and time on the carbonized *Coconut* shell, the catalyst yield decreases progressively as the impregnation ratio increases from 2 to 10 gdm^{-3}. At 8 to 10 gdm^{-3}, there was a minimal decrease in the yield of both the *Coconut* catalyst with the highest yield observed at 3: 2 with 86.63% yield. The effect of varying impregnation ratio of catalyst prepared by physical activation to potassium carbonate (K_2CO_3) at constant temperature and time, the result obtained showed a gradual decrease with an increase in the concentration of K_2CO_3. Optimum yield was observed at 1:6 (catalyst: K_2CO_3) with total yield of 76.30%. The catalyst exhibits an alkaline nature for all the catalyst prepared at different activation temperature and impregnation ratio, at 800°C with impregnation ratio of 3:6 K_2CO_3.

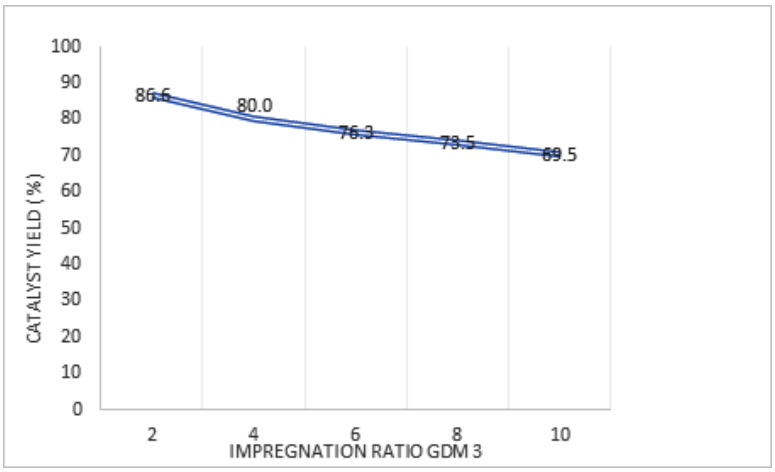

Figure 2: Effect of impregnation ratio (gdm^3) on catalyst yield at constant temperature (^oC)

Effect of Temperature Variation on pH of Catalyst

Figure 3: shows the pH of catalyst from carbonized *Coconut* shell at constant impregnation of K_2CO_3 and time. As the temperature of the reaction increases the pH increases from 9.2 to 10.8. This shows the alkalinity of the catalyst. The optimum temperature for carbonization was observed at 800°C with pH of 10.4. The pH of the catalyst was found to be 10.5. The value of pH obtained in this work is more effective because pH of catalyst obtained from lignocellulosic material is very effective at low pH than high pH (Edward *et al.,* 2014).

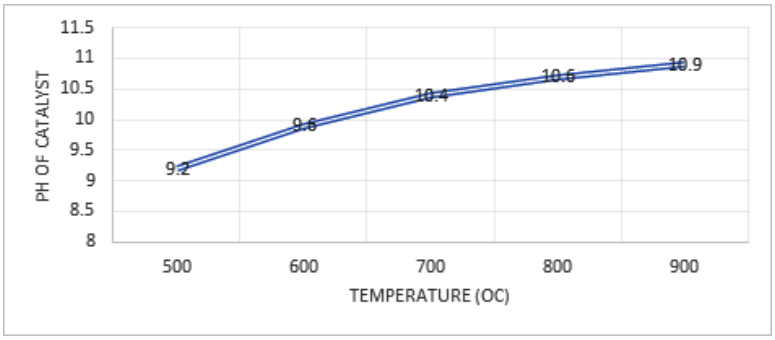

Figure 3: Effect of temperature variation on pH of catalyst at constant impregnation ratio (gdm^3) and time

Effect of various impregnation ratio (gdm^{-3}) of K_2CO_3 on pH of the catalyst

Figure 4: from the results it shows that the pH of catalyst increases with increasing concentration of K_2CO_3 this shows an increasing alkalinity of the catalyst. There was a minimal increase from 2 to 4 gdm^{-3}. The optimum pH was observed to be 10.5 at 3:6.

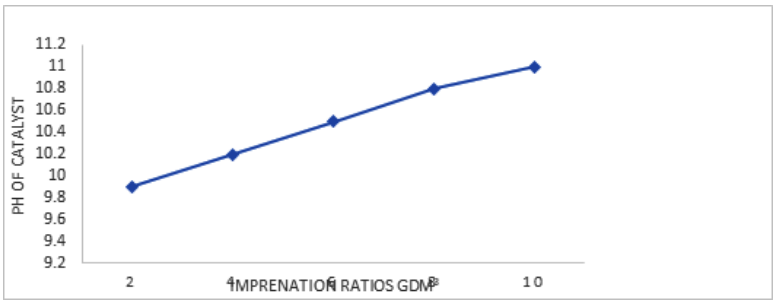

Figure 4: effect of various impregnation ratio (gdm^3) on pH of catalyst at constant temperature (°C) and time

Impact of Temperature Variation on ash Content of the Catalyst

Figure 5 shows the ash content of *Coconut* shell catalyst which was activated at different temperature range and constant concentration of K_2CO_3 and time. The effect of activation temperature increases the ash content of catalyst in both coconut shell and mahogany shell catalyst at 1000°C, catalyst activated at 500 to 700°C shows a gradual increase in ash content from 5.4 to 9.6 and as the temperature increases from 700 to 900°C the ash content increases 9.6 to 13.2 for *Coconut* shell catalyst, as the temperature increases from 700 to 900 °C the ash content was observed to be 11.2 to 15.3. The catalyst shows a lower ash content. High ash content is undesirable for catalyst since it reduces the mechanical strength of catalyst.

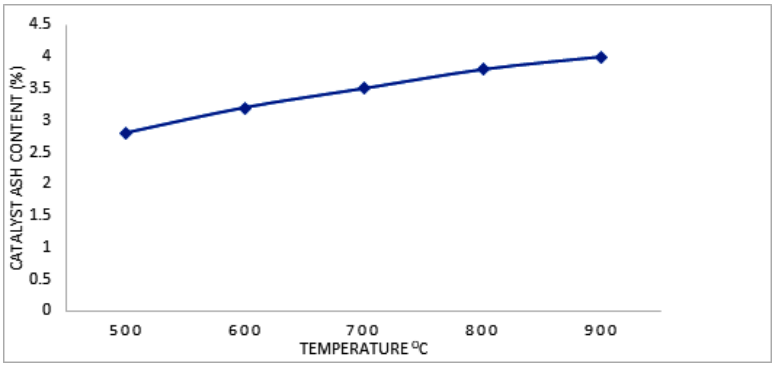

Figure 5: Growth trend of ash content of the catalyst under various temperature at constant impregnation and time

Impact of the variation of impregnation ratio on ash content of the catalyst

Figure 6: shows an increasing ash content with increasing impregnation ratio. The highest percentage ash for *Coconut* shell catalyst was observed at 3:10 with 14.8%.

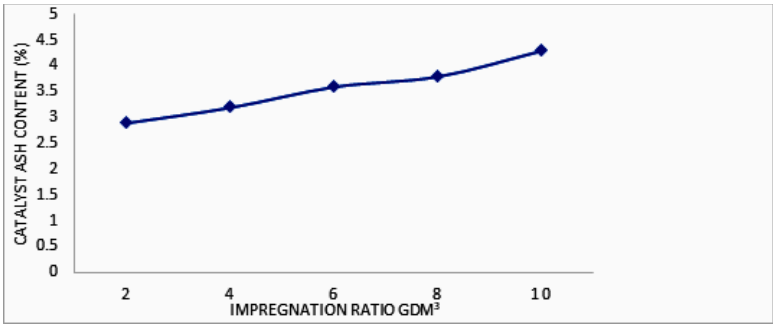

Figure 6: Growth trend of ash content of the catalyst under various impregnation ratio

Moisture Content (%) of Catalyst at Different Reaction Temperature.

Figure 7: At different reaction temperature, the moisture content of *Coconut* shell catalyst shows a significant decrease in moisture content with the lowest moisture content at 900°C with 3.2 % and the highest was 8.9 % at 500°C. Figure 8: shows a gradual increase in moisture content as the impregnation ratio increases from 2 to 10 gdm^3. Moisture content increases from 5.6 to 9.0% in the coconut shell catalyst and 4.8 to 8.9 in *Coconut* shell Catalyst. The moisture content of the catalyst produced at different activation temperatures and impregnation ratios was found to decrease with an increase in activation temperatures and increase with an increase in impregnation ratio, catalyst produced at higher activation temperature 700 to 900°C show a lower moisture content of 5.4 and 3.2% respectively. Lower moisture content increases the rate of adsorption.

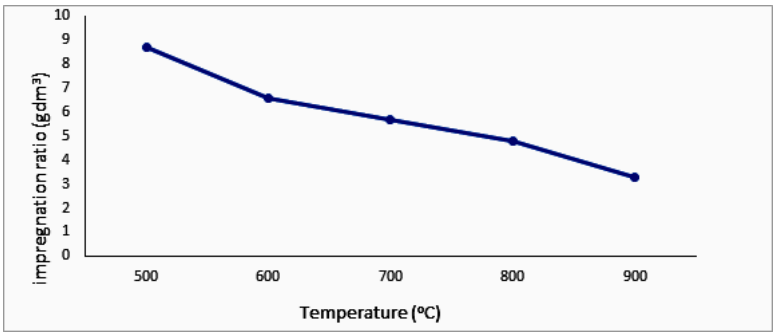

Figure 7: Moisture content of catalyst under different reaction temperature (°C) at constant impregnation ratio (gdm^3) and time (h).

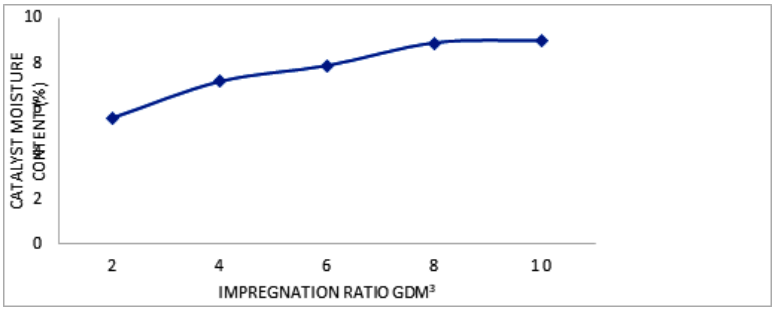

Figure 8: Moisture content of catalyst at different impregnation ratio (gdm^3), constant reaction temperature (°C) and time (h).

Morphological characterization of *Coconut* Shell Catalyst

Figure 9 and 10 shows the different morphology of physically prepared *Coconut* shell activated carbon, coconut shell catalyst produced at 800°C and 3:6 K_2CO_3 impregnation ratio. From the micrographs, it can be seen that the external surface of the carbon has some pores on the surface which indicates the porosity of activated carbon. Figure 14 shows the morphology of *Coconut* shell catalyst chemically prepared at 800°C from the scanned result, the external surface developed some cracks, crevices of honeycomb-like structure and some crystals and strands with pores scattered on the surface of the carbon. A closer look shows some pores developed on the crystals. The crystals formed on the surface are most likely the potassium compound as is hinted out by the result of the scan (Eliseo *et al.,* 2015).

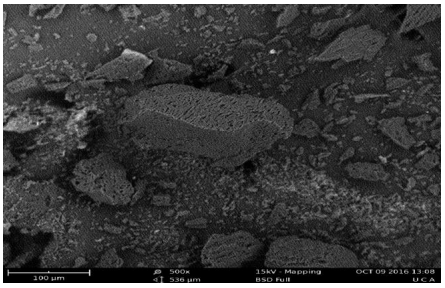

Figure 9. SEM for physically prepared *Cocos. nucifera* shell catalyst

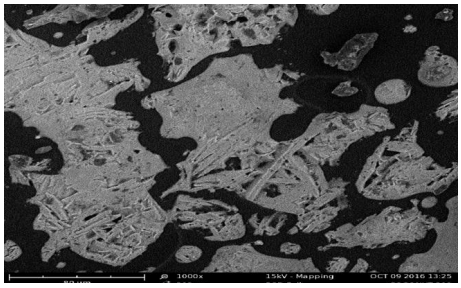

Figure 10: SEM result for *Coconut* shell catalyst produced at 800°C.

Fourier Transformed Infrared (FI-IR) for Coconut Shell Catalyst Produced at Different Activation Temperatures °C.

Fourier transform infrared (FTIR) spectroscopic analysis was used to study the surface chemistry of both physically and chemically prepared coconut shell catalyst. Figure 11 and 12 reveal the FTIR spectra of the *Coconut* shell catalyst where the peaks were slightly shifted. Figure 11 shows the spectra of physically produced *Coconut* shell catalyst with varying peaks of 3339.7cm-1 which is associated with -OH stretching, 2885.0cm-1 which corresponds to C-C stretch, weak peak at 1684.8 corresponds to C=C stretch, C=O was found at 1581.8, at 1151.7 corresponds to the stretching vibration of C-O and at 745.5cm-1 C-H was found.

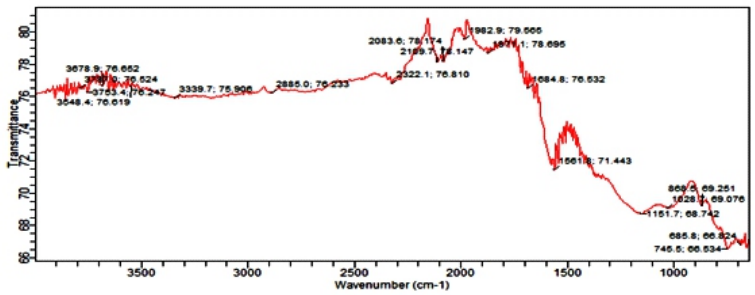

Figure 11 Fourier transform infrared (FTIR) for prepared *Coconut* shell catalyst at 700°C

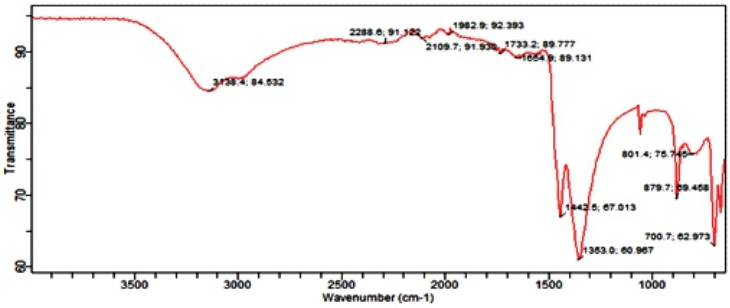

Figure 12 Fourier transform infrared (FTIR) for *Coconut* shell catalyst produced at 800°C

Conclusion

The heterogenous catalyst produced by physically activated *Coconut* shell has shown a good active site which can be used as catalyst for the production of biodiesel and other oil from plant seeds. This study serves as a tool to identify non-edible potential raw materials and to produce heterogeneous catalyst (AC supported on K_2CO_3) based on indigenous sourced raw materials for possible optimization of the bio-diesel production.

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DETERMINANTS OF PROFITABILITY IN LISTED NIGERIAN CONGLOMERATE SECTOR

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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.

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

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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:

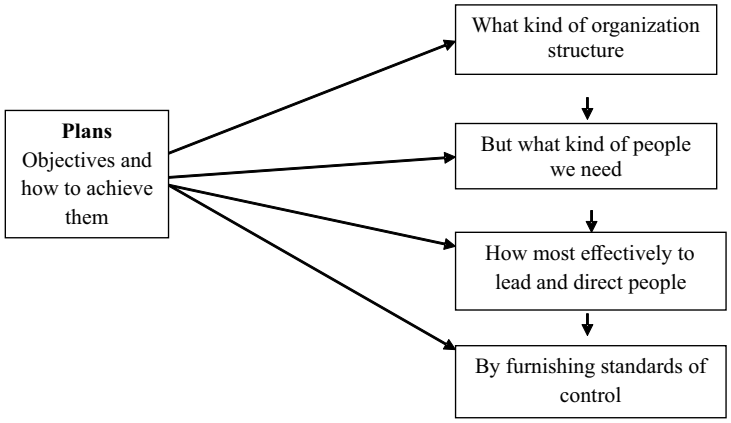

Figure: Planning precedes all managerial functions

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.

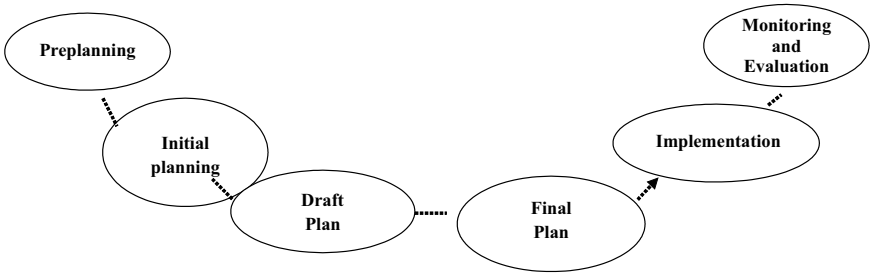

Figure 2: Basic steps in the planning process

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.

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EFFECT OF EXERCISE ON BLOOD PRESSURE AND PULSE AMONG TABLE TENNIS CLUB PLAYERS IN WUKARI, TARABA STATE, NIGERIA

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Abstract

This current research study investigated the effect of exercise on blood pressure and pulse of Table Tennis Club players in Wukari, Taraba State, Nigeria. A total of fifteen players of Wukari Table Tennis Club, Wukari, Taraba State, Nigeria was used for the purpose of this research. The equipment used for this research is Wrist Digital cs70 Sphygmomanometer. Each player was requested to relax for few minutes before the exercise and after the exercise for the measurement of his blood pressure and pulse. The cuff of the Wrist Digital Sphygmomanometer was wrapped around the left wrist. The display was placed on the palm side of the wrist. The player was asked to sit upright and ensure the blood pressure monitor was at the same height as his heart. The on/off key was clicked, and the device measured the blood pressure and pulse automatically. The results were recorded. The pulse of all the players increased after exercise. The highest increase was by 38 which represent 58% of the player's initial pulse, while the least increase was by 5 which represents 6% of the player's initial pulse. The mean pulse of all the players increased after exercise. The mean pulse of the table tennis players after exercise is statistically significant ($p<0.05$) when compared to the mean result of their pulse before exercise. The blood pressure of twelve players was within the normal range, while blood pressure of three players was high before exercise. After exercise, the blood pressure of nine players was normal, while the blood pressure of six players was high. Blood pressure of seven players

reduced after the exercise, while blood pressure of eight players increased after exercise. The mean blood pressure of all the players was normal before exercise and after exercise. The mean blood pressure of all the players increased slightly after exercise, but still within the normal range. This study showed that blood pressure may slightly increase immediately after exercise, while pulse is significantly increased by exercise. The rate of increase in pulse by exercise may differ based on individual. Blood pressure may reduce or increase in different individuals following exercise. However, blood pressure may slightly increase in more people than reducing immediately after exercise.

***Keywords**: Blood pressure, Cardiovascular disease, Exercise, Hypertension, Pulse.*

Introduction

Physical exercise is an activity presenting systematic repetitions of oriented movements feature with consequent increase on the oxygen intake due to muscular demand thus generating work (Barros *et al*., 1999). The exercise represents a subgroup of physical activity designed with the objective of maintaining the physical conditioning. Aerobic endurance exercise appears to be more effective at lowering blood pressure than other kinds of exercise, including resistance exercise (Bouchard *et al*., 1998). Any aerobic activity seems to work, including walking, jogging or cycling, although cycling seems to be the most effective (Bouchard *et al*., 1999).

Moderate intensity exercise seems to be the most effective for reducing blood pressure in hypertensive patients (Hagberg *et al*., 2000). This would be equivalent to ≈1.5 mile per day of brisk walking at an energy cost of 150 kcal per day for an average-sized person. This exercise intensity can be accomplished much easier in middle age and old hypertensive patients than more vigorous exercise can, results in less musculoskeletal injuries and cardiovascular events, and can be maintained throughout life.

Moderate aerobic exercise training would correspond to a target heart rate of 75% to 85% of HRmax, or to 65% to 75% in older individuals, to be gradually achieved and maintained throughout the training program. When possible, target HR should be determined on the basis of HRmax actually achieved during an ergometric exercise test to exhaustion, rather than on the basis of nomographic tables (220 minus age). This would avoid overestimation of the training load with respect to the actual exercise capacity/fitness level, which often is less than predicted on the basis of age-predicted maximum HR. This precaution would contribute to lessen musculoskeletal injuries and, most important, lessen exercise-induced cardiovascular events. Reductions in blood pressure are seen usually within 10 weeks after starting an exercise training program. This result could reinforce motivation in patients. However, it should be remembered that the benefits of exercise training are rapidly lost after quitting regular physical activity. Hence, patients have to be informed on this issue and be continuously encouraged to be physically active. It is important to bear in mind that exercise

therapy must be continued all life long, musculoskeletal comorbidities permitting.

There are lots of stories of many people suffering and dying as a result of blood pressure related issues. It has been noted that many are not even aware of their blood pressure status and its consequences. Due to lack of proper knowledge of hypertension and hypotension, most patients do not know they may be suffering from them until the condition becomes critical. It is currently being argued: how exercise could influence blood pressure. This warranted research into the currently study. The findings of this research will help sports men and women and the general public to know the effects of exercise on blood pressure and pulse.

Materials and Methods

Study Population and Design

This current project research study was conducted in May, 2022. A total of fifteen regular players of Wukari Table Tennis Club, Wukari, Taraba State, Nigeria was used for the purpose of this research. The players's blood pressures and pulse were checked before and after playing game.

Equipment used

The equipment used for this research is Wrist Digital cs70 Sphygmomanometer.

Determination of blood pressure and pulse

Each player was requested to relax for few minutes before the exercise and after the exercise for the measurement of his blood pressure and pulse. The cuff of the Wrist Digital Sphygmomanometer was wrapped around the left wrist. The display was placed on the palm side of the wrist. The player was asked to sit upright and ensure the blood pressure monitor was at the same height as his heart. The on/off key was clicked and the device measured the blood pressure and pulse automatically. The results were recorded.

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: Pulse in Wukari table tennis club players before and after exercise

S/N	Before exercise	After exercise	Difference between before and after exercise	Percentage difference before and after exercise (%)
1	74	97	23	31
2	89	115	26	29
3	64	87	23	36
4	71	104	33	46
5	59	64	5	8
6	71	88	17	24
7	81	86	5	6
8	87	99	12	14
9	84	106	22	26
10	64	73	9	14
11	71	109	38	54
12	102	117	15	15
13	91	104	13	14
14	60	94	34	57
15	64	73	9	14

The pulse of all the players increased after exercise. The highest increase was by 38 which represent 58% of the player's initial pulse, while the least increase was by 5 which represents 6% of the player's initial pulse.

Table 2: Mean pulse in Wukari table tennis club players before and after exercise

Parameters	Before exercise	After exercise	Difference between before and after exercise	Percentage difference before and after exercise (%)
Pulse	75.47 ± 12.91^{a}	94.40 ± 15.82^{b}	18.93 ± 10.59^{c}	25.87 ± 16.27^{d}

The mean pulse of all the players increased after exercise. The increase in mean pulse of the table tennis players after exercise is statistically significant ($p<0.05$) when compared to the mean result of their pulse before exercise.

Table 3: Blood pressure level in Wukari table tennis club players before and after exercise

S/N	Blood pre ssure before exercise (mmHg)	Remark before exercise	Blood pressure after exercise (mmHg)	Remark after exercise	Difference in blood pressure between before and after exercise (mmHg)
1	181/113	High	164/99	High	17/14
2	122/73	Normal	113/76	Normal	9/-3
3	122/80	Normal	143/85	Slightly high	-21/-5
4	136/89	Normal	157/139	High	-21/-50
5	133/80	Normal	118/86	Normal	15/-6
6	137/82	Normal	155/85	High	-18/-3
7	174/102	High	138/84	Normal	36/18
8	105/86	Normal	151/87	High	-46/-1
9	124/76	Normal	131/80	Normal	-7/-4
10	129/75	Normal	122/73	Normal	7/2
11	117/68	Normal	133/86	Normal	-16/-18
12	114/67	Normal	119/71	Normal	-5/-4
13	175/89	High	158/94	High	17/-5
14	110/72	Normal	114/67	Normal	-4/5
15	129/75	Normal	122/73	Normal	7/2

The blood pressure of twelve players was within the normal range, while blood pressure of three players was high before exercise. After exercise, the blood pressure of nine players was normal, while the blood pressure of six players was high. Blood pressure of seven players reduced after the exercise, while blood pressure of eight players increased after exercise.

Table 4: Mean blood pressure level in Wukari table tennis club players before and after exercise

Parameters	Mean blood pressure before exercise (mmHg)	Mean blood pressure after exercise (mmHg)	Remark
Blood pressure	134/82	136/86	Increased slightly after exercise. Normal

Result represents mean of results obtained (n=15).

The mean blood pressure of all the players was normal before exercise and after exercise. The mean blood pressure of all the players increased slightly after exercise, but still within the normal range.

Discussion

The pulse of all the table tennis players showed an increase after exercise. This means that it may be certain for exercise to increase pulse rate in individual. It has been reported that both surprise and stress induce physiological response: elevate heart rate substantially (Mustonen and Pantzar, 2013). Exercise may be regarded as stress to the body. The level of increase differs from one player to another. It was observed that the highest increase in a particular player was by 38 which represent 58% of the player's initial pulse, while the least increase in a player was by 5 which represents 6% of the player's initial pulse (table 1). Different research suggests that heart rate variability can be used as an accurate measure of psychological stress and may be used for an objective measurement of psychological stress (Kim *et al*., 2018). It means that the increase in the pulse rate of the players could suggest stress. The result of this study also implies that pulse rate may depend on the intensity or level of exercise or, and on individual health status.

A comparison of the mean pulse rate of the players before and after exercise showed that the mean pulse of all the players increased after exercise. The increase in mean pulse of the table tennis players after exercise is statistically significant ($p<0.05$) when compared to their mean result before exercise. The difference in the pulse means about 18, which represent about 26% of the mean pulse of the players before exercise (table 2). This significant increase in mean pulse of the players affirmed the fact that pulse rate is increased by exercise. Individuals with low pulse rate may be advised to engaged in exercise to modulate their pulse rate. The available evidence in research indicates that the normal range for resting heart rate is 50-90 beats per minute (Aladin *et al*., 2014).

Following the measurement of the blood pressure of the players, it was observed that the blood pressure of twelve players was within the normal range, while the blood pressure of three players were high before exercise (table 3). This showed that some individuals may have high blood pressure without knowing as some testified that it has been long since they checked their blood pressure. it is encouraged that people, especially the aged should frequently check their blood pressure to detect any early challenge associated with blood pressure. Exactly 80% of the players have their blood pressure within the normal range. None of the players is suffering hypotension. This is because a systolic blood pressure of less than 90 millimeters of mercury (mmHg) or diastolic of less than 60 mmHg has been reported to be generally considered as hypotension. (Flynn *et al*., 2017).

After exercise, the blood pressure of nine players was recorded to be within the normal range, while the blood pressure of six players was above the normal range. This implies that blood pressure may increase above the normal range immediately after exercise. Blood pressure of seven players reduced after the exercise, while blood pressure of eight players increased after exercise. This means that blood pressure may increase in some individuals and may reduce in some individuals immediately after exercise. Some of the result of this research supports a previous reported finding which stated that in mildly hypertensive men, short-term physical activity decreased blood pressure for 8 to 12 hours after exercise, and average blood pressure was lower on exercise days than on non-exercise days (Pescatello *et*

al., 1991). The pattern of change in blood pressure may differ from one person to another following an exercise. However, it is possible that if the players are allowed to have enough rest after the exercise, the level of change in blood pressure may differ. Out of the six players their blood pressures were high after the exercise, two already had a high blood pressure before the exercise. Their blood pressure even reduced following the exercise, though the level was still above the normal range. This supports the claim that exercise may reduce blood pressure in hypertensive patients. Some researchers have reported that along with pharmacological therapy, there is now established evidence and overall consensus in current guidelines on the effectiveness of regular physical activity in the treatment of hypertension, in combination with drug(s) therapy or even alone (Hagberg *et al.*, 2000; Whelton *et al.*, 2002; Elley and Arrol, 2005). Among the six records of high blood pressure level after exercise, three had their diastolic reading less than 90. This mean that the systolic reading was the major reading above the normal range. A comparison of the mean blood pressure of the 15 players before and after exercise showed that the blood pressure increased slightly after exercise, but still within the normal range. The mean blood pressure of all the players was normal before exercise and after exercise (table 4). This showed that exercise may not affect blood pressure of individuals negatively. However, the effect of exercise on blood pressure may differ in some individuals.

Conclusion

This study showed that blood pressure may slightly increase immediately after exercise, while pulse is significantly increased by exercise. The rate of increase in pulse by exercise may differ based on individual. Blood pressure may reduce or increase in different individuals following exercise. However, blood pressure may slightly increase in more people than reducing immediately after exercise.

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

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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.

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

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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.

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

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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.

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USING RADIATION DOSE PARAMETERS TO ASSES RADIOLOGICAL HEALTH RISK IN NASARAWA STATE, NIGERIA

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Abstract

In many developing countries like Nigeria, farmlands are contaminated by human activities like; mining, waste disposal, industrial waste, agricultural practices, use of inorganic fertilizers, sewage, sludge, and other anthropogenic activities that have affected man and the environment. In this research work, the activity concentrations of natural radionuclides, transfer factors (TF) from soil to crops, absorbed dose rate (ADR), and excess lifetime cancer risk (ELTCR) have been evaluated in soil and crop samples from twenty places in Nasarawa state, Nigeria. High purity Germanium (HpGe) detector was used to determine the activity concentration of radionuclides. The absorbed dose rate and ELTCR. The mean activity concentrations of 40K, 232Th, and 238U in the soil samples were 408.69, 24.08, and 30.71 Bq kg–1, respectively, while the average activity concentration of 40K, 232Th, and 238U in crop samples were 142.63, 46.06, and 17.45 Bqkg–1, respectively. The Raeq concentration, the external, and internal hazard indices were evaluated and ranged from 81.77 to 159.09 Bqkg–1, 0.22 to 0.43, and 0.28 to 0.53, with average values of 115.50, 0.31, and 0.40Bqkg–1, respectively. The mean TF for 40K, 232Th, and 238U of the study area were 0.053, 0.369, and 0.366, respectively. The mean for the ADR and annual outdoor effective dose equivalent in soil samples were 105.88 nGyh–1 and 0.13 mSvy–1. The mean AEDR for the study area is higher than the safety limit. The ELTCR ranged from 0.17 ×10–3 to 1.16 ×10–3, with a mean of 0.46 ×10–3. This value is above the average value approved by UNSCEAR 2000. Analysis of238Uand 232Th recorded the highest soil to crop TF compared to 40K in the area. Correlation analysis showed a strong positive correlation between activity concentration of radionuclides in soil and crop for 40K and 232Th and a weak correlation for 238U due to soil type and microbial activities in most of the study area. To

save the farmland from further pollution, organic manure should be encouraged, and instructions on the usage of inorganic fertilizer and agrochemical should be ad held strictly to avoid over-usage.

Keywords: *Radionuclide, absorbed dose, transfer factor, excess lifetime cancer risk, activity concentration.*

Background to the Study

Terrestrial and cosmogenic radiations are the major sources of radioactivity in our world today, and it has affected the soil, crops, human, air, and water (Otwama *et al.,* 2013; Yousif *et al.,* 2017). These radionuclides come from natural sources like40K, thorium, and uranium series, other sources are due to the use of radionuclides by man in agriculture, mining, medical science, manufacturers, and the use of nuclear weapons. (Yousif *et al.,* 2017). Over time, the environment is beginning to suffer negative effects from these radionuclides due to an increase in several human activities to meet up with the daily increasing need of a man in various sectors.

The soil-to-plant transfer factor (TF) is very important when it has to do with the evaluation of the radionuclide activity concentration in crops, and that of an internal and external radiation dose as a result of consumption of food crops. Radionuclide TF of different radionuclides is influenced by some factors such as the physicochemical properties of the soil, the form in which the activity enters the soil, duration of radionuclide in soil, nature of soil, kind of the crop, agricultural practices, climate condition of the area, and the way the root tubers are prepared after harvested, like peeling root crops, washing, and exposure to sunlight (Asaduzzman *et al.,* 2014; Qureshi *et al.,* 2014).The level of radionuclide deposits within the soil can predict the degree of contamination in crops planted in a polluted area based on some physicochemical parameters analyses, but it cannot inform on the health effects of radiation exposure on individuals who consume these crops that have been polluted. Hence, the evaluation of doses is typically administered in investigating the health safety of persons undergoing radiation exposure through consumption of food that has been contaminated (Qureshi *et al.,* 2014). The absorption rate of radionuclide by a human via food consumption is a function of the number of activity concentrations in crops via root uptake, and the quantity of contaminated food consumed over time which eventually deposits these radionuclides into organs and body parts, resulting in health challenges.

Nasarawa State is an agricultural state with increasing human activities and natural disasters that may have environmental pollution challenges because of the high level of mining activities within the area, use of agro-chemical, fertilizer application for agricultural purposes, indiscriminate waste disposal, and erosion. Agricultural produce like yam, maize, cassava, etc., from polluted areas, may accumulate to become an immediate source of radiation to the community if not checked (Ononugbo *et al.,* 2019). The State is rapidly growing in agriculture, industrialization, and human population (6). Hence, the knowledge of radioactivity levels ingrown food crops within the study area is extremely important to determine the dose received by humans.

Study Areas

Nasarawa State is located within the North central part of Nigeria. It is found on lat. 7° 45' and 9° 25' N of the equator, and long.7°, and 9° 37' E of the GM. The state is surrounded by many States; Kaduna State, Plateau State, Taraba State, Federal Capital Territory, Benue State, and Kogi State. The State features a total acreage of 26,875.59 Km2 and the population of people in the area according to the population census report 2006, was about 1,826,883 having a density of67persons/km2. The topography of the State is majorly hilly and plain lowlands. The climate condition of the area is typical of the Torrid Zone due to its location. The State has a high and low temperature of 81.7° F and 16.7° F respectively. The rainfall of the State ranges from 131.73 to 145cm, depending on the area.

Collection of Samples

Soil samples were collected to a depth of about 20-30 centimeters following the generally accepted method by IAEA, 2010. This is often to incorporate the surface layer like the rooting zones. The soil mixed into a uniform sample for the entire zone. A total of forty (40) samples were collected for both soil and crops sample was well.

Soil Samples

A total of twenty (20) different soil samples were collected. The topsoil samples were collected (about 20-30 cm deep) from each location. About one kilogram of soil sample was packed and put in a nylon bag tied and labeled with masking tape. The soil samples were pounded to fine particles, sieved (removing large pieces), and mixed for homogenization. The Samples were dried at about 110 °C for twenty-four hours to get a steady weight. A mass of about 0.5kgof the soil sample from each sampling point was placed using a Marinelli beaker, sealed, and stored for a period of twenty-eight days at 370C to permit secular equilibrium between parent nuclides, and daughter nuclides before using the HPGe detector.

Crop Samples

About one kilogram of every crop was collected from every location and put in nylon bags, labeled, and taken to the laboratory. These crops were collected as they mature. A total of twenty (20) food crops (yam, maize, beans, and cassava) were collected and emptied into a nylon bag, tied, and labeled. The food crop that is a tuber was first washed under running water to get rid of all the attached sand and mud particles before it was peeled and then dried in air. The Samples were further weighed and dried in the oven at about 110 °C for twenty-four hours to get constant dry weight. Samples were packed and grounded for homogenization. About 500 g of every sample were packed into one liter of Marinelli beaker and sealed for four (4) weeks to succeed in secular equilibrium between parent nuclei with their daughter nuclei. This was wiped out to permit all radionuclides and their short-lived progenies to succeed in secular radioactive equilibrium before gamma spectroscopy. Samples were placed within the HPGe detector for analysis to identify the varied energy levels within the spectrum. With the help of the detector, the activity concentrations of radionuclides were evaluated.

Estimation of Soil-to-plant Transfer Factor (TF)

The depth of soil used ranges from 20 to 25 cm to cover the rooting zone. The transfer factor (TF) was estimated using (Tuovinen *et al.,* 2011):

TFp = Activity concentration of radionuclides in plant dry matter Activity concentration of radionuclides deposit in soil dry mass (1)

Where *TFp* is the transfer factor of activity to crop.

Radiation Hazard Index

The internal and external hazard indices are defined (Alharbi and El-Taher, 2013) as;

Internal hazard index(H*int*); $H_{int} = A_k 4810 + A_u 185 + A_{Th} 259 \leq 1$ (2a)

External hazard index(H*ext*); $H_{ext} = A_k 4810 + A_u 370 + A_{Th} 259 \leq 1$ (2b)

The index is obtained from the expression of Raeqvia the idea that its highest allowed values agree with the upper limit of Raeq (370 $Bqkg^{-1}$) to limit the radiation dose of 1.5 mSv/y. The radiation hazard is considered significant only when the index value is up to one.

Dose Evaluation

Absorbed dose rate (ADR)

The ADR in the air of farmlands was evaluated, considering the effect of radiation on humans above one meter from the ground of the polluted area. The expression used was given by (UNSCEAR, 2000);

$AD\ (nGyh\text{-}^{1}) = 0.462A_u + 0.604A_{Th} + 0.0417A_k$ (3)

where A_K, A_u, and A_{Th} are the specific activities ($Bqkg^{-1}$) for ^{40}K, ^{238}U, and ^{232}Th, respectively. The conversion factors of concentration to dose are 0.0417, 0.462, and 0.604, respectively.

Annual effective dose rate (AEDR)

The yearly effective dose rate of any considered persons was estimated using the conversion coefficient from the absorbed dose rate in the air to the effective dose given as (0.7uSvy-1) and taking into consideration the outdoor occupancy factor of (0.2), therefore the indoor occupancy factor (0.8) (UNSCEAR, 2000). The outdoor AED is obtained from the expression (UNSCEAR, 2000);

Outdoors AEDR (mSvy-^{1}) = AD(nGyh-^{1}) X (8760h) X (0.7SvG-^{1}) X (0.2) (4)

Excess Lifetime Cancer Risk (ELTCR)

The ELTCR of a person living or working in a contaminated area is the probability of that person developing cancer over a lifetime considering the level of exposure to radionuclides. These determined using (Taskin, *et al.,* 2009);

*ELTCR = AED (usvy)*AL*RF* (5)

where; ELTCR is the excess lifetime cancer risk, AEDR is the annual effective dose rate, AL is the average lifetime, RF is the risk factor (0.05). The world average of ELTCR was pegged at 0.299×10^{-3}.

Statistical Analysis

Graphs of variations in the activity of crop and soil and transfer factors were plotted for the study area. Correlation analyses were also carried out between activity concentration in the

soil and the activity concentration in food samples using SPSS software to determine the extent to which the variations in activity concentration in the soil affects the variation of activity concentration in food crops using the coefficient of determination. Regression analyses were evaluated to ascertain the linearity of TF, and activity of radionuclide in soil.

Results and Discussion

Activity Concentration in Soil and Crop

The average activity concentration of ^{40}K in soil shows wide distribution from the results of the study area. The activity concentration of ^{40}K ranges from 309.4 to 569.3 $BqKg^{-1}$, with an average value of 408.7 $BqKg^{-1}$, which is a little above the world average value of 400 $BqKg^{-1}$ ^{232}Th ranges from 16.8 to 29.6 $BqKg^{-1}$,with an average value of 24.08 $BqKg^{-1}$, which is below the world average. The activity concentration for ^{238}U in the area ranges from 22.8 to 48.3 $BqKg^{-1}$, with an average value of 30.70 $BqKg^{-1}$(Table 2 and Figure 3), this is also below the world average value. The lower value of radionuclide (^{232}Th, and ^{238}U) observed in this zone could be as a result of frequent flooding and erosion as observed and complained by the farmers of the area during interactions with them. The washing away of the topsoil could also reduce the level of radionuclides in the soil.

Activity concentration of radionuclides in crops for ^{40}K ranges from 16.56 to 298.22 $BqKg^{-1}$, with an average value of 127.59 $BqKg^{-1}$. The value for 232Th ranges from 8.67 to 288.66 $BqKg^{-1}$, with an average value of 46.06 $BqKg^{-1}$, and the activity concentration of 238U ranges from 16.24 to 19.23 $BqKg^{-1}$, with an average value of 17.45 $BqKg^{-1}$(Table 3). The activity concentrations in crops were all above the safety limit for Crops in the tropical environment. This could be a result of the use of agrochemicals and fertilizers in farmland and possible contamination of crops from the environment (ambient radiation) and the type of soil (Ocheje and Wansah, 2018), Doma area has more clay soils and that could contribute to uptake by Crops (Table 1). Comparing the output of the activity concentration in soil of the area to the activity concentration in crops with the approved limit by IAEA, the crops show higher values of radionuclide absorption. This implies that the levels of radioactivity in crop samples in the study areas may pose a radiological hazard when such food is ingested directly.

Table 1: Physcio-chemical properties of agricultural soils in Nasarawa state locations

LGA	**Clay(%)**	**Silt(%)**	**Sand(%)**	**pH level**	**Organic matter (%)**
Lafia	14 - 25	20 – 35	70 - 78	5.6 – 6.8	0.48 – 1.06
Akwanga	20 - 26	32 – 41	55 - 72	5. 6 – 6.2	0.88 – 1.26
N/Eggon	8 - 10	10 – 15	74 - 82	4. 8 – 6.8	0.46 – 0.68
Doma	28 - 45	18 – 25	50 - 65	4.5 – 6.4	0.68 – 1.88

Table 2: Average activity concentration of soil sample in Nasarawa state

LGA	N	^{238}U(BqKg-1)	^{232}Th(BqKg-1)	^{40}K(BqKg-1)
Lafia	5	24.8007	16.75	309.395
Keffi	5	26.8233	22.115	569.33
N/eggon	5	22.91	27.82	389.7075
Doma	5	48.2967	29.6267	366.3375
Mean		30.7077 ± 5.92	24.0780 ± 2.92	408.6925 ± 56.14

Table 3: Average activity concentration of crop sample in Nasarawa state

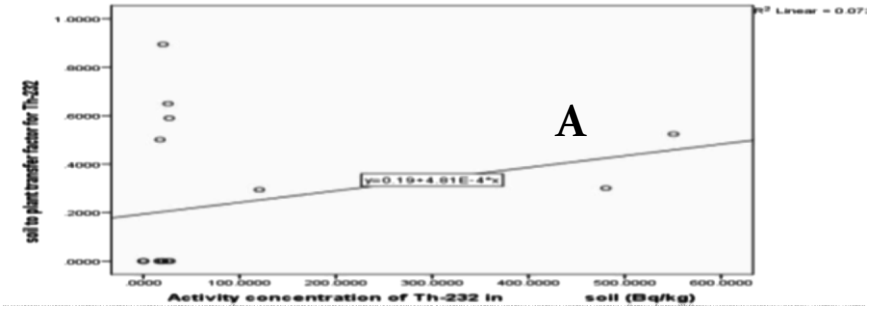
LGA	N	^{238}U(BqKg-1)crp	^{232}Th(BqKg-1)crp	^{40}K(BqKg-1)crp
Lafia	5	16.78	8.67	142.6375
Keffi	5	17.28	16.67	221.135
N/eggon	5	18.045	17.08	126.975
Doma	5	17.7	141.8	19.6
Mean		17.4513 ± 0.27	46.055 ± 31.97	127.5869 ± 41.47

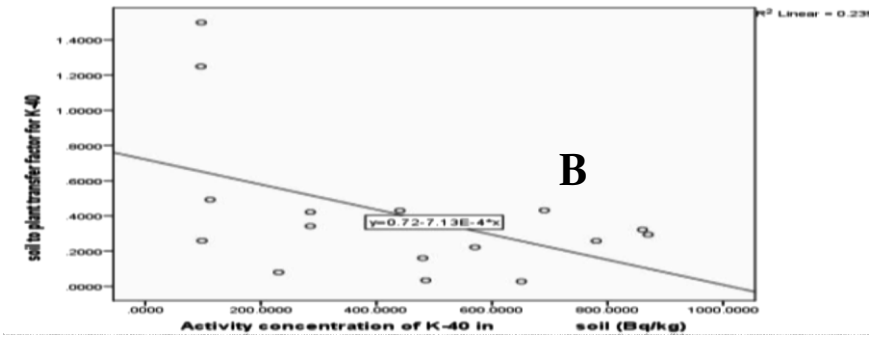
Table 4: Average Transfer factor from soil to crops of the sample area LGA

Location	TF(U)	TF(Th)	TF(K)
Lafia	0.73968	0.482202	0.329113
Keffi	0.644215	0.753787	0.388413
N/Eggon	0.453478	0.363288	0.335358
Doma	0.366485	0.369431	0.053503

Table 5: Radiological hazard indices of soil samples Nasarawa state

Locations	Absorbed dose(nGy/h)		AEDR(uSv/h)x 10^{-3}	Raeq(Bq/kg)		ELTCR (x 10^{-3})
Lafia	40.063501	0.049161922	81.7687	0.2208	0.2822	0.172066727
Keffi	50.344896	0.061778222	102.2862	0.2763	0.3487	0.216223777
N/Eggon	63.13782906	0.07747643	159.0914	0.4296	0.5261	0.271167505
Doma	269.9741547	0.331285285	118.8708	0.3211	0.4516	1.159498498
mean	105.8801± 4.9	0.1299 ± 0.07	115.5043 ± 16.39	0.3120±0.04	0.4022±0.05	0.4547 ± 0.23





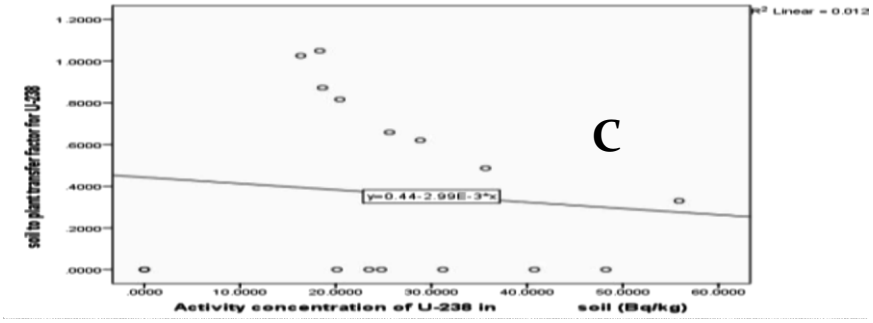


Figure 2: Regression linearity analyses of TF and activity of radionuclides (a, b and c)

Conclusion

The activity concentration in soil, and crop samples, and the TF of soil to the crop has been evaluated for 20 locations in Nasarawa state, Nigeria. The mean activity concentration of 40K, 232Th, and 238U in the soil samples were 408.69, 24.08, and 30.71 Bq kg–1, respectively, while the average activity concentration of 40K, 232Th, and 238U in crop samples were 142.63, 46.06, and 17.45 $Bqkg^{-1}$, respectively. The R_{aeq} concentration, the H_{ext}., and H_{int}. Hazard indices were estimated and ranged from 81.77 to 159.09 $Bqkg^{-1}$, 0.22 to 0.43, and 0.28 to 0.53, with average values of 115.50, 0.31, and 0.40$Bqkg^{-1}$, respectively. The average soil to crop TF for ^{40}K, ^{232}Th, and ^{238}U were 0.053, 0.369, and 0.366, respectively. The mean ADR and the mean AEDR in soil samples were 105.88 $nGyh^{-1}$ and 0.13 $mSvy^{-1}$, respectively. The mean AEDR for the study area is higher than the world average (0.07$mSvy^{-1}$) and 0.1 $mSvy^{-1}$ recommended by internal standards. The result available from this research work states that the activity concentration of radionuclides in crops is not solely a function of the number of radionuclide deposits in the soil. These imply that other factors contribute to the activity concentration of radionuclides in crops like ambient radiations, type of crops, climatic conditions, fertilizers applied directly at the root region of crops, agrochemicals used for weeding, duration of crops in soil, and the type of crop (cereal, vegetable or tubers). Hazard indexes for both the external and internal indices evaluated show no significant radiation effect on farmers working in the farmlands of the study areas.

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ASSESSMENT OF RADIONUCLIDE ACTIVITY CONCENTRATION OF CASSAVA (*MANIHOT ESCULENTA*) AND YAM (*DIOSCOREA ALATA*) OBTAINED FROM SOME FARM LANDS IN BENUE STATE, NIGERIA

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Abstract

One of the major sources of human exposure to radionuclides could be from ingestion of food crops grown on contaminated soil. This work is aimed at assessing the level of health risk associated with the intake of ^{238}U, ^{226}R, ^{232}Th and ^{40}K in yam and cassava cultivated in farm lands in Ukum local Government area of Benue State. The activity concentration of naturally occurring radionuclides in the samples, were measured using a High Purity Germanium (HPGe) Detector. The mean activity concentrations of radionuclides in yam were 2.81±0.42 Bq/kg, 1.02±0.36 Bq/kg, 0.82 ± 0.15 Bq/kg and 335.23 ± 17.20 Bq/kg for ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K respectively. Mean activity concentrations of radionuclides in cassava were 3.29±0.46 Bq/kg, 1.15±0.29 Bq/kg, 1.38 ± 0.18 Bq/kg and 272.65±14.40 Bq/kg for ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K respectively. The estimated mean values of external hazard index (Hex) and internal hazard index (Hin) were 0.08, 0.07 and 0.11, 0.08 respectively in cassava and yam respectively. The estimated mean values of gamma absorbed dose rate in yam and cassava were 15.71 nGy. y^{-1} and 13.66 nGy. y^{-1} respectively. The mean values of Annual effective dose (AED) due to consumption of cassava and yam were 0.070 μSv yr^{-1} and 0.186 μSv yr^{-1}, respectively. The mean estimated values of excess lifetime cancer risk due to consumption of cassava and yam were 0.00019 and 0.00022, respectively. The values obtained for the radiological doses for the yam and cassava samples were below the world recommended values. It is recommended that farmers should be educated to only apply the right types and quantities of fertilizers to soil in order to check further increases in concentration levels of these radionuclides in soil and plants.

***Keywords**: Activity Concentration, Radionuclides, Health Risk, Yam, Cassava.*

Background to the Study

Radioactive materials circulate through the biosphere and end up in the air, water, grasses and vegetables. Plants are therefore exposed to radioactive substances through environmental contamination and grazing on contaminated forage (Ajayi *et al.*, 2009). Most human activities include the introduction of heavy metals into a plant environment in the form of phosphate fertilizers applied on lands. Rock phosphates contain high levels of uranium, radium and thorium which can result in higher soil, outdoor air, and groundwater content of radon which is a decay product of Uranium. Radionuclides accumulated in arable soil can be incorporated metabolically into plants and eventually get transferred into the bodies of animals when contaminated forages are eaten (Qureshi *et al.,* 2014)

Indirect sources of radiation can also result from the use of well or ground water that contains radon or any. Naturally occurring radionuclides of ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K have significant contributions in the ingestion dose and are present in the biotic system of plants, animals, soil, water and air. Distribution of radionuclides in different parts of the plant depends on the chemical characteristics and several parameters of the plants and soil (Markovic and Stevovic, 2019).

Contamination of the food chain occurs as a result of direct deposition of radionuclides on the plant leaves, root uptake from contaminated soil or water, and animals ingesting contaminated plants, soil or water. Ingestion of food crops grown in contaminated soil can be a major source of human exposure to radionuclides since it can lead to internal radiation doses. Yam (*Dioscorea alata*) is a tuber commodity which is largely consumed by people living in Benue State. It is used to make different delicacies such as the common white soup and pounded yam within the study area. Cassava (*Manihot esculenta*) is a root crop that is commonly grown, and it provides a major staple food in the study area. Cassava tubers in its raw for is processed into garri and other forms of delicacies which is a common food consumed by people living in Akwa Ibom State. Since radionuclides are naturally available in soil and can also be enhanced by man through activities such as successive application of phosphate fertilizers and pesticides, mining and milling operations, burning of fossil fuels amongst others, it is therefore necessary to know the uptake of natural radionuclides by the plant from the soil (Jibril *et al.,* 2007). Some works have been done on the level of radionuclide concentration in some consumables, but not much has been done on radionuclide uptake by yam and cassava from soils in Akwa Ibom State. This work is aimed at assessing the level of health risk associated with the intake of ^{238}U, ^{226}R, ^{232}Thand ^{40}K in yam and cassava obtained from farm lands in Benue State.

Materials and Method

Study Area

The study area covered selected Local Government Areas (LGA) of Benue State. Benue State is one of the North Central states in Nigeria with a population of about 4,253,641 in 2006 census. The state derives its name from the Benue River which is the second largest river in Nigeria after the River Niger. The state borders Nasarawa State to the North; Taraba State to the East; Kogi State to the West; Enugu State to the South-West; Ebonyi and Cross River State to the South; and has an international border with Cameroon to the South-East. It is inhabited predominantly by the Tiv, Idoma and Igede. Minority ethnic groups in Benue are Etulo, Igbo, Jukun peoples etc. Its capital is Makurdi [7]. Benue is a rich agricultural region; popularly grown crops include: oranges, mangoes, sweet potatoes, cassava, soya bean, guinea corn, flax, yams, sesame, rice, groundnut and palm tree.

Sample Collection and Preparation

Sample sites were selected from cultivated farmlands in the study area. Some factors considered in selection of sample sites include: farmlands where highly-consumed crops were cultivated; and farmlands cultivated for both subsistence and small-scale commercial purposes. The type of pesticide used if any were noted, fertilizers used were also noted, whether organic or inorganic fertilizers.Plant samples collected were thoroughly washed with tap water, cassava and yam samples were peeled, and then all plant samples were washed in distilled water to remove surface sand and debris (Jwanbot *et al.,* 2013). The samples were then cut into small pieces and exposed to ambient air in a dust-free environment before being dried to a constant weight for 48 hours in a monitored oven maintained at I50^{o}C in the laboratory. The samples were then ground to powdery form, sieved and then weighed. The weight of the plant samples varied between 220g and 300g.

Method for Sample Analysis

The prepared yam and cassava samples were taken to National Institute of Radiation Protection and Research in University of Ibadan for analysis. The activity concentration of naturally occurring radionuclides in the samples were measured using a High Purity Germanium (HPGe) Detector. The HPGe used was manufactured by Canberra, model GC 8023 with serial number 9744. It is coupled to a pre amplifier, model 2002CSL with serial number 13000742. The standard source used for calibration was Multi-Gamma Ray Standard (MGS6M315). The detector has a resolution (FWHM) of 2.3Kev, ^{60}Co at 1.33Mev with relative efficiency of 80%. The software used for analysis was Genie 2K.

Activity Concentration in Samples

The activity concentration (AC) in unit of Bq kg^{-1}, for the radionuclides present in the yam and cassava samples with

$$C = \frac{N_t}{Tp_yEM} \qquad (1)$$

Where C is the activity concentration of radionuclides in Bq kg^{-1}, N_t is the net count under corresponding photo peak, T is the counting time in seconds, P_r gamma intensity of specific

gamma-ray, £ absolute efficiency, and M mass of sample in (kg), respectively. The world recommended value for AC in the samples for ^{238}U, ^{226}Ra, ^{232}Th, and ^{40}K are 35 Bq/kg, 35 Bq/kg, 30 Bq/kg and 400 Bq/kg, respectively (UNSCEAR, 2000)

Annual Effective Dose

The Annual effective dose received by the public from the consumption of the cassava and yam samples was estimated using Equation (2) (Ajayi and Adesida, 2009).

$$\text{Total AED} = {}^{\Sigma}A_i \times DCfi \times Cr \quad (2)$$

A_i(Bq/kg) is the specific activity of radionuclide i, DCf_i (mSv/Bq) is the dose conversion factor of radionuclide i, C_r (kg.yr^{-1}) is the annual consumption rate of the samples. The DCf values are 2.8×10^{-7}; 4.5×10^{-8}; 2.3×10^{-7} and 6.2×10^{-9} Sv/Bq for ^{226}Ra, ^{238}U, ^{232}Th and ^{40}K, respectively (IAEA, 1994)

Excess lifetime cancer risk (ELCR)

The excess lifetime cancer risk (ELCR) associated with the consumption of the radionuclies in the cassava and yam samples were calculated using Equation (3) (Thabayneh and Jazzar, 2012). This was to determine the potential carcinogenic effects of the long-term consumption of these samples (UNSCEAR, 2000)

$$ELCR = AED \times RF \times DL \quad (3)$$

Where AED is the annual effective dose, DL is the duration of life (55 years) and RF is the fatal cancer risk factor which is 0.05 for the public (UNSCEAR,2000). The ELCR recommended world mean value is 0.0029 (UNSCEAR,2000).

Gamma Absorbed Dose Rate (D)

The external terrestrial gamma absorbed dose rate in air was calculated by using (4) (ICRP,1994).

$$D\ (nGy.y^{-1}) = (R_K \times A_K) + (R_U \times A_U) + (R_{Th} \times A_{Th} \quad (4)$$

Were R_K (0.0414), R_U (0.462) and R_{Th} (0.604) are the conversion factors for ^{40}K, ^{238}U and ^{232}Th, respectively (ICRP, 1994). A_K, A_U and A_{Th} are the activity concentrations of ^{40}K, ^{238}U and ^{232}Th, respectively, in Bq.kg^{-1}.

External (Hex) and Internal (Hin) Hazard Indices

The external hazard index (H_{ex}) and internal hazard index (H_{in}) values were calculated using Equations (5) and (6) (ICRP, 1996). These are hazard indicators that predict the external and internal detriment of natural radiation from ^{40}K, ^{238}U and ^{232}Th.

$$H_{ex} = 0.0027A_u + 0.00386\,ATh + 0.000208\,A_k \quad (5)$$

$$H_{in} = 0.0054\,A_U + 0.00386\,A_{Th} + 0.000208\,A_k \quad (6)$$

Where A_U, A_{Th} and A_K are the activity concentrations of ^{238}U, ^{232}Th and ^{40}K in Bq.kg^{-1} respectively.

Results and Discussion

Activity Concentration in Yam and Cassava Samples

The activity concentration of ^{238}U, ^{226}Ra, ^{232}Th, and ^{40}K in the yam and cassava samples is presented in Tables 1 and 2 while the average annual consumption rates is presented in Table 3

Table 1: Activity concentration of ^{40}K, ^{226}Ra, ^{238}U and ^{232}Th in Bq.kg^{-1} for the yam samples from the Study Areas.

LGA	SAMPLE CODES	238U	232Th	90K	
Gboko	Y1	BDL	BDL	261.20±13.82	
	Y2	BDL	0.66±0.07	175.23±9.27	
	Mean	BDL	0.33±0.03	218.21±11.54	
Ukum	Y3	7.42±1.53	1.00±0.19	566.30±29.96	
	Y4	4.10±0.60	BDL	473.56±25.05	
	Y5	11.44±1.25	3.95±0.73	0.33±0.13	355.77±18.82
	Y6	BDL	2.44±1.08	1.16±0.30	371.86±19.67
	Mean	5.74±0.84	2.21±2.87	0.62±4.86	441.87±23.37
Logo	Y7	BDL	ND	3.40±0.50	381.92±20.21
	Y8	BDL	BDL	BDL	95.97±5.08

Table 2: Activity concentration of ^{40}K, ^{226}Ra, ^{238}U and ^{232}Th in Bq.kg^{-1} for the Cassava Samples from the Study Areas.

LGA	SAMPLE CODES	238U	226Ra	232Th	90K
Gboko	C1	BDL	2.02±0.66	2.16±0.28	256.57±13.57
	C2	5.72±0.98	ND	0.32±0.09	137.55±7.32
	Mean	2.86±0.49	1.01±0.33	1.24±0.18	197.06±10.44
Ukum	C3	BDL	BDL	BDL	59.70±3.16
	C4	ND	ND	2.76±0.33	583.64±30.87
	Mean	BDL	BDL	1.38±0.16	321.67±17.01
Logo	C5	10.12±1.24	ND	0.96±0.21	228.88±12.11
	C6	BDL	3.21±0.93	2.70±0.33	426.37±22.55
	Mean	5.06±0.62	1.60±0.46	1.83±0.27	327.62±17.33

BDL = Below Detection Limit, ND= not detected

Table 3: Average annual Consumption Rates of Yam and Cassava Samples from the Study Areas.

Samples	Daily Consumption (g)	Frequency per week	F (frequency/7)	Annual Rate (kg.yr^{-1})
Yam	250	2	0.28	26.00
Cassava	300	5	0.71	78.00

Radiological Health Risk Assessment of ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K in the yam and cassava Samples.

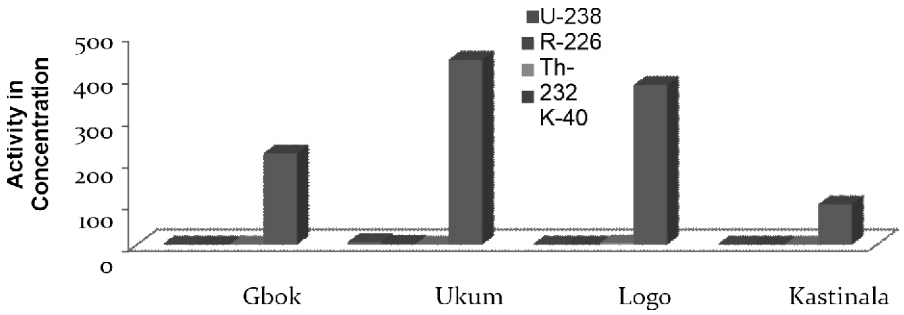
The health risk was assessed based on the estimated values of D, ELCR, Hex, Hin and Total AED for the yam and cassava samples as presented in Tables 4 and 5 respectively. Figures 1 through 8, shows the level of distribution of the various radiological doses in the yam and cassava samples.

Table 4: Estimated values of D, ELCR, Hex, Hinand Total AED for the yam samples from the study areas.

SAMPLE CODES	D (nGy.y^{-1})	ELCR	Hex	Hin	Total AED (μSv.yr^{-1})
Y1	10.84	0.00012	0.05	0.23	0.042
Y2	7.66	0.00009	0.04	0.05	0.032
Y3	27.48	0.00029	0.14	0.04	0.106
Y4	21.52	0.00027	0.11	0.16	0.099
Y5	20.21	0.00028	0.10	0.12	0.101
Y6	16.10	0.00023	0.08	0.13	0.085
Y7	17.87	0.00024	0.09	0.08	0.082
Y8	3.99	0.00004	0.02	0.09	0.016
Mean	15.71	0.00019	0.08	0.11	0.070

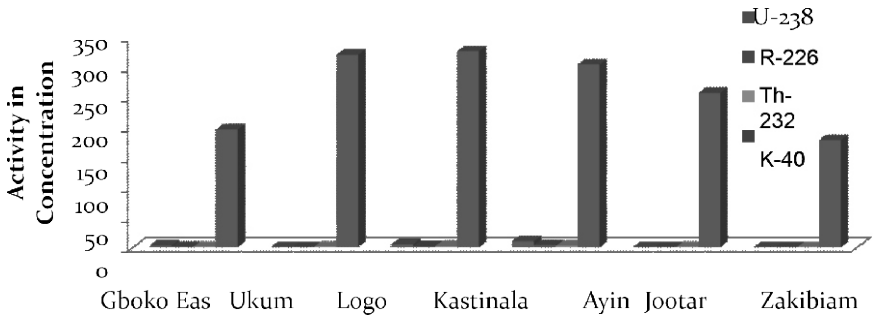
Table 5: Estimated values of D, ELCR, Hex, Hin and Total AED for the Cassava Samples from the Study Areas.

SAMPLE CODES	D (nGY.y^{-1})	ELCR	Hex	Hin	Total AED (μSv.yr^{-1})
C1	11.93	0.00057	0.06	0.02	0.207
C2	8.53	0.00026	0.04	0.06	0.093
C3	2.49	0.00008	0.01	0.06	0.030
C4	25.83	0.00091	0.13	0.01	0.332
C5	14.73	0.00045	0.08	0.13	0.164
C6	19.29	0.00089	0.10	0.10	0.325
C7	15.40	0.00068	0.08	0.10	0.249
C8	22.30	0.00101	0.12	0.11	0.369
C9	7.31	0.00026	0.04	0.15	0.096
C10	15.05	0.00051	0.08	0.04	0.184
C11	7.45	0.00024	0.04	0.08	0.088
Mean	13.66	0.00022	0.07	0.08	0.186



Study Areas

Figure 1: Distribution of the mean activity concentration in Bq.kg-1 of the yam Samples from the study areas.



Study Areas

Figure 2: Distribution of the mean activity concentration in Bq.kg-1 of the cassava Samples from the study areas.

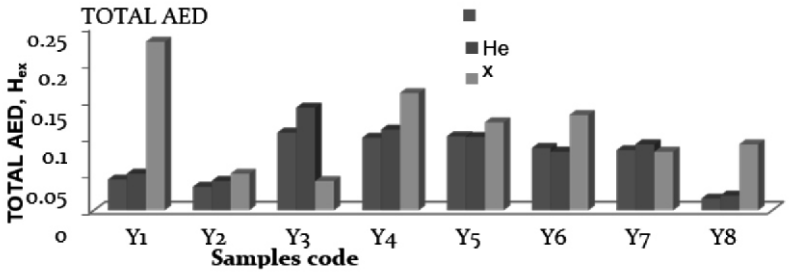


Figure 3: Distribution of the total AED (µSv.yr-1), Hex and Hin of the yam samples from the study areas.

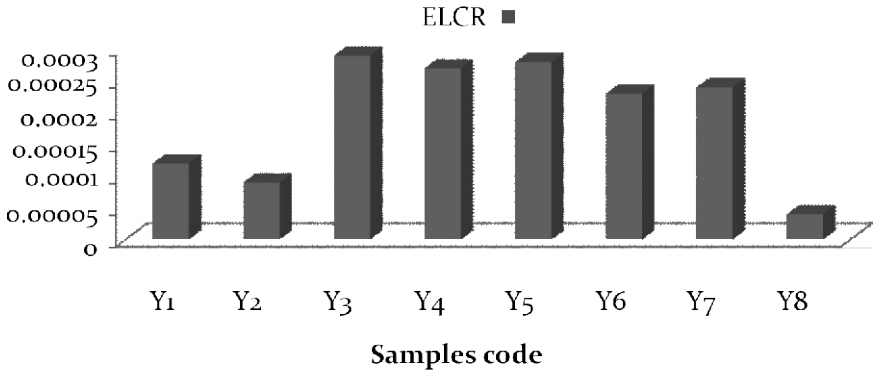


Figure 4: Distribution of the excessive life time cancer (ELCR) risk of the yam samples from the study areas.

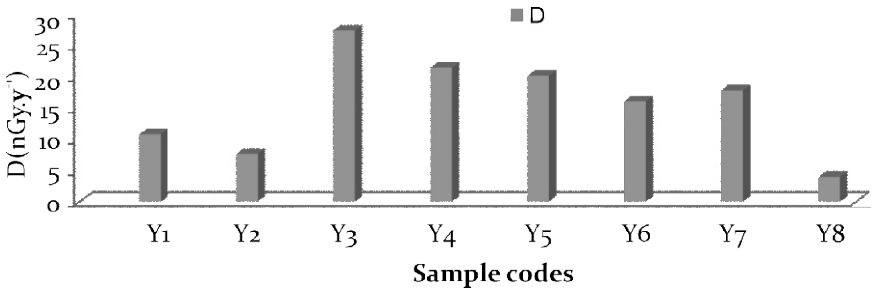


Figure 5: Distribution of the gamma dose rate (nGy.yr-1) of the yam samples from the study areas.

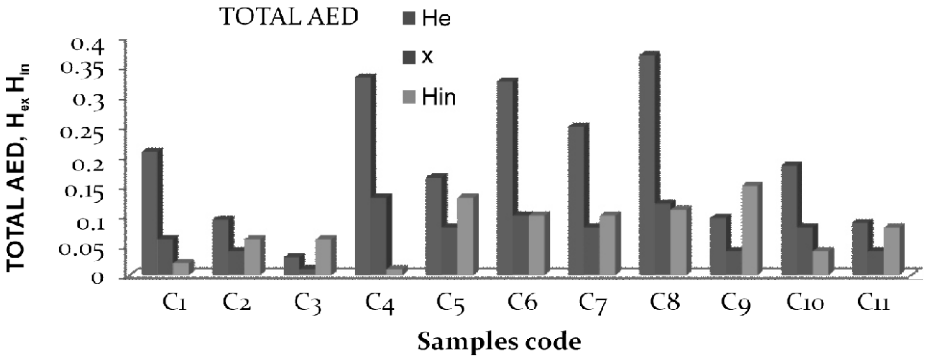


Figure 6: Distribution of the total AED (μSv.yr^{-1}), Hex and Hin of the cassava samples from the study areas.

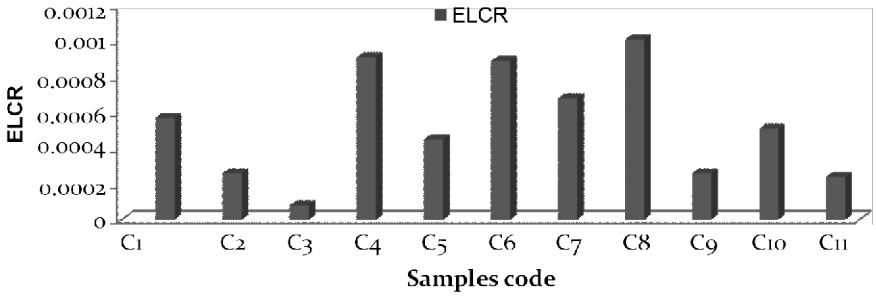


Figure 7: Distribution of the excessive life time cancer (ELCR) risk of the cassava samples from the study areas.

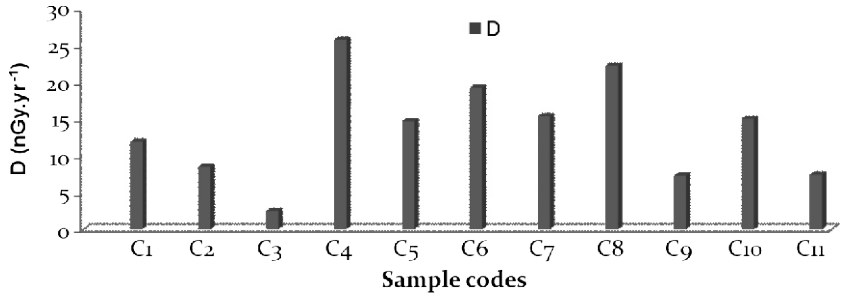


Figure 8: Distribution of the gamma dose rate (nGy.yr^{-1}) of the cassava samples from the study areas.

Discussion

The mean activity concentrations of radionuclides in yam were 2.81±0.42Bq/kg, 1.02±0.36 Bq/kg, 0.82±0.15 Bq/kg and 335.23±17.20 Bq/kg for ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K respectively. Mean activity concentrations of radionuclides in cassava were 3.29±0.46 Bq/kg, 1.15±0.29 Bq/kg, 1.38±0.18 Bq/kg and 272.65±14.40 Bq/kg for ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K respectively. Activity concentration of ^{238}U, ^{226}Ra and ^{232}Th in yam and cassava were within the permissible maximum values (UNSCEAR,2000) (UNSCEAR, 2013).

The results for radiological health risk assessment of ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K due to consumption of yam are presented in Table 4. The parameters presented are estimated values of gamma absorbed dose D, Excess lifetime cancer risk ELCR, External hazard index H_{ex}, Internal hazard index H_{in}, Annual effective dose (AED) due to consumption of yam. In yam the absorbed dose ranges from 3.99 nGy.yr^{-1} to 27.48 nGy.yr^{-1}with mean of 15.71 nGy.yr^{-1} the values are within permissible limits. Estimated values of ELCR due to consumption of yam ranged from 0.00004 to 0.00029 with a mean of 0.00019, these values are within the recommended limit of 0.0029 (UNSCEAR,2000). The distribution of the excessive life time cancer (ELCR) risk due to consumption of yam from the study area is shown in Figure 4. The estimated annual effective doses due to consumption of yam ranged from 0.016 μSv.y^{-1} to 0.106 μSv.y^{-1} with mean of 0.070 μSv.y^{-1} these values are well below the recommended reference limit. For the yam samples, H_{ex} ranged from 0.02 to 0.14 with a mean of 0.08 while H_{in} ranged from 0.04 to 0.23 with mean of 0.11 these values are all within the world reference limit of 1 (UNSCEAR, 2000).

The results for radiological health risk assessment of ^{238}U, ^{226}Ra, ^{232}Th and ^{40}K due to consumption of cassava are presented in Table 5. The parameters presented are estimated values of gamma absorbed dose D, Excess lifetime cancer risk ELCR, External hazard index H_{ex}, Internal hazard index H_{in}, Annual effective dose (AED) due to consumption of cassava. The estimated annual effective doses due to consumption of cassava ranged from 0.030 μSv.y^{-1} to 0.369 μSv.y^{-1} with a mean of 0.186 μSv.y^{-1}. These values are well below the

recommended reference limit. The H_{ex} ranged from 0.01 to 0.13 with a mean of 0.08 while the H_{in} ranged from 0.01 to 0.15 with mean of 0.08 these values are all within the world reference limit of 1. In cassava samples, the absorbed dose ranged from 2.49 nGy.yr^{-1} to 25.83 nGy.yr^{-1} with mean of 13.66 nGy.yr^{-1} the values are within permissible limits. Estimated values of ELCR due to consumption of cassava ranged from 0.00008 to 0.00091 with a mean of 0.00022, these values are within the recommended limit of 0.0029 (UNSCEAR, 2000).

Conclusion

In conclusion, the estimated values of the gamma absorbed dose rate (D), Excess lifetime cancer risk (ELCR), External hazard index (H_{ex}), Internal hazard index (H_{in}) , Annual effective dose (AED) due to consumption of yam and cassava are presented in Tables 4 and 5 respectively. The estimated mean values of absorbed dose in yam and cassava were 15.71 nGy. y^{-1} and 13.66 nGy. y^{-1} respectively. It was observed that in this study that the yam and cassava samples had absorbed dose rate lower than the world reference limit of 55 nGy. y^{1}. Mean estimated values of excess lifetime cancer risk due to consumption of cassava and yam were 0.00019 and 0.00022, respectively. All the samples had ECLR values within permissible limit of 0.0029 (UNSCEAR, 2000).

Estimated mean values of external hazard index were 0.08 and 0.07 in the cassava and yam samples respectively, these were all within the world reference value of 1. Internal hazard index estimated mean values were 0.11 and 0.08 in cassava and yam respectively, these were all also within permissible limit of 1. The mean values of Annual effective dose (AED) due to consumption of cassava and yam were 0.070 and 0.186 μSv yr^{-1}, respectively. These values are within and well below recommended reference value of 1000 μSv yr^{-1} or 1 mSv yr^{-1} (UNSCEAR, 2000).

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NEW REACTOR DESIGN FOR PHOTO-OXIDATION OF ACETONE

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Abstract

The rate of CO_2 production obtained from the photodecomposition of acetone with different loadings of TiO_2 as photocatalyst is remarkable. During this investigation, the acetone was fed at the rate of 2.8 $mmolh^{-1}$ and air flow rate was maintained at 4.3 Lh^{-1}. The reaction was carried out at near room temperature as the cold cathode lamps increased temperature very slowly to 63 ^{o}C. No CO_2 was produced either without light or catalyst indicating photocatalytic reaction. There was a proportional increase in the production of CO_2 with increase in TiO_2 loading. A maximum rate of 5.75 ± 0.07mMh^{-1} for CO_2 production was achieved with a catalyst loading of 5 mg/g_{beads}. Increasing the catalyst loading above 5 mg/g showed a decrease in CO_2 production rate which can be attributed to reduced contact between light and catalyst. This technique used here can be adopted for decomposition of various Volatile Organic Compounds (VOCs).

Keywords: *Acetone, photoreactor, photooxidation, photodecomposition*

Background to the Study

For a photocatalytic reaction, a simultaneous contact between the reactants, catalyst and light (photons) is necessary. In order to minimise the $e–/h^{+}$ recombination rate, the catalyst particles must be sufficiently small (tens of nanometres), (Liu, Zhao, Andino, & Li, 2012) which renders conventional mechanical filtration ineffective. Certain coupled catalysts such as Fe_3O_4-TiO_2 core-shell however, can be separated from the reaction mixture using magnetic separation. This type of reactor is used for wastewater treatment especially where post-reaction purification can be carried out easily. For gas phase reaction applications, it is possible to monitor reactions spectroscopically as they proceed in situ.– (Long, & Wang, 2016) However, the catalysts have to be immobilised in order to achieve homogeneous

illumination. Meanwhile, the supporting medium needs to be transparent to avoid light absorption and blocking by the solid substrates. The chemical reactants and products can be effectively separated from the immobilised catalysts which is essential for a flow reactor.

Photoreactions have also been reportedly performed in a continuous flow system in which the catalyst is immobilised on several materials such as glass rods, mesh, sponge, silica gel, activated carbon and a lot more, to maximise the contact between reactants and catalysts without sacrificing the light illumination. Since the concentration of gaseous pollutants are typically low (in order of 10^{-9} M)–(Raillard, Héquet, Le Cloirec, & Legrand, 2004), (Nagda & Rector, 2003) diffusion-limitations of reactions,(Fujishima, Rao, & Tryk, 2000) are not an issue for most domestic applications. Interestingly, using an adsorbent catalyst support can improve the performance of the photoreactor as the adsorbent support can increase the concentration of substrate near the catalyst relative to the gas-phase. This acts as a storage for the reactants that can diffuse to available active sites on catalyst while preventing the escape of reaction intermediates and driving the reaction to completion. This suggests that choice of support can influence the rates of adsorption, surface diffusion as well as desorption.

Nevertheless, in gas-phase systems, catalyst/substrate contact area is reduced which is a drawback, although the light illumination is maximised. Loss of catalyst and deactivation due to accumulation of less reactive intermediates are also possible issues.(Henderson, 2008), (Fujishima, Zhang, & Tryk, 2008) In this work, a flow type photo reactor was constructed and tested for photo decomposition of acetone in gas-phase. Flow reactors with immobilised catalysts have been reported to perform optimally for gas-phase photoreactions.(Verbruggen et al., 2012)' ––(Nguyen, Lin, Wu, & Bai, 2015) However, the efficiency can be achieved by careful design as well as selection of a number of reactor parameters which include source of UV light, reactor configuration, lamp location, type of catalyst, distribution and impregnation of catalyst and more importantly, interaction between the light, catalyst and reacting substrate. The gas phase reactor used in this work is highly compatible with photocatalytic reactions, since the light can illuminate the whole reaction vessel uniformly.

Experimental

Catalyst Immobilisation

Prior to pre-treatment, the glass beads were washed with acetone and then refluxed for 2 hours in 6M NaOH. The glass beads were rinsed with deionised water until the washings were neutral, then rinsed with ethanol and allowed to dry in air. This was followed by weighing to account for any loss in mass that could have resulted from the base treatment. The glass beads were then coated overnight with appropriate amounts of catalyst (TiO_2) to give loadings of 1-7 $mg_{catalyst}/g_{beads}$, followed by a second weighing to check the catalyst loading.

Introduction of Acetone in the Gas Stream

Following a modified procedure reported by Stengl *et al.* (Lin et al., 2013) 5 ml of acetone in liquid form was placed in a Dreschel bottle under a continuous gas stream. Using

compressed air as carrier gas at a flow rate of 4.31 ± 0.51 L/h, the acetone was introduced to the reactor.

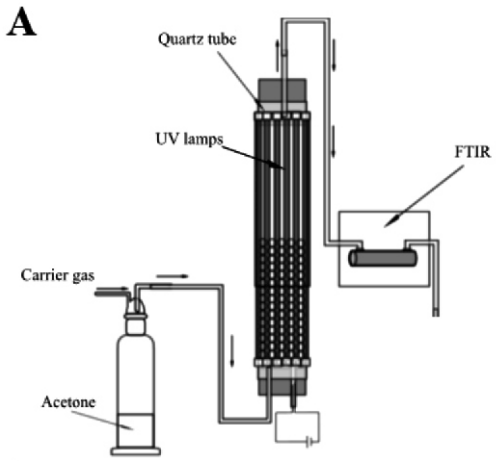


Figure 1: Schematic diagram showing the experimental set up.

Due to the high volatility of acetone, the inlet concentration was controlled by maintaining the dip tube in the Dreschel bottle at 2 cm above the liquid to diffuse the acetone vapour, shown in Figure 1. The vapour was collected by the outlet tube on the top. In this arrangement, if the dip tube is moved closer to the liquid level, the acetone vapour concentration will increase and vice versa. If the dip tube is below the liquid level, the concentration of acetone in the mix will be too high for the photoreactor and detection. The true concentration of acetone introduced in the flow reactor was measured by FTIR where the gas stream was passed through a gas sampling cell mounted in the optical pathway of the FTIR (Figure 1). The length of the sampling tube is fixed at 15 cm, which was made from stainless steel tube. Either NaCl, KBr or CaF_2 discs were used as IR windows. After balancing the adsorption equilibrium by the photoreactor and catalysts in the dark, the lights were turned on and the acetone and CO_2 concentrations were monitored. By monitoring these concentrations, it was possible to gain insight into the photo-degradation kinetics of acetone by TiO_2 photocatalysts, thus confirming the functionality of the designed reactor.

Results and discussion

Effectiveness of Acetone Photo-degradation

For the environmental treatment, VOCs have to be mineralized into CO_2 and H_2O without trace of organic fragments. Otherwise, such fragments might cause more hazardous than the original VOCs. By applying UV illumination on the photoreactor fed with acetone and air, CO_2 gas was increased immediately. The transient plot for the CO_2 concentration with light on and off is shown in Figure 2.

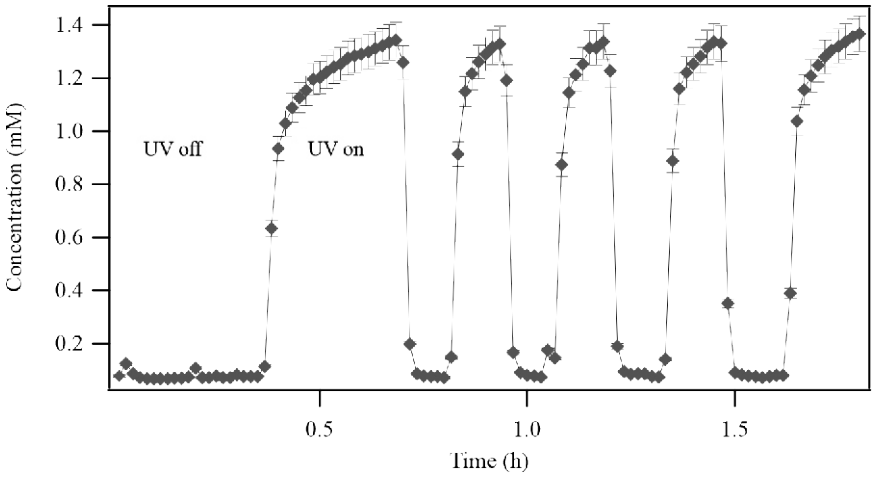
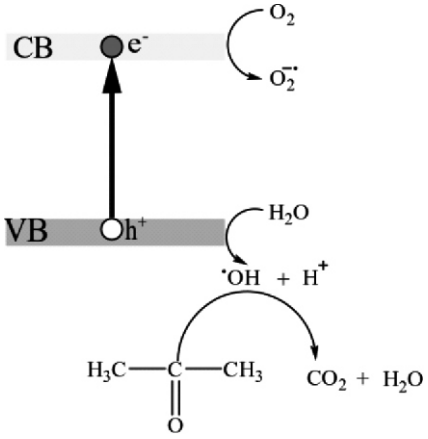


Figure 2: Concentration of CO_2 in a gas stream containing acetone versus flow time with the UV illumination on and off.

Verbruggen *et al.(2011)* reported similar increase in CO_2 concentration in their study of the photodecomposition of acetone. When the light is switched on, the initial concentration slowly increased to the saturation concentration, while the gas flow is constant. This suggests that the created CO_2 might be adsorbed by the catalysts until the surface is saturated. By increasing the reaction temperature, the adsorption can be reduced and one might expect a faster increase in the CO_2 concentration. It is worth mentioning that no CO_2 was observed in the absence of either light or catalyst. Hence it confirms the nature of photocatalytic mechanism (Scheme 1).



Scheme 1: Mechanism for the photocatalytic decomposition of acetone

The sharp drop of CO_2 concentration when light was switched off possibly reflects the decaying kinetics of the excited states in TiO_2 and desorption kinetics of the adsorbed CO_2. As the desorption is normally slower, hence the decrease of CO_2 when light is off is dominated by the slow desorption kinetics alone. As it has been established that the

concentration of CO_2 in the gas stream is as a result of the complete mineralization of acetone by TiO_2 photocatalyst, it became necessary to evaluate the effect of catalyst loading on the glass beads by monitoring the increase in CO_2 concentration per load. This is the focus of the next section.

Effects of Catalyst Loading

The quantity of catalysts loaded on each beads could affect the photocatalytic reaction rate. At lower loading, there is not enough TiO_2 particles to be excited and to contact acetone, so the overall reaction rate will be low. At higher loading, each bead will absorb more photons and will result in insufficient, un-uniform light illumination. As a result, the reaction rate will also be reduced. Hence an optimum catalyst loading exists which balances the light illumination and contact with reactants. In order to find the optimum loading, the reaction rate was measured as a function of TiO_2 loading.

Here the reaction rate is defined by the CO_2 eluting rate, r_{CO_2}, at constant gas flow and constant light illumination. The CO_2 production rate, , was calculated as the product of the gas flow rate, f, and the CO_2 concentration, $[CO_2]$, shown in Equation (1). The CO_2 concentration was determined by the FTIR signal intensity at 2300 cm^{-1} calibrated with known CO_2 concentration. The intensity of the CO_2 under dark condition was also subtracted. Similar method was used for measuring the acetone flow rate. By considering the contributions of gas flow rate to the concentration, the flow rate of CO_2 makes a better representation of CO_2 production in comparison with to the molar concentration, since the molar concentration can be affected by overall gas flow rate, hence the reason for this approach.

$$r_{CO_2} = f[CO_2] \qquad (1)$$

The rate of CO_2 production obtained from the photodecomposition of acetone with different loadings of TiO_2 is presented in Figure 3. During this measurement, the acetone was fed at the rate of 2.8 mmol/hr and air flow rate is maintained at 4.3 L/h. The reaction was carried out at near room temperature as the cold cathode lamps increase temperature very slowly to 63 °C.

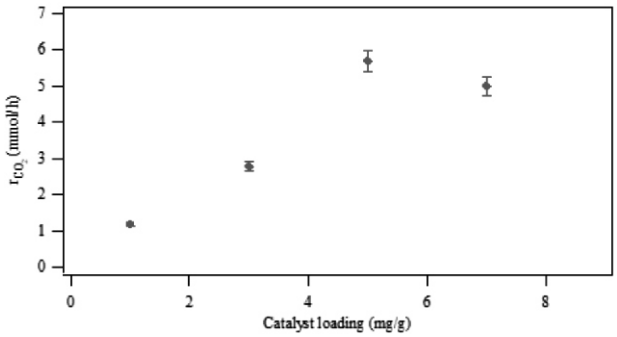


Figure3: CO_2 production rates from the photodecomposition of acetone at different catalyst loading.

As shown here, there was a proportional increase in the production of CO_2 with increase in TiO_2 loading. This observed increase in CO_2 production continued until a maximum rate of $5.75 \pm 0.07 mM_{CO_2}/h$ was achieved with a catalyst loading of 5 mg/g_{beads}. Loading greater than 5 mg/g showed a decrease in CO_2 production rate which can be attributed to reduced light/catalyst contact. In this case, only catalyst closest to the light source became activated as the coating was too thick. Excess catalyst loading resulted in enhanced local UV adsorption and potentially, increased the surface area as well as active sites for the photocatalytic decomposition of acetone. An optimum catalyst loading of 5 mg/g_{beads} was found to be the best TiO_2 loading for maximum efficiency of photodecomposition of acetone under the studied conditions.

Decomposition of Acetone

To study the photodecomposition process of acetone, the flow rate of acetone with and without light was monitored. As can be seen in Figure 4, upon UV illumination a rapid initial increase in concentration of acetone was observed until a steady state was reached; during which the acetone adsorption and decomposition was balanced on the catalyst surface. When the UV irradiation was turned off, the photodecomposition process became halted which resulted in a slow rise in concentration of acetone until another steady state was reached. The increase of acetone concentration at the beginning of light on and slow increase after light is off suggests there are significant effects of adsorption.

The illumination of light causes the desorption of acetone and when light is off, the feed acetone is adsorbed back on the catalyst surface.

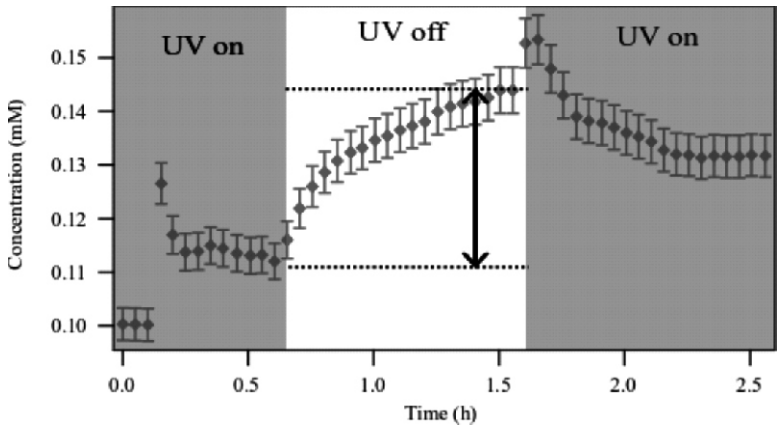


Figure 4: Acetone concentration in the presence and absence of UV illumination using 5 mg/g catalysts. The initial acetone concentration was regarded as the background and has been subtracted. The difference between the two steady state concentrations used to determine the decomposition rate of acetone is shown by the dotted lines and arrow. The actual concentration of photo decomposed acetone [A], is given by the difference between the concentrations in dark and under illumination, $[A]_{dark} - [A]_{UV}$. Knowing the gas flow rate, f, allows to determine the rate of decomposition of acetone, $-r_A$ using Equation 2.

$$-r_A = f[A]_{dark} - [A]_{UV}] \qquad (2)$$

In this study, the gas flow rate was 4.3 mM/h and $[A]_{dark}$ is 0.145 mM while $[A]_{UV}$ is 0.113 mM, reading from Figure 4. Thus the acetone decomposition rate is 0.14 ± 0.02 mM/h. The decomposition efficiency can also be characterized using the concept of conversion. Conversion is defined by the ratio between the decomposed acetone [*A*] and the inlet concentration $[A]_{dark}$ using Equation 3.

$$\text{Conversion}\% = \frac{[A]_{dark} - [A]_{UV}}{[A]_{dark}} \qquad (3)$$

In the present work conversion of 22 % was achieved for the photodecomposition of acetone, based on the values of [A]*dark* and and [A]*UV* from Figure 4.

Higher conversion value has been reported for photodecomposition of acetone. Žabová and Dvořák(Han et al., 2012) reported 35% conversion of acetone in their study on the photodecomposition of acetone in gas-phase over Degussa P25. They attributed the higher conversion rate to their TiO2 immobilisation substrate (polystyrene mesh) which allowed for a significant increase in gas-catalyst contact area with respect to the glass beads used in the present study. However, the ease of handling catalyst makes the immobilization technique used in this work a more industrially viable choice.

The photocatalytic mineralisation of acetone to CO2 is known to proceed through various stable chemical intermediates and the mechanism largely depends on the experimental conditions. Several routes have been proposed in the literature for the photo conversion of acetone, many of which show that acetone undergoes several chemical transformations before finally mineralizing completely.(El-Maazawi, Finken, Nair, & Grassian, 2000a) However, there is likelihood that many partial oxidation products were formed considering that during photodecomposition of acetone, the initial oxidation steps are more kinetically favoured rather than total mineralization.(Henderson, 2008),(Fujishima et al., 2008),(Verbruggen et al., 2011) The partial oxidation products include many carbonyl moieties such as acetic acid,(Henderson, 2008),(Sakai, Kubota, Yamaguchi, Fukuoka, & Inumaru, 2013) formic acid,(Xu & Raftery, 2001) and mesityl oxide(El-Maazawi et al., 2000b),(Coronado, Kataoka, Tejedor-Tejedor, & Anderson, 2003; Xu & Raftery, 2001). Most of them are easily oxidized. In this experiment, variation in CO2 produced was also monitored as shown in Figure 5. The maximum production rate of CO_2 was found to be 1.31± mM/h. This makes it 9.4 times as much as the corresponding decomposition rate of acetone (0.14 ± 0.02 mM/h).

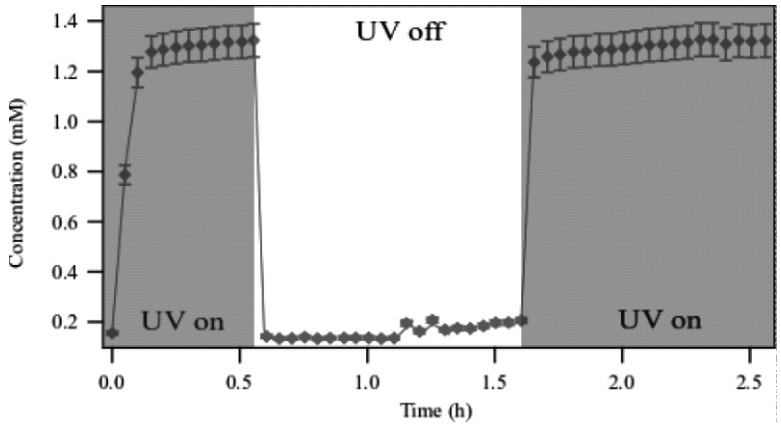


Figure 5: CO_2 concentration from acetone decomposition with and without UV illumination during the photodecomposition process

Due to stoichiometric ratio (1:3) between acetone and CO_2, it would be expected that the CO_2 concentration would only be 3 times of decomposed acetone. The higher-than-expected CO_2 concentration suggests there are other factors affecting the CO_2 concentration. The possible reason for this is that there are significant amount of organic species, including acetone, and its partial oxidation products such as acetic acid,(Henderson, 2008),(Sakai et al., 2013) formic acid,(Xu & Raftery, 2001) and mesityl oxide(El-Maazawi et al., 2000b),(Coronado et al., 2003; Xu & Raftery, 2001) were absorbed in the photoreactor. They are then gradually released after being oxidized into CO_2, since the reaction was carried out at room temperature. The adsorption behaviour was confirmed with the initial increase in the acetone concentration when light was switched on. At room temperature, such adsorption is inevitable. As such, the parameter of conversion could underestimate the performance of the TiO_2 photoreactor. A high temperature measurement could eliminate the adsorption and could give more accurate result.

The existence of intermediates could interfere with the measuring of acetone concentration. The extinction coefficient of these species will not be the same as that of acetone, consequently the carbonyl peak area can increase by unknown amounts due to contribution of the intermediates. As such, the observed reduction in the concentration of acetone could be overestimated. Verbruggen *et al.(2011)* reported similar results where concentrations of produced CO_2 exceeded the complete mineralisation of the photo decomposed species. They also suggested that the deposition of organic residue on the photocatalyst surface may be responsible for the high concentration of CO_2.

Conclusions

In this study, a new catalyst immobilization technique with high catalyst-support adherence efficiency have been demonstrated. The key equations used for the design of the photoreactor were derived. The reactor was designed to achieve a uniform irradiation field that affords a plausible control over the average light intensity. The success of the design will

produce more reliable experimental data and provide a more simplified photocatalytic process. A promising industrial implication is envisaged when an excellent catalyst adherence on the glass beads with high stability was achieved with the lowest catalyst loading amount.

In this study, the gas-phase, flow-type photo-reactor was successfully tested for photodecomposition of acetone. The immobilisation method developed in this study is indeed complementary and simple to implement. By utilising a highly active, inexpensive commercially available photocatalyst (P25) it was possible to achieve acetone decomposition. The streamline design of the reactor made it possible for all the reacting species to be in contact while the transparency of the glass beads provided an excellent UV light penetration to even the innermost part of the reactor, hence the observed high photo activity. The formation of CO_2 from carbonaceous species adsorbed on the surface of the catalyst during the photodecomposition reactions have been observed. Prolonged illumination in the absence of reactant (acetone) can easily deplete the deposition of these accumulated carbonaceous species and release more active sites for the adsorption of substrate.

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

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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.

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

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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.

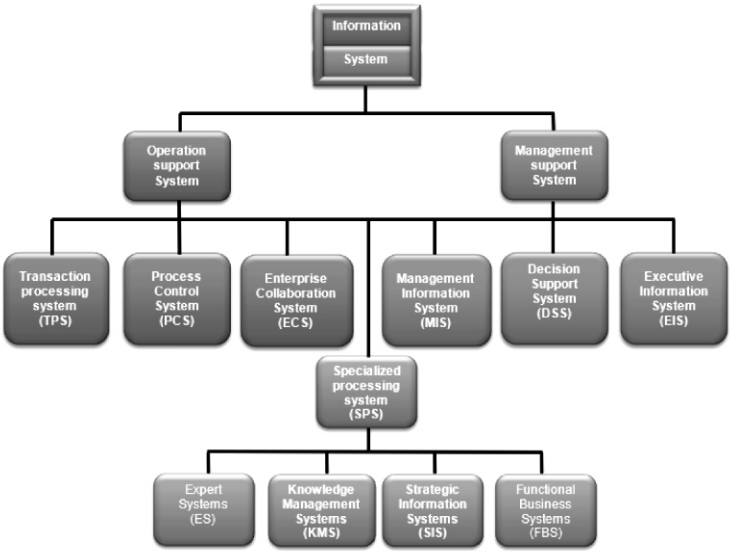
Laudon and Laudon (2013), termed information system as a set of interrelated components that collect, retrieve, process, store, and distribute information to support decision making and control in an organization. Information Systems can also be used to analyze problems, visualize complex subjects, and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

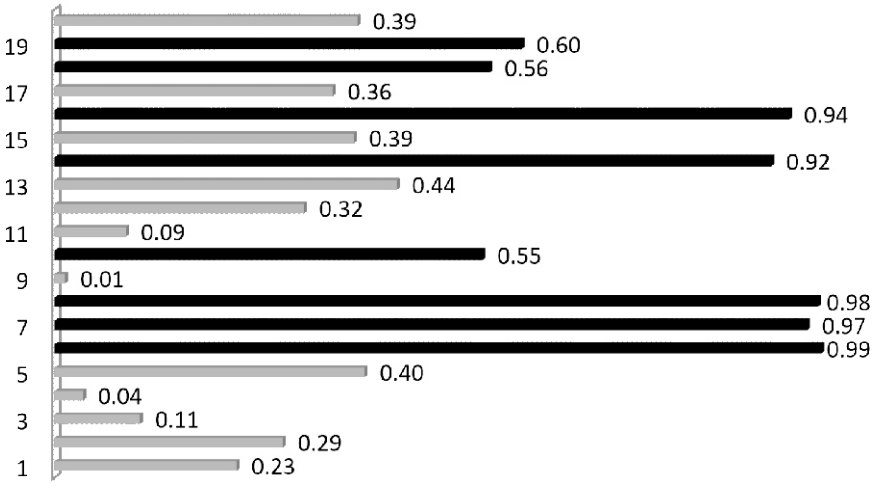


Figure 3: **The least utilized Information System facilities in Nigeria Tertiary Institutions.**

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.

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

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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

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

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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.

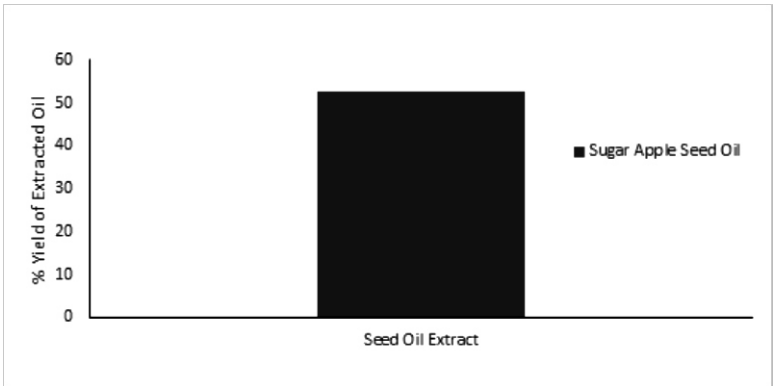

Figure 1. Extracted yield of sugar apple seed oil

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.

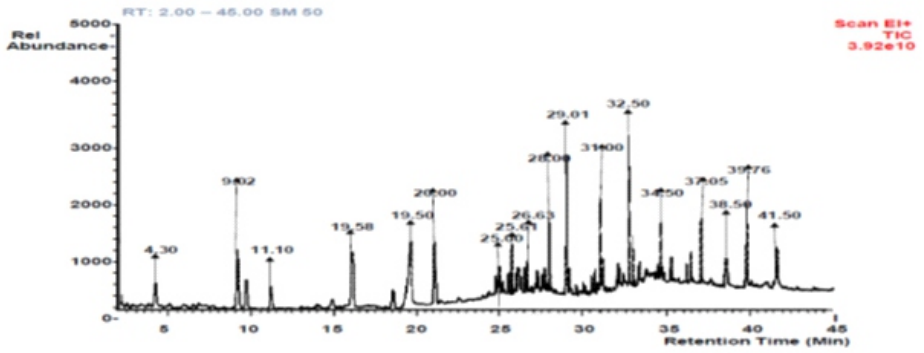

Figure 2: GCMS spectrum regions of sugar apple seed oil

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.

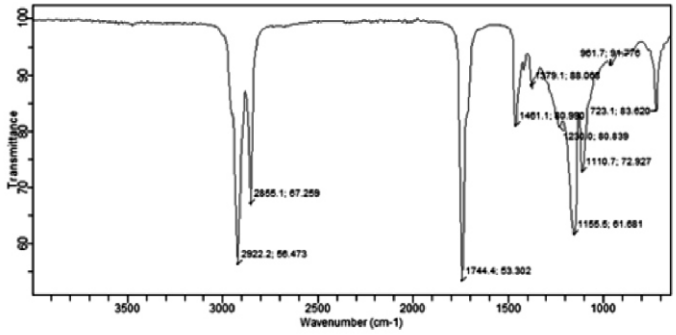

Figure 3: FTIR Peaks identified in sugar apple seed oil

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.

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