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From Editorial Desk

The language of a higher Education enterprise is "publish or perish". One either publish books, journal articles, bulletins or chapter in books or you perish by becoming inactive, stagnant or non-productive, at most a zero educated person (person without value). Therefore, this premise I thank you for contributing articles to our journal of Natural Science and Environmental Studies. We thank our Dean Prof. Dr. Chidi Uhuegbu for allowing the publication and giving a huge grant to ensure the publication at this hard period in Nigeria economic history. We are grateful to the professors of the faculty both the regular and those on parttime. Mention must be made of few of them for their impacting advises: Prof. Emma Adinna (Ph.D), Prof. Mrs. Josephine Okafor (Ph.D), Prof. Mrs. Miriam Unachukwu (Ph.D), Prof. Mrs. Christie Oyeka (Emeritus Prof.), Prof. Emeritus Nduka Okafor (Ph.D), Prof. Chukwuali and a host of others. We also thank the HODs: Architecture Dr. C. Chukwu; Biological Sciences, Dr. P.N. Olisaka; Chemical Sciences, Dr. Mrs. Anosike; Computer Science/Mathematics, Dr. F. Okebalama; Dr. L. Onuora and others for their support.

Thanks. Soi Dei Gloria (To God Be All Glory)

Prof. Dr. Ndidi M. Ozofor
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**TREND AND SEASONAL VARIATION OF INFANT MORTALITY IN
ENUGU STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY
TEACHING HOSPITAL PARK LANE, ENUGU**

BY

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ABSTRACT

This study examines the trend and seasonal variation of infant mortality death rate at Enugu State university of Science Technology Teaching Hospital Parklane Enugu from 2010-2020. IBM SPSS Statistics 22 and Microsoft Excel 2010 analytical packages were used for the calculations and analysis of the annual trend and seasonal indices. The Moving Average was used in computing the seasonal trend, the Regression Model was selected with a view of showing an understanding to the appropriate method to be used for the Trend and thus the forecasts. The Annual Infant Mortality rate shows that 2019 recorded the highest infant mortality rate, and 2011 and 2015 recorded the lowest infant mortality rate. And thus, from the forecast, the second Quarter could produce the highest mortality rate for the years 2021, 2022, 2023 and 2024.

Background of the Study

Infant Mortality has been one of the world's most health challenges. Though, one of the Millennium Development Goals, this challenge has not yet been adequately addressed among the underdeveloped and developing countries like Nigeria.

According to World Health Organization (*WHO, 2011*), Infant mortality is the death of a child within the first year of life while the Organization for Economic Co-operation and Development (*OECD, 2001*) Infant mortality rate is the number of deaths under one year of age occurring among the live births in a given geographical area during a given year per 1,000 live births occurring among the population of the given geographical area during the same year.

According to Madise et al (2001), Infant mortality has long been identified as an important tool for evaluating a population's health and healthcare system and a barometer for measuring a county's well-being and the state of health and health facilities. The realization of the importance of infant mortality and the need to reduce its occurrence has led to the fight against mortality in infants both at the national and international levels.

Highlighted as an area of public health concern in society, the fight against infant mortality led to the implementation of the United Nations Millennium Development Goals. According to Sachs and Mc Arthur, (2005) The fourth MDG in particular, addresses the issue of reducing mortality worldwide by up to two-thirds in 2015. This global fight against the deaths of children within the first year of their lives which has been on for a few decades saw most European countries make significant progress between 1990 and 2015 sufficient enough to meet the childhood mortality reduction target set in the fourth tenet of the MDG. However, the majority of the countries in Asia

and Africa (Nigeria inclusive) failed to meet the recommended target for the reduction of childhood mortality and as a result, the Sustainable Development Goal was rolled out.

It is believed that year, thousands of children are born in this country and thousands of these children die from diseases such as diphtheria, whooping cough, tetanus, poliomyelitis, measles, and childhood tuberculosis. This is stated in a pamphlet on the Expanded Program on Immunization (EPI) published by the Federal Epidemiological unit, Federal Ministry of Health, Lagos, 2017.

According to Adetoro and Amoo, (2014) In Nigeria, the infant mortality rate still remains unacceptably high despite modest improvement in child health outcomes during the 20th century by the National Bureau of Statistics (NBS, 2017).

The current infant mortality rate in Nigeria is estimated at 70 per 1000 live births implying that 1 in 15 live births in Nigeria dies before their first birthday. These rates remain high in comparison to the proposed target set by the United Nations as contained in the SDG 3.2 objective.

Childhood mortality in general and infant mortality, in particular, has long been a public health menace in Nigeria. Identified as one of the barometers for the measurement of any population's state of health, health facilities, and well-being, relevant authorities in government and stakeholders in public health have all moved to reduce and possibly eliminate its occurrence with little success.

Statement of the Problem

This study is drawn from the realization that knowledge of reliable and accurate forecasts of infant mortality rate is both necessary and important for planning suitable intervention programs and preventive measures for the reduction of infant mortality in Nigeria.

Objective of the study

- To study the trend of infant mortality rate in St. Patrick hospital and Maternity Enugu State.
- To study the seasonal indices and therefore ascertain the month with the highest and lowest infant death.
- To forecast the trend for 2022, if there will be an increase in the number of infant mortalities.

Significance of the Study

This study shows the trend and seasonal variation of infant mortality rate in St. Patrick hospital and Maternity Enugu State.

- Findings from the study will contribute to fellow researchers in the field of statistics, health, etc
- This is also important to the Government in decision-making in the fight against infant mortality.
- This study will also benefit conference/workshop and paper presenters. They will use it as Journal articles etc.

➤ The study is also a requirement for the researcher to be awarded the BSc in Statistics.

Limitations/Constraints of the study

Due to finance and time factors the study is limited to the use of time series analysis and data used was sourced and collected from St. Patrick Hospital and Maternity, Enugu State.

Delimitation/Scope of the Study.

This research covers a period of 10 years (2010 – 2021) of monthly infant mortality rate in St. Patrick Hospital and Maternity, Enugu, and is restricted to the records of St. Patrick Hospital and Maternity, Enugu State.

Definition of Special Terms

Trend: A general direction in which a situation changes or develops with time.

Seasonal Index: A measure of how a particular season through the same cycle compares with the average season of the cycle.

Mortality: (death rate) the number of deaths that occur at a specific time, in a specific group, or from a specific cause.

Infant: A child under the age of 1 year, specifically a newborn baby.

MDG: Millennium Development Goal.

Theoretical Framework

The theoretical frameworks used in this study are time series analysis. Time series analysis is a specific way of analyzing a sequence of data points collected over an interval of time. This type of analysis is a statistical method of analyzing data from repeated observations on a single unit or individual at regular intervals over a large number of observations.

Mathematically, A time series is defined by a value $y, y, y\dots$ of a variable at a time $t, t, t\dots$ thus y is a function of t , symbolized by

$$y = f(t).$$

Study Area

This paper is focused on Enugu State University Teaching Hospital Parklane, Enugu. This hospital serves the inhabitants of Enugu State Nigeria, Enugu metamorphosed from the then Nursing Home established in 1930 for the colonial masters to a first-class hospital for government officials and elites in the society in 1952.

During the Nigerian civil war of 1967-1970, it was renovated to a general hospital and used extensively to treat the wounded.

Gradual and progressive expansion led to the establishment of surgical, maternity, Theatre, and Pediatric facilities in 1985. it was then approved for the training of house officers. It became a specialist hospital in November 2005 and teaching in May 2006.

Current Literature Review

In understanding the importance of infant mortality in terms of their impact on the population, it is unbelievable that detailed information about death throughout the world has not been available

until recently, hence from the literature available, there have been some studies on similar topics.

Research conducted by Rusen (1984) on death and birth, discovered that having a birth interval longer than two years has a significant beneficial influence on the health of infants and mothers alike and that infant mortality at its peak is among children born very shortly and at the end of their mother's last pregnancy.

Also, Anaeto (1984) of the department of psychology, university of Calabar on similar topics on maternity Case analysis of Death and birth in the university of Calabar, Teaching Hospital, reached that the ratio of maternity care to death is 206 to 1. She established the presence of a trend and cyclical and irregular variables in her data that has no seasonal movement.

Raphael (2000) carried out a similar work but on a different larger population. In his study on births in a general hospital in Enugu, he reported the existence of a downward trend, cyclical and irregular components but no seasonal movement and concluded that the reported birth in general hospital was gradually decreasing between (1992-1999).

Macxim (2002) conducted a statistical analysis on childbirth at the University Teaching Hospital Aba and conclude that there was a downward trend in his forecasting and the absence of seasonal variation. In his summary, there is a gradual fall in childbirth between (1999-2000).

Jinadu et al. (1991) stressed that several diseases causing child mortality have a relationship with hygiene conditions and the healthiness of the environment these are not limited to dirty feeding bottles, utensils, inadequate disposal of household refuse, and poor storage water, to mention but few. The author attributed poor hygiene as a factor that impacts child mortality.

Kravdal (2004) stated that apart from the effect of maternal education on child mortality in India, the community level of education which represents the average educational level of women in an enumeration area also has a strong association with infant mortality. The author emphasized the impact of maternal education on child mortality in India and this is applicable to Nigeria. It is assumed that mothers who are educated practice healthy sanitation living which helps in reducing the rate of infant mortality. Applying a multilevel discrete-time hazard model in estimating the data, it was found that the average education of women in a census enumeration area has a strong impact on infant mortality.

Gayus (2006) opined that the speed of mortality decline will not slow down, relative to past performance. He added that demographers who tend to forecast linear increase in life expectancy tends to predict faster gains because they rely solely on international trends to determine the forecast. However, demographers studying healthy sub-populations argued that fairly large advances in life expectancy are achievable through modifications in the forecast behavior (Akinwande and Ibrahim, 2016). It was revealed that the quality of care given during and after the birth of an infant is primary, especially with insufficient Government investment in public healthcare. Also, some authors expressed dismay over findings that the majority of the births do occur in unorthodox facilities and babies only get to the hospital after irreparable damage may have occurred.

In addition, the review identified the need for improving the counting of stillbirths and neonatal

deaths as an important factor in tracking Sustainable Development Goal 3.2 and improving vital statistics in low-income and middle-income countries (LMICs). This is because some authors noted that the validity of self-reported stillbirths and neonatal deaths in surveys is often threatened by misclassification errors between the two birth outcomes. Hence, the need for the present study to fill the gap as observed in the literature review.

Sources of Data

There are two statistical sources of data; namely the primary source and the secondary source. The data used for this study are the mortality data for infants in the Hospital between 2010 and 2021 Enugu State University Teaching Hospital Parklane, Enugu, presented in Table 1.

Infant mortality data were collected from the Enugu State University Teaching Hospital Parklane, Enugu.

Method of Data Collection

The method of data collection used for this study is a secondary method of data collection from the department of statistical records Enugu State University Teaching Hospital Parklane, Enugu.

Method of Data Presentation and Analysis

In this study, time series were employed in analyzing and interpreting the data; showing the trend and the seasonal variation.

The research in this study made use of time series analysis. Time series is a set of observations taken at different periods especially equal time intervals the periods can be daily, weekly, monthly, yearly, etc.

An example of time series is the number of students admitted to a particular school every year, the yearly production of steel, monthly rainfall, stock exchange indices, etc.

Mathematical a Time series is defined by a value $Y, Y, Y\dots$ of a variable at a time $t, t, t\dots$ thus Y is a function of t , symbolized by $Y = F(t)$. The analysis of time series can be carried out by adopting either **The Multiplicative model:** $Y=T*S*C*I$ OR

The Additive model: $Y=T+S+C+I \quad (1)$

Where Y is the value of the valuable at a particular time.

T, S, C, and I are the components

Characteristics of Time Series

Secular Movement or Trend (T): This refers to the upward and downward movement that characterizes a time series over some time. It is the general direction in which the graph is moving over a long period. This is the long-term. Thus, the trend reflects the long-term growth or decline in the time series.

Cyclical Movement or Variation (C): This refers to the oscillatory movement in a time series with a period of oscillation of more than one year.

Seasonal Movement or Variation (S): This refers to the identical or almost identical pattern that a time series appears to follow during corresponding months of successive years. Such movements are due to recurring events that take place annually.

Irregular Movement or Random variations (I): This refers to the sporadic motions of time series due to pure chance events. In some cases, the importance of an irregular fluctuation may not be significant while in others, they may be very effective and may give rise to cyclic movements.

Using the traditional or classical approach to multiplication relationships among various components the composite series can be symbolized by the following express

$$Y_t = T_t \cdot S_t \cdot C_t \cdot R_t \quad (2)$$

Where T_t = The trend component

S_t = The seasonal fluctuation

C_t = The cyclic fluctuation

R_t = The random fluctuation

t = The time index.

Linear regression analysis was applied to determine the trend of the infant mortality rate.

Linear regression analysis is one of the simplest methods of determining trends of an incidence in time series.

The equation is given by:

$$Y_t = a + bt \quad (3)$$

Where t is the explanatory variable (year) and Y is the dependent variable (infant mortality data).

The slope line is b and a is the intercept.

Mathematically denoted by the functional relationship

$$Y = f(t) \quad (4)$$

Where Y is the value of the variable under consideration at time t .

Suppose Y is the estimated value of the dependent variable at Y_t at time t , then Y_t can be predicted from simple linear equation.

The model can be written as

$$Y_t = a + b_t \quad (5)$$

Alternatively, (2) can be written as

$$Y_t = \beta_0 + \beta_1 t + \epsilon_t \quad (6)$$

Taking the estimate of the model, it becomes

$$\hat{Y}_t = \hat{\beta}_0 + \hat{\beta}_1 t \quad (7)$$

Where;

\hat{Y}_t = the estimated value of the dependent variable being used for prediction,

$\hat{\beta}_0$ = the intercept measuring the value \hat{Y}_t at time t of the population

$\hat{\beta}_1$ = the slope of the line measuring the change in the variable \hat{Y}_t that results from a unit change in time t

t = the independent variable $t = 1, 2, 3 \dots 10$

ϵ_t = random error term $\sim NID(0, \delta^2)$

In the estimation of the **seasonal indices**, we must estimate how the data in the time series vary from month throughout a typical year.

However, IBM SPSS Statistics 22 and Microsoft Excel 2010 analytical packages were used for the calculations and analysis of the annual trend and seasonal indices.

Data Presentation

Table 1: Number of infant mortality in Enugu State University teaching Hospital Parklane, Enugu from 2010-2020.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2010	8	2	7	5	1	4	1	3	4	7	5	2
2011	7	2	2	4	4	1	2	3	2	2	2	2
2012	4	0	1	6	3	8	7	1	5	9	7	3
2013	5	7	1	4	3	7	4	6	5	2	4	2
2014	7	6	10	5	8	2	0	0	4	6	3	1
2015	3	3	8	5	5	3	0	0	1	5	1	1
2016	4	3	5	7	3	3	6	2	4	6	4	2
2017	2	6	3	5	3	4	7	6	8	1	6	2
2018	4	6	7	8	3	5	6	2	9	5	2	7
2019	5	7	9	5	7	8	12	4	6	5	3	6
2020	3	5	8	6	4	2	9	5	1	6	1	2

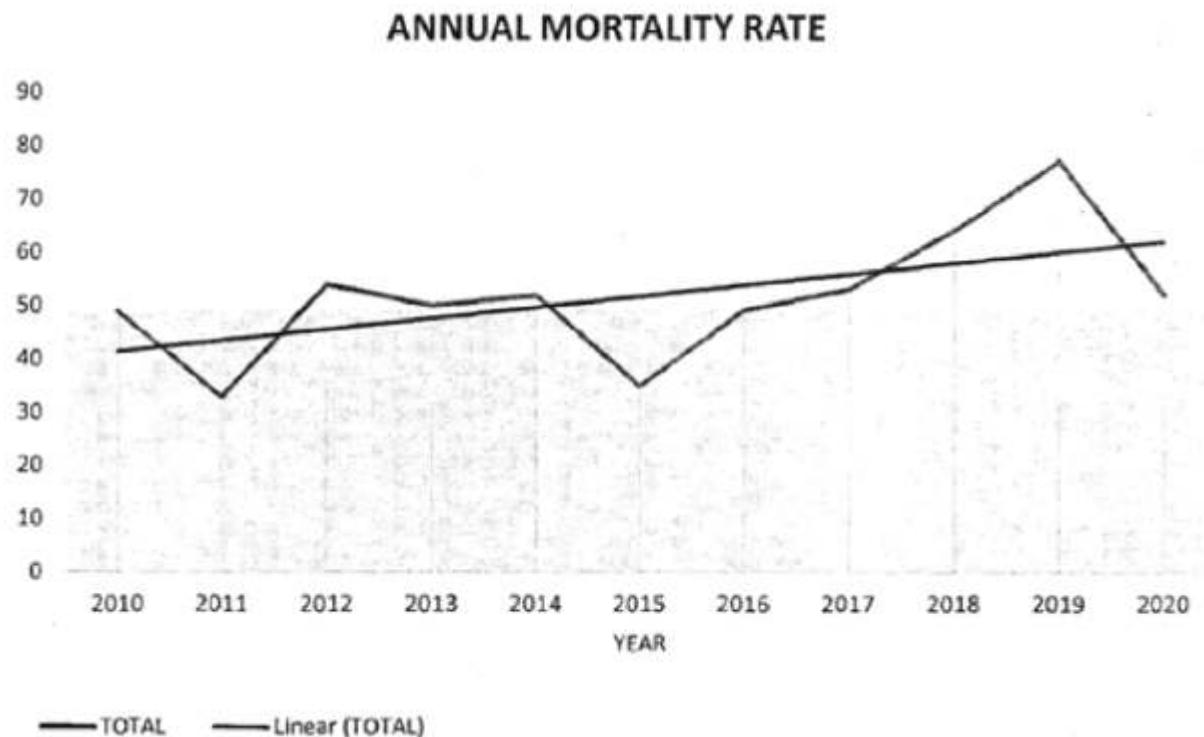
Data Analysis

Table 2: Quarterly infant mortality rate data in Enugu State University Teaching Hospital Parklane, Enugu from 2010-2020.

YEAR	Q1	Q2	Q3	Q4	TOTAL
2010	17	10	8	14	49
2011	11	9	7	6	33
2012	5	17	13	19	54
2013	13	14	15	8	50
2014	23	15	4	10	52
2015	14	13	1	7	35
2016	12	13	12	12	49
2017	11	12	21	9	53
2018	17	16	17	14	64
2019	21	20	22	14	77
2020	16	12	15	9	52
GRAND TOTAL	160	151	135	122	568

The table above shows that 4th quarter within the decade recorded the lowest infant mortality while the 1 St quarters recorded the highest infant death with the peak at 2014.

Fig. 1: Annual Infant Mortality 2010-2020.



From Fig. 1 above, it is clear that 2019 recorded the highest infant mortality, and 2011 and 2015 recorded the lowest infant mortality rate.

Table 3: Estimation of the Seasonal Component, Random and Trend Variation Using the Moving Average

I	YEAR	QUARTER	MORTALITY	MT(4)	MA(4)	CMT(4)	CMA(4)	S _{t-1}	S _t	DESEASONALIZE	T _t
1	2010	1	17					1.093	15.554	10.266	
2		2	16					1.094	9.145	10.396	
3		3	8	49	12.25	23.00	11.90	0.70	0.877	9.120	10.526
4		4	14	43	10.75	21.25	10.63	1.52	0.890	15.727	10.657
5	2011	1	11	42	10.50	20.75	10.38	1.16	1.093	10.064	10.787
6		2	9	41	10.25	18.50	9.25	0.97	1.094	8.230	10.911
7		3	7	33	8.25	15.00	7.50	0.93	0.877	7.980	11.047
8		4	6	27	6.75	15.50	7.75	0.77	0.890	6.740	11.178
9	2012	1	5	35	8.75	19.00	9.50	0.53	1.093	4.575	11.308
10		2	17	41	10.25	23.75	11.88	1.43	1.094	15.545	11.438
11		3	13	54	13.50	29.00	14.50	0.90	0.877	14.620	11.569
12		4	19	62	15.50	30.25	15.13	1.26	0.890	21.343	11.699
13	2013	1	13	59	14.75	30.00	15.00	0.87	1.093	11.894	11.829
14		2	14	61	15.25	27.75	13.88	1.01	1.094	12.802	11.959
15		3	15	50	12.50	27.50	13.75	1.09	0.877	17.100	12.090
16		4	8	60	15.00	30.25	15.13	0.53	0.890	8.987	12.228
17	2014	1	23	61	15.25	27.75	13.88	1.66	1.093	21.043	12.350
18		2	15	50	12.50	25.50	12.75	1.18	1.094	13.717	12.480
19		3	4	52	13.00	23.75	11.88	0.34	0.877	4.560	12.611
20		4	10	43	10.75	21.00	10.50	0.95	0.890	11.233	12.741
21	2015	1	14	41	10.25	19.75	9.88	1.42	1.093	12.809	12.871
22		2	13	38	9.50	18.25	9.13	1.42	1.094	11.888	13.001
23		3	1	35	8.75	17.00	8.50	0.12	0.877	1.140	13.132
24		4	7	33	8.25	16.50	8.25	0.85	0.890	7.863	13.262
25	2016	1	12	33	8.25	19.25	9.63	1.25	1.093	10.979	13.392
26		2	13	44	11.00	23.25	11.63	1.12	1.094	11.888	13.522
27		3	12	49	12.25	24.25	12.13	0.99	0.877	13.680	13.653
28		4	12	48	12.00	23.75	11.88	1.01	0.890	13.480	13.783
29	2017	1	11	47	11.75	25.75	12.88	0.85	1.093	10.064	13.913
30		2	12	56	14.00	27.25	13.63	0.88	1.094	10.974	14.044
31		3	21	53	13.25	28.00	14.00	1.50	0.877	23.939	14.174
32		4	9	59	14.75	30.50	15.25	0.59	0.890	10.110	14.364
33	2018	1	17	63	15.25	30.50	15.25	1.11	1.093	15.554	14.434
34		2	16	59	14.75	30.75	15.38	1.04	1.094	14.631	14.563
35		3	17	64	16.00	33.00	16.50	1.03	0.877	19.380	14.693
36		4	14	68	17.00	35.00	17.50	0.80	0.890	15.727	14.923
37	2019	1	21	73	18.00	37.25	18.63	1.13	1.093	19.213	14.955
38		2	30	77	19.25	38.50	19.26	1.04	1.094	18.289	15.086
39		3	22	77	19.25	37.25	18.63	1.18	0.877	25.079	15.216
40		4	14	72	18.00	34.00	17.00	0.82	0.890	15.727	15.346
41	2020	1	16	64	16.00	30.25	15.13	1.06	1.093	14.639	15.476
42		2	12	57	14.25	14.25	14.25	0.84	1.094	10.974	13.607
43		3	15	52					0.877	17.100	15.737
44		4	9						0.890	10.110	15.867

Table 4: Goodness of Fit Statistics for the estimated Simple Linear Regression Model

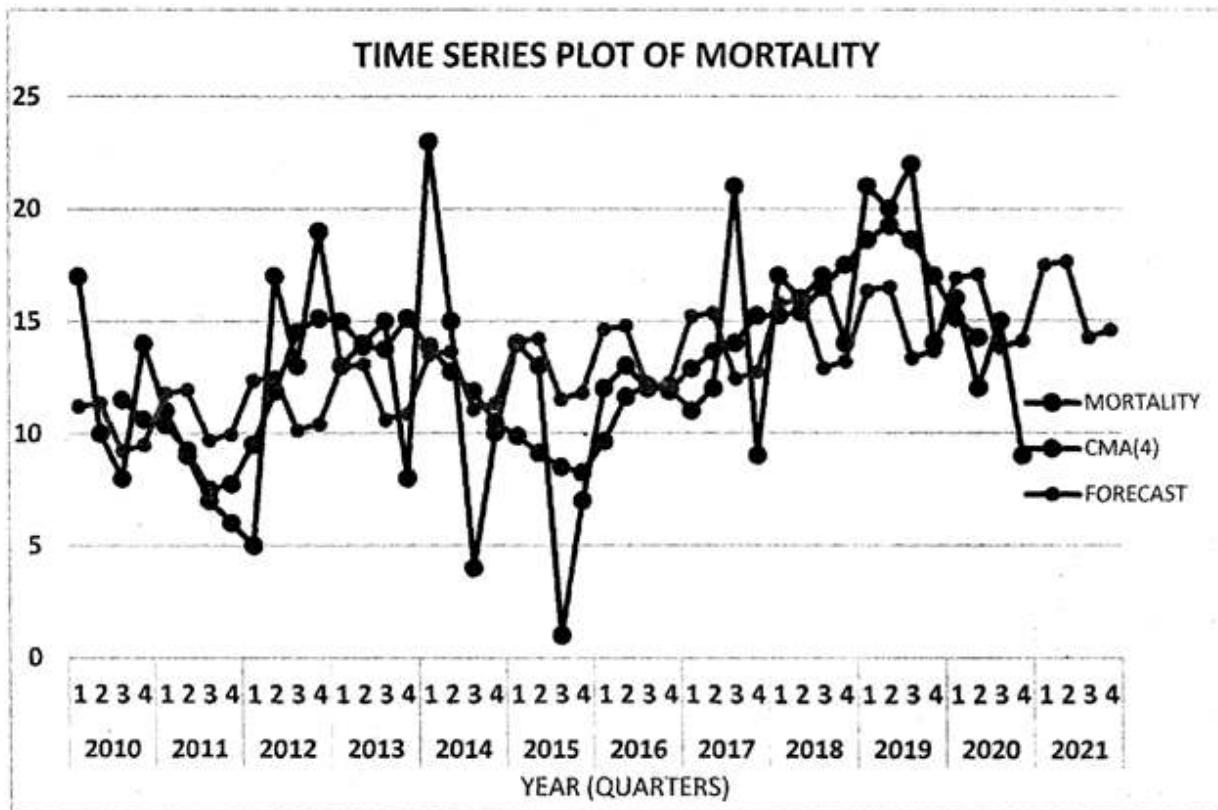
Multiple R	0.332697247
R Square	0.110687458
Adjusted R Square	0.08951335
Standard Error	4.799110766
Observations	44

Table 5: Model Adequacy Check for the Linear Trend Model

ANOVA	Df	SS	MS	F	Significance F
Regression	1	120.39677	120.39677	5.227490932	0.027341001
Residual	42	967.3214942	23.03146415		
Total	43	1087.718264			

	2021	2022	2023	2034
Q1	17.485	18.055	18.624	19.194
Q2	17.636	18.206	18.776	19.346
Q3	14.262	14.719	15.176	15.633
Q4	14.589	15.053	15.517	15.981

Fig. 2 Time Series Plot of Mortality Showing the Quarterly Forecast



Data Interpretation

The linear trend equation is

$$\text{Infant mortality} = 10.14 + 0.13 \text{ time}$$

Where Y is the dependent or respond variable. t is the time in the years, varies from (2010, 2011, 2012, ...2020)

And the coefficient of determination $R^2 = 0.11$

In this study from the figure 1, the graph gave us an uptrend movements Which implies that the number of infant mortality rate has been increasing over the decade. The forecast also shows a continuous increase.

Summary of Findings

The value of the R-square of 0.11 shows 11 percent of the dependent variable while the remaining 48 percent was the error term.

The value of the adjusted R-square of 0.0895 shows that the graph of the dependent variable and the independent variables will have a goodness of fit: of 8.95 percent.

From the year 2015 to 2019, infant mortality rate experienced a linear increase with its highest peak in 2019. This shows that the year 2019 recorded the highest number of infant death while 2011 and 2015 recorded the lowest.

The 4t quarters of the year 2021, 2022, 2023 and 2024 (as forecasted) should, record the lowest number of infant mortality rate while the 2nd quarters the highest infant mortality death.

Conclusion

From this study $R^2 = 0.11$. This implies that the coefficient of determination obtained indicates a bad fit. And thus, from the forecast, the second Quarter could produce the highest mortality rate for the year 2021, 2022, 2023 and 2024. This study is based on the result of the data analyzed.

Therefore, I concluded that there will be a continuous increase in infant deaths.

Recommendation

The researcher advises that a higher model is used like quadratic linear model, cubic or parabolic model in other to improve the coefficient of determination.

References

- Adetoro, GW and Amoo, E.Q. (2014). A Statistical Analysis of Child Mortality: Evidence from Nigeria. *Journal of Demography and Social Statistics*, Department of Demography and Social Statistics, Obafemi Awolowo University, Ile-Ife. Nigeria. 1:110-120.
- Dickey, DA. and Fuller, WA. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*.
- Madise, N., Magadi, M and Diamond, I. (2001). Factors Associated with Unfavourable Birth Outcomes in Kenya. *Journal of Biosocial Science*.
- MDG Report. (2015). Nigeria Millennium Development Goals. www.mdgs.gov.ng.
- National Bureau of Statistics- NBS and United Nations Children's Fund- UNICEF (2017). Multiple Indicator Cluster Survey (MICS) 2016-17, Survey Findings Report. Abuja, Nigeria.
- National Bureau of Statistics and United Nations Children's Fund.
- Usman, A., Sulaiman, MA. and Abubakar, I. (2019). Trends of Neonatal Mortality in Nigeria from 1990 to 2017 using Time Series Analysis. *J. Appl. Sci. Environ.*
- World Health Organization- WHO. (2011). Child Mortality Millennium Development Goal (MDG) 4. The Partner for Maternal and New Born Birth.
- World health organization 2011 http://www.WHO.int/pmnch/media/pressmaterials/fs/fsmdg4_childmortality/en/.

APPRECIATING AND VALUING DIVERSITY IN TEACHING VISUAL ARTS: GOALS AND METHODS

Key words: Teaching visual Arts, valuing diversity and appreciation, goals and methods

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INTRODUCTION

The value of diversity and differences in the visual arts practice, research and education can best be experienced and appreciated by a clear understanding of what the visual art means. "Visual arts" is a broad category of art which includes a number of artistic disciplines from various sub-categories. The definition of visual art usually encompasses the following: all aspects of fine and applied arts, which include activities, such as drawing, painting, and sculpture. Others are graphics art, ceramics, fashion, textile, glass design, with associated activities like manuscript illustration, book illustration, calligraphy, printmaking and architecture. It also includes a number of modern art forms and expression: Assemblage, collage, mixed-media, conceptual art, installation, happenings, performances and film art including associated disciplines such as photography, video arts and animation or any combination thereof. These groups of activities also include high tech discipline, others like computer graphics and so on. Other modern visual arts, new environmental

or experimental graphics or land art which includes transitory forms like ice/snow sculpture and presumably graffiti art.

The visual art also encompasses a number of decorative art discipline and crafts: ceramics and studies in pottery, mosaic art, mobiles, tapestry, and glass art (including stained glass). Wider definition of visual art sometime includes applied art area such as graphics design, textile, fashion design, glass design, industrial design and interior design new type of body art. These include tattoo art, face and body painting

It is necessary, pertinent to consider the value of diversity and differences in visual art practice and research because of its role in education in general. Many adults and others have not had the opportunity (or the desire) to explore the world of art in any systematic way. As a consequence, their reactions to visual art exist at a very basic level; "I like it or I don't like it" being the principle reaction to works of art, where ever encountered. One need only review the following questions to gain some insight into the complexity of the

world of art. Being able to provide reasonable answers to these questions would demonstrate one's ability to understand and appreciate art, at least at a very fundamental level. In order to understand art it is necessary to nurture an appreciation for the varied functions and values of art; to demonstrate that the visual arts are extraordinary phenomena, and that they are essential to our well being, individually religious and as a society.

What is visual art?

Visual art is about creating and making the general aesthetics of a work, and to create aesthetics style of any art or any related work of art. It is important to work with fundamental elements of art and design, arranging them according to the principles. These elements and principles together form the building blocks of art and design and a firm understanding of them is crucial in creating visual design/art of any product. These elements are the main media through which designer and artist translate images and ideas into concrete terms. In man's visual communication experiencing everything large and small, natural or man-made can be describe in terms of these elements.

Visual art are constructed from very basic elements or components that we experience through our sense of sight and/or touch; namely, lines, two and/or three dimensional shapes, textures,

colors, dark and light qualities, and actual or implied space. For any analysis and criticism of any work of art, the following should be considered or look into:

- Should natural objects be considered as works of art?
- Is art anything we want it to be, or does the term "art" refer to objects that have special characteristics?
- What conditions need to exist before we are willing to classify something as art? An understanding of the above questions will help towards understanding what art is all about.

Diversity in Art teaching

Fine and applied arts learning is an integral part of the society we live in. Art is part of the cultural heritage of every nation. It is what makes us most human, and complete as people. The arts cannot be learned through occasional or random exposure any more than math or science can. Education and engagement in fine arts are an essential part of the school curriculum and an important component of the educational program of every student. Education in the arts is an integral part of the development of each human being.

In any educational system it is very important that there is a wide array of diverse group of people in the classroom, this is so because it creates a realistic setting and also encourages students to grow outside their boundaries and learn something new about a culture, and any other subject they may not be familiar with. In any

fine arts class diverse group of students exists, it is important to recognize the fact that all students are unique in their own way in terms of creativity and innovation. Their differences could consist of their reading level, physical ability, cultural background, personality, religious beliefs, and others. There has always been diversity in any setting especially in art studio or classroom environment, it is important to embrace it and make positive use of it.

The authorities should value diversity and the need to model this attitude to their students need is important. The values of diversity in fine arts need to be recognized and people should respect the fact that students are different and that these differences is generally a good thing. For example, when attempting to solve a problem, it is better to bring together a diverse team with many skills and many different ways of approaching the problem than it is to bring together a team that has all their strength concentrated in one area. Sufficient data exists to overwhelming support the belief that study and participation in fine and applied arts is a key component in improving learning throughout all academic areas.

Evidence of its effectiveness is in reducing students dropout, raising students attendance, developing other team players, a love for learning, improving greater student dignity, enhancing students creativity, and

producing a more prepared individual for the workplace for tomorrow has been documented in studies. The fine arts also provide learners with non-academic benefits such as promoting self-esteem, motivation, aesthetics awareness, cultural exposure, creativity, improve emotional expression, as well as social harmony and appreciation of diversity.

The following are findings reported on art related research: The Impact of the Arts on Learning (Fiske, 1999) that should be noted by every parent, teacher, and administrator. The arts reach students not normally reached, in ways and methods not normally used. This leads to better student attendance and lower dropout rates.) It changes the learning environment to one of discovery. This often re-ignites the love of learning in students tired of just being fed facts.

Students connect with each other better. When this is done well, it often results in fewer fights, greater understanding of diversity and greater peer support in any leaning setting. The arts provide challenges to students of all levels. Each student can find his/her own level from basic to gift. Students learn to become sustained, self-directed learners.

Is the study of Fine Arts important?

The study of f and applied arts is so important because of the benefits associated with it. They engage many areas of the brain and also have far-

reaching effects on the learner's mind (Jensen.2001). The arts promote the understanding and sharing of culture. They promote social skills that enhance the awareness and respect of others. The fine arts enhance perceptual and cognitive skills. The Burton study of more than 2000 children found that those in the arts curriculum were far superior in creative thinking, self-concept, problem-solving, self-expression, risk-taking, and cooperation than those who were not (Burton et al., 1999). The arts have the capacity to engage everyone. Today's world is witness to the Information Age. The primary sources of content information are no longer teacher lectures or textbooks canted. Learning is not limited to what you know, but is dependent upon how to find information and how to use that information quickly, creatively, and cooperatively. "We are in the twilight of a society based on data. As information and intelligence becomes the domain of computers, society will place a new value on the one human ability that can't be automated: emotion (Jensen. 1999, p. 84)."

An effective education in the fine arts helps students to see what they look at, hear what they listen to, and feel what they touch. Engagement in the fine arts helps students to stretch their minds beyond the boundaries of the printed text or the rules of what is provable. The arts free the mind from rigid certainty. Imagine the benefits of seeking,

finding, and developing multiple solutions to the myriad of problems facing our society today! These processes, taught through the study of the arts, help to develop the tolerance for coping with the ambiguities and uncertainties present in the everyday affairs of human existence. There is a universal need for words, music, dance, and visual art to give expression to the innate urgings of the human spirit.(Eisner, 1987) The premier organizations in the corporate world today recognize that the human intellect "draws from many walls." Arts education gives access to the deepest of those walls.

Creativity and innovation

The act of creativity can be seen as that which provides the urge for continuing exploration and discovery. Creativity is being more closely related to the thinking abilities and to the attitudinal development. It is a continual process for which the best preparation involves creativity itself..

Every child is born creative. The urge to explore, investigate, discover, what is on the other side of the screen is not limited to human behavior, but is experienced by the whole animal kingdom,(Lower field and Brittan 1975). One of the most commonly agreed upon components of creative thinking is the ability to produce a large number of ideas. In general sense the idea of creativity means different things to different people of the world.

Creativity exists everywhere in people's life. It can be found in designing and packaging, processing and production, fabric and fashion, sign and architectural design, applied science and technology, visual arts, theatre, music, film (video production) and a host of other activities. Creativity in the modern dispensation is used as a powerful tool to attract attention to a nation or country powerful endowment. Creativity can be meaningful to individual, if it is ideologically and culturally inclined. Runco (1994) opines that creativity is in terms of cognitive processes that lead to an original and adaptive insight, idea or solution. Thus, creativity is the most essential of all human resources and skills (Bolaji 2007). Akinboye (2004) sees creativity as a tool that propels organizations, catapults careers, and generate potent growth and viable outcomes.

Creativity is at the heart of art and design, at all stages throughout the design process. The most exciting and challenging design is that which is truly innovative; the creation of a radical departure from anything currently on the market (Baxter, 1995). The more people try to define creativity by identifying with specific sets of values, meanings, beliefs, and symbols, the more our creativity will be focusing on how values, meanings, beliefs and symbols are formed, the greater the chance that our creativity will become

less restricted (Bolaji 2007).

One major way to spark creativity is through exploration, exploring exposes one to new things. New things are inspiring, while exploring one might stumble across a new way of doing something, a new thing to do, or something more subtle. Sometimes one uncover a bit of information that clicks with things he has been thinking about and completes (or helps to complete) the picture he has been developing in his mind. Other times one may discover a tool, a process or an approach that others are using which is unrelated but still inspiring in its ingenuity. In general, exploration can fuel ones creativity.

Creativity is a term that is often used indiscriminately. Distinctions are not made between "making," "producing" or "creating" works of art. Students are expected to create such works whenever they are engaged in art activities. "Creative self-expression" is a very common phrase in art education discourse. It implies that when students are expressing reactions to their own experiences they are being creative ... even though what they produce may be very similar to what they have produced before or to what their peers "create".

In addition, it is often believed that students' abilities to create art are dependent on inherited traits, which are not easily altered by classroom experiences. Because of these assumptions, the nature of creative

behavior is not sufficiently differentiated, and there are seldom any specific efforts made to develop particular creative skills. Articulating the skills associated with the production of art includes clarifying the aspects of creative behavior that are agreeable to change in the art class. For example, "fluency" and "flexibility" are traits that are associated with creative behavior. In order to insure that these traits are nurtured, art activities must require students to generate a variety of responses (fluency) and/or easily alter their works (flexibility) to increase their expressive impact.

It must be remembered, however, that the extent to which students will be successful and creative (producing art that is both worthy as art and innovative) will depend on the student having acquired an adequate range of the technical, observational, representational and interpretative skills that are essential to the production of art.

What can teachers do to encourage, value, and promote diversity?

Fine arts practice requires students be provided with an environment that is conducive to learning both theoretical and practical skills. The society people find themselves is more diverse, it is important that students learn to value and use diversity to the greater good. In any setting valuing diversity should be a thing of concern to all in order to create an environment where each

student feels valued and respected. In order to value diversity, it is necessary:

- Take time to learn about students' background, interests, and learning style.
 - ◆ This will allow create an environment that is conducive to each individual student.
- Allow time for the students to learn about each other and gain an appreciation for the diversity they bring to the classroom.
 - ◆ Students should be reminded how boring it would be if all alike and there were no difference
 - ◆ Students should be aware that everyone has strengths and weaknesses. When working as a team students should be encouraged to take advantage of the strength of the team members in order to produce the best possible results.
- Bring in different people to the class as resources that students might be able to connect with.
 - ◆ Search out people that are different from each other and that might share certain qualities with other students.
 - ◆ Students need role models. Many times when they see they are connected in some way to a person they will be more apt to listen and learn from them.
- Never tolerate bullying, teasing, and other put-down behavior at any time in the classroom/studio.
 - ◆ Implement a "zero tolerance" for anything that is disrespectful, hurtful, or intolerant of diversity.

The idea of diversity encompasses recognition and respect. It means understanding that each individual is unique, and recognizing their individual differences. These can be along the dimensions of race, ethnicity, gender, sexual orientation, socio-economic status, age, physical abilities, religious beliefs, political beliefs, or other ideologies. It is the discovery of these differences in a safe, positive, and nurturing environment that matters in any art studio and classroom environment. This is all about understanding each other and moving beyond simple tolerance to embracing and celebrating the rich scope of diversity contained within each individual.

Research is a highly valued activity in that being engaged in legitimate fine art making task implies that one is also engaged in a worthwhile research activities. The value of diversity therefore is the exploration of these differences in a safe, positive, and nurturing environment.

Enhancing our capacity to deal creatively with diversity Enhancing our capacity to deal creatively with diversity and helping ourselves collectively tap into the incredible richness that awaits us there. A tremendous amount of wisdom, know how and methodology exists on this subject already, albeit not as well integrated as we might like. So we all have adventures to undertake to help develop it and weave it together.

Students do have differences which can be categories into primary and secondary types of diversity. The first is visible differences such as gender, ethnic origin, and age fall into the primary category; whistles obvious differences such as class, sexuality, and disability and work style come under the secondary category. Research work on the issue of diversity should be focused on the positives and strengths of difference as well as the problems. It engages with and understands the totality of people's identity and experience, and in addition recognizes and confronts experiences of oppression and discrimination and their impact on the individual. Many differences occurring

within behavior, lifestyles, customs and habits embrace tradition going back generations and these are often encapsulated in what we know as culture. Lemos and Crane (DoH, 2001)highlighted a lack of cultural awareness and unequal treatment in service delivery.

Diversity is a concept that embraces a wide range of characteristics including:

- language
- Race
- ethnic background
- Dress
- Values
- Age
- Gender
- educational background
- religious observances
- political interests

- notions about social and community responsibilities
- economic status
- mental, physical disabilities

Diversity, or difference, is a central feature of modern existence, partly because of interaction between cultures; may be for historical reasons; and can be through the growth of international communications technology. As a result, we have to be aware and accepting of differences if we want to reap the benefits that naturally flow from diversity.

We are living in a society that is ethnically and culturally diverse and it is important that services reflect this. This is important in an art environment that better reflect the lives of different people and section of the society. In the same way that cultures interact with each other, diversity brings new skills and fresh ideas. We are all different one from each other and it is these differences that have a penetrating value and direct pertinence to the workplace.

The key elements of working with diversity and discrimination are:

- That discrimination is often, subtle, unintentional and cumulative.
- That people often respond to being told they are discriminatory by being defensive, dismissive, denying, disregarding or downgrading.
- That discrimination can be active or passive. Doing nothing in some situations can be as damaging as actively discriminating.
- That people are multi-dimensional.

They are not just a race or gender, but have an age, a class, sexuality, an educational experience. All these things will affect who they are.

- There are often hidden elements to our own and others diversity; a sexuality, dyslexia, a particular faith
- The impact of people difference on others, remembering that we are as different from others as they are of us, and power relationships arising
- Recognize and celebrate the strengths and positives of diversity is so important in our society.

Educational values art

In general education, art contributes to the development of a very important area of literacy by cultivating abilities to utilize a non-verbal language of expression and communication. Art plays an essential role in supporting and changing culture. It enhances almost everything that humans manufacture. Art is so important in our personal lives and as fundamental as a vehicle of expression and communication that individuals and societies could hardly exist without. So student should take due advantage of this involvement in art in order to contribute to cognitive development and to their growth and well-being.

CONCLUSION

Appreciating and valuing diversity in teaching visual arts normal starts with a clear understanding of its fundamentals, it is necessary to nurture an appreciation and value of art, and to demonstrate that the visual art are an extraordinary

phenomenon, that are essential to the wellbeing for the individual and the society. The value of diversity and the differences can then be appreciated by a clear understanding of what the visual art means. The visual art is an integral part of the society, education engagement in art activities is an essential part of the school curriculum which when acquired helps in human development. The value and diversity in teaching the visual arts need to be recognized and respected. Art provides learner with academic benefit such as promoting self esteem, motivation, aesthetics, awareness, creativity, innovation and emotional expression as well as social harmony and appreciation of diversity. Fine art practiced by nature requires that students be provided with an environment that is conducive to learning both theoretical and practical skills. Education in every society is very important factor to the cultural and artistic development of the society.

Art contributes to the development of a very important area of literacy by cultivating abilities to utilize a non verbal language of expression and communication. Art plays an essential role in supporting and changing culture. There are benefits associated with this dispensation that are rooted in exploration and innovation. Thus, there are far reaching benefits for any developing nation that makes creativity the center of its philosophical ideology. Methodologies that aid exploration and

discovery of potentials, a problem-solving ability which allows the learner the opportunity for creativity should be focus of any educational endeavor or curriculum transformation. The need for a paradigm shift from theoretical and paper certification to a practical application of knowledge necessary for future employment and skill development in the art and design for self-employment is very necessary for Africans development.

There are benefits associated with this dispensation that are rooted in visual art teaching in Nigeria higher institution which is through exploration and innovation. Thus, there are far-reaching benefits for any developing nation that makes creativity the centre of its philosophical ideology.

REFERENCE

- Akinbeye, J. O. (2004). Creativity, Innovation and Success, Ibadan-Nigeria: Stirling-Hordens Publishers NigeriaLtd.
- Anya, A.O. (1982). The Environment of Isolation The Ahiajoku Lecture, Ministry of Information, Owerri, Nigeria
- Baxter, M.R. (1995). Product Design, Practical Methods for the Systematic Development of New Products, New York: Chapman and Hall
- Bolaji, S.D. (2007). Akinpelu's Educational Philosophy and its Implication to Educational System in Nigeria,
Unpublished Master's Thesis Submitted to the Department of Educational Foundations, Faculty of Education, University of Lagos
- Lower field and Brittian, L. (1995). Creative and Mental Growth, New York: Macmillan Publishing Co. Inc.
- Murray, J. (1966). Introduction to African Art, London: Camelot Press Ltd.
- Rodney W. (1982) How Europe underdeveloped Africa, Enugu, Nigeria: Ikenga Publishers
- Runco, A. M. (1994). Encyclopedia of Human Behavior, New York: Academic Press Inc

ULI MOTIFS: IT'S AESTHETICS ON ARCHITECTURAL WALLS

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Abstract

This paper looks into the need to give the Uli art Culture of Eastern Nigeria an artistic visual design identity based on their tradition. The exploratory design analysis which is used is based on the concepts that ideas and materials for the old and new methods of the Utu culture. It has been analyzed and synthesized into more dynamic indigenous system of visual communication in Nigeria that will enhance the general development of the society. The analyses of signs, symbols, posters and other art works were carried out based on their artistic, aesthetic and functional design mainly as it concern the Uli and Nsibidi visual method of communication design in modern time. The research harmonize the traditional and the modern method with a view to developing a new visual made communication method based on their culture and technology in recent time. The culture just like their close associates could also reduce these sign and symbols into simple code for confidentiality, security, affection and economic transitions among themselves.

Keywords: Uli motifs, culture, visual design, architectural walls

INTRODUCTION

Uli motifs or representations are an Igbo art form initially used by women to

decorate the body and architectural walls on certain occasions. It consists of a system of symbolic drawings or design in the form of animals, plants, material, objects and other abstract designs. Uli motifs are studied in order to bring it closer to the visual artist and also understanding its aesthetics preferences in Igbo culture.

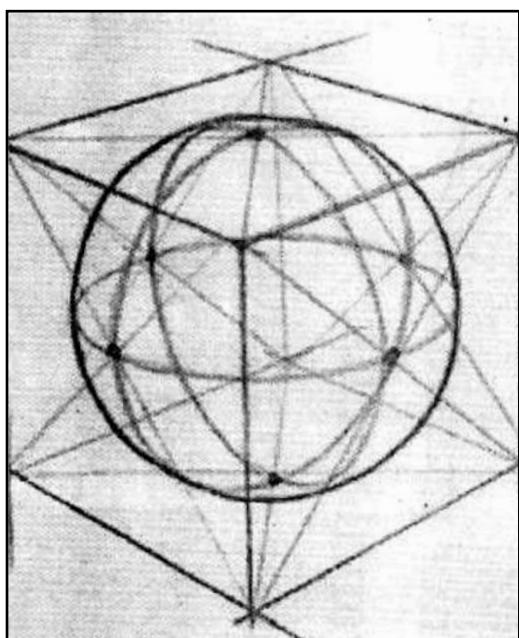
The motifs represent things of physical importance, aesthetic appeal and relevance to traditional belief, (Willis 1987). Udechukwu (1981) stated that "Uli is calligraphic in form and it is quite possible that it was linked with some kind of writing somewhere in the past: that ide (to write) appears in ide Uli (to draw with Uli) and ide ife (to write something) or ide akwukwo (to write on paper) shows their close kinship as well as the possibility of one deriving from the other. In 1992, Obiora Udechukwu, showed works of both "traditional" and modern uli women artists, in an exhibition titled Uli: Different Times, Different Hands organized at University of Nigeria, Nsukka, These creative exercises by both old and modern artists provided a new stylistic approach, that is most original and philosophical creative art

idiom in the use of Nigerian indigenous images that emerged in modern time. Willis (1987) in her work titled, A Lexicon of Igbo Uli Motifs asserts that, "the woman's perception of all aspects of life and nature, and most notably, ideas and objects which are held to be particularly important and representative of Igbo culture, are transmitted into visual vocabulary which provides important reference materials for designers, architects, art historians, and ethnographers alike. It is on record that over the past thirty years, there have been many studies on the form and function of Uli drawing and design as seen in specific locations: K. C.Murray's notes on Uli painting in the Bende area of Abia State, Nigeria and M.D.W. Jeffrey's note on Uli paintings and design in Awke, Anambra State have provided a significant number of motifs. Uli draws and designs as an art form, expresses the culture of Igbo people.

Architectural graphics is an abstract wall design mostly used to (enhance) enliven large public space which otherwise would be very dull. Design can involve recognizable motifs appropriate or typical to the situation under or may be completely abstract. Signs and architectural graphics should be properly use in the environment in order to educate and make people aware of their culture. Sign system or architectural graphics is very important and useful in the present changing world of things. It points the way or

directs travelers quickly and clearly, thereby playing a crucial role in accelerating and making life's what living. Colorful design elements are particularly useful in old and new buildings or projects where there is a rich mixture of shops and restaurants; in airports hospitals and public places. Sign package and construction is not only determined by the graphics element of types and style but also by the environment in which the scheme has to appear and the function the signs are expected to play. The boundary between sign and architectural graphics (wall treatments, flags and banners for example) is often subtle, at times non-existence. Some wall graphics can serve the dual function of displaying information and providing large area of color. But architectural graphics as an abstract wall design are mostly used to (enhance) enliven large public space which otherwise would be very dull. Design can involve recognizable motifs appropriate or typical to the situation under or may be completely abstract. Art in general sense is the expression or application of human creative skill and imagination, typically in a visual form such as graphics, painting or sculpture, producing works to be appreciated primarily for their beauty or emotional power. Art can be defined as a diverse range of activities executed by human beings, as well as the products of these activities. Art can be of many forms as well. A visual art is the creation of images that can be seen by the eyes. The

visual art also include sculpting, painting, ceramics, graphics, photography, and other visual media. Other form of art includes music, theatre, dance, film, and other arts that require performing fall under the performing arts category. Literature and other form of interactive arts fall under broader definition of arts while fields such as interior design, architecture, industrial design of applied arts. Art can also be defined as the representation of reality, communication of emotion, expression or other qualities. Aesthetics is the branch of philosophy that explores arts and the related concepts such as interpretation and creativity.

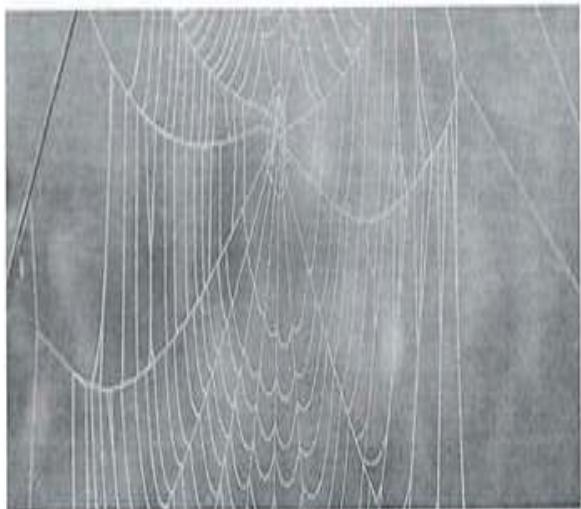


Geometric shapes and lines
Uka, 2000

Line an element of design play important function in art production is very useful in any visual representation. Akalaka in Igbo means "the lines of the hand or palm", predetermine that a man

would be encode the choice he made at the point of reincarnation of returning to the world of the living. What is line - It is the bases of all visual formation. The designer who occupies a responsible position in the society by creating functional and beautiful things using his hands through his brain condition by his mind either by inspiration, talent or intuition of expression as a force in the realization of works of art. The designer or artist using available tools at his disposal engages in a serious business of creation. The design through his media of expression he designs/creates and covey the weight of his creative experiences, just like the architect use different lines, basic geometric shapes in the design and construction of buildings and other structures, Artist/designer is always concerned with their place and their works. Art is a historical document which mirrors and reflects the social tendencies of the time of its creation, which provides the viewer with the artistic motivation into the visual power of in expansion of and exploration into the nature of man. Art in geometric representation of idea in different types of lines circle, curves, straight and so on. Line is the bases of all formation; it can be viewed from different perspectives as a chain of spots joined together, a stroke made with a pain, narrow long mark. Line can be thick, straight, zig-zag and so on; it can be similar and contrasting. Lines are used to divide space, direct the eyes and also create form. These are major types

of lines. Actual lines, implied lines and three dimensional lines. Line is a basic element in architectural construction. Descriptive geometry is the branch of geometry which allows the representation of three-dimensional objects in two dimensions, by using a specific set of procedures. The resulting techniques are important for engineering, architecture, design and in art. This branch of mathematics concerned with the properties and relations of points, lines, surfaces, solids, and higher dimensional analogs, the shape and relative arrangement of the parts of something, for example the "the geometry of spiders' webs" and buildings.



Uka, 2020

Dimensional Form: here the designer drawn or craft out his works in various plans of space to represent the real objects intended to produce. This type of design process can further be classified into 2D and 3D designs. 2-dimensional designs are works done on flat surface. It involves such activities

as drawing, painting on fabrics, well paper and advertising layout: designing in two plans. 3-dimensional designs are works executed in the round. It includes such activities as sculpture, architecture, handicraft such as jewelry, pottery, leather works, clothing and machine-made objects such as chairs, automobiles, package, 3D animation and so-on, are example of 2D and 3 D drawing. This is designing in three plans. All geometric aspects of the imaginary object are accounted for in true size/to-scale and shape, and can be imaged as seen from any position in space. All images are represented on a two-dimensional surface.

Descriptive geometry uses the image-creating technique of imaginary, parallel projectors emanating from an imaginary object and intersecting an imaginary plane of projection at right angles. The cumulative points of intersections create the desired image.

The research into the aesthetics of Uli motifs design on architectural walls in Nigeria is very necessary as it concerns our culture, it is important to clarify the meaning of "aesthetics" as a domain to be investigated. Uli motifs or representations is an Igbo art form initially used by women to decorate the body and walls on certain occasions, it consists of a system of symbolic drawings or design inform of animals, plants, material objects and other abstract designs. Ulimotifs are studied in order to bring it closer to the visual artist and also understanding of its

aesthetics preferences in Igbo culture. Generally speaking, aesthetics can be a set of principles that concern with the nature and appreciation of beauty, specifically, a set of principles underling the work of a particular artist or artistic movement.

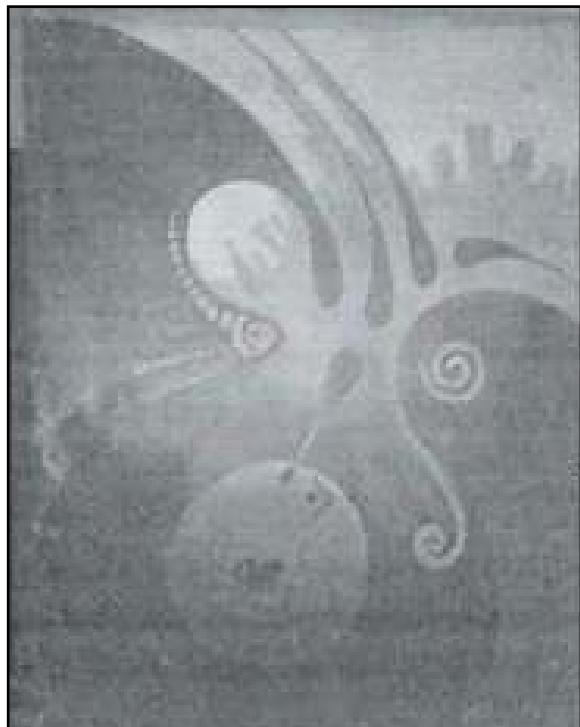
Aesthetic qualities are qualities seen by the viewer when looking at the artwork. For the artist/designer, Aesthetic qualities are when art elements and principles come together to create a certain feel, to the image such as warm color which create a sense of beauty and harmony. To demonstrate the value of learning about the cultural context of works of art, the aesthetic analysis exercise that follows will also include reviewing some of the cultural components associated work. In order to demonstrate the value of learning about the cultural context of works of art, the aesthetic analysis exercise that follows will also include reviewing some of the cultural components associated with the work.

Visual metaphors are implied as a consequence of analyzing the relationships between the formal structures and subject matter of works of art. In addition to their role as symbols, the crosses can also function as visual metaphors if the artist will take the time to analyze their form-content relationships. A metaphor is a figure of speech that transfers one thing to another through implied comparisons. It is used to infuse writing and speech with vitality, which make both more

interesting; example is when "the artist made minced meat out of his colors. When an artist start thinking beyond merely identifying a work's visual elements (the character of its lines, shapes, colors, and so on.) and the ways in which these elements are organized. It is essential to consider the proposition that works of art speak to us through both their formal organization and the signs, symbols and metaphors that can be associated with them. Works of art become most meaningful for us when they evoke thoughts and feelings."

Art is the expression or application of human creative skill and imagination, typically in a visual form such as graphics, painting or sculpture, producing works to be appreciated primarily for their beauty or emotional power. Art can be defined as a diverse range of activities executed by human beings, as well as the products of these activities. Art can be of many forms as well. Avisual art is the creation of images that can be seen by the eyes and these include sculpting, painting, ceramics, graphics, photography, and other visual media. Other forms of art include music, theatre, dance, film, and other arts that require performing fall under the performing arts category. Literature and other form of interactive arts fall under broader definition of arts while fields such as interior design, architecture, industrial design and the likes fall under the category of applied arts. Art can also be defined as the representation of reality, communication of emotion, expression

or other qualities. Aesthetics is the branch of philosophy that explores arts and the related concepts such as interpretation and creativity.



Ekekwe Chukwunyere Daviud 2002

Title: Death & Resurrection Some of the mortifies are "Akalaka" in Igbo means "the lines of the hand or palm", which can predetermine that, a man could or would be encoding the choice he made at the point of reincarnation of returning to the world of the living. In Igbo culture, line is the bases of all visual formation. The designer who occupies a responsible position in the society by creating functional and beautiful things using his hands through his brain condition by his mind either by inspiration, talent or intuition of expression as a force in the realization of works of art. The designer or artist using available tools at his disposal engages in a serious business

of creation. The design through his media of expression he designs /creates and covey the weight of his creative experiences.

Art is a historical document that mirrors and reflects the social tendencies of the time of its creation; it provides the viewer with the artistic motivation into the visual power of in expansion of and exploration into the nature of man. Art can be represented in different forms and media; it can be a geometric representation of idea with different types of lines circle, curves, straight and so Line is the bases of all formation; it can be viewed from different perspectives as a chain of spots joined together, a stroke made with a pain, narrow long mark.

Line can be thick, straight, zig-zag and so on; it can be similar and contrasting. Line is used to divide space, direct the eyes and also create form. These are major types of lines. Actual lines, implied lines and three dimensional lines there all so exist bother types of line in art works outside these regard of research.

CONCLUSION

Uli motifs have through this paper exposed the Igbo cultural heritage and it's aesthetics on architectural wall design in Nigeria. Art which is the expression or application of human creative skill and imagination, typically in a visual form such as graphics, painting or sculpture, producing works to be appreciated primarily for their beauty or emotional power. Art is a

historical document which mirrors and reflects the social tendencies of the time of its creation it also provides the viewer with the artistic motivation into the visual communication power inheriting it. The ideas or ways of doing something new is one way of changing and developing our environment, Uli and Nsibidi artists have introduced new ways of representing their works in contemporary time. African's have embraced creativity and innovation as a way forward towards the expression of our artistic ingenuity to the whole world. Creativity and spontaneity may succeed in limiting uncertainty leading to more stable living conditions of Africans. Changes brought by creativity and spontaneity can be subsumed under the more general

frame work of a quest for order which can be assumed to lie at the heart of any kind of socialization. The symbols, signs and motifs used by Nsibidi and Uli artist are form of visual presentation and communication which in deed form part of our daily living. In the traditional setting these signs, symbols and motifs were used by our ancestors to communicate and other things. This was mainly to communicate messages, ideas and information in form that can be read or looked upon for aesthetics and other purposes. The term "visual" presentation in graphics communication is used to refer to the actual presentation of information to the public through a visual medium such as text, images, symbols, and a combination of other graphics elements via a particular media of presentation.

REFERENCES

- Arnol A.S. (1937) "Art and Industry in Arechukwu" Nigeria No. 12, pp-11
- Isichei Elizabeth (1975) A History of the Igbo people, London: Macmillan, p. 3.
- Jefferys M.D. W (1957) Negro abstract art or Ibo body patterns. S. A.M.A.B. (South African Enugu, Fourth Dimension Publishers
- Kalu, O.U. (1978 Ed) "Writing in pre-colonial Africa; A case study of Nsibidi", African Cultural Development, and Ireland, Vol. 30
- Macgregor, J.K. (1909). "Some notes on Nsibidi" in The Journal of the Royal Anthological Institute of Great Britain
- Murrey K.C. (1972) Ibo body painting Unpublished notes and drawings Museums Association Bulletin) No. 6, pp. 219-229
- Talbot 1912:305, 1969.932). Peoples, IV. pp95-96
- Ubom, LP. (1987). "Cultural development in Cross River State" in Akwa Ibom and Cross River State: the Land, the People and Their Culture: Abasiattai

Monday B. (Ed), Calabar, Wusesn Press Limited

Udechukwu Obiora (1981) Uli AND LI: aspects of Igbo and Chinese Drawing and
PaintingNigeria Magazine NOS. 134-135

Umoetuk, O. U. (1985), "Body Art in Ibibio Culture" Nigeria Magazine, Vol. 53 No. 2
April-June

Willis Elizabeth A (1987) ALEXICON OF IGBO ULI MOTIFS in Nsukka Journal of
the Humanities Number 1, June 1987

Kalu, O.U. (1978). "Writing in pre-colonial Africa; A case study of Nsibidi", African
Cultural Development,Enugu: Fourth Dimension Publishers.

Isichei Elizabeth(1975)A History of the Igbo people, London: Macmillan, p. 3.
and Ireland. Vol. 30

Macgregor, I.K. (1909). "Some notes on Nsibidi" in The Journal of the Royal
Anthological Institute of Great Britain

Jefferys, M.D. W (1957) "Negro abstract art or ibo body patterns' S. AM. A. B. (South
African

Murrey K.C. (1972) 'Ibo body painting" Unpublished notes and drawings
Museums Association Bulletin) No. 6, pp. 219-229

Udechukwu Obiora (1981) Ull AND LI aspects of Igbo AND Chinese Drawing and
Painting.Nigeria Magazine NOS. 134-135

Talbot (1912:308), 1969:932) Peoples, IV. pp95-96

Ubom, I.P. (1987); "Cultural development in Cross River State" in Akwa Ibom and
Cross River State: the Land, the People and Their Culture: Abasiattai
Monday B. (Ed), Calabar, Wusesn Press Limited

Umoetuk, O. U. (1985); "Body Art in Ibibio Culture" Nigeria Magazine; Vol. 53 No.
2 April-

Willis Elizabeth A (1987) ALEXICON OF IGBO ULI MOTIFS in Nsukka Journal
of the Humanities Number 1, June 1987

PROXIMATE ANALYSIS, ANTIOXIDANT PROPERTIES AND ASCORBIC ACID CONTENT OF FICUS CAPENSIS FRUITS

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Abstract

The application of different parts of *ficus capensis* tree in ethno-medical and nutritional purposes have gathered tremendous interests among scholars currently. However, there is almost absent of such scholarly report on the fruits of this tree. Hence this work is aimed at stimulating the bioprospection of the fruits in order to establish its medicinal and nutritional qualities. The proximate analysis, antioxidant properties and ascorbic acid content of *ficus capensis* fruits collected from Maryland, Enugu South Local Government Area of Enugu State Nigeria is reported. The parameters investigated were determined using standard biochemical methods. The proximate analysis of the fruits give the following distribution: Ashcontent (9.0%), crude fiber (4.53%), crude protein (8.28%), moisture content (6.0%), crude lipid (3.5%), and carbohydrate (68.69%). The high percentage of carbohydrate shows that this fruit is a good source of energy. The antioxidant activity of the methanol extract of the fruits was tested using DPPH- Scaving assay. The DPPH- free radical scavenging activity of the methanol extract of the fruits show good antioxidant activity. Ascorbic acid was determined by redox titration using iodine solution according to AOAC 1990. This showed that the fruits are quite rich in ascorbic acid which adds to the medicinal and nutritional values of the fruits.

Keywords: *Ficus capensis* fruits, moraceae, Proximate composition, Antioxidant Property, Metabolic extract, Ascorbic acid.

INTRODUCTION:

Ficus is a genus of family moraceae and consists of about 850 species. About 200 different varieties of *ficus* are present as woody trees, shrubs and vines in the forests of tropical and subtropical regions. Since ancient times, *ficus* species has been used as a source of food to improve the health of mankind. Most of the species of *ficus* are used in industrial products as nourishing foods. These are composed mainly of water, lipids, essential amino acids, minerals and vitamins. *Ficus* genus worked as food additives that are used frequently as health – promoting Mediterranean diet. It has great importance as nutraceutical and in biopharmaceutical industries. They are known as rich sources of amino acids that are totally free from cholesterol and fat contents. *Ficus carica* is

an excellent source of minerals containing copper, manganese, magnesium, potassium and calcium according to human needs.

Ficus species have been used as traditional medicines to cure diseases, such as, astringents carminatives, stomachic, vermicides, hypotensive, anthelmintic and anti-dysentery drugs.

Ficus species, such as, *Ficus racemosa*, *F. glomerata*, *F. glumosa*, *F. carica*, *F. religiosa* and *F. benghalensis* are known from ancient times as herbal medicines to treat diabetic disorders as regulating enzymatic activities, carbohydrates absorption rate, increasing insulin sensitivity, insulin secretion, hepatic glycogen synthesis, peripheral glucose uptake and antioxidant status of body.

Ficus Capensis is a fast growing, deciduous or ever green tree. It usually grows to about 5-12 meters (16-39ft) in height but may attain a height of 35-40 meters (115-131ft). The large alternate and spirally-arranged leaves are ovate to elliptic with irregular serrated margins. Fresh foliage is conspicuous red color. The bark of young tree is smooth and pale greyish-white in color in contrast to the flaky, yellow bark of *F. sycomorus*, with increasing age, the bark becomes darker and rough. The figs are carried on long drooping spurs or fascicles which may emerge from surface roots, the trunk or especially from lower main branches. The figs are 2 – 4cm in diameter and acquire a rosy speckled exterior when ripe (Palgrave, 1984).



Fig.1: *FICUS CAPENSIS* TREE

MATERIALS AND METHODS

Collection of plant material

The fresh fruits of *Ficus capensis* used for the study were collected from the fig tree (*F. capensis*) from Maryland, Enugu South Local Government Area of Enugu State. They were authenticated by

a Botanist at University of Nigeria Nsukka, in the Department of Bioresources and Conservation Research Centre Nsukka.

Preparation of plant material

The fruits of *Ficus capensis* were first plucked, washed and drained under air. The fruits were cut into pieces after draining under air and were spread under the sun to dry. After drying of the fruits sample, it was then pulverized to powder using an electric grinding machine (Panasonik MX-337N). The powdered material was stored in an air-tight container.

Preparation of the extracts

Four hundred grams (400g) of the powdered fruit sample was extracted with 1500ml of methanol using cold maceration for 24 hours with continuous stirring. The mixture was filtered with whatman No.1 filter paper. The filtrate was concentrated using oven under a reduced pressure at 40°C to obtain the crude extract of *ficus capensis* fruits. The crude extract was stored in a refrigerator until it is ready for use.

PROXIMATE ANALYSIS

Determination of Percentage Moisture

The hot oven method of Pearson (1976) was used. One (1g) of the sample was measured into a thoroughly washed and oven dried crucible. The sample in the crucible was put in the oven at 105°C for 1 hour to dry and the weight was recorded. The sample was dried for another 30 minutes and cooled in desiccators. The weight was also taken. This was repeated till a constant weight was attained. Moisture content was then calculated thus:

$$\% \text{ Moisture} = \frac{W_2 - W_3}{W_2 - W_1} \times 100$$

where Weight of crucible = W_1 , Weight of crucible + sample before drying = W_2 , Weight of crucible + sample after drying = W_3

Determination of Percentage Ash Content.

An empty crucible was washed, dried and the weight was noted. Two grams of the ground sample was weighed accurately into a platinum crucible and was ignited in a universal hot-air oven for 24 hours at 600°C. The platinum crucible and its content were then cooled to room temperature in desiccator. The ash content was then obtained by calculation.

$$\% \text{ Ash content} = \frac{W_2 - W_1}{2g} \times \frac{100}{1}$$

Where weight of empty platinum crucible = W_1 , weight of platinum crucible + sample after burning = W_2 .

Determination of Percentage Crude Fibre

In the determination of crude fibre, we used the method of Joslyn (1970)

Two (2g) of ground sample was measured and put in 250 ml conical flask, soaked in 100 ml of 1.25 % v/v H₂SO₄ for 10 minutes, and heated for 30 minutes on a hot plate. The resulted mixture was filtered and the residue washed with hot distilled water three times to ensure that it is no more acidic. The residue was re-soaked in 200 ml of 1.25% w/v NaOH and heated again for another 30

minutes. The solution was filtered in a known weight of filter paper, dried in oven at 100°C for 2 hours, cooled and reweighed.

$$\% \text{ Crude Fibre} = \frac{\text{weight of Fibre}}{\text{weight of sample}} \times 100$$

Weight of ash = weight of Platinum Crucible + Ash - Weight of Platinum Crucible,

Weight of Fibre = Weight of Residue - Weight of Ash

Determination of Percentage Fat and Oil

Soxhlet extraction method of AOAC (2000) was used. Five gram (5g) of the sample was wrapped in a filter paper and put in a Soxhlet extractor. A heating mantle was applied below a conical flask with n-hexane inside, which aided in oil extraction. The system was recycled 8 – 9 times to achieve maximum yield of oil. At the end of the recycling, the extractor was disconnected and distillation apparatus set up to separate the solvent (n-hexane) from the oil, as a way of solvent recovery. An empty beaker was weighed and the mixture containing oil and traces of the solvent after distillation was transferred into the weighed beaker and heated to remove the remaining n-hexane leaving only the oil. This was cooled in desiccators and the weight of the beaker determined again.

$$\% (\text{Oil and Fat}) = \frac{W_2 - W_1}{\text{Weight of sample}} \times 100$$

W_1 = Weight of empty beaker, W_2 = Weight of beaker + Oil

$W_2 - W_1$ = Weight of Oil

Determination of the Percentage Crude Protein Content:

The Kjeldahl method of AOAC (2000), was used.

This method comprises of three major stage. These are digestion, distillation and titration stages.

Digestion: 0.5 g of the sample was measured into a Kjeldahl flask, 10g of sodium tetraoxosulphate (V1) (Na_2SO_4), was added to increase the boiling point, and 1g of copper (II) tetraoxosulphate (VI) (CuSO_4) was added as catalyst. Then 20 ml of concentrated tetraoxosulphate (IV) acid was added.

This was digested by heating with bunsenburner in a fume cupboard until the solution turned bluish green, indicating complete digestion. Heating was stopped and the solution was allowed to cool for 24 hours.

On cooling, the solution solidifies and the colour changed from bluish green to white. The essence of the digestion is to convert all the nitrogen to ammonium ions (NH_4^+).

Distillation stage:

200ml of distilled water was added to the solidified sample in the kjeldahl flask to dissolve it, giving an exothermic reaction. The solution was placed in a refrigerator to cool. After cooling, 60ml of 40% NaOH was added to it.

Also, 3 pieces of zinc metal, acting as catalyst was added and then transferred to a round bottom flask connected to distillation apparatus and heat. The distillate was collected in a 250ml conical

flask containing 4% boric acid (100ml) and 2 drops of screened methyl red indicator. The collected solution in the conical flask was pink in colour but when the distillation was completed, the colour changed to light blue.

Titration stage

The collected solution (distillate) of about 200ml was titrated with 0.1N H₂SO₄. The end point was taken when the colour of the solution changed from blue to pink.

$$\text{Percentage Crude Protein} = \frac{100 \times TV \times 0.0014}{\text{Weight of sample}}$$

Where, 100 = conversion of %, TV = titer value,

0.0014 = constant, which implies that 0.0014 is liberated by 1ml of 0.1N H₂SO₄

Determination of Percentage Carbohydrate

The method of Pearson (1976) was used. Thus, the carbohydrate content of the sample was determined by taking the sum of ash, protein, moisture, crude fibre, fat and oil from 100. That is % Carbohydrate = 100 - (% Ash + % Protein + % Moisture + % Crude Fibre + % Fat and Oil).

ANTIOXIDANT

DPPH Scavenging Assay

DPPH- free radical scavenging capacity of the extract was evaluated according to the method of Brand Williams (1995).

A number of 0.5mls of the different concentration of the extract and standard were mixed with 3mls of methanol and 0.3mls of DPPH, the mixture were vortex for 1min and left to stand at room temperature in the dark for 30mins and the absorbance was read at 517nm, against a sample blank containing 0.5ml of the sample and 3.3ml of methanol, with a control containing 3.5mls of methanol and 0.3mls of DPPH solution.

ASCORBIC ACID (VITAMIN C)

Vitamin C was determined by redox titration using iodine solution as stated in AOAC (1990).

A number of 5g of sample was weighed into a conical flask and 50mls of water was added and allowed to stand for 24hours after which it was filtered. 20ml of the filtrate was measured into a conical flask. 150ml of distilled water was added. 5mls of potassium iodide solution (0.6M) and 1M hydrochloric acid was added each. 1ml of 5% starch indicator was added. The solution was titrated with 0.6M potassium iodate solution to end point (blue black coloration).

RESULTS AND DISCUSSION

PROXIMATE COMPOSITION

TABLE 1: Percentage proximate compositions of the *ficus capensis* fruit extract

Proximate Parameters	(%) Composition
Ash content	9%
Crude fiber	4.53%
Crude protein	8.28%
Moisture content	6.0%
Crude lipid	3.5%
Carbohydrate	68.69%

From table 1 above it could be seen that the high ash content (9.0%) in the fruits is indicative of the high mineral contents. Mineral helps in water balance, bone and body metabolism. Minerals are essential components of many enzymes, vitamins, hormones and respiratory pigments. They are cofactors in metabolism processes.

Crude fiber (4.53%). Fiber is an essential body nutrient. It helps in lowering constipation, high blood pressure, diabetes, cardiovascular diseases and cancer (Ishu, 2013). Thus its appreciable amount in the proximate composition of the fruit raises the nutritional qualities of this fruit. Moisture content (6.0) of the fruit shows that the fruit is a good source of water for the cells of the body (Okeke et al, 2008). The amount of moisture in the food is an indication of the water activity, hence it is used to determine food susceptibility and stability of spoilage microorganisms. Fat content (3.5%). Fat gives palatability to foods, serves as storage and transport forms of metabolic fuel, serves as thermal/ electrical insulators for subcutaneous tissues, emulsifier for drugs preparation and forms structural components of bio membranes (Antia et al, 2006). Essentially fat-soluble vitamins are processed by dietary lipids and consumption of much fats are known to cause cardiovascular diseases like atherosclerosis, cancer and aging (Antia et al, 2006) hence the moderate quantity of fat in the fruits of Ficus capensis demonstrates its importance for medicinal and nutritional uses,

The percentage composition of protein in the fruit under study is 8.28%. Proteins is essential for healthy growths in children, repair and maintenance in adult, production of immunoglobulins for body defense, production of enzymes and hormones (Emebu and Anyika, 2011).

The percentage carbohydrate in this study (68.69%) is high. Carbohydrates provides energy to body cells, mostly the brain cells which solely depend on glucose component of carbohydrates for its function (Effiong and Udoefia, 2009). The high content of carbohydrate in the proximate composition of the fruits shows that it is a good source of energy.

IN VITRO ANTIOXIDANT STUDIES

DPPH Scavenging Assay

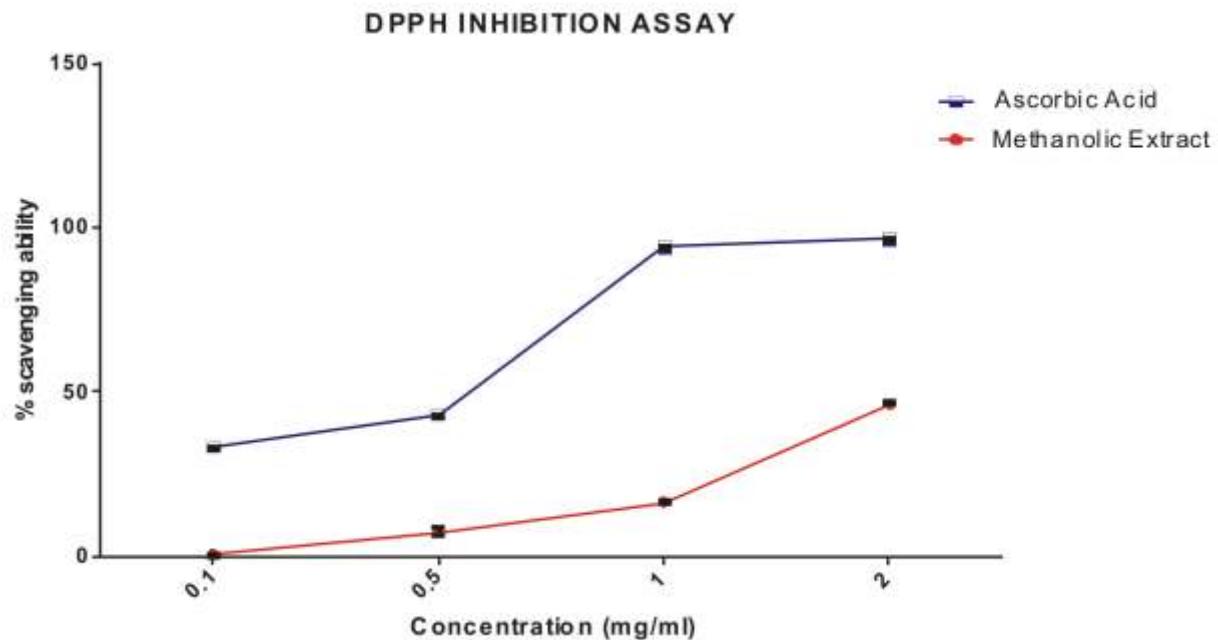


FIG 2: In vitro 1-1-DIPHENYL 2-PICRYL HYDRAZYL activities of Methanolic Extract of *Ficus capensis* fruits.

Fig 2 shows *in vitro* DPPH activities of Methanol extract of *ficus capensis* fruits. Different concentrations of extract were compared with ascorbic acid standard (0.1- 2.0 mg/ml). From the results obtained, methanol extract of *ficus capensis* fruits showed result of antioxidant activities at four concentration used (0.1, 0.5, 1.0, and 2.0). It is observed that the extract showed low antioxidant activities when compared with ascorbic acid standard.

Antioxidants protect cells against the damaging effects of reactive oxygen species otherwise called, free radicals such as singlet oxygen, super oxide, peroxy radical, hydroxyl radicals and peroxy nitrite which results in oxidative stress leading to cellular damage (Mattson & Cheng, 2006). Natural antioxidants play a key role in health maintenance and prevention of the chronic and degenerative diseases, such as atherosclerosis, cardiac and cerebral ischemia, carcinogenesis, neurodegenerative disorders, diabetic pregnancy, rheumatic disorder, DNA damage and ageing (Uddin *et al.*, 2008; Jayasri *et al.*, 2009). Antioxidants exert their activity by scavenging the 'free-oxygen radicals' thereby giving rise to a fairly 'stable radical'. The free radicals are metastable chemical species, which tend to trap electrons from the molecules in the immediate surroundings. These radicals if not scavenged effectively in time, they may damage crucial bio molecules like lipids, proteins including those present in all membranes, mitochondria and, the DNA resulting in abnormalities leading to disease conditions (Uddin *et al.* 2008). Thus, free radicals are involved in a number of diseases including: tumour inflammation hemorrhagic shock, atherosclerosis, diabetes, infertility, gastrointestinal ulcerogenesis, asthma, rheumatoid arthritis, cardiovascular disorders, cystic

fibrosis, neurodegenerative diseases (e.g. parkinsonism, Alzheimer's diseases), AIDS and even early senescence (Uddin *et al.*, 2008; Chen *et. al.*, 2006).

Antioxidant composition

Antioxidants are the substances which can scavenge free radicals and reduce the oxidative stress in the living and non-living systems. The antioxidants possess electron donating ability and inhibit the free radical-mediated oxidative reactions by various mechanisms, such as, hydrogen donation, metal chelation, metal and lipid reduction, inhibition of lipid peroxidation and free radical inhibition. Free radicals are the reactive oxygen and nitrogen species which are produced during various biochemical reactions particularly redox reactions. If not controlled properly, these free radicals may initiate the chain reactions in the biomolecules particularly the lipids and protein, cause the oxidative stress, and finally lead to the oxidative damage to the cell organelles, cells and tissues. The oxidative damage to the cells and tissues may further lead to various health problems including cardiovascular, neurological, hepatic, and musculoskeletal abnormalities and aging. In non-living system, the free radicals cause oxidative stress and rancidity in the food stuff for human. The naturally occurring antioxidant compounds have been proved to be effective in preventing the oxidative damage to the living and non-living systems. These substances are either synthesized endogenously or taken from exogenous natural sources such as plants. The naturally occurring antioxidants include some enzymes such as glutathione peroxidase, catalase, superoxide dismutase and some non-enzymatic phytochemicals compounds including phenolic acids, polyphenols, flavonoids, anthocyanins, ascorbic acid, tocopherols, and B-carotenes. Some synthetic antioxidant compounds have been also reported to be effective against free radical-induced oxidative damage.

ASCORBIC ACID CONTENT

Table 2: The result of the ascorbic acid content of *ficus capensis* fruit at different concentration per gram

Concentration	Concentration per gram of Ascorbic acid
5g	0.000216
15g	0.000648
100g	0.000432

Ascorbic acid is one of the most important water soluble vitamins. It is essential for collagen, carnitine and neurotransmitter biosynthesis.

Ascorbic acid (vitamin c) is food substance needed by human to prevent scurvy, a disease of the gums, bones and blood vessels, and to increase the body's resistance to infection. Ascorbic acid acts as an antioxidant, a nutrient that chemically binds and neutralizes the tissue-damaging effects of substances in the environment known as free radicals (Redmond, 2008).

As a result, ascorbic acid is vital for the growth and maintenance of healthy bones, teeth, gums, ligaments and blood vessels. Also because of its role in formation of collagen, the body's major

building protein, ascorbic acid is a central component of all the body organs.

Vitamin C is a cofactor in at least eight enzymatic reaction including severe collagen synthesis reaction that when dysfunctional, causes the most severe symptoms of scurvy (Food Standard Agency, 2007).

CONCLUSION

The study has shown proximate composition, antioxidant properties and ascorbic acid content of *ficus capensis fruits*, in a detailed form that enabled us to show the medicinal and nutritional qualities of the fruits. *Ficus Capensis Fruits* possess antioxidant potential due to higher concentration of phytochemical compounds. The fruits have a valuable role in human nutrition and have a great medicinal importance due to the presence of a variety of bioactive phytochemical compounds. These phytochemicals and water-soluble vitamins make *ficus capensis fruits* a medicinal plant which show various bioactive activities, particularly the antioxidant activity. On the account of its high antioxidant potential, *ficus capensis fruits* can be used for the management of oxidative stress and the treatment of various diseases. Oxidative stress is an important cause of many human diseases. The role of antioxidants in pharmacology is widely studied mostly in the treatment of different types of neurodegenerative diseases and stroke. Antioxidants are mostly used as food supplements so as to maintain health and prevent diseases. *Ficus capensis fruits* is a good source of antioxidants.

REFERENCES

1. Achi, N.K., Chimaraoke, O., Ekeleme – Egedigwe, C.A. Onyeanya J.C. (2017). Phytochemical, Proximate Analysis, Vitamine and Mineral Composition of Aqueous Extract of Ficus Capensis Leaves in South Eastern Nigeria.
2. Ahmed F, Urooj A. (2010). Traditional uses, medicinal properties, and phytopharmacology of *Ficus racemosa*: A review. Pharmaceutical Biology. 48(6):672-681.
3. Al-Snafi A E. (2017). Pharmacology of *Ficus religiosa* – a review. IOSR journal of Pharmacy. 7(3):49-60.
4. Antia, B.S; Akpan, E.J., Okon, P.A. and Umpren, I.U. (2006). Nutritive and anti-nutritive evaluation of sweet potatoes (*Ipomea Batatas*) leaves. Pakistan Journal of Nutrition 5:166 168.
5. AOAC (1990) Association of Official Analytical Chemists. Method of Analysis; 15th edition, Washington DC. 222-236.

6. AOAC (2000). Official Methods of Analysis International. Seventeenth Edition. Association of Official Analytical Chemist. Washington DC, USA.
7. Ayinde BA, Omogbai E, Amaechina FC. (2007). Pharmacognosy and hypotensive evaluation of *Ficus exasperate* Vahl (*Moraceae*) leaf. Acta Poloniae Pharmaceutica. 64(6):543-546.
8. Borokini, T.I., Ighere, D.A., Clement M., Ajiboye, T.O., Alowonle, A.A. (2013). Ethnobiological survey of traditional medicine practice for women's health in Oyo State.
9. Brand-Williams, W., Currelier, M.E. and Berset, C. (1995). Use of free radical methods to evaluate antioxidant activity. Lebensm Wiss Technol. 28:25-30.
10. Chen, F.N., Shieh, P. Kuo, D. and Hsieh, C. (2006) Evaluation of the antioxidant activities of Ruellia tuberosa. Food Chemistry. 94: 14 – 18.
11. Deepa, P. et al (2018). A role of Ficus species in the management of diabetes mellitus: A review Journal of Ethnopharmacology. 215: 210 – 232.
12. Diplock, A.T., Charleux, J.L., Crozier-Willi, G., Kok, F.J., Rice-Evans., Robertroid, M., Stahl, W. and Vina-Ribes, J. (1998). Functional food science and defence against reactive oxidative species. Brazilian Journal of Nutrition 80: S77 – S112.
13. Effiong, G.S., Ibia, I.o and Udofia, U.S. (2009) Nutritive and Energy value of some wild fruits in South Eastern Nigeria. Electronic Journal of Environment, Agriculture and Food Chemistry. 8(10): 917 – 923.
14. El-Fishawy A, Zayed R, Afifi S. (2011). Phytochemical and pharmacological studies of *Ficus auriculata* Lour. Journal of Natural Products. 4:184-195.
15. Emebu P.K., Anyika, J.U (2011). Proximate and Mineral composition of Kale (*Brassica Oleracea*) grown in Delta State, Nigeria. Pakistan Journal of Nutrition, 10(2):190-194.
16. Ephraim P.L., Helen M.P., Alison D.P. and Robert A.N. (2008). Ethnobotany and potential as anticancer and anti-inflammatory agents, Journal of Ethnopharmacology. 119 (2): 195 – 213.

AN APPRAISAL OF MAINTENANCE CONDITIONS OF RESIDENTIAL BUILDINGS IN HOUSING DEVELOPMENT CORPORATION ESTATES IN ENUGU METROPOLIS, NIGERIA

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Abstract

Residents always seek to change the use and extend the lives of their buildings by remodeling, modifying or abandoning occupied buildings in extreme case of dilapidation. Enugu has faced high building maintenance needs that require the synergy of both residents and facility providers as the needs of the residents would not be met at the rate of population increase. The aim of this paper is to appraise maintenance conditions of physical elements of residential buildings and infrastructure in Housing Development Corporation Estates in Enugu metropolis with a view to improving on building maintenance framework that could influence design concepts of public residential buildings. Survey design method was applied and it focused on four public residential buildings of ESHDC estates in Enugu metropolis. After stratification of the estates, based on their ages and simple random sampling, occupied buildings were selected for this research. Analysis of Variance (ANOVA) test was used to test differences between the variables Maintenance Conditions of Residential Buildings (MCRB) in ESHDC of Enugu Metropolis V51 (ordinal) and V52 (Nominal). With $p < 0.05$, the study found there was significant difference between the maintenance conditions of the buildings in the four housing estates investigated. The policy implication of these findings were that for improved building maintenance conditions, efforts should be made to spread across all the buildings by both residents of the estates and ESHDC as

implementation would likely be easier for the desired higher commitment to building and infrastructure maintenance. The proposed hypothesis was that 'there is no significant difference between the estates in maintenance conditions of residential buildings in ESHDC estates in Enugu Metropolis'.

Keywords: Building maintenance, public residential, poor funding, management system.

INTRODUCTION

Building maintenance culture is an attitude which appears to be lacking in Nigerian public residential buildings, as well as in office, educational or industrial buildings. Poor maintenance culture has become a widely recognized problem in Nigeria which has affected the quality of public residential buildings. These provide occupants with less conducive, safe, comfortable, healthy and secure indoor environment to carry out their daily activities of work, study, leisure and family life as well as social interactions, at times, at subsidized rates. To achieve this purpose, buildings are designed, planned, constructed and managed, based on standards and specifications established by government agencies, professionals and experts who are conversant with the needs and expectations of residents. These standards and specifications do not conform to the ever changing needs and expectations of residents; and so users always seek to improve maintenance conditions of their buildings for continued satisfactory use of their accommodation.

Building maintenance is the work undertaken to keep, restore or improve every building, its services and infrastructure in an acceptable liveable standard thereby sustaining the utility value of the building. This may include refurbishment to raise the original standards where appropriate. The ability to upgrade an existing residential building not only extends its useful life, but is clearly a more sustainable option than the process of demolition and reconstruction as in urban renewal programmes. The physical environment and infrastructure of residential buildings dictate the well-being of man. Hence, maintenance of buildings, is likened to the last leg of a relay race and a component of a conclusive phase of sustainable architecture.

Building maintenance programmes in Nigeria, have not received desired attention in the past as the emphasis is on the development of new facilities by both the facility providers and the beneficiaries. This approach by the providers is in the effort to solve the haphazard rural-urban paradigm that characterise urban growth in Nigeria. The need for maintenance commences immediately the buildings are occupied by users. Many development control guidelines are in place to let the building developers remain in tandem with global standards. Buildings are generally required to provide safe and conducive environment for the performance of various human activities. Odediran, Opatunji, and Eghunure (2012) stated that the ability of a building to provide the required environment for an activity is a measure of its functionality. Therefore as the components of a building begin to deteriorate, it becomes necessary to take measures to ensure that the desired characteristics of that building, which provides safety and

convenience are retained.

Occupied residential buildings, in public housing estates in Nigeria, have been found to lack adequate maintenance attention from the estate managers. Similarly, the infrastructural facilities are in very poor and deplorable conditions. A pilot survey of such estates in Enugu metropolis corroborates these assertions. There is thus the need for adequate and affordable buildings and infrastructure maintenance in ESHDC estates in Enugu metropolis. The efforts of the Enugu State Government to achieve sustainable public housing, has not led to better building maintenance framework. It would appear that the adoptive building regulations and tenancy agreements with residents and contract agreements with facilities managers are not being implemented.

It is against this background that this study examines the major challenges militating against building and infrastructure maintenance conditions in Enugu with a view to stimulating relevant stakeholders in designing appropriate strategies for effective building maintenance in the study area. The aim of this research is to evaluate the maintenance conditions of physical elements of residential buildings in Housing Development Corporation Estates in Enugu metropolis with a view to keeping to improved maintenance guidelines for public residential buildings.

LITERATURE REVIEW

If all the building elements were of good quality and built according to international best practices, from the onset, a building is expected to last for between fifty to sixty years before maintenance is required. Hitherto,

buildings may become worn-out and require maintenance a few months after it is occupied owing to unreliable quality of available building materials in the market (Olanrewaju, 2011). Odediran, Opatunji, and Eghunure (2012) stated that the ability of a building to provide the required environment for an activity is a measure of its functionality. Therefore as the components of a building begin to deteriorate, it becomes necessary to take measures to ensure that the desired characteristics of that building are retained. Zeiler and Boxem (2008) and Meir, Garb, Jiao, and Cicelsky, (2009) have shown that sometimes original standards and specifications do not conform to the ever changing needs and expectations of residents, and so users usually seek improved maintenance conditions of their buildings for their continued satisfactory use. The ability to upgrade an existing residential building not only extends its useful life, but is clearly a more sustainable option than the process of demolition and reconstruction as in urban renewal programmes (Bullen, 2007).

Due to the multi-disciplinary nature of building maintenance, the purposes for studying maintenance conditions of **residential buildings** differ among researchers. Hsieh (2008) agreed with Kantrowitz and Nordhaus (1980) that maintenance conditions of **residential buildings** stemmed from the need to document the problems of public residential buildings, develop solutions to them as well as recommend framework for future public building maintenance programmes. Issues to be covered in the review of literature are

discussed below. These authors agreed commonly on open-ended evaluation, broad based and multifaceted data gathering approaches and analysis in distinguishing the outcome of different building maintenance strategies in public residential buildings in housing estates. Waziri and Vanduhe (2013) listed ten factors that affect defects of public buildings in Malaysia as lack of building maintenance, moisture problem from wet areas leading to leakage, environmental conditions, aging of the buildings, poor quality control: preventive methods, lack of training and skills of maintenance crew, lack of motivation in taking care of buildings, poor communication in maintenance process, defective materials used for maintenance works, and inability to appreciate the site conditions. These factors have been identified and ranked according to their descriptive analysis and applied to ESHDC residential buildings in Enugu metropolis.

Most building infrastructure in Nigeria, whether owned or hired by Government, corporate bodies or individuals are very poorly maintained largely due to poor maintenance culture and relatively high cost of maintenance (Usman, Gambo & Chen, 2012). Zagreus, Huizenga, Arens, and Lehrer (2004) pointed out how important the views of residents are in investigating the performance of building components to meet the needs and expectations of the residents. Gupta and Chandiwala, (2010) also added that the use of questionnaires in the evaluation of performance of residential environment is based either on researchers' observations or

user satisfaction surveys. Vischer (2002) opined that users give their views and feelings about buildings-in-use based on their experience and interactions with buildings. Preiser (1999), Nawawi and Khalil (2008) and Chohen, Che-Ani, Memon, Tahir, Abdullah and Ishak (2010) reported that professionals design and construct buildings and never use them and so their views would not be compared to the views of the residents who occupy them particularly as it concerns maintenance. It is observed that in the course of exploring residential building maintenance, some researchers adopted questionnaire surveys to examine residents' satisfaction with the buildings in public housing estates in different countries. For example, in Papua, New Guinea and Abuja, Nigeria, Kaitilla, (1993) as well as Ukoha and Beamish (1997) respectively, reported that residents in public buildings were dissatisfied with the building features. In contrast, Olatubara and Fatoye (2007) and Fatoye and Odusami (2009) revealed that residents in public buildings in Lagos, Nigeria, were most satisfied with building design features, including the number of rooms, the ceiling heights, and the location of different rooms in their dwelling units. In Malaysia, [Oh \(2000\)](#) cited in Mohit, Ibrahim and Rashid (2010) found out that middle income households in Bandar Baru Bangi, were satisfied with the space and cost of their buildings, but dissatisfied with the size of kitchen and plumbing works. These studies help to explain that occupants of mass-produced buildings in public housing estates in Nigeria are satisfied or dissatisfied with the

different components of their buildings and infrastructure. Different factors that determine residents' satisfaction with the building maintenance in public housing estates in Nigeria are rare. Fatoye and Odusami (2009) opined that users' satisfaction with buildings was related to the performance of public buildings in housing projects and the existing studies rarely associated occupants' satisfaction with the residential building maintenance in public housing projects in the country. Hence, this research would attempt to address residents' continued use of buildings through building maintenance and the joint involvement of both providers and beneficiaries with maintenance. Thus the gap existing in total involvement of all stakeholders would be filled.

METHODOLOGY

The research design for this study was survey design. It focused on public residential buildings of ESHDC housing estates in Enugu metropolis. A multistage stratified random sampling method was adopted in the selection of the study sample. The first stage of the stratification involved ESHDC estates based on the ages of the estates. The total number of the ESHDC housing estates is 15 as shown in Table 1. This constitutes the Research population.

Table 1: ESHDC housing estates in Enugu Metropolis Occupied By 2012 with in date order

S/ N	Name of Estate	Location	Year develo ped	Number of Plots/Flats
1.	African Real Estate, Uwani	Uwani	1963	108
2.	Riverside Estate phases I & II	A/Nike (low, medium and high density)	1966	821
3.	Trans Ekulu Phases I to VI including RCC Plots and RD Plots	T/Ekulu	1976	2589
4.	Republic Layout Phase I, II, III, IV (former EHOCOL	Ind L/Out (low, medium and high density)	1990	273
5.	Harmony Estate	Umuchigbo (Not yet functional)	1998	1338
6.	Q-series Mini Estate		2000	9
7.	Golf Course Estate phases I, I ext, II, IV, V	GRA (medium and low density)	2000	509
8.	Independence Avenue Pocket layout	Independence L/out	2001	38
9.	Ekulu East Estate	Former Zoo (Low Density only)	2002	142
10	Greenland Estate Phases I, II, III	Bungalows @ RACK	2003	216
11	New Abakaliki Road Layout Area A	Emene	2004	275
12	Maryland Estate Phases I, II. (Former Loma Linda)	Ind. L/out	2007	406
13	Coal City Gardens Estate, GRA	GRA, behind CAN	2007	323
14	Liberty estate I, II		2008	101
15	Ivory Quarters Parcel A. B. C	T/E Near CBNQtrs	2010	78

Source: Fieldwork, 2015

B. Sampling Frame

Stratified sampling technique was used to first create four columns in accordance with their age groupings and then select the four estates based on simple balloting. Simple random sampling was used to select the buildings on streets to interview one resident in one building by choosing the first building on the street and subsequently any fifth house on the street alternating the two sides of the street. Balloting was then carried out to choose one housing estate from each stratum based on their ages (5 to 15; 16 to 25; 26 to 34; and 35 and above) as highlighted on Table 2 resulting in the choice of Ekulu East, Golf, Republic and Riverside estates respectively. Hence the choice of the four estates emerged as highlighted in Table 2.

Table 2: Stratification of occupied Housing Estates by age from which balloting was done.

5 to 15 years	16 to 25 years	26 – 35 years	Above 35 years
Coal City	Golf Estate	Republic Layout	African Real Estate
Ekulu East	Harmony Estate		Riverside Estate
Greenland	Ind. Avenue Layout		T/Ekulu
Maryland	Ivory Quarters		
Pocket Layout	New Abakaliki Rd		
	Q-Series		

Source: Field Work, (2015)

C. Sampling Technique

All the buildings had equal chances of being investigated. One household head of any of the chosen buildings was interviewed. Thus the number of plots/households in the estates were as shown in Table 3, one hundred and forty two (142) plots/buildings are in Ekulu East Estate. Five hundred and nine (509) plots/buildings are in Golf Estate Phases I to V. Republic Housing Estate has 273 buildings while eight hundred and twenty one (821) households occupy Riverside Housing Estate Abakpa Nike, Phases I and II. One thousand seven hundred and forty five (1745) buildings/plots was the sampling frame. The sample size is the number of copies of questionnaire distributed as shown on Table 3.

Table 3: Selected Housing Estates of the ESHDC and Available number of units

	ESTATE	LOCATION	YEAR of estab	NO. OF UNITS
1.	Ekulu East Estate	Former Zoo	2002(16)	142
2.	Golf Course Estate phases I, II, III, IV, V	GRA	2000(18)	509
3	Republic Layout Phase I, II, III, IV (former ETHICAL)	Independence L/Out	1990(28)	273
4	Riverside Estate phases I & II	A/Nike	1966(52)	821
	Total			1745

Source: Fieldwork, 2015

D. Sample Size:

For the purpose of this study, the sample size was determined statistically using the method given by Taro Yamane (1973) for the calculation of sample size. This gave 326 respondents. Four housing

estates were chosen from stratified sampling to balance the sampling from both old and new, as new buildings require maintenance as soon as they are occupied and show different levels of dilapidation. The residents' population distribution for the questionnaire was as follows: Ekulu East Housing Estate (27), Golf Estate (95), Republic Housing Estate (51), and River Side Estate (153)

RESULTS AND DISCUSSION

The following are the results of the specific ten variables (V31 to V40) investigated in the study to gather data on maintenance conditions of the buildings. A composite variable (Maintenance condition of Buildings) was obtained by computing a mean score variable from these. This was then used to test the differences between buildings in the different housing estates.

(i) Condition of floor in the house (Variable 15):

It is important in this analysis to appraise the perception of residents on the floor finishes. Greater number of residents, up to 70%, indicated that the floors were in good maintenance condition. This is illustrated in Table 6.

Table 6: Aggregated Condition of Floor finishes in the house

Value Label	Valid Percent	Cumulative Percent
Very bad	18.6	18.6
Bad	11.4	30.0
Neutral	14.2	44.2
Good	44.7	88.9
Very good	11.1	100.0
Total	100.0	

Source: Fieldwork, 2018

(ii) Condition of Wall Finishes in the house:

When polled on their perception of the **Condition of Wall finishes in the houses**, responses from the residents, showed that 74.4%, which is quite significant, considered the walls in their buildings as good and very good. Only 25.6% of residents have bad walls. This is illustrated by Table 7

Table 7: Condition of Wall Finishes

Value Label	Valid Percent	Cumulative Percent
Very bad	3.0	3.0
Bad	22.6	25.6
Neutral	19.0	44.6
Good	42.1	86.8
Very good	13.2	100.0
Total	100.0	

Source: Fieldwork, 2018

(iii) Condition of Roof Frames in the house:

The study collected data from respondents at various levels of study of roof frames. The goal of this is to emphasize the need for adequate roof frames in the stability of the buildings. The responses from the residents indicate that 91.9% considered the roof frames as good in their buildings. The percentage is just 13% This is illustrated in Table 8

Value Label	Valid Percent	Cumulative Percent
Very bad	.6	.6
Bad	7.5	8.0
Neutral	13.0	21.0
Good	58.6	79.6
Very good	20.4	100.0
Total	100.0	

(iv) Condition of Ceiling in the house:

Table 9:Area-wise data on condition of Ceiling

The area-wise data analysis of this variable indicates that most of the ceilings at Ekulu East and Republic Estates are good. A low percentage of respondents indicate bad ceiling conditions while high percentages of residents are undecided about the condition of their ceilings in Golf, Republic and Riverside estates. This illustration is in Table 9.

Table 9:Area-wise data on condition of Ceiling

Value label	Ekulu East		Golf Estate		Republic Estate		Riverside Estate	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Very bad	0	0	1.9	1.9	0	0	.6	.6
Bad	3.6	3.6	2.8	4.7	1.7	1.7	2.9	3.5
Neutral	3.6	7.1	34.0	38.7	30.5	32.2	23.5	27.1
Good	53.6	60.7	47.2	85.8	45.8	78.0	57.6	84.7
Very good	39.3	100.0	14.2	100.0	22.0	100.0	15.3	100.0
Total	100.0		100.0		100.0		100.0	

Source: Fieldwork, 2018

(v) Maintenance Condition of External Wall in the house (Variable 23):

The area-wise data analysis of this variable indicates that 64.3% of the buildings at Ekulu East estate have good external walls and as high as 35.7% was bad. Buildings with good external wall constitute 55.6% of buildings at Golf estate; at Republic Estate it was 98.3 of the buildings that have good external walls while in Riverside estate almost half of the buildings have bad external walls. This is illustrated on Table 10.

Table 10: Area-wise data on Maintenance Condition of External Wall

Value label	Ekulu East		Golf Estate		Republic Estate		Riverside Estate	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Very bad (1)	0	0	7.5	7.5	0	0	1.8	1.8
Bad (2)	35.7	35.7	36.8	44.3	1.7	1.7	47.1	48.8
Neutral (3)	46.4	82.1	35.8	80.2	72.9	74.6	23.5	72.4
Good (4)	3.6	85.7	13.2	93.4	20.3	94.9	25.9	98.2
Very good (5)	14.3	100.0	6.6	100.0	5.1	100.0	1.8	100.0
Total	100.0		100.0		100.0		100.0	

Source: Fieldwork, 2018

(vi) *Appraisal of maintenance condition of doors:*

Analysis of Doors in the buildings shows that majority of residents disagree that doors need maintenance. This is shown by the 63.9% of residents who indicated their disagreement with the need to maintain doors. 19.8% of the residents are undecided on the situation of their doors. If the research assumes that the doors are relatively good, majority of the doors are in good condition since the total percentage of good doors would increase to 83.7%. This is illustrated in Table 11

Table 11: Appraisal of Condition of doors maintenance

Value Label	Valid Percent	Cumulative Percent
Strongly disagree	9.4	9.4
Disagree	54.5	63.9
Neutral	19.8	83.7
Agree	14.3	98.1
Strongly Agree	1.9	100.0
Total	100.0	

Source: Fieldwork 2018

(vii) *Maintenance Condition of outdoor paint of the building (Variable 28):*

The area-wise data analysis of this variable indicate that 78.6% of the outdoor paints of the house are in good maintenance condition in Ekulu East; 80.2% in Golf estate; 81.4% in Republic estate and 71.2% in Riverside Estate hence the general indication is that outdoor paints are good and very good. This is illustrated on Table 12.

Table 12: Area-wise data on maintenance condition of outdoor paint of the building

Value label	Ekulu East		Golf Estate		Republic Estate		Riverside Estate	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Very Bad (1)	0	0	2.8	2.8	0	0	2.4	2.4
Bad (2)	21.4	21.4	17.0	19.8	18.6	18.6	26.5	28.8
Neutral (3)	3.6	25.0	34.0	53.8	45.8	64.4	15.3	44.1
Good (4)	64.3	89.3	37.7	91.5	33.9	98.3	49.4	93.5
Very Good (5)	10.7	100.0	8.5	100.0	1.7	100.0	6.5	100.0
Total	100.0		100.0		100.0		100.0	

Source: Fieldwork, 2018

xxix. *Condition of indoor paints of the house (Variable 29):*

The area-wise data analyses of indoor paints indicate that 92.9% of indoor paints are in good maintenance condition in Ekulu East; 88.7% at Golf estate; 98.3% in Republic estate and 97.6% in Riverside estate, hence it can be concluded that indoor paints are in good maintenance condition. This is illustrated on Table 13

Table 13: Appraisal of Area-wise data on Condition of indoor paints of the house

Value label	Ekulu East		Golf Estate		Republic Estate		Riverside Estate	
	%	Cum %	%	Cum %	%	Cum %	%	Cum %
Very Bad (1)	0	0	6.6	6.6	0	0	.6	.6
Bad (2)	7.1	7.1	4.7	11.3	1.7	1.7	1.8	2.4
Neutral (3)	3.6	10.7	33.0	44.3	35.6	37.3	14.1	16.5
Good (4)	57.1	67.9	46.2	90.6	57.6	94.9	75.3	91.8
Very Good (5)	32.1	100.0	9.4	100.0	5.1	100.0	8.2	100.0
Total	100.0		100.0		100.0		100.0	

Source: Fieldwork, 2018

Test of hypothesis

ANOVA tests were used to test differences in maintenance conditions of buildings between and within the estates. The result of the analysis showed a significant difference value of 0.000 occurs with degree of freedoms of 3 and 356, between and within the estates respectively, mean squares of 6.059 and 0.427 between and within the estates respectively. These are indicated in Table 14.

Table 14: One-way ANOVA analysis test results, showing the differences between and within ESHDC Estates in Maintenance condition of their buildings in Enugu.

		ANOVA				
Maintenance condition		Sum of Squares	degree of freedom	Mean Square	F	Sig.
	Between Groups	18.176	3	6.059	14.191	.000
	Within Groups	151.990	356	.427		
	Total	170.167	359			

Source: Fieldwork, 2018

RECOMMENDATIONS AND CONCLUSION

As a result of the outcomes of the study, the following recommendations are made to aid the improvement of maintenance framework for public residential buildings in the study area of Enugu metropolis:

1. Efforts should be made to let all occupants and ESHDC to have more commitment of resources to maintenance as the research has shown.
2. The management should look into the logistics of organizing maintenance of the buildings at regular intervals in line with the chosen maintenance periods (three to five years) as indicated by the respondents and introduce a mechanism to implement it since the extant regulations are jeopardized by bylaws introduced by ESHDC. It would appear hypocritical, therefore, to expect all residents to have equal capacity to improve maintenance conditions at such given intervals without the coordination of the corporation.
3. It is proposed that the state insurance company arranges to collect premium from residents and ESHDC, at subsidized rates, towards Maintenance Management Fund. As the residents/owners pay insurance premiums towards building and infrastructure maintenance. If this provision was addressed, maintenance bills would be taken care of more easily by ESHDC as they arise.
4. Training programmes should be introduced to make the occupants, ESHDC

and even interested public get involved with maintenance of mechanical and plumbing works in the buildings. It is most important when the sewage systems need urgent attention as soon as the needs arise. The damages are often caused by the residents' insensitivity to the maintenance conditions owing to ignorance.

5. The quest to ensure that public residential buildings provide liveable conditions for the occupants within their lifespan cannot be achieved without adequate and regular maintenance. This is because the maintenance process ensures that the spaces remain secure, healthy, comfortable, safe and conducive, thus enabling their occupants to carry out life activities. Finding ways to improve the existing maintenance conditions is therefore imperative as well as feasible, particularly as relevant catalysts for this have been identified through research.

6. The management system adopted by ESHDC is one and needs to be decentralized for this dependent variable to seek predictors. The different estates have peculiar demands of maintenance patterns. More staff will be engaged and the improvement of the maintenance framework would be achieved from the management systems.

Policy guidelines and integrated action and co-operation of all stakeholders, (including relevant professionals, ESHDC and residents) involved in the planning, development and management of public residential building maintenance in Enugu are recommended. It has been shown statistically (Table 14), that there is significant difference in Maintenance Conditions of residential buildings in ESHDC estates in Enugu metropolis. This is contrary to the hypothesis which states that '*there is no significant difference in maintenance conditions of residential buildings in ESHDC estates in Enugu metropolis*'.

REFERENCES

- Bullen, PA (2007): 'Adaptive Reuse and Sustainability of Commercial Buildings', *Facilities*, vol. 25, no. 1/2, pp. 20-31.
- Chohen, A.H. Che-Ani, A.I. Memon, Z. Tahir, M.M Abdullah, N.A.G. Ishak, N.H., (2010). Development of user's sensitivity index for design faults in low rise urban housing, a study of development metropolitan city. *American Journal of Scientific Research*, 12, pp. 113–124
- Fatoye, E.O and Odusami, K.T. (2009). Occupants' Satisfaction Approach to Housing Performance Evaluation: The case of Nigeria. Paper Presented at the RICS COBRA Research Conference held at the University of Cape Town, 10-11th September, 2009. Downloaded from www.rics.org/cobra on 22nd February 2010.
- Kunya, S.U., Achuenu, E.A. and Kolawale, J.O. (2012). Evaluation of Factors Affecting Maintenance Expenditures of Federal Tertiary Institution in Nigeria. *Construction Focus*. 1(1):98-105
- Meir, I.A., Garb, Y., Jiao, D., Cicelsky, A., (2009). Post-occupancy evaluation: an inevitable Step Toward sustainability. *Advances in Building Energy Research* 3, 189–220.
- Mohit, M.A, Ibrahim, M. & Rashid, Y.R. (2010). Assessment of Residential satisfaction in newly Designed Public Low-Cost Housing in Kuala Lumpur, Malaysia. *Habitat International* .Vol. 34, p18-27
- Odediran, S.J., Opatunji, O.Y. and Eghnure, F. O. (2012). Maintenance of Residential Buildings: Users' Practices in Nigeria. *Journal of Emerging Trends in Economics and Management Sciences* 3(3):261-265
- Olanrewaju, A. (2011). Behavioural issues in maintenance of university buildings. Macmillan Publishers Ltd. 14791110 *Journal of Retail & Leisure Property* Vol. 9, 5, 415428. *Building Condition Assessment Imperative and Process*.
- Usman N.D., Gambo M.J. and Chen J.A. (2012). Maintenance culture and its impact on the Construction of residential buildings in Nigeria: *Journal of Environmental Science and Resources Management*, Vol 4
- Waziri, B.S, Vanduhe, B.A, (2013). Evaluation of Factors Affecting Residential Building Maintenance in Nigeria: User's Perspective. *Civil and Environmental Research*, Vol.3, No.8.

PHYTOCHEMICALS, PROXIMATE AND MINERAL CONTENT SCREENING OF CARICA PAPAYA, RIPE AND UNRIPE SEEDS

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ABSTRACT

The seeds of paw-paw (*Carica papaya*) are usually thrown away during preparation of paw-paw fruit. Apart from being edible fruit, the *Carica papaya* have served at various levels in the management of some human ailments. Different parts of the plant are used to treat several diseases such as malaria, diabetes, ulcer and skin diseases. This study is aimed at investigating the phytochemicals, proximate and mineral content of ripe and unripe seeds of *Carica papaya*. Extracts from the seeds obtained from 9th mile corner, Udi L G A. Enugu were evaluated using standard methods. Phytochemical screening of the extracts of the seeds showed that unripe seeds of *Carica papaya* have higher percentage composition of glycosides (0.116%) than the ripe seeds (0.00561%). Alkaloid content for ripe seed is 0.118% and the unripe (0.00530%). Saponin content for the ripe seed is 5.355% and the unripe 9.329%. The result of the proximate

analysis showed that moisture content for ripe seeds is 79.78% and that for the unripe is 81.26%, Ash content - 1.267% for ripe, 0.4112% for unripe seeds. Crude fibre content for ripe seeds is 3.69% and 0.098% for the unripe. Protein content for the ripe seeds is 0.0006% and unripe is 0.0000%. Lipid content for the ripe seed is 0.18% and unripe 0.26%. Carbohydrates content for ripe seed is 15.07% and unripe 17.08%. The results indicates that paw-paw seed contained high moisture content, low ash, low Lipid. The seeds also contained very low protein. Elemental minerals such as Ca, K, Mg, Mg, Fe and Zn were found present both in the ripe and unripe seeds.

INTRODUCTION

Papaya belongs to a small family *caricaceae* having four genera in the world. The genus *carica* papaya is represented by four species in India of which *carica papaya* is the most

widely cultivated and best known specie (Jean et al, 2011). It is commonly known as papaya melon tree, pawpaw or papau, kapaya lapaya,papyas, papye. Tapayas, Fanmugua, Papita, Arand -kharpuja, Papaya baun and papaya (Bhattachrjee, 2001). The taxonomical classification includes Kingdom (plantae), Order (brasscales), Family (caricaceae) Genus (carica) and Species (papaya). Papaya is an herbaceous succulent plant that possess self-supporting stems. The papaya is a native of North-America and has spread to several regions of the world and its largest producers are India, Brazil, Mexico, and Nigeria. It is well distributed in most of the tropical countries. It is generally found in tropical zones of the planet as it thrives in hot humid frost free climates Papaya plant is considered a tree, though its palm-like trunk, up to 8 meters tall, the tree is covered by deeply lobed leaves (Chan-Prove et al, 2010). The internal cavity of the fruit contain numerous black seeds, edible spicy coated with mucilaginous substance and it comprises about 15% weight of the fruit (Burla Sunitha et al, 2018).

A study conducted by the University of Florida researchers Nan Dang and

colleagues in Japan has documented papaya's powerful anti-cancer properties and its impact on numerous lab-grown tumours. Papaya seeds contain fatty acids, crude fibre, crude protein, papaya oil, caraine, caricen, gluco-tropaeolin, benzyl isothiocyanate, etc. Papaya is available throughout the year and is considered a powerhouse of nutrients (Aranvid et al, 2013). All the nutrients of papaya as a whole improve cardiovascular systems, protect against heart diseases, heart attacks, strokes and prevent colon cancer (Megan,2017).

According to Aranvid et al, the fruit is an excellent source of beta carotene that prevents damage caused by free radicals that may cause some forms of cancer. Papaya helps in the digestion of protein as it is a rich source of proteolytic enzymes. Papain, a digestive enzyme found in papaya can be extracted, dried as a powder and used as an aid in digestion. The unripe fruit is used as a remedy for ulcer and impotence (Elizabeth, 1994). The fruit is used as a remedy for abdominal disorders Ayoola and Adeyeye (2010), examined the phytochemical and nutrient content of papaya leaves, the study revealed the presence of phytochemicals in them which makes papaya leaves a potential anti malaria

agent. The study also shows that the yellow leaves are equally used as anti anaemic agent while the brown leaves can be effective as a body cleanser. Juice from papaya root is used to ease urinary troubles in some countries.

A decoction formed by boiling the outer part of the roots of the tree helps in the cure of dyspepsia. Papaya seeds are very pungent and peppery, making them most unpalatable, however the seeds seem to have more potent medicinal values than the flesh. Papaya seeds are rich in fibre. They keep our digestion on track, thus helping in the removal of toxins from our body .Carica papaya seeds have been confirmed in many studies for their anthelmintic properties against nematodes found in animals (Chota, 2010).

Papaya seeds possess several pharmacological activities including anthelmintic, anti-fertility, contraceptive, anti-inflammatory, analgesic and antimicrobial properties (Agarwal et al, 2016). Other pharmacological uses of the seeds include carminative, emmenagogue, abortifacient, counter irritant, and anti-fertility agent in males. Seed juice can be used to treat bleeding, piles and in large liver and spleen (Roshan et al, 2014).

Chinoy et al, 2006 proved the anti-

fertility, anti-implantation and abortifacient properties of extracts from papaya ripe seeds. Papaya ripe seeds are also used to produce indigenous Nigerian food condiment called Daddawa, the house word for fermented condiment (Dakare, 2004). Athelminthic activity of papaya seeds have been attributed to the presence of capain andcarpasemine. This study is aimed at investigating the phytochemical, proximate and mineral content of ripe and unripe papaya seeds in order to explore more of its medicinal potentials.

Materials and Methods

Sample preparation

The ripe and unripe pulps of paw paw (carica papaya) were purchased from a local farm at ninth mile corner Ngwo in Enugu State. The pulps were transported to the laboratory where they were cut and seeds of ripe and unripe papaya were collected and stored in different sample tubes for preparation. Fresh seeds were blended and stored in sterilized laboratory tubes from where samples were collected for analysis.

Phytochemical Analysis

The phytochemical screening of extracts of samples was done using methods described by J B Harbone (1984).

Mineral Analysis

The analysis of selected minerals were determined using methods of AOAC (2000). Calcium, potassium, iron, zinc and magnesium were determined by atomic absorption spectrophotometric methods.

1.0g of the prepared samples were first digested with 5ml of acid mixture (40 % Hydrofluoric acid) and 5 drops of sulphuric acid were added using a plastic pipette or measuring cylinder in a platinum crucible. The fume was evaporated to dryness on a hot plate .The procedure were repeated until the sample is completely decomposed. The residues were extracted with diluents and transferred quantitatively to a 200ml volumetric flask. The solutions were diluted to a volume with diluents. Potassium, magnesium, calcium and sodium were determined by flame photometric method, while iron and zinc were determined by atomic absorption spectrophotometric method.

Proximate Analysis

This analysis involves the determination of the percentage constituents of the following parameters. Moisture content, ash content, fat content, protein content

crude, fiber and carbohydrate. The moisture was determined using the procedures in AOAC (1993). protein level was determined by Kjeldahl method, according to association of analytical chemists AOAC(1995). The ash was determined by calcinations at 600°C according to official methods and recommended practices of the American oil chemists' society AOAC (1993). The lipids were extracted using soxhlet with petroleum ether at 60°C according to AOAC(1993).Total fiber were determined according to the method of Porsley et al. Carbohydrate was determined by Difference % Carbohydrate=100 - (% Ash+ % Fibre+ % Moisture+ % Protein+ % Fat).

RESULTS

Proximate Analysis of Ripe and Unripe Pawpaw Seeds

S/N	Sample	% Moisture	% Ash	% Crude Fibre	% Protein	% Lipid	% Carbohydrate
1	Ripe seeds	79.788	1.267	3.689	0.0006	0.18	15.0754
2	Unripe seeds	81.262	0.411	0.982	0.0000	0.26	17.085

Elemental / Mineral Analysis

S/N	Parameters	Ripe (%)	Unripe (%)
1	Ca	33.62	27.78
2	K	12.89	18.55
3	Mg	44.27	37.52
4	Mn	44.26	51.33
5	Fe	29.52	14.02
6	Zn	38.31	27.09

Phytochemical Analysis of Ethanol Extract

S/N	Constituent	Experimental method	Ripe Seeds	Unripe Seeds
1	Carbohydrate			
A	Carbohydrate	Molisch's test	++	++
B	Polysaccharides	Iodine test	-	-
C	Reducing sugar	Benedict's test	++	++
		Fehling's test		
D	Reducing monosaccharides	Barfoeds test	-	-
E	Pentose sugar	Bial's test		
F	Ketose sugar	Seliwanoff's test	-	+
2	Protein			
A	Protein test	Biuret test	-	+
B	Protein test	Picric acid test		
C	Amino acid	Ninhydrin test	+	-
D	Aromatic amino acid	Xanthoprotein	-	-
E	Fixed oil	Filter paper	--	+

Metabolites				
3	Saponins	Frothing test	++	++
4	Glycosides		-	-
5	Alkaloids	Picric acid test		
		Wagner's test	++	+
		Dragendorff test	++	++
Tannin & phenol				
A		Ferric chloride test	-	-
B		10% FeCl ₃ test	-	++
		1% Potassium Ferricyanide	-	++
Flavonoids				
A		Shinoda test	-	-
B		Zinc-HCl reduction	-	-
C		Lead Acetate test	-	-
Terpenoids				
A		Salkowski test	-	-
B		Steroid		
	a		-	-
	b		-	-
	c		-	-

present in moderately high concentration ++.

+++ present in very high concentration

44 Quantitative Phytochemical Analysis

Table of Results for Quantitative Phytochemical Analysis (in percentage %)

S/N	Parameters	Average concentration (%) for ripe seeds	Average concentration (%) for unripe seeds
1	Glycosides	0.116	0.056
2	Alkaloid	0.116	0.056
3	Saponin	5.355	9.329
4	Flavonoids	-	-
5	Phenol	-	0.032
6	Tannins	-	0.057

Phytochemical Analysis of Dichloromethane Extract

Parameter	Test method	Dichloromethane unripe	Dichloromethane Ripe
Moisture	+	+	-
Iodine	-	-	-
Barfoeds	-	-	-
Fixed oil	-	-	-
Ninhydrine	-	-	-
Xanthoprotein	-	-	-
Burret	-	-	-
Silwingff	-	-	-
Saponin	Foam	-	-
	Glycosides	-	-
Alkaloid	Wagner's	-	-
Tannin and phenol	Ferric	-	-
	Chloride	-	-
	10% Ferric chloride	-	-
Flavonoid	Shinoda	-	-
	Zinc	-	-
	Lead Acetate	-	-
Terpenoids steroids	Salkowski	-	-
	A	-	-
	B	-	-
	C	-	-

		Zinc reduction	HCl	-	-
B		-	-	-	-
C	Lead acctate test	-	-	-	-
Terpenoids					
A	Salkowski test	-	-	-	-
B	Sterod	-	-	-	-
	a	-	-	-	-
	b	-	-	-	-
	c	-	-	-	-

+ presence in trace concentration

++ presence in moderately high concentration

+++ presence In very high concentration

DISCUSSION OF RESULTS

The proximate composition of ripe and unripe pawpaw seed have been studied and are presented in table 2 as seen above. The moisture content of the both seed was 77.188% for ripe pawpaw and 81.262% for unripe seeds this implies that the moisture content of the both seeds are high and can reduce the shelf life of the seeds as reported by Puangrsi et al. The ash content indicates level of mineral content of the seeds. The ash also represents the presence of organic materials from where mineral contents could be obtained while the crude fiber indicates that the seeds contain a portion of cellulose, hemicellulose and lignin which help in the maintenance of human health and has been known to reduce cholesterol level in the body. High fiber foods are effective anti-constipation agents. Fiber also reduces the risks of various cancers, bowel diseases and improves general health and well-being of individual, The pawpaw unripe seeds show a high percentage of lipid and carbohydrates than the ripe seeds which implies that it can be considered as a potential source of carbohydrate for energy. It is a potential raw material for feed formulation since it can aid good bowel movement and improves absorption, (Onwuka, 2005).

The results of the phytochemical

screening are presented in table 4.3. The phytochemical analysis were carried out on prepared sample extracts of ripe and unripe pawpaw seeds to ascertain the presence of the phytochemical components present in the respective seeds. Tannins and terpenoids were present in extract of unripe seeds. According to David (1983), saponins have expectorant action through stimulation of a reflex of the upper digestive tract. Saponins also reduces blood cholesterol by preventing its re absorption. They also possess antitumor and antimutagenic activities and can lower the risk of cancer in human by preventing cancer cells from growing (Esan 2014). The presence of tannins showed that the extract is rich in polyphenolic compounds these are antioxidants which could prevent cellular damage.

The results in the analysis to determine the metabolites, results show that the unripe pawpaw seeds has higher number of positive results than the ripe pawpaw seed indicating higher presence of the metabolites examined, Hence from the results of the analysis shown in primary metabolites the ripe pawpaw seed has the higher positive than the unripe pawpaw seed while in secondary metabolites the unripe pawpaw seed has the higher positive results than the ripe pawpaw seed.

The results of some selected mineral

contents of both the ripe and unripe seeds are shown in table 4.2, the result shows that the ripe pawpaw seed have higher mineral contents than the unripe, minerals like calcium which helps keep the bone and teeth strong, also body cell uses calcium to activate certain enzymes and help to transport ions across the cellular membrane. It also plays a key role in maintaining the regular heart-beat. The presence of these ions is important in the diet of pregnant women, nursing mothers, infants, convulsing patients and elderly people to prevent anemia and other related diseases. The mineral contents of some commonly consumed Nigeria foods and the

values obtained in this present work is in agreement with those reported in similar works as seen in Brown K. H, et al, 1993 and Oluyemi E A et al, 2006.

CONCLUSION

The phytochemicals, proximate and mineral composition of ripe and unripe pawpaw seeds have been evaluated in this study. It was observed in this study that these seeds which are often disposed, causing environmental problems contained essential nutrients that can be user human and animals. These seeds' extract are applicable as counter irritant carminative, and can be used as an antifertility agent.

REFERENCES

- Abdulazcez, A. M., Ameh, D. A., Ibrahim s, A. J., Ambali, S. F. (2009). Effect of fermented and unfermented seed extracts of carica papaya on pre- implantation embryo development in female wistar rats (*Rattus norvegicus*). *Scientific Res. Essay*, 4(10), 1080-1084.
- Abdulazeez, A. M., (2008). Effect of fermented and unfermented seed Extract of carica papaya Thesis submitted to department of on implanation in wistar rats (*Rattus norvegicus*). biochemistry A.B.U Zaria.
- Aravind, G., Debjit Bhomik, Durnwel S ,Harish G,(2013). Traditional and medicinal uses of carica papaya, *Journal of medicinal plant studies* Vol.1Issue1 Pages 1-15 ISSN2320-3862.
- Agarwal A, Shen H, and Rao A., (2001). Lycopene content of tomato products, its stability, bioavailability and in vivo antioxidant properties. *Journal of medicinal food* .Pages 15-49.Agarwal A.Vyas S, and Agarwal D P. (2016) Therapeutic Benefits of Carica Papaya leaf extracts in Dengue Fever Patients Scholars Journals of Applied Medical Sciences 4(2a);299-302. Atta A Bonsu, (1999) "The Power of Garlic in Cardiovascular Disease Prevention' Buea Cameroun.P72.
- AOAC (1980) Official Methods of Analysdis 13th Ed Washington D.C. AOAC (1995) Official and Tentative Methods of Analysis
- Ayoola P B, and Adeyeye A, (2010) Phytochemical and Nutrient evaluation of Carica Papaya

(PawPaw) Leaves. IJRRAS, 5 (3)325-328.

Barbara, Minton L., (2008). Papaya is a tasty way to fight cancer and poor digestion. International journal of Oncology.

Bhattachrjee, S, K., (2001). Carica papaya. In: hand book of medicinal plant, 3 revised edition. editors: shashi Jain pointer publisher, jaipur. 1-71. Burla Sunita, Venkata Sheshamamba, PMalati, A Nancy, Grace Ruth. A Swetha Mallika.and Vivek Sharma.(2018) Physiochemical Properties and Proximate Analysis of Carica Papaya Seeds ,Journal of Pharmacognosy and Phytochemistry.

Brown K, H., Guptal K, S., Esrey S, A., Oni G, A. (1993). Evaluation of Face to Face Weaning Food intervention in Kwara State.Nigeria knowledge of trial and adoption of home prepared weaning food. Social Science Medicine.36:665_672.

Chan-Prove P, Rose P, Hane P, Macleod N, Kernot I, Evan D, et al (2010) Agriclink Series, Your Growing Guide to Better Farming Paw paw Information kit.Queensland Horticulture, Institute of Primary Industries Qld Nambour.

Chinoy N, J., Dilip, T., Harsha, J. (2006) effect of carica papaya seed extract on female rat ovaries and uteri phytocher. Res. 9(3):165-169.

Chota, A., Sikasunge, C, S., Phiri, A, M., Musukwa, M, N., Haazele, F., Phiri, I, K. (2010). A comparative study of efficacy of piperazine and carica papaya for a control of helminthes parasites in village chickens in Zambia tropical animal health production. 42:315-318.

Clinton, S, K., (1998) lycopene: chemistry, biology and implications for human health and disease. Nutrition reviews 1:35-51.

Dakare, M., (2004) fermentation of carica papaya seeds to be used as "daddawa" an MSC thesis, department of biochemistry, A.B.U Zaria.

Dev, N. Iqba A., (2015). Processing and quality evaluation of green papaya (Carica papaya) leaf tea. Journal of agriculture and crop science 2:1-6.

David, H. (1983). The new holistic Herbal. Third Ed. Findhorn press, USA Pp. 24. El moussaoui, A., Nijis, M., Paul, C., Wintjens, R., Vincentelli, J., AzarakanM, (2001). Revising the enzymes stored in the laticifers of carica papaya in the content of their possible participation in the plant defence mechanism. Cell. Mol. Life sci. 58:556-570.

Elizabeth Kafaru (1994) Immense Help from Natures Workshop, 1" Ed. Elikaf Health Services LTD. Ikeja Lagos.

Esan H, Mansour (2015). What are Saponins and what are their <http://www.researchgate.net>. benefits?

G.I. Onwuka, (2005). Food Analysis and instrumentation Theory and Practice. Lagos Naphtal prints Pp142-143.

Harbone J. (1993) Phytochemical Methods. Harpmand and Hall LTD London. Pp49-60.

L.K. (2010). A Comparative Study of Efficacy of piperazine and Carica papaya for a control of Helminthes parasites in village chicken in Zambia.Trop.animal, health prod. 42:315-318

Jean J, soucy J, pouliot, R. (2010), (2011). Effect of retinoic acid on keratinocyte proliferation and

- differentiation in a psoriatic skin model. *Tissue eng part A.* 17:1859-1868. DOI: 10.1089-046
- JB Harbone. (1984) Photo-chemical methods. A guide to Modern Techniques of plant Analysis (2nd Ed) chapman and Hall, Newyork .Pp228.
- Kermanshai, R, M, C., carry, B, E., rosenfeld, J., summers, P. S., weretilnyk, E, A. Knachik, F, Caryallo, L., Bernstein, P, S, Muri, C, J., Zhao, D. Y., Katz, N, B. (2002). Chemistry, distribution and metabolism of production of tomato carotenoids and their impact on human health. *Experimental medicine and biology,* 227:227:845-851.
- Lohiya, N, K, Manivanna, B, Garg, S, (2006). Toxicological investigations on the methanol sub-fraction of the seeds of carica papaya as a male contraceptive in albino rats reprod. *Toxicol.* 22:461.
- Marotta F, Weksler, M, Naino, Y, Yoshida, C, Yoshioka, M, Marandola, P, (2006). Nutraceutical supplementation, effect of a fermented papaya preparation on rodex status and DNA damage in healthy elderly individuals and relationships with GSTMI genotype, a randomized, placebo controll, cross-over study. *Annals of the New York academy of sciences.* 1067(1):400-407.
- Menard R, Khouri, H, E, Plouffe, C, Dupras, R, Ripoll, D, (1990). A protein engineering study of the role of aspirate 158 in catalytic mechanism of papain. *Biochemistry.*29:6706-6713.
- Megan Ware (2017). What are the health Benefits of Papaya? Medical News Today.com. Oloyode O, I. (2005). Chemical Profile of Unripe pulp of Carica Papaya. *Pakistan Journal of Nutrition,* 4:379-381.
- Proskey L.ASP, M, G Furda, I, Devries, J W Shweizer, T. Fet..(1985). Determination of Total Dietary Fibre in Foods and Food Products. Collaboration Study. *J. Assoc.of Anal. Chem.* 68:667-678.
- Racheal, link, M, S, R, D., (2020). Medicinal review by atlarnason Bsc, Phd. <https://www.health.com/nutrition/papaya>. Seeds Ram, M, Ray P, K.. (1992). Influence of fruiting season of seed production of Papaya in north Bihar. Abstracts .viii. All India seed seminar on recent advances and science and technology, naui, solan (india). 1992; 9(11):27.
- Rao, A, V, Mira, M, R. Rao, L, G., (2006). lycopene. *Advances in food and Nutrition research* 2006, 51:99-164.
- Roshan A, Verma N K and Gupta A (2014) A Brief Study on Carica papaya. A review. *International Journal of Current Trends in Pharmaceutical Research,* 2(4);541-550.
- Sandra, M, Resmi, M (2019). Phytochemical screening of pawpaw seed.Saran, P, L, choudhary, R, Solanki, T, S., (2013). Singh K. new bottlenecks in seed production of papaya under north eastern plains zone. *New initiative ICAR news, A sci. tech. news lett.* 19(3)4 Saha, M. (2007). In vitro propagation of precociously germinated seedlings of Carica papaya 1. variety madhubindu. *Bionano front.* 1(1):55-57
- Singh,K, Ram, M, Kumar, A. (2010).Forty years of papaya Research at Pusa. Aihar. India.*Acta Hortic,* 851:81-88.
- Stahl, W, Schwarz, W, sundquist, A, R. Sies, H., (1992). Cis-Trans isomer of lycopene and beta - carotene human serum and tissue. *Archives of biochemistry and biophysics* 294:173-177.

Sofowora E. A. (1993). Medicinal plants and Traditional Medicine in Africa. First Ed. New York.
John Wiley and sons Pp1-23.

Sorger G, J. (2001) Benzyl isothiocyanate is the chief or sole anthelmintic in papaya seed extract.
Phytochem 57(3)427_535.

T. puargrsi, S.M, Abdulkarim and H.M. Ghazal (2005). Properties of Carica papaya Seed oil
following Exdtraction using Solvent and Aqueous Enzymatic methods of Good Lipids. Pp62-76

RANDOM FOREST HYPERPARAMETER TUNING IN MACHINE LEARNING FOR IMPROVED PERFORMANCE IN INTRUSION DETECTION SYSTEMS

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ABSTRACT

In recent times, researchers have been proposing different Intrusion Detection methods to deal with the increasing number and complexity of threats as technology keeps emerging. In this context, Random Forest models have been providing a notable performance on her predictive capacity to applications in the realm of behavioural-based Intrusion Detection Systems and other related fields of specialization which includes medicines, Banking, commerce, etc in terms high magnitude forecasting and optimal predictions . In this work, in-depth evaluation analysis of the Random Forest tuning were carried out with respect to classification, feature selection, and proximity metrics. This empirical research will provide an inclusive review of the general basic concepts related to Intrusion Detection Systems, which includes taxonomies, data collection, modeling and evaluation metrics. Furthermore, the manual hyperparameter tuning technique was used for this research work and a desirable experimental output was achieved as showed in this work.

Key Words: Random Forest, Machine Learning, Optimization, Hyperparamenters, Classification, Evaluation Metrics.

1. INTRODUCTION MACHINE LEARNING

Machine learning (ML) algorithms have been widely used in many applications domains, including advertising, recommendation systems, computervision, natural language processing, and user behavior analytics (Jordan & Michell,2015). This is because they are generic and

demonstrate high performance in data analytics problems. Different ML algorithms are suitable for different types of problems or datasets (Ziler & Huber, 2019). In general, building an effective machine learning model is a complex and time-consuming process that involves determining the appropriate algorithm and obtaining an optimal model architecture by tuning its hyper-parameters (HPs) (Shawi ,et al,2019). Two types of parameters exist in machine learning models: one that can be initialized and updated through the data learning process (e.g., the weights of neurons in neural networks), named model parameters; while the other, named hyper-parameters, cannot be directly estimated from data learning and must be set before training a ML model because they define the architecture of a ML model (Kuhn & John, 2013). Hyper-parameters are the parameters that are used to either configure a ML model (e.g., the penalty parameter C in a support vector machine, and the learning rate to train a neural network) or to specify the algorithm used to minimize the loss function (e.g., the activation function and optimizer types in a neural network, and the kernel type in a support vector machine) (Diaz et al, 2017). To build an optimal ML model, a range of possibilities must be explored. The process of designing the ideal model architecture with an optimal hyper-parameter configuration is named hyper-parameter tuning. Tuning hyper-parameters is considered a key component of building an effective ML model, especially for tree-based ML models and deep neural networks, which have many hyper-parameters (Hutter et al,2019). Hyper-parameter tuning process is different among different ML algorithms due to their different types of hyper- parameters, including categorical, discrete, and continuous hyper-parameters (Decastro-Garca et al,2019). Manual testing is a traditional way to tune hyper-parameters and is still prevalent in graduate student research, although it requires a deep understanding of the used ML algorithms and their hyper-parameter value settings (Abreu, 2019). However, manual tuning is ineffective for many problems due to certain factors, including a large number of hyper-parameters, complex models, time consuming

model evaluations, and non-linear hyper-parameter interactions. These factors have inspired increased research in techniques for automatic optimization of hyper-parameters; so-called hyper-parameter optimization. (HPO) (Steinholtz,2018). The main aim of HPO is to automate hyper-parameter tuning process and make it possible for users to apply machine learning models to practical problems effectively (Shawi ,et al,2019). The optimal model architecture of a ML model is expected to be obtained after a HPO process. Some important reasons for applying HPO techniques to ML models are as follows (Hutter et al,2019):

2. 1. It reduces the human effort required, since many ML developers spend considerable time tuning the hyper-parameters, especially for large datasets or complex ML algorithms with a large number of hyper-parameters.
2. It improves the performance of ML models. Many ML hyper-parameters have different optimums to achieve best performance in different datasets or problems.
3. It makes the models and research more reproducible. Only when the same level of hyper-parameter tuning process is implemented can different ML algorithms be compared fairly; hence, using a same HPO method on different ML algorithms also helps to determine the most suitable ML model for a specific problem.

It is crucial to select an appropriate optimization technique to detect optimal hyper-parameters. Traditional optimization techniques may be unsuitable for HPO problems, since many HPO problems are non-convex or non-differentiable optimization problems, and may result in a local instead of a global optimum (Lou, 2016). Gradient descent-based methods are a common type of traditional optimization algorithm that can be used to tune continuous hyper-parameters by calculating their gradients (Maclaurin et al, 2015). For example, the learning rate in a neural network can be optimized by a gradient-based method. Compared with traditional optimization methods like gradient descent, many other optimization techniques are more suitable for HPO problems, including decision-theoretic approaches, Bayesian optimization models, multifidelity optimization techniques, and

metaheuristics algorithms (Decastro-Garca et al,2019). Apart from detecting continuous hyper-parameters, many of these algorithms also have the capacity to effectively identify discrete, categorical, and conditional hyper-parameters. Decision-theoretic methods are based on the concept of defining a hyper-parameter search space and then detecting the hyper-parameter combinations in the search space, ultimately selecting the best-performing hyper-parameter combination.

3. Bergstra et al, 2019 concluded that Grid search (GS) is a decision-theoretic approach that involves exhaustively searching for a fixed domain of hyper-parameter values. . James & Yoshua,2019 also discussed Random search (RS) as another decision-theoretic method that randomly selects hyper-parameter combinations in the search space, given limited execution time and resources. In GS and RS, each hyper-parameter configuration is treated independently.

1.2 DECISION TREE

Decision Tree is a graphical representation of all possible solutions to a decision, decision tree is based on some conditions and it can be easily be explained. It represents a function that takes as Input a vector of attribute values and returns a “decision” – a single output value.

Decision tree is a flow-chart-like tree structure that uses a branching method to illustrate every possible outcome of a decision. Each node within the tree represents a test on a specific variable- and each branch is the outcome of that test. It is also a simple flowchart that selects labels for input values.

This flowchart consists of decision nodes, which check feature values, and leaf nodes, which assign labels. To choose the label for an input value, we begin at the flowchart's initial decision nodes, known as its roots node. This node contains a condition that checks one of the input value's features, and selects a branch based on that features value. Following the branch that describes our input value, we arrive at a new decision node, with a new condition on the input value's features. We continue following the branch selected by each node's condition, until we arrive at a leaf node which provides a label for the input value. Decision tree algorithm falls under the category of supervise learning. They can be used to solve both regression and classification problems. A decision tree reaches its decision by performing a sequence of tests.

For Example

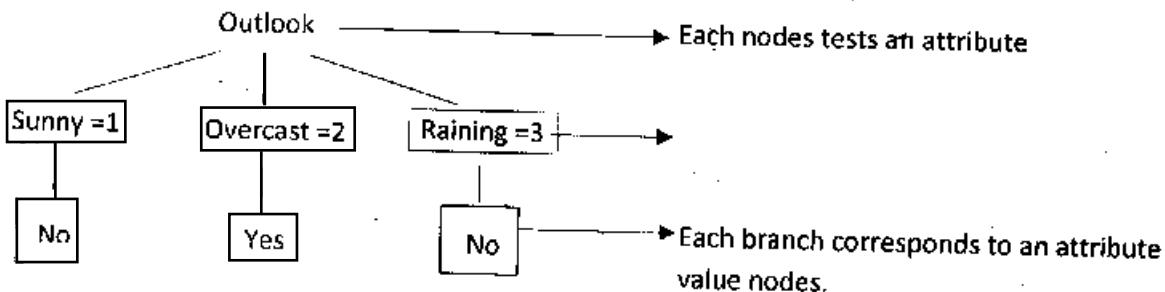


Figure 1.1 Decision Tree Learning Algorithm

ID₃ (Iterative Dichotomies 3)

- ID₃ is one of the most common decision tree algorithm.
 - Dichotomies means dividing into two completely opposite things.
 - Algorithm iteratively divides attribute into two groups based on the most dominant attribute and others to construct a tree.
 - Then, it calculates the Entropy and information gain of each attribute. In this way, the most dominant attribute can be found.
 - After that, the most dominant one is put on the tree as decision node.
For
 - Entropy and gain scores would be calculated again among the other attributes.
 - Procedure continues until reaching a decision for that branch.

Formulas:

A decision tree is also a simple flowchart that selects labels for input values. This flowchart consists of decision nodes, which check feature values, and leaf nodes, which assign labels. To choose the label for an input value, we begin at the flowchart's initial decision nodes, known as its roots node. This node contains a condition that checks one of the input value's features, and selects a branch based on that features value. Following the branch that describes our input value, we arrive at a new decision node, with a new condition on the input value's features. We continue following the branch selected by each node's condition, until we arrive at a leaf node which provides a label for the input value.

Once we have a decision tree, it is straightforward to use it to assign labels to new input values. What's less straightforward is how we can build a decision tree that models a given training set. But before we look at the learning

algorithm for building decision trees, we'll consider a simpler task: picking the best “decision stump” for a corpus.

A **decision stump** is a decision tree with a single node that decides how to classify inputs based on a single feature. It contains one leaf for each possible feature value, specifying the class label that should be assigned to inputs whose features have that value. In order to build a decision stump, we must first decide which features should be used. The simplest method is to just build a decision stump for each possible feature, and see which one achieves the highest accuracy on the training data, although there are other alternatives that we will discuss later. Once we've picked a feature, we can build the decision stump by assigning a label to each based on the most frequently for the selected examples in the training set (i.e. the examples where the selected feature has that value). Given the algorithm for choosing decision stumps, the algorithm for growing larger decision trees is straightforward. We begin by selecting the overall best decision stump for the classification task. We then check the accuracy of each of the leaves on the training set. Leaves that do not achieve sufficient accuracy are then replaced by new decision stumps, trained on the subset of the training corpus that is selected by the path to the leaf.

1.3 Entropy and information Gain

There are several methods for identifying the most informative feature for a decision stump. One popular alternative called **information gain**, measures how much more organized the input values become when we divide them up using a given feature. How disorganized the original set of input values are, we calculate entropy of their labels, which will be high if the input values have highly varied labels, and low if many input values all have the same label. In particular, **entropy** is defined as the sum of the probability of each label times the log probability of that same label:

$$H = - \sum_{l \in \text{labels}} P(l) * \log_2 P(l). \quad \dots \quad (3)$$

For example, Figure above shows how the entropy of labels in the weather prediction task depends on the ratio of sunny to overcast to raining attributes names. Note that if

Most input values have the same label (e.g., if $P(\text{sunny})$ is near 0 or near 1), then entropy is low. In particular, labels that have low frequency do not contribute much to the entropy (since $P(l)$ is small), and labels with high frequency also do not contribute much to the entropy (since $\log_2 P(l)$ is small). On the other hand, if

the input values have a wide variety of labels, then there are many labels with a “medium” frequency, where neither $P(l)$ nor $\log_2 P(l)$ is small, so the entropy is high. Once we have calculated the entropy of the label of the original set of input values, we can determine how much more organized the labels become once we apply the decision stump. To do so, we calculate the entropy for each of the decision stump's leaves, and take the average of those leaf entropy values (weighed by the number of samples in each leaf). The information gain is then equal to the original entropy minus this new reduced entropy. The higher the information gain, the better job the decision stump does of dividing the input values into coherent groups, so we can build decision trees by selecting the decision stumps with the highest information gain.

Another consideration for decision tree is efficiency. The simple algorithm for selecting decision stumps described earlier must construct a weather decision stump for every possible feature, and this process must be repeated for every node in the constructed decision tree. A number of algorithms have been developed to cut down on the training time by storing and reusing information about previously evaluated examples.

However, decision trees also has a few disadvantages. One problem is that, since each branch in the decision tree splits the training data, the amount of training data available to train nodes lower in the tree can become quite small. As a result, these lower decision nodes may overfit the training set, learning patterns that reflect idiosyncrasies of the training set rather than linguistically significant patterns in the underlying problem. One solution to this problem is to stop diving nodes once the amount of training data becomes too small. Another solution is to grow a full decision tree, but then to **prune** decision nodes that do not improve performance on a dev-test.

A second problem with decision trees is that they force features to be checked in a specific order, even when features may act relatively independently of one another. For example, when classifying documents into topics (such as a sports, automotive, or murder mystery), features such as has word (football) are highly indicating of a specific label, regardless of what the other feature value are. Since there is limited space near the top of the decision tree, most of these features will need to be repeated on many different branches in the tree. And since the number of branches increases exponentially as we go down the tree, the amount of repetition can be very large.

A related problem is the decision trees are not good at making use of features that are weak predictors of the correct label. Since these features make relatively small incremental improvements, they tend to occur very low in the decision tree. But by the time the decision tree learner has descended far enough to use these features, there is not enough training data left to reliably determine what effect they should have. If we could instead look at the effect of these features across the entire training set, then we might be able to make some conclusions about how they should affect the choice of label.

The fact that decision trees require that features be checked in a specific order limits their ability to exploit features that are relatively independent of one another.

Computer security is the ability to protect a computer system and its resources in reference to Confidentiality, Integrity and Availability (Urasva, 2015). The main goal of any Intrusion Detection System is to detect attacks. Random forests (Breiman, 2001) are considered as one of the most successful general-purpose algorithms in modern-times (Biau and Scornet, 2016). They can be applied to a wide range of learning tasks, but most prominently to classification and regression. A random forest is an ensemble of trees, where the construction of each tree is random. After building an ensemble of trees, the random forest makes predictions by averaging the predictions of individual trees. Random forests often make accurate and robust predictions, even for very high-dimensional problems (Biau, 2012), in a variety of applications (Criminisi and Shotton, 2013; Belgiu and Drăguț, 2016; Díaz-Uriarte and Alvarez de Andrés, 2006). Recent theoretical works have established a series of consistency results of different variants of random forests, when the forests' parameters are tuned in certain ways (Scornet, 2016; Scornet et al., 2015; Biau, 2012; Biau et al., 2008). **Random forest** has nearly the same hyperparameters as a **decision** tree or a bagging classifier. Furthermore, knowing the attacks and how they are classified is important to enable better comprehension and critical analysis. In Table 1 represent the first dimension of the attack taxonomy proposed by Hansman and Hunt (2005), which is used in other works (e.g., Bhuyan et al. (2014), Ghorbani et al. (2010), and Sperotto et al. (2010)) and provides a good understanding about attacks on networks.

In the literature, there are a variety of attack taxonomies devoted to specific

major attack types or attacked systems or protocols, such as DDoS attacks (Mirkovic and Reiher 2004), cloud systems (Juliadotter and Choo 2015; Mishra et al. 2017), web applications (Alvarez and Petrovic 2003; Watson 2007), Supervisory Control and Data Acquisition (SCADA) systems (Zhu et al. 2011), protocol DNP3 that is usually used in SCADA systems (East et al. 2009), P2P communication (Yue et al. 2009), embedded systems (Papp et al. 2015), botnets (Dagon et al. 2007), and the Internet infrastructure, for example, attacks on the Border Gateway Protocol (BGP) used for routing in the Internet (Chakrabarti and Manimaran 2002). Taxonomies also can be oriented to attack response (Souissi and Serhrouchni 2014; Wu et al. 2011), target systems, causes, impact, time, among other characteristics. In 2008, Igure and Williams had explored on classical attacks on taxonomies.

RESEARCH DESIGN

This research work deals with an optimization of behavioral based random forest algorithm as a machine learning tool in intrusion detection systems. The research methodology will effectively discuss possible directions which this research work will take in order to achieve its objectives. The detailed information on the process involved in data acquisition will be presented also. Hyperparameters are important for machine learning algorithms since they directly control the behaviors of training algorithms and have a significant effect on the performance of machine learning models. Several techniques have been developed and successfully applied for certain application domains. This research work has proposed a technique which will improve a dataset's data content by translating it into a brand new feature subspace of lower dimensionality than the original. Normally machine learning algorithm transforms a problem that needs to be solved into an optimization problem and uses different optimization methods to solve the problem. The optimization function is composed of multiple hyperparameters that are set prior to the learning process and affect algorithm performance of the model.

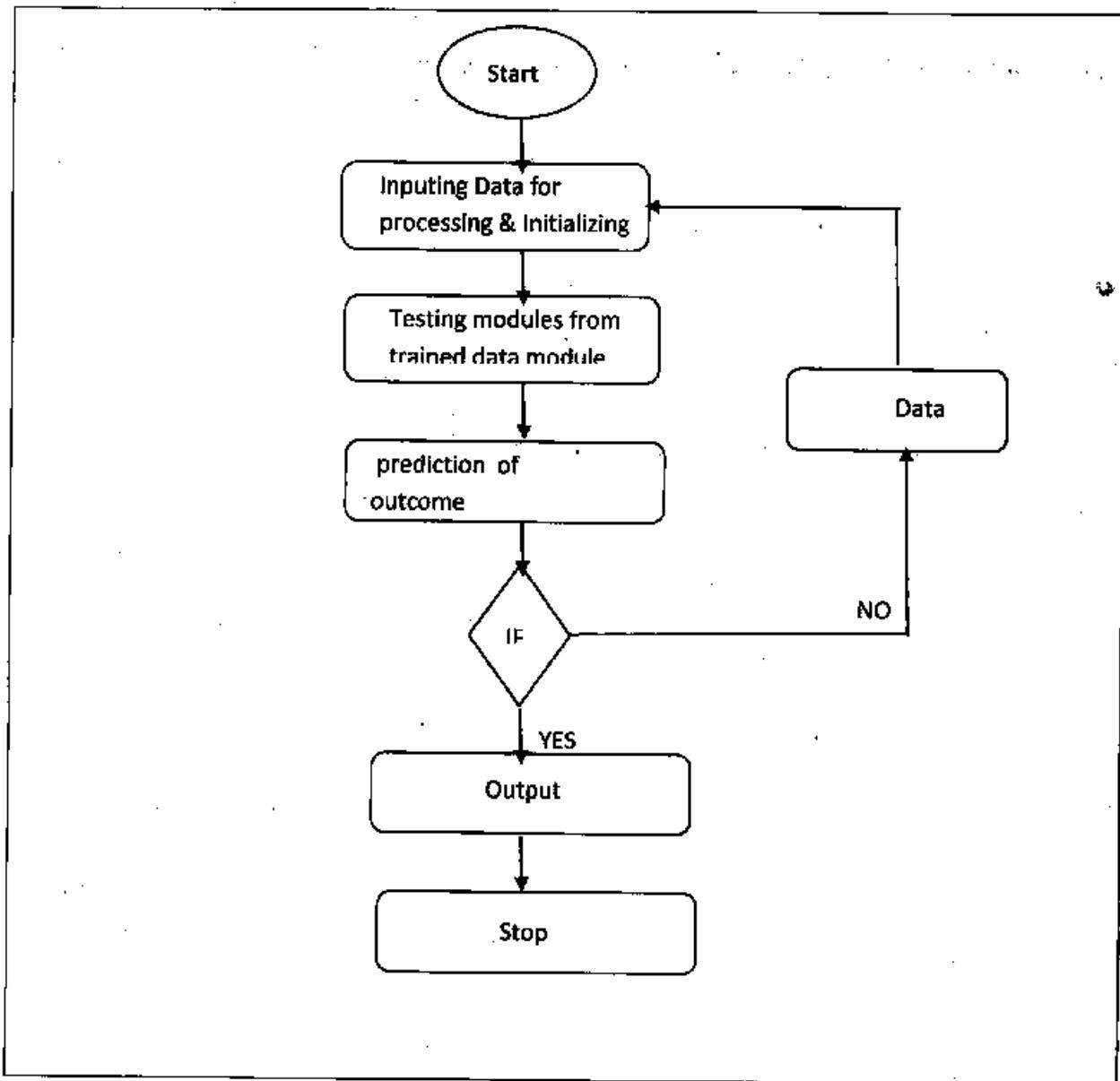
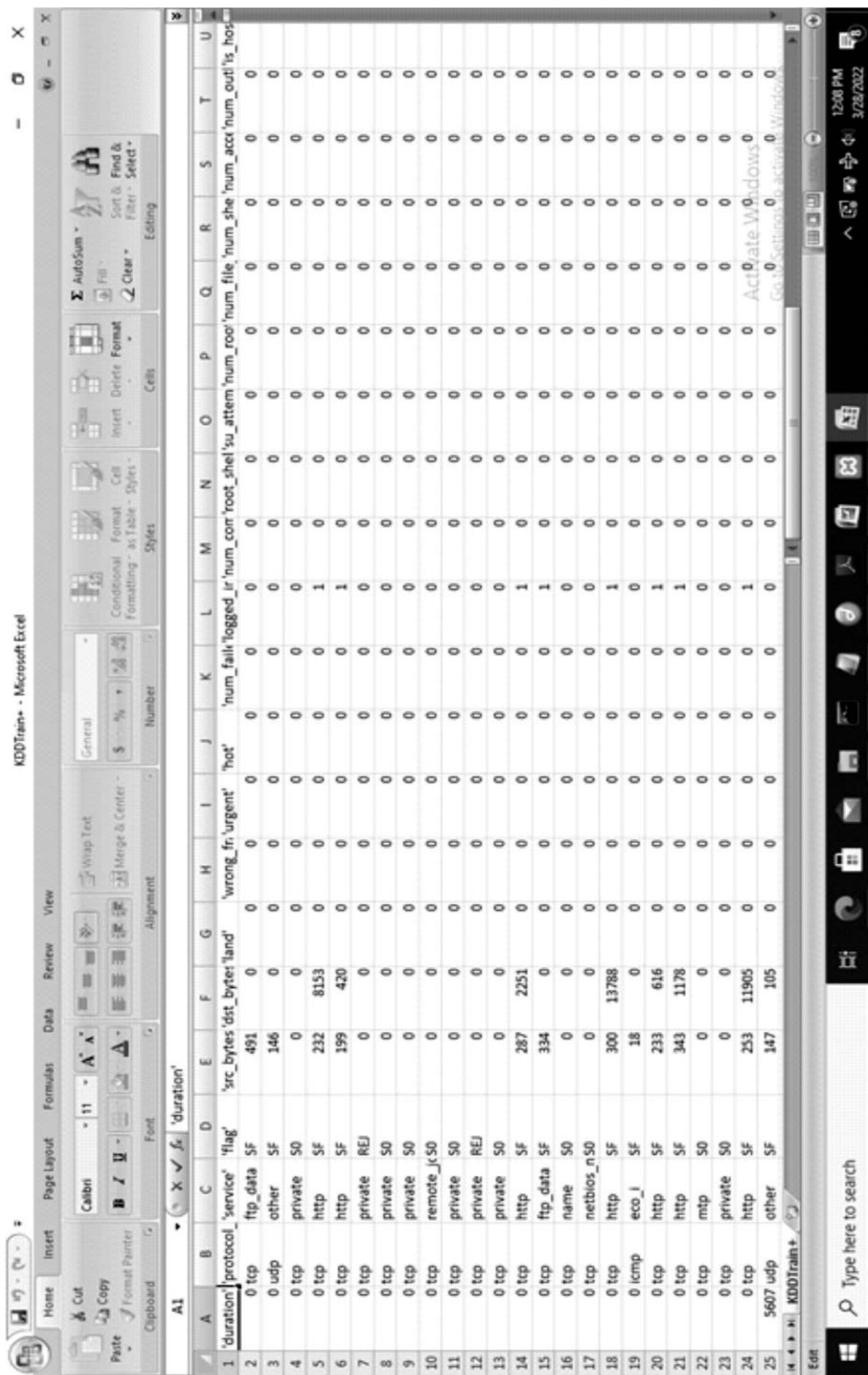


Fig 3.2 Program Flowchart



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	
1	'duration'	'protocol'	'service'	'flag'	'src_bytes'	'dst_bytes'	'land'	'wrong_fragment'	'frag_ip_ttl'	'frag_size'	'num_failed_logins'	'logged_in'	'num_root'	'num_file_creations'	'num_shells'	'num_uploads'	'num_outbound_cmds'	'is_host_login'	'is_guest_login'	'is_ip_suspicious'	'is_anomaly'	'is_rogue'	'is_ddos'	'is_sm_ips_ports'	'is_activex'	'is_windows'	'is_unix'
2	0	tcp	ftp_data	SF	491	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	0	udp	other	SF	146	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4	0	tcp	private	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
5	0	tcp	http	SF	232	8153	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
6	0	tcp	http	SF	199	420	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
7	0	tcp	private	REJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	0	tcp	private	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9	0	tcp	private	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10	0	tcp	remote_J_S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11	0	tcp	private	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
12	0	tcp	private	REJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
13	0	tcp	private	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
14	0	tcp	http	SF	287	2251	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
15	0	tcp	ftp_data	SF	334	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
16	0	tcp	name	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
17	0	tcp	netbios_ns0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
18	0	tcp	http	SF	300	13788	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
19	0	icmp	echo_I	SF	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
20	0	tcp	http	SF	233	616	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
21	0	tcp	http	SF	343	1178	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
22	0	tcp	mtp	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
23	0	tcp	private	S0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
24	0	tcp	http	SF	253	11905	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
25	5607	udp	other	SF	147	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Fig 3.3 dataset in csv(comma separated values) format file

The Info on dataset used is given below:

<class 'pandas.core.frame.DataFrame'>

RangeIndex: 125973 entries, 0 to 125972

Data columns (total 42 columns):

#	Column	Non-Null Count	Dtype
0	'duration'	125973	non-null int64
1	'protocol_type'	125973	non-null object
2	'service'	125973	non-null object
3	'flag'	125973	non-null object
4	'src_bytes'	125973	non-null int64
5	'dst_bytes'	125973	non-null int64
6	'land'	125973	non-null int64
7	'wrong_fragment'	125973	non-null int64
8	'urgent'	125973	non-null int64
9	'hot'	125973	non-null int64
10	'num_failed_logins'	125973	non-null int64
11	'logged_in'	125973	non-null int64
12	'num_compromised'	125973	non-null int64
13	'root_shell'	125973	non-null int64
14	'su_attempted'	125973	non-null int64
15	'num_root'	125973	non-null int64
16	'num_file_creations'	125973	non-null int64
17	'num_shells'	125973	non-null int64
18	'num_access_files'	125973	non-null int64
19	'num_outbound_cmds'	125973	non-null int64
20	'is_host_login'	125973	non-null int64
21	'is_guest_login'	125973	non-null int64
22	'count'	125973	non-null int64
23	'srv_count'	125973	non-null int64
24	'serror_rate'	125973	non-null float64
25	'srv_serror_rate'	125973	non-null float64
26	'rerror_rate'	125973	non-null float64
27	'srv_rerror_rate'	125973	non-null float64
28	'same_srv_rate'	125973	non-null float64
29	'diff_srv_rate'	125973	non-null float64
30	'srv_diff_host_rate'	125973	non-null float64
31	'dst_host_count'	125973	non-null int64
32	'dst_host_srv_count'	125973	non-null int64

```
33 'dst_host_same_srv_rate'           125973 non-null float64
34 'dst_host_diff_srv_rate'          125973 non-null float64
35 'dst_host_same_src_port_rate'     125973 non-null float64
36 'dst_host_srv_diff_host_rate'    125973 non-null float64
37 'dst_host_serror_rate'           125973 non-null float64
38 'dst_host_srv_serror_rate'       125973 non-null float64
39 'dst_host_rerror_rate'           125973 non-null float64
40 'dst_host_srv_rerror_rate'       125973 non-null float64
41 'class'                          125973 non-null object
dtypes: float64(15), int64(23), object(4)
memory usage: 40.4+ MB
```

Following the collection of data obtained, the data collected was checked for the presence of error in data entry including misspellings and missing data. Following this process, there was no error in misspelling of any data in the record.

HANDLING MISSING VALUE (This is to check which feature contains missing values)

```
print (df.isnull().sum())
'duration'                      0
'protocol_type'                  0
'service'                         0
'flag'                            0
'src_bytes'                       0
'dst_bytes'                       0
'land'                            0
'wrong_fragment'                 0
'urgent'                           0
'hot'                             0
'num_failed_logins'               0
'logged_in'                        0
'num_compromised'                 0
'root_shell'                       0
'su_attempted'                     0
'num_root'                         0
'num_file_creations'               0
'num_shells'                        0
'num_access_files'                  0
'num_outbound_cmds'                 0
```

```
'is_host_login'          0
'is_guest_login'         0
'count'                  0
'srv_count'              0
'serror_rate'             0
'srv_serror_rate'        0
'rerror_rate'             0
'srv_rerror_rate'        0
'same_srv_rate'          0
'diff_srv_rate'          0
'srv_diff_host_rate'     0
'dst_host_count'          0
'dst_host_srv_count'      0
'dst_host_same_srv_rate' 0
'dst_host_diff_srv_rate' 0
'dst_host_same_src_port_rate' 0
'dst_host_srv_diff_host_rate' 0
'dst_host_serror_rate'    0
'dst_host_srv_serror_rate' 0
'dst_host_rerror_rate'    0
'dst_host_srv_rerror_rate' 0
'class'                  0
dtype: int64
```

7 Evaluation Metrics

The evaluation metrics generated from this research work is given below;
Parameter distribution of random forest used for the randomized search

#Number of trees to use for building the random forest

n_estimators = [int(x) for x in np.linspace(start = 10, stop = 80, num = 10)]

#Number of features to consider at every split

max_features = ['auto', 'sqrt']

#Maximum number of levels in tree

max_depth = [2,4]

#Minimum number of samples required to split a node

min_samples_split = [2, 5]

#Minimum number of samples required at each leaf node

min_samples_leaf = [1, 2]

```
criterion=['gini', 'entropy']
# Method of selecting samples for training each tree
bootstrap=[True, False]
```

Parameter distribution code

```
# Create the param grid
param_grid = {'n_estimators': n_estimators,
'max_features': max_features,
'max_depth': max_depth,
'min_samples_split': min_samples_split,
'min_samples_leaf': min_samples_leaf,
'criterion': criterion,
'bootstrap': bootstrap}
print(param_grid)
```

OPTIMISED HYPERPARAMETER TUNNING OF RANDOM FOREST CLASSIFIER RESULT

Cross Validation at 10 fold fitting 10 folds for each of 10 candidates, totalling 100 fits Randomized Search CV(cv=10, estimator=RandomForestClassifier(), n_jobs=4,

```
param_distributions={'bootstrap':
[True, False],
'criterion': ['gini', 'entropy'],
'max_depth': [2, 4],
'max_features': ['auto', 'sqrt'],
'min_samples_leaf': [1, 2],
'min_samples_split': [2, 5],
'n_estimators': [10, 17, 25, 33, 41, 4856, 64, 72, 80]},  
verbose=2)
```

Best Parameter Result Generated From the Parameter Range Provided

```
rf_RandomGrid.best_params_
{'n_estimators': 72,
'min_samples_split': 5,
```

```
'min_samples_leaf': 2,  
'max_features': 'sqrt',  
'max_depth': 4,  
'criterion': 'entropy',  
'bootstrap': True}
```

Optimized Hyperparameter Tuning Of Random Forest Classifier Result
Train Accuracy - : 97.833%

COMPARATIVE ANALYSIS RESULT WITH OTHER RELATED MACHINE LEARNING ALGORITHM

The optimized value (accuracy) obtained from this research work is later compared with other algorithm. The results is shown below

Naive Bayes Algorithm Result

```
from sklearn.model_selection import train_test_split  
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2,random_state=9)  
#Split the dataset  
from sklearn.naive_bayes import GaussianNB  
nv = GaussianNB() # create a classifier  
nv.fit(X_train,y_train) # fitting the data  
from sklearn.metrics import accuracy_score  
y_pred = nv.predict(X_test) # store the prediction data  
#accuracy_score(y_test,y_pred) # calculate the accuracy  
print("Accuracy of Naive Bayes Algorithm is :  
{ }".format(accuracy_score(y_test,y_pred)*100))  
Accuracy of Naive Bayes Algorithm is : 52.92716808890653
```

Logistic Regression

```
import matplotlib.pyplot as plt  
import numpy as np  
from sklearn.linear_model import LogisticRegression  
from sklearn.metrics import classification_report, confusion_matrix  
model = LogisticRegression(solver='liblinear', random_state=0)  
model.fit(X, y)
```

```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='warn', n_jobs=None, penalty='l2',
                   random_state=0, solver='liblinear', tol=0.0001, verbose=0,
                   warm_start=False)
```

```
model = LogisticRegression(solver='liblinear', random_state=0).fit(X, y)
```

```
model.predict(X)
```

```
model.score(X, y)*100
```

```
Accuracy: 88.57215435053544
```

RANDOM FOREST CLASSIFIER

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report
from sklearn.metrics import accuracy_score
rf=RandomForestClassifier(n_estimators=50,min_samples_leaf=0.2,random_state=42)
rf.fit(X_train,y_train)
pred=rf.predict(X_test)
print("Accuracy of Random Forest model is :
{}".format(accuracy_score(y_test,pred)*100))
Accuracy of Random Forest model is : 91.82
```

SUPPORT VECTOR MACHINE

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size =0.2)
from sklearn.svm import SVC
svclassifier = SVC(kernel='rbf', degree=8)
svclassifier.fit(X_train, y_train)
y_pred = svclassifier.predict(X_test)
from sklearn.metrics import classification_report, confusion_matrix
from sklearn.metrics import accuracy_score
print("Accuracy of the Support Vector Machine model is :
{}".format(accuracy_score(y_test,y_pred )*100))
Accuracy of the Support Vector Machine model is : 53.70
```

DISCUSSION ON TABLE 1

This section of experiment was carried out with selected numbers of hyperparameter values which included the numbers of estimators, minimum sample leaf and random state, results of the experiments clearly stated below the table. When the value of the estimator was set at 500, Min. Sample leaf 300 and Random state 250, it was observed the performance in outcome with respect to accuracy declined, which implies that the greater the numbers of trees on the nodes, the less predictive the accuracy of the outcome. It was also observed that when the estimators value was set on 5, Min. Sample leaf 2 and Random state at 3, the efficiency on the outcome was greatly achieved.

This is just a phase testing of my model to check for correctness on predictive purpose, and this is also a manual phase on my software module.

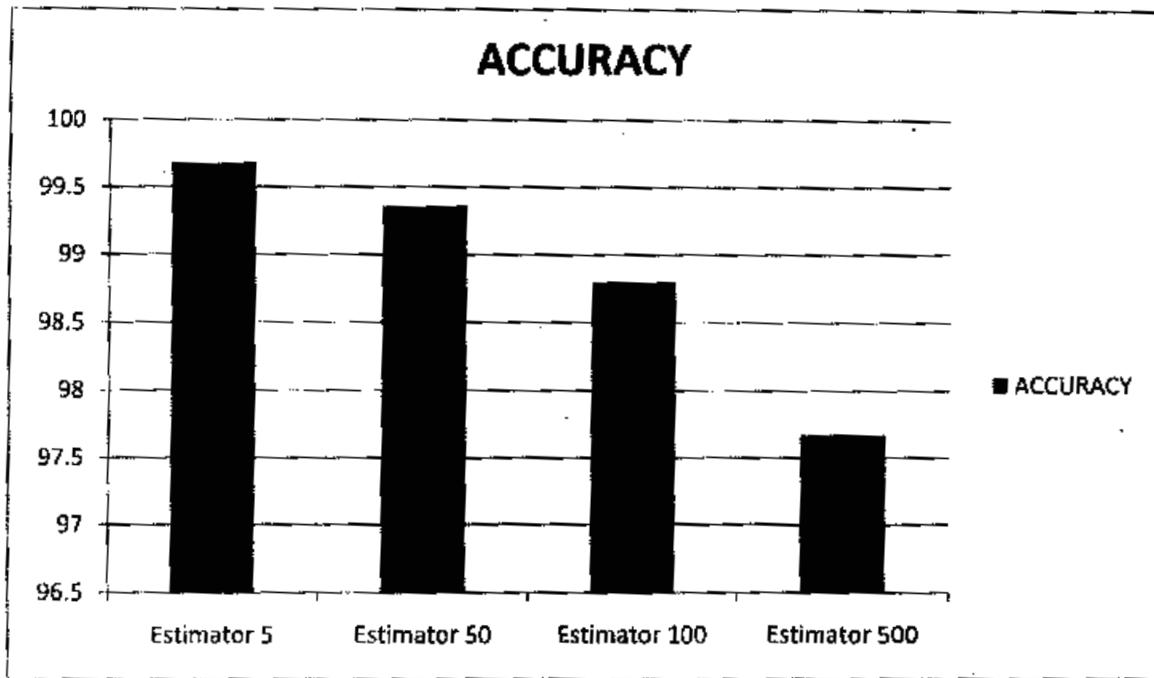


Fig 4.3 Graph depicting accuracy level of the manual hyperparameter tuning.

ESTIMATORS	ACCURACY
Estimator 5	99.68
Estimator 50	99.36
Estimator 100	98.8
Estimator 500	97.67

References

- (1) Barreiros M, Lundqvist P (2011). QoS-Enabled Networks: Tools and Foundations. West Sussex, UK: John Wiley & Sons.
- (2) Bhoyer, R., Ghonge, M., Gupta, S., 2013. Comparative study on IEEE standard of wireless LAN/Wi-Fi 802.11 a/b/g/n. Int. J. Adv. Res. Electron. Commun. Eng. (IJARECE) 2 (7).
- (3) Chiu DM, Sudama R (1992). Network monitoring explained: design and application. Ellis Horwood Series in Computer Communications and Networking.
- (4) Cisco (2008). Performance Management Best Practices for Broadband Service Providers. USA: Cisco Systems Inc.
- (5) Feng, P. 2012. Wireless LAN security issues and solutions. In: Robotics and Applications (ISRA), 2012 IEEE Symposium on (pp. 921–924). IEEE.

- (6) Gokhale AA (2005). Introduction to Telecommunications (2 ed.). New York, United States of America: Thomson Delmer Learning.
- (7) Haykin S (2001). Communication Systems (4 ed.). New York, USA: John Wiley & Sons, Inc.
- (8) Hong J, Li VOK (2009). Impact of Information on Network Performance – An Information-Theoretic Perspective. IEEE Glob. Telecomm. Conf. Publ. pp.1-6.
- (9) Keiser G (2002). Local Area Networks. New York, United States of America: McGraw-Hill Companies.
- (10) Koendjbiharie S, Koppius O, Vervest P, van Heck E (2010). Network transparency and the performance of dynamic business networks. 2010 4th IEEE International Conference on Digital Ecosystems and Technologies (DEST). pp.197-202.
- (11) Kouvastos DD (2011). Network Performance Engineering: A Handbook on Convergent Multi-service Networks and Next Generation Internet. German: Springer-Verlag Berlin Heidelberg.
- (12) Lathi, B. (1998). Modern Digital and Analog Communication Systems. New York: Oxford University Press Inc.
- (13) Lawniczak AT, Tang X (2006). Packet Switching Network Performance Indicators as Function of Network Topology and Routing Algorithms. IEEE Conference (CCECE '06) Publication. pp.1008-1011.
- (14) Milliken WC (2005). Patent No. 6978223. USA.
- (15) Nassar DJ (2000). Network Performance Baselining (1 ed.). USA: MTP.
- (16) Park KI (2005). QoS in Packet Networks. USA: Springer.
- (17) Prasad, RS, Murray M, Dovrolis C, Claffy K (2003). Bandwidth estimation: metrics, measurement and tools. Networking Journal, IEEE.
- (18) Seshan S, Stemm M, Katz RH (1997). SPAND: Shared Passive Network Performance Discovery. USENIX Symposium on Internet Technologies and Systems. California: USENIX.
- (19) Sheldon, F.T., Weber, J.M., Yoo, S.M., Pan, W.D., 2012. The insecurity of wireless networks. Secur. Privacy IEEE 10 (4), 54–61(20) Soldani D, Li M, Cuny R (2006). QoS and QoE

Management in UMTS Cellular Systems. West Sussex, UK: John Wiley & Sons.

- (21) Spohn DL (2000). Data Network Design. New York, United States of America: McGraw-Hill Companies Inc.
- (22) Stallings W (1996July9). Knowing wiring basics can boost local net performance. Network World , P. 29.
- (23) Stanford Linear Accelerator Center (SLAC). (n.d.). Network Monitoring Tools. Retrieved August 29, 2013, from <http://www.slac.stanford.edu/xorg/nmtf/nmtf-tools.html>.
- (24) Walrand J, Varaiya P(2000). High-Performance Communication Networks. USA: Academic Press.
- (25) Ogunrinde, S. I., 2004. Network Programming and Design, Heinemann Educational Press, pp. 1-12
- (26) Menkiti, A. I., 2005. Logic Circuits, Devices and Applications, EFTIMO Nig Press, Calabar, pp 82-90
- (27) Yucalar, F. & Erdogan, S. Z., July 2009. A Questionnaire Based Method for CMMI Level 2 Maturity Assessment. Journal of aeronautics and Space Technologies, pp. 39-46
- (28) **Vincent A. Akpan, Reginald O. A. Osakwe and Amaku Amaku, Efficient Networking Of Tini For Real-Time Weather Data Logging & Deployment Over Ethernet And Serialcommunication Links.** International Journal of Communications, Network and System Sciences (IJCNS), September 2013, P. O. BOX 54821, Irvine CA 92619-4821, USA. (PUBLISHED)
- (29) Amaku Amaku, Raphael E.Watti, John Joshua, Optic Fiber As A Reliable Medium For Metropolitan Area Networking (Man) Connectivity, International Journal of Engineering and Technology (IJET) Volume 4 No. 7, July, 2014, ISSN: 2049-3444 © 2014 –IJET Publications UK.
- (30) Amaku Amaku, Rapheal Watt, Igbinosa G., Bandwidth As A Determinant Factor For Effective Internet Connectivity In Educational Research Purpose In Higher Institution Of Learning. International Journal of Engineering and Technology (IJET) Volume 6 No. 4, April , 2016, ISSN: 2049-3444 © 2016 –IJET Publications UK.
- [31] M.I. Jordan, T.M. Mitchell, Machine learning: Trends, perspectives, and prospects, Science Random Forest Hyperparameter Tuning In Machine Learning For Improved Performance In Intrusion Detection Systems

349 (2015) 255260. <https://doi.org/10.1126/science.aaa8415>.

- [32] M.-A. Zller and M. F. Huber, Benchmark and Survey of Automated Machine Learning Frameworks, arXiv preprint arXiv:1904.12054, (2019). <https://arxiv.org/abs/1904.12054>.
- [33] R. E. Shawi, M. Maher, S. Sakr, Automated machine learning: State-of-the-art and open challenges, arXiv preprint arXiv:1906.02287, (2019). <http://arxiv.org/abs/1906.02287>.
- [34] M. Kuhn and K. Johnson, Applied Predictive Modeling, Springer (2013)
ISBN: 9781461468493.
- [35] G.I. Diaz, A. Fokoue-Nkoutche, G. Nannicini, H. Samulowitz, An effective algorithm for hyperparameter optimization of neural networks, IBM J. Res. Dev. 61 (2017) 120.
<https://doi.org/10.1147/JRD.2017.2709578>.
- [36] F. Hutter, L. Kotthoff, and J. Vanschoren, Eds., Automatic Machine Learning: Methods, Systems, Challenges, Springer (2019) ISBN 9783030053185.
- [37] N. Decastro-Garca, . L. Muoz Castaeda, D. Escudero Garca, and M. V. Carriegos, Effect of the Sampling of a Dataset in the Hyperparameter Optimization Phase over the Efficiency of a Machine Learning Algorithm, Complexity 2019 (2019).
<https://doi.org/10.1155/2019/6278908>.
- [38] S. Abreu, Automated Architecture Design for Deep Neural Networks, arXiv preprint arXiv:1908.10714, (2019). <http://arxiv.org/abs/1908.10714>.
- [39] O. S. Steinholtz, A Comparative Study of Black-box Optimization Algorithms for Tuning of Hyper-parameters in Deep Neural Networks, M.S. thesis, Dept. Elect. Eng., Lule Univ. Technol., (2018).
- [40] G. Luo, A review of automatic selection methods for machine learning algorithms and hyper-parameter values, Netw. Model. Anal. Heal, Informatics Bioinforma. 5 (2016) 116.
<https://doi.org/10.1007/s13721-016-0125-6>.
- [41] D. Maclaurin, D. Duvenaud, R.P. Adams, Gradient-based Hyper-parameter Optimization through Reversible Learning, arXiv preprint arXiv:1502.03492, (2015).
<http://arxiv.org/abs/1502.03492>.
- [42] J. Bergstra, R. Bardenet, Y. Bengio, and B. Kegl, Algorithms for hyper-parameter optimization, Proc. Adv. Neural Inf. Process. Syst., (2019)25462554.

- [43] B. James and B. Yoshua, Random Search for Hyper-Parameter Optimization, *J. Mach. Learn. Res.* 13 (1) (2019) 281305.
- [44] N. Landwehr, M. Hall, and E. Frank, Logistic model trees, *Mach. Learn.*, vol. 59, no. 12, pp. 161-205, 2015.
- [45] Breiman Leo (2001). "Random Forests". *Machine Learning* 45 (1): 5–32.
- [46] Liaw, Andy (16 October 2012). "Documentation for R package random forest". Retrieved 15 March 2013.

**GREEN SYNTHESIS OF SILVER NANOPARTICLES USING
GONGRONEMA LATIFOLIUM AQUEOUS
Leaves Extract and their Antimicrobial and Antioxidant Properties**

By

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Abstract:

The synthesis of nanomaterials is very important in developing novel substances with potential therapeutic effects. Significant advancements have been made in the improvement of the synthetic methods. This research was directed at synthesizing silver nanoparticles (AgNps) via the biological method which is eco-friendly and investigating their antimicrobial and antioxidant activities. The leaf extracts of *Gongronema latifolium*, were used to synthesize silver nanoparticles by reducing silver ions (Ag^+) to silver metal (Ag^0). The synthesized silver nanoparticles were characterized via UV-visible, Fourier transform infrared (FTIR), Scanning electron microscope (SEM) and energy dispersive x-ray (EDX) spectroscopic analyses respectively. The SEM result revealed the morphology of the synthesized AgNps as a spherical particles with a diameter range 40-50 nm. The UV spectra showed peaks at 424 nm which is characteristic of AgNps. The EDX analysis showed a strong silver signal with 4.32 keV in addition to other weak signals which may be due to biomolecules bounded to the surface of the nanoparticles. The IR spectra absorption bands were observed at 3415 cm^{-1} , 2920 cm^{-1} , 2490 cm^{-1} , 1660 cm^{-1} , 1385 cm^{-1} which are characteristics of the following stretching vibrations, -OH, C-H, C=O, C-N respectively. The extracts and the synthesized AgNps were tested against two gram positive bacteria (*Staphylococcus aureus* and *Escherichia coli*) and two gram negative (*Helictobacter Pylori* and *Clostridium*) bacteria. The particles exhibited some level of inhibition against the microorganisms. Assessment of 2, 2 diphenyl-1-hydrazyl (DPPH) scavenging assay showed that the extracts of *Gongronema latifolium* and the synthesized AgNps possess antioxidant properties.

Keywords: Nanoparticles, *Gongronema latifolium*, Antimicrobial, Antioxidant, Microorganisms.

1.0 Introduction

Nanoparticles are materials with size range of 1nm to 100 nm^[1]. They possess promising properties that are dependent on size, morphology and behavior. Nanoparticles have very wide of applications indifferent fields such as medical, engineering, agriculture, telecommunication just to mention but a few^[2]. One of the most important properties that make them very useful is their higher surface to volume ratio. That is, as the particles decrease in size, the surface area is exposed thereby making them more accessible and reactive. This explains why they exhibit high catalytic and antimicrobial activities as observed in silver nanoparticles. The increase in their specific surface area brings about a corresponding increase in their biological effectiveness due to the increase in surface energy^{[2], [3]}. There are different synthetic approaches used to produce nanoparticles, they include chemical, physical and biological^[3]. While the chemical method appears to be one of the shortest methods, it is usually not eco-friendly because it requires the use of very toxic chemicals which are harmful to the environment when they are released. The physical method on the other hand yielded particles with different sizes, chemical compositions and distribution as well as formation of aggregates. The biological method is the only environmental friendly protocol because it does not require the use of toxic chemicals and does not produce harmful byproducts^{[4], [5]}. Another advantage is, the presence of active biomolecules enhances the production of the nanoparticles through bio-reduction. This method is known as green synthesis of nanoparticles and has proven to be better than other methods^{[5] [6]}. Much interest has been shifted to this area of research in nanoscience since it allows better control of shape and size of nanoparticles that can be used for different nanotechnological applications. Different environmental friendly materials like plant extracts, bacteria, fungi and enzymes^[6] have been employed in the synthesis of nanoparticles that are eco-friendly, with very high compatibility for industrial, pharmaceutical, medical and other applications^[7].

Recently, the use of medicinal plants has gained more attention for the synthesis of nanoparticles due their availability and many of them have been successfully utilized to produce nanoparticles that possess very promising medicinal value. Different parts of medicinal plants such as the leaves, stems, roots, fruits, flowers, and seed have been used and reported^[8].

Nigeria is naturally endowed with so many medicinal plants used for treating different diseases and since they are rich with biochemical compounds, they can be used for the synthesis of nanoparticles^[9]. Although many plants have been used for

the synthesis of silver nanoparticles, no research work has been reported for the synthesis of silver nanoparticles using *Gongronema latifolium* leaf extracts^[10].

Gongronema latifolium is an edible and medicinal plant mostly found in the rain forest zones of Nigeria and other tropical African countries. It has a wide range of nutritional and ethno-medical uses in different tropical African communities. It is a member of the *Asclepiadaceae* family.

The plant produces white latex and yellow flowers and can be propagated by seed or stem cuttings^[11].

Imo and Uhegbu (2015)^[12] reported that *Gongronema latifolium* contains different types of alkaloids, flavonoids, total phenolic compounds, lignan, terpenes, sterol, allicin, hydroxycinnamic acids, saponins and carotinoids. The author also reported that some of the phytochemicals detected in high quantities when 100g of *Gongronema latifolium* (benth) leaf extracts was analyzed included cinchonidine, oxoassoanine, lupanine and buphanidrine (alkaloids), hyperoside, quercetin, kaemferol (Flavonoids), tannic acid, ferulic vanillic (total phenolic compound), retusin and galgravin (lignan), nerol (geraniol) and betapinene (terpenes), 5-avenasterol, stigmasterol (sterol), chlorogenic acid, caffeic acid. (hydroxycinnamic acids), saponine and sapogenin (saponin) and beta-cryptoxanthin, xanthophylls (carotenoid). The result showed that *Gongronema latifolium* (Benth) leaves possess an appreciable quantity of phytochemicals which is responsible for reduction of metallic salts to their nano-metallic particles^[12].

Gongronema latifolium leaves are used as vegetables for the preparation of soups. They have a bitter-sweet flavor. The leaves are also sometimes used to spice locally brewed beer. According to Plant Resources of Tropical Africa (PROTA), the soft stem is used as chewing stick in Sierra Leone^{[10], [11], [12]}.

In this present report, the synthesis of silver nanoparticles, using the aqueous leaf extracts of *Gongronema latifolium* is reported for the first time. The green synthesized nanoparticles were characterized using Ultraviolet-Visible (UV), Fourier Transform Infra-red (FTIR), Scanning Electron Microscopy (SEM) and Energy Dispersive X-ray (EDX) analyses. In addition to the above, the synthesized nanoparticles were screened for antibacterial and anti-oxidant activity against different pathogenic microbes and scavengers respectively.

2.0 Methods

2.1.0 Materials

Silver nitrate was purchased from Aldrich, and was used without further purification. Deionized water was used throughout the process and filtration was

done with Whatman No.1 filter paper. All the glass wares washed and dried in hot air oven before use.

2.1.1G. *latifolium*

The leaves were obtained from Ogbete main market Enugu in Enugu state, Nigeria and were identified as *Gongronema latifolium* in Department of Chemical Sciences of Godfrey Okoye University, Thinkers Corners Enugu. The collected leaves were washed with running tap water and twice with distilled water before use. The leaves were then air dried at room temperature for two weeks in order to remove all the moisture present. The dried leaves were thereafter ground using a mechanical grinder to fine powder and stored for further analysis. **Figure 1** below shows the picture of *Gongronema latifolium* plant.



Figure 1: A picture of *Gongronema latifolium* plant.

2.1.2 Plant leaves extract preparation

10.00 g of the fine powdered was mixed with distilled water (200 ml) and boiled at 100°C for 25 minutes. The mixture was filtered via a filter paper and the filtrate was centrifuged and then filtered the second time through a Whatman No.1 filter. The extract (filtrate) obtained was thereafter transferred into a reagent bottle and stored in a refrigerator to be used for the nanoparticles synthesis.

2.1.3 Synthesis of silver nanoparticles

100 ml (1 mmol) aqueous solution of silver nitrate, AgNO₃ (aq) was poured into a conical flask and 20 ml of the extract obtained above was added drop-wise with the help of a micropipette while heating and continuous stirring at 60°C for 20 minutes. The solution changed from a colorless to a brownish solution which confirms the formation of colloid silver nanoparticles (AgNPs). The solution was then centrifuged

at 9000rpm for 20 minutes and the supernatant was collected. The solvent was removed by evaporation via a water bath and concentrated to obtain a semi solid product which is the silver nanoparticles. The silver nanoparticles were restored for further analysis^[13].

2.1.4 Characterization

The synthesized silver nanoparticles were confirmed via UV-visible spectrophotometer (UV-1800 Shimadzu double beam). The infrared measurements were used to determine the presence of the biomolecules in the extract and the AgNPs via Jasco 5300-Fourier Transform Infrared spectrophotometer model. The clear particles mean size and morphology of the AgNPs was characterized by SEM and EDX analyses.

2.1.5 Antibacterial activity of *Gongronema latifolium* leaves synthesized AgNPs

The synthesized AgNPs from *G. Latifolium* leaf extracts were tested for their antibacterial activity against two gram positive (*Staphylococcus aureus* and *Escherichia coli*) and two gram negative (*Helicobacter Pylori* and *Clostridium*) bacteria by agar well diffusion method^[18]. Into each agar well, 0.5 ml sample prepared by dissolving 0.5mg of nanoparticles in 1 ml of distilled water was dispensed. In a separate well, distilled water was also dispensed to serve as control. The plates were incubated at 37°C for 24 hrs. After incubation, the diameter of the zone of inhibition for each well was measured in millimeters (mm). The assay was done in triplicates for each sample and bacterial species.

2.1.6 Antioxidant assay

The antioxidant property of the synthesized silver nanoparticles obtained from *Gongronema latifolium* leaf extract was determined via 2, 2-diphenyl-1, 1-hydrazyl (DPPH) assay according Thaipong et al 2010^[19]. A 0.8mmol/L stock solution of DPPH was prepared and 1.0 ml of different concentrations (0.1, 0.5, 1.0, 2.0 and 4.0 mg/mL) of the synthesized AgNPs and the extract were added to four test tubes labeled a, b, c and d. respectively. A volume of 1.0ml of the prepared DPPH was added to each of the test tubes containing the samples. The mixtures were shock vigorously and allow to stand in a dark room for 30mins at room temperature. After 30mins the absorbance was taken at 517nm against methanol control while ascorbic acid served as the standard. Percentage DPPH radical scavenging activity was calculated using the formula^[20].

$$\% \text{ DPPH radical scavenging} = \frac{\text{control absorbance} - \text{sample absorbance}}{\text{sample absorbance}} \times 100$$

3.0 Results and Discussion

3.1.0 UV-vis analysis

The addition of *G. latifolium* leaf extracts to aqueous solution of silver nitrate, AgNO_3 (aq) brought about a color change in the resultant solution from yellowish-brown to reddish-brown and finally to brown which indicated the formation of silver nanoparticles, AgNPs. The UV-vis absorption spectrum of the synthesized AgNPs is shown in **Figure 2** below. The only peak observed at 455 nm is a characteristic absorption band for silver and since no other peak was shown in the spectrum, it confirms that only the synthesized silver nanoparticles are present.

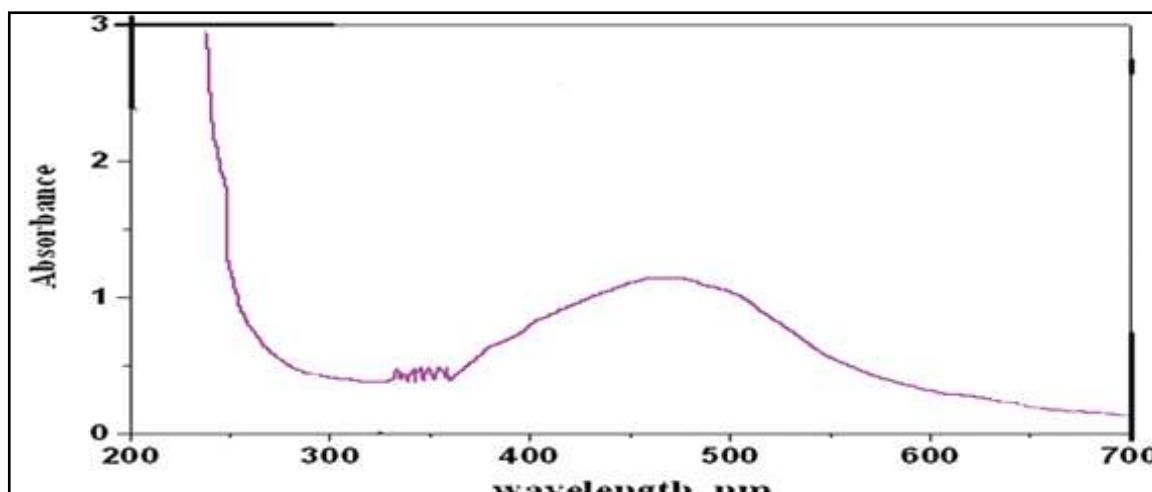


Fig 2: UV-Vis absorption spectrum of the synthesized AgNPs

3.1.2 Fourier-transform infrared spectroscopy(FTIR) Analysis

The FTIR spectrum of the synthesized silver nanoparticles, AgNPs of *G. latifolium* leaf extracts revealed a very strong absorption band at 3415cm^{-1} which is -OH stretching vibration for either alcohols or phenolic compounds. The absorption peak at 2920cm^{-1} is attributed to CH stretching while absorption peak at 1660cm^{-1} assigned to a carbonyl (C=O) stretch as well as 1385cm^{-1} for C-N stretch (**Figure 3**).

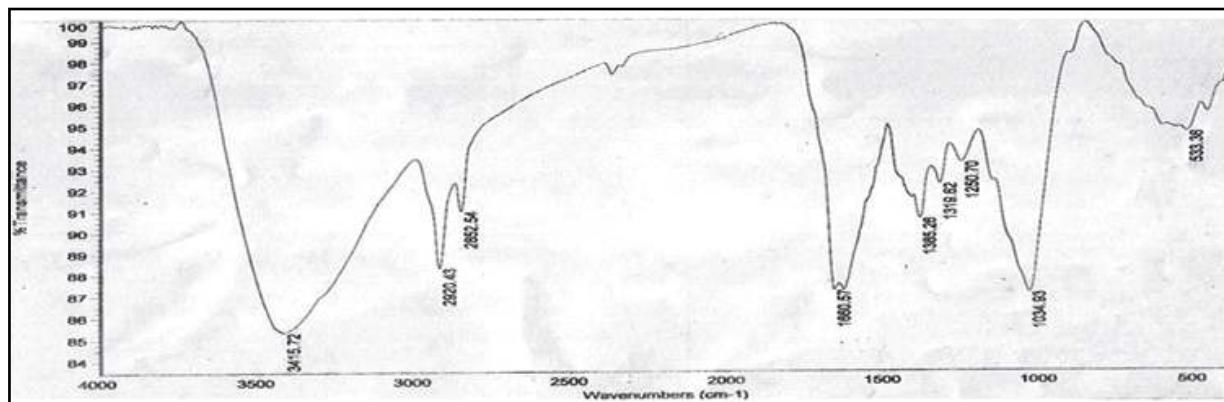


Figure 3: FTIR spectrum of synthesized silver nanoparticles, AgNPs from *G. latifolium* leaf

extracts.

3.1.3 Scanning electron microscope (SEM) Analysis

The SEM image of the synthesized silver nanoparticles AgNPs is shown in **figure 4**. From the SEM result, the morphology of the particles revealed they are spherical shapes with different sizes in the range 40-50 nm. This may be attributed to the presences of different types of capping agents in the extracts. The above claimis supported by the shifts and difference absorption peaks observed in the FTIR analysis.

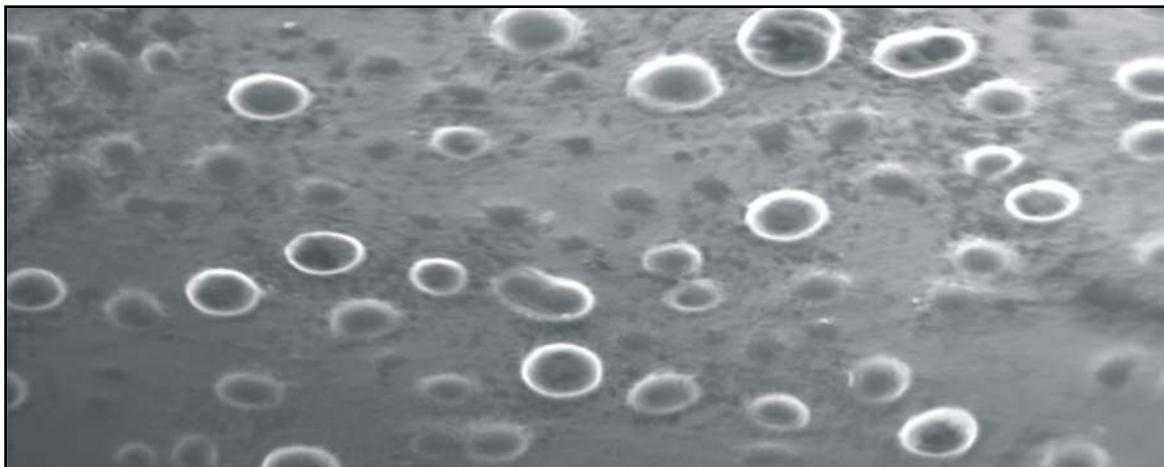


Fig 4: SEM image of the synthesized silver nanoparticles obtained from *G. latifolium* leaf extracts.

3.1.4 Energy dispersive X-ray (EDX) analysis

EDX analysis of the synthesized silver nanoparticles in **Figure 5**below showed the presence of elemental metal signals. The EDX profile showed a strong silver signal of 4.32keV (70%) in addition to with other weaker signals which may have originated from the biomolecules boundto the surface of the nanoparticles.

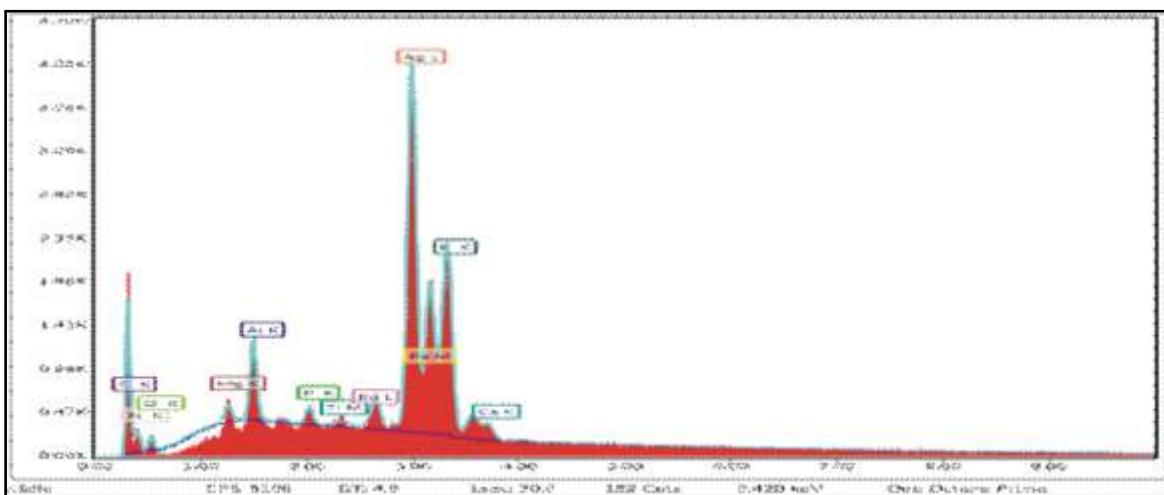


Fig 5: EDX analysis of the synthesized silver nanoparticles obtained from *G. latifolium* leaf extracts.

3.1.5 Antibacterial activity

The synthesized silver nanoparticles, Ag NPs of *G. latifolium* leaf extracts showed highest inhibition against *Staphylococcus aureus* and *Clostridium*, a moderate inhibition against *E.coli* and least inhibition against *Helicobacter pylori*. Both *Ciproflox* and *Chloramphenicol* were used as standard drug for gram positive and gram negative organisms respectively. From the results shown in **Table 1**, the synthesized silver nanoparticles Ag NPs displayed zones of inhibition for all the tested microorganisms while the standard drugs were selective in activity.

Table 1: Antimicrobial activity of synthesized nanoparticle on selected gram positive and negative organisms, compared to standard drugs

Microorganisms	<i>S. aureus</i>	<i>E.coli</i>	<i>Clostridium</i>	<i>H. pylori</i>
Zone of inhibition of synthesized AgNps extract (mm)	12.7	10.6	12.7	7.6
Zone of inhibition of ciprofloxacin (mm)	30	-	30	-
Zone of inhibition of chloramphenicol (mm)	-	20	-	-

The above observations agreed with the claim that silver nanoparticles, AgNps have very good antimicrobial activity against various pathogenic organisms as has been reported by different authors^{[22][23]}. The antibacterial activity of AgNPs obtained from *G. latifolium* leaf extracts against both gram-positive and gram-negative bacteria as observed in **Table 1** above is in agreement with the findings of previous studies carried out with other plant materials^[24]. The graphical representation of the antimicrobial activity of the synthesized silver nanoparticles and standard drugs is shown in **Figure 6**.

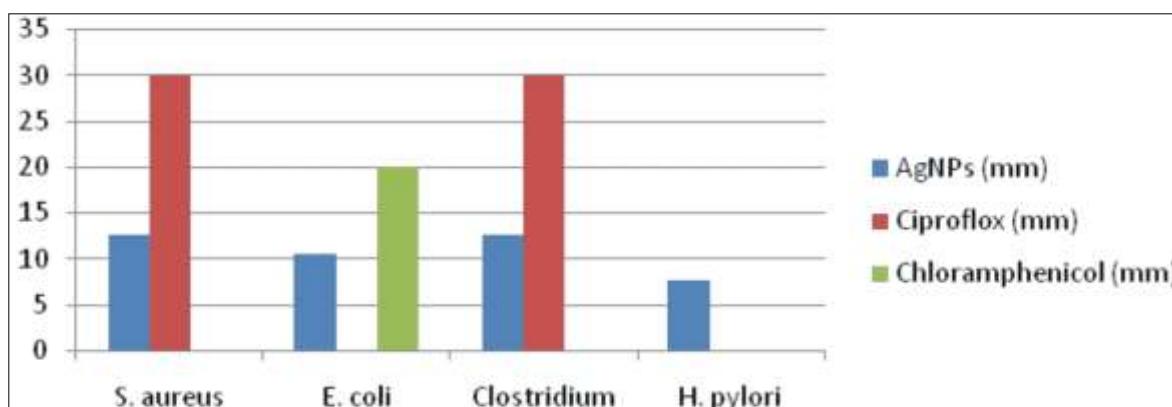


Fig 6: Graphical representation of the antimicrobial activity of the synthesized silver nanoparticle and the standard drugs, ciprofloxacin and chloramphenicol.

3.1.6 Antioxidant assay

DPPH scavenging property of the synthesized AgNPs of *G. latifolium*

The antioxidant scavenging property of the synthesized silver nanoparticles were determined by 2, 2-diphenyl-1,1-hydrayl (DPPH) assay^[25]. As shown in **Table 2**, the DPPH scavenging activity increased with increase in the concentration of silver nanoparticles comparable to that of Ascorbic acid used as standard antioxidant. This result showed that the AgNPs of *G. latifolium* possess antioxidant properties.

Table 2: Comparison of the antioxidant effect of synthesized nanoparticles with standard

Concentration (mg/ml)	Silver Nanoparticles	Ascorbic Acid
0.1	28.33±0.62	33.29±0.51
0.5	33.20±0.635	41.37±0.65
1.0	40.20±0.52	93.33±0.61
2.0	44.39±0.55	96.37±0.61
4.0	50.33±0.58	98.39±0.61

Results are expressed as mean ± S.E.M (S.E.M = Standard Error of the Mean)

The percentage inhibition of DPPH radical scavenging property of AgNPs and that of ascorbic acid as a standard antioxidant is shown in **Table 3** and a chart of the same results is shown in **Figure 7**.

Table 3: Percentage inhibition of DPPH radical scavenging activity of synthesized AgNPs of *Gongronema latifolium* compared with Ascorbic acid

Concentration (mg/ml)	<i>G. latifolium</i> synthesized AgNPs% of inhibition of DPPH	Ascorbic acid % inhibition of DPPH
0.1	28.33	33.30
0.5	33.20	41.40
1.0	40.20	93.33
2.0	44.39	96.33
4.0	50.33	98.40

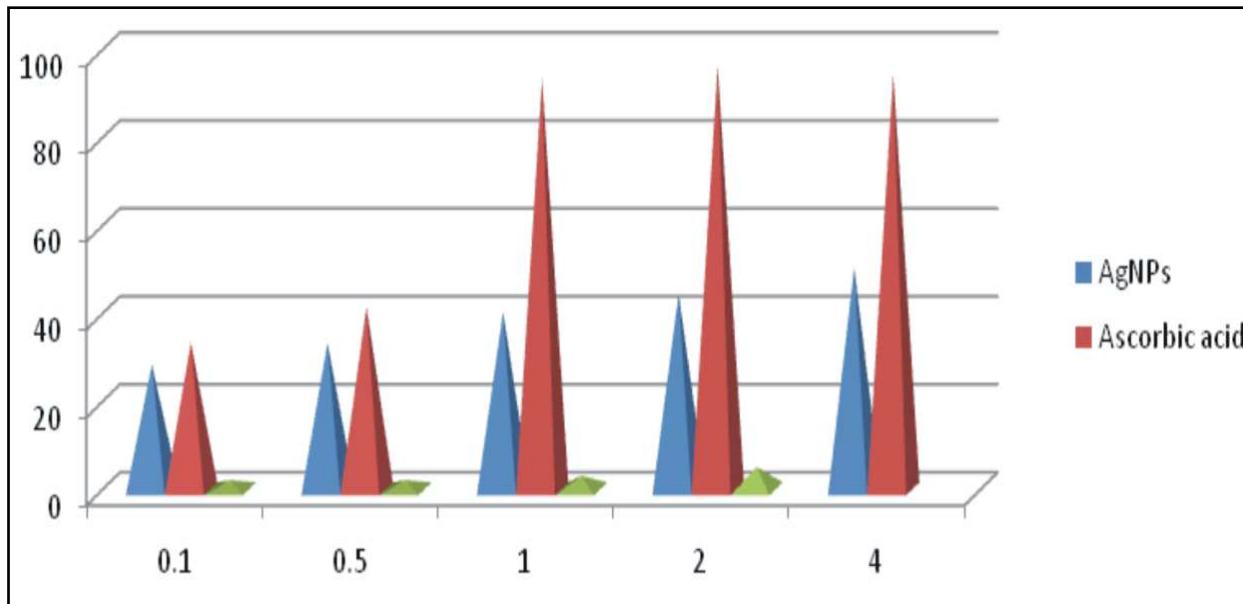


Figure 7: A chart showing the percentage of radical scavenging properties of AgNPs and ascorbic acid

4.0 Conclusion

Many methods of synthesis of nanoparticles via physical and chemical approaches have limitations such as the generation of by-products which are not environmental friendly, difficult to sustain and not cost-effective. Recently, the green synthetic approaches which are easy, cost-effective, eco-friendly, well-controlled are encouraged. The synthesized silver nanoparticles AgNPs with particle size of 40-50 nm were successfully synthesized using the leaf extracts of *G. latifolium*. The nanoparticles were characterized via UV, IR, SEM and EDX spectroscopic analytical techniques. The nanoparticles were found to exhibit antibacterial activity against *S. aureus* and *E. coli*, *Clostridium* and *H. pylori*. In addition to the above the particles also exhibited promising antioxidant activities. The biological method used for the synthesis of the silver nanoparticles AgNPs using *Gongronema latifolium* leaf extracts was very fast, cost effective and eco-friendly.

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References

1. Hamidreza Kamrani (2018) **Synthesis and characterization of copper nanoparticles by bis-(acetylacetoneato)-copper (II) using nonionic surfactants and the effect of their structures on nanoparticles size and yield;** *Non-metallic Materials* 8 (1) 11-21. <https://doi.org/10.4236/ojinm.2018.82002>
2. Shakil Ahmed Polash, Nilofar Yakub Nadaf, Md. Atikur Rahman &Abdullah Mohammad Shohael (2016) **Green synthesis of silver nanoparticles (AgNPs): Agricultural applications and future vision;** *Journal of Biodiversity and Environmental Sciences*, 13(2); 35-57, <http://www.innspub.net>
3. S. Rajeshkumar &L.V. Bharath (2017) **Mechanism of plant-mediated synthesis of silver nanoparticles -A review on biomolecules involved, characterization and antibacterialactivity;** *Chemico-Biological Interactions*, 273 (1), 219-227
4. Shar ma VK, Yagard RA, &Lin Y (2009) **Silver nanoparticles: Green synthesis and their antimicrobial activities.** *Advanced Colloid Interface Science* 145(1-2):83-96.
5. Subha V., Ernest Ravindran R. S.& Sruthi P, Renganathan S. (2015): **An eco-friendly approach for synthesis of silver nanoparticles using *Ipomoea pes-caprae* root extract and their antimicrobial Properties;** *Asian Journal of Pharmacy and Clinical Research*, 8 (5), 104-107
6. Rammohan Pal (2017) **Green Synthesis of silver and gold nanopaticles using edible fruit juice/extract: an overview;** *Journal of Inst. Chemistry*, 89(1), 22-32
7. Balogun M. E., Besong E. E., Obimma J. N., Mbamalu O. S. & Djobissie F. A. (2016) ***Gongronema latifolium:* A phytochemical, nutritional and pharmacological review;** *Journal of Physiology and Pharmaceutical Advances* 6 (1): 811-824, <https://doi.org/10.5455/jppa.1969123104000>
8. Bandaranayake W. M. (1998) Traditional and medicinal uses of mangroves. *Mangroves Salt Marshes*, 2nd edition, 133-48
9. Leela A, &Vivekanandan M. (2008): Tapping the unexploited plant resources for the synthesis of silver nanoparticles. *African Journal of Biotechnology*, 7(17):3162-3165.

10. Hutchinson J. & Dalziel J. M. (1931) Flora of West Tropical Africa: The Crown Agents for the Colonies. Milbank: 1931; Westminster;
11. G. H. Gurib&Fakim A (Ed.). PlantResources of Tropical Africa (PROTA);Available:<http://www.prota4u.org/search.asp>. Accessed February 5 2019.
- 12. Chinedu Imo, & Friday O. Uhegbu (2015); Phytochemical analysis of *Gongronemalatifolium*benth leaf using gas chromatographic flame ionization detector; *International Journal of Chemical and Bimolecular Science* 1 (2), 60-68,<http://www.aiscience.org/journal/ijcbs>**
13. Srikanth K, Vikram G, &Rama Swamy N (2014); Eco-friendly and green synthesis of silver nanoparticles using leaf extract of *Strychnospotatorum linn* and their bactericidal activities. *Journal of Biotechnology*5(5):706-714.
- 14. Nagababu P, & Umamaheswara Rao V. (2016);Cost-effective green synthesis and characterization of silver nanoparticles from *Avicennia alba* leaf extracts and their antibacterial activity; *Asian Journal of Pharmacy and Clinical Research*, 9 (1), 301-303**
15. Edim E. H., Egomi U.G., Ekpo U. F. &Archibong E. U. (2012) A review on *Gongronema latifolium*: A novel antibiotic against staphylocous aureus related infections. *International journal of Biochemistry and Biotechnology*, 1 (8), 204-208
16. Fiedor J. & Burda K. (2014)Potential role of carotenoids as antioxidants in human health and disease, *Nutrients* 6 (1), 466–88.
17. Jayaprakasha G. K., Jena B. S., Negi P. S. & Sakariah K. K. (200)Evaluation of antioxidant activities and antimutagenicity of aurmeric oil: a byproduct from curcumin production. *Natureforsch*57c (1), 828-835.
18. Lin, Sujogya kumar (2014); Screening methods in the study of antimicrobial properties of medicinal plants. **International journal of biotechnology and research substances**. 4th OAUInter African symposium on traditional pharmacopoeia and African medicinal plants. Abuja-Nigeria.
19. Thaipong K, Boonprakob U, Crosby K, Cisneros-Zevallos L & Byrne D. H. (2006)Comparison of ABTS, DPPH, FRAP, and ORAC assays for estimating antioxidant

- activity from guava fruit extracts. *Journal of Food Composition and Analysis* 19 (1): 669–676
20. Pisoschi A.M, Cheregi M. C. & Danet A. F. (2009) Total antioxidant capacity of some commercial fruit juices: electrochemical and spectrophotometric approaches. *Molecules*, 14(1), 480-493.
21. Muhammad Qasim Nasar, Ali Talha Khalil, Muhammad Ali, Mehwish Shah, Muhammad Ayaz & Zabta Khan Shinwari (2019) Phytochemical analysis, *Ephedra procera* leaf extracts mediated green synthesis of silver Nanoparticles, their cytotoxic and antimicrobial potentials; *Medicina*, 55(1), 1-18
22. Noorbakhsh, F., Rezaie, S., & Shahverdi, A. R. (2011) Antifungal effects of silver nanoparticle alone and with combination of antifungal drug on dermatophyte pathogen *Trichophyton rubrum*. In *International conference on Bioscience, Biochemistry and Bioinformatics*, 2011; 5, 364-367
23. Poonam Verma & Sanjiv Kumar Maheshwari (2019) Applications of silver nanoparticles in diverse sectors; *International. Journal of Nano Dimensions*, 10(1): 18-36
24. Umamaheswara Rao V. & Nagababu P. (2014). Phytochemical screening, antibacterial, antioxidant and anthelmintic activities of *Suaedanudiflora*, *International Journal of Pharmaceutical Sciences Rev Res*, 29(1): 320-7.
25. S.R.Sivakumar, V.Sridhar& K. Abdul (2017)Antioxidant, antimicrobial and sewage treatment of synthesized silver nanoparticles from leaf extract of *Hygrophila auriculata (Schumsch) Heine*.*Indonesian Journal of Pharmaceutical. Science*, 4(8); 2350-2361

BIOFILM FORMING ABILITY AND THE PRESENCE OF *IcaD* GENE IN BACTERIA ISOLATED FROM BATHING TOWELS OF STUDENTS OF A PRIVATE TERTIARY INSTITUTION

By

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Abstract:

Background:

A towel is an absorbent fabric or paper used for drying or cleaning a body or wiping surface. The skin itself provides a large area for microbial colonization and hence the skin ecosystem is not uniform.

Aim:

The aim of this study was to determine the presence and nature of biofilm forming bacteria and the presence of *icaD* genes found on bathing towels.

Methods:

A total of 20 bathroom towels samples were used following the standard microbiological techniques. Colony morphology, Gram's staining and biochemical tests were used for isolation and identification of bacteria. Antimicrobial susceptibility test was performed by Kirby-Bauer disc diffusion method and the Congo Red Agar was used for the screening of biofilm production. Finally, the detection of *icaD* gene was determined by PCR.

Results:

Nineteen(19) out 20 isolates were identified tentatively as *Staphylococcus* spp. and the other was identified as *E. coli*. All the isolates produced biofilm. In particular, isolates 3, 5, 12, and 13 produced the most biofilm (strong). On the other isolates 15, 16, 18, 19 were moderate biofilm formers. Isolates 1,2,4,6,7,8,9,10,11,14, 17,20 were weak producers of biofilm.

Conclusions:

The findings from this study indicated that there is a high level of bacterial contamination on bathroom towels. This is of tremendous clinical significance, because of its potential to cause epidemics in school hostels. Moreover, the antibiotic susceptibility of isolates showed resistance to at least three antibiotics. Furthermore, it indicated a similar scenario in other places.

Keyword: Towels, Bacteria, Biofilm, *icaD*, *Staphylococcus* spp.

Article History

1. BACKGROUND

A towel is an absorbent fabric or paper used for drying or cleaning a body or wiping surface. It absorbs moisture through direct contact often either by using a rubbing or blotting motion. Microbes strive in warm and moist environment that is full of oxygen under optimum temperature of (25°C-37°C) and PH of (5-9) (Liam and Hudson 2004).

The skin itself provides a large area for microbial colonization and hence the skin ecosystem is not uniform. The most common microorganisms found on the skin as its normal flora include *staphylococcus epidermidis* (which is found mostly in the regions of the upper body), *staphylococcus hominis* (found on the arms and legs) and *micrococci* yellow pigmented species, some others include gram positive Bacilli belonging to a group of bacteria known as *Coryneform* which include *Corynebacterium* and *Propionibacterium*. Most organisms have the ability to spread on towels and are then infectious. Some include; *Escherichia coli* (Arch chemical 2012), *Salmonella typhimurium*, *Staphylococcus aureus*. *Bacillus aureus* (Spicer 1959), *Campylobacter* (Liam and Hudson 2004).

A biofilm may be defined as a microbe-derived sessile community featured under organisms that are attached to a substratum, interface or each other embedded in matrix of extracellular polymeric substance and exhibit an altered phenotype with respect to growth, gene expression and protein production.

The biofilm infection life cycle generally follows the same steps of attachment (which has to do with the interaction between bacteria and the implant) accumulation(which involves interactions between bacterial cells) maturation (formation of viable 3D structure) and dispersion/detachment (release from the biofilm).

2. METHODS

2.1 Collection of samples and Isolation of Bacteria

A total of 20 bathroom towels were swabbed to

extract bacteria from the towels with the use of sterile cotton swabs. Once the sample was obtained, the swab was placed in a sterile 15ml centrifuge tube and placed in a 4°C refrigerator until further analysis. After 24 hours, each sample was streaked onto Nutrient agar, MacConkey agar, Mannitol salt agar and Membrane faecal coliform agar plates. Four-quadrant streak plate technique was performed. All the plates were incubated for 24 hours at 37°C. After the overnight incubation, the plates were observed for colony characteristics. Isolated colonies were then sub-cultured onto fresh nutrient agar. Single isolated colonies from nutrient agar plates were subjected to Gram staining, and Standard Biochemical tests to identify the organism.

2.2 Phenotypic Characterization of Biofilm Producers

Bacteria Isolates were incubated on a Congo red medium for 24-48hours at 37°C. Indication of black colonies represented positive results. The weak producers indicated remains pink and then an intermediate result is indicated with the presence of occasional darkening at the center of the colonies present with absence of dry colonial crystalline morphology (Cappuccino & Sherman, 2005). Catalase test was done to determine the ability of the bacteria to degrade hydrogen peroxide by producing the enzyme catalase. An immediate bubble formation indicated a positive result and no bubble formation indicated catalase negative result (Cappuccino & Sherman, 2005).

2.3 Antibiotic Susceptibility Testing

In this research work the antibiotic susceptibility testing of the organisms were performed by Kirby-Bauer disc diffusion method.

2.4 Dna Extraction Using Zr

Fungal/Bacterial Dna Miniprep

(Manufactured By Zymo

Research Cat Number: D6005)

uld 2mLs of bacterial cells broth to to a ZR lashingTM Lysis Tube. Add 750ul Lysis Solution) the tube. Secure in a bead fitted

with 2 ml tube-older assembly and process at maximum speed for >5 minutes. Centrifuge the ZR BashingBeadTM ysis Tube in a microcentrifuge at > 10,000 x g for minute. Transfer up to 400 ul supernatant to a ymo-SpinTM IV Spin Filter (orange top) in a oilection Tube and centrifuge at 7.000 x g for 1 inute. Add 1,200 ul of Fungal/Bacterial DNA inding Buffer to the filterate in the Collection jbe from Step 4. Transfer 800 ul of the mixture)in Step 5 to a Zymo-SpinTM HC Column in a Eletion Tube and centrifuge at 10,000 x g for 1 inute. Discard the flow through from the Eletion Tube and repeat Step 6. Add 200 ul NIA Pre-Wash Buffer to the Zymo-Spin TM IIC

Column in new Collection Tube and centrifuge at 10,000 x g for 1 minute. Add 500 ul Fungal/Bacterial DNA Wash Buffer to the Zymo-SpinTM IIC Column and centrifuge at 10,000 x g for 1 minute. Transfer the Zymo-SpinTM IIC Column to a clean 1.5 ml microcentrifuge tube and add 10Oul (35 ul minimum) DNA Elution Buffer directly to the column matrix. Centrifuge at 10,000 x g for 30 seconds to elute the DNA.

2.5 Electrophoresis for DNA and PCR

Measure 1 g of agarose (for DNA); 2g of agarose for PCR. Mix agarose powder with 100 mL IxTAE in a microwavable flask. Microwave for 1-3 min until the agarose is completely dissolved (but do not over boil the solution, as some of the buffer will evaporate and thus alter the final percentage of agarose in the gel. Let agarose solution cool down to about 50 °C (about when you can comfortably keep your hand on the flask), about 5 mins. Add 10µL EZ vision DNA stain. EZ vision binds to the DNA and allows you to visualize the DNA under ultraviolet (UV) light. Pour the agarose into a gel tray with the well comb in place. Place newly poured gel at 4 °C for 10-15 mins OR let sit at room temperature for 20-30 mins, until it has completely solidified.

2.6 Loading Samples and Running an Agarose Gel

Add loading buffer to each of your DNA samples or PCR products. Once solidified, place the agarose gel into the gel box (eleetrophoresis unit). Fill gel box with IxTAE (or TBE) until the gel is covered. Carefully load a molecular weight ladder into the first lane of the gel. Carefully load your samples into the additional wells of the gel. Run the gel at 80-150 V for about 1-1.5 hours. Turn OFF power, disconnect the electrodes from the power source, and then carefully remove the gel from the gel box.

Visualize DNA fragments or PCR product under UV transilluminator.

2.7 PCR Mix Components

The PCR mix is made up of 12.5µL of Taq 2X Master Mix from New England Biolabs (M0270); 1 µL each of

1 0µM forward and reverse primer; 2µL of DNA template and then made up with 8,5µL Nuclease free water. Initial denaturation at 94°C for 5mins, followed by 36 cycles of denaturation at 94°C for 30sec, annealing at 55°C for 30secs and elongation at 72°C for 45sec. Followed by a final elongation step at 72°C for 7 minutes and hold temperature at 10 °C forever.

3.RESULTS

Out of the 20 presumptive isolates, nineteen (100%) were identified tentatively as *Staphylococcits* spp. The isolates were all resistant to cefazidime (100%), cefuroxime (100%), gentamycin (20%), ceftriaxone (100%), erythromycin (90%), cloxacillin (100%), ofloxacin (10%) and augmentm (100%). A moderately high susceptible activity was observed against gentamiein (30%) and augmentin (35%). Moderate sensitivity activity was observed in gentamicin (50%), erythromycin (10%), while a high level of susceptibility was observed in ofloxacin (55%).

All the isolates (1-20) produced biofilm. In particular, isolates 3, 5, 12, and 13 produced the most biofilm (strong). On the other isolates

15, 16, 18, 19 were moderate biofilm formers. Isolates 1,2,4,6,7,8,9,10,11,14, 17, 20 were weak producers of biofilm. There is a significant difference between the three groups ($p < 0.05$) as shown in appendix 11, The gDNA extracted from the isolates is presented in figure 1 while Figure 2 showed *icaD* genes in isolates. The figure suggests absence of these genes in 3 and 4.

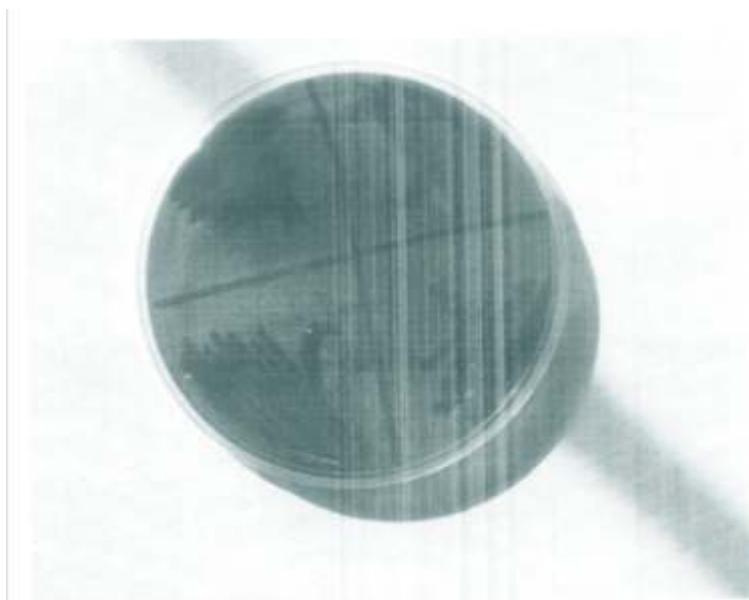


Fig 1: Biofilm production by *S. aureus*; Strong producer and on Congo Red Agar

Table 1: Biofilm producer isolates on Congo red agar (CRA)

Isolate	Biofilm formation		
	Strong biofilm	Moderate biofilm	Weak biofilm
1	-	-	+
2	-	-	+
3	+	-	-
4	-	-	+
5	+	-	-
6	-	-	+
7	-	-	+
8	-	-	+
9	-	-	+
10	-	-	+
11	-	-	+
12	+	-	-
13	+	-	-
14	-	-	+
15	-	+	-
16	-	+	-
17	-	-	+
18	-	+	-
19	-	+	-
20	-	-	+

KEY:

+ = Strong biofilm producers

- = Non biofilm produced

M 1 2 3 4 5 6 7 8

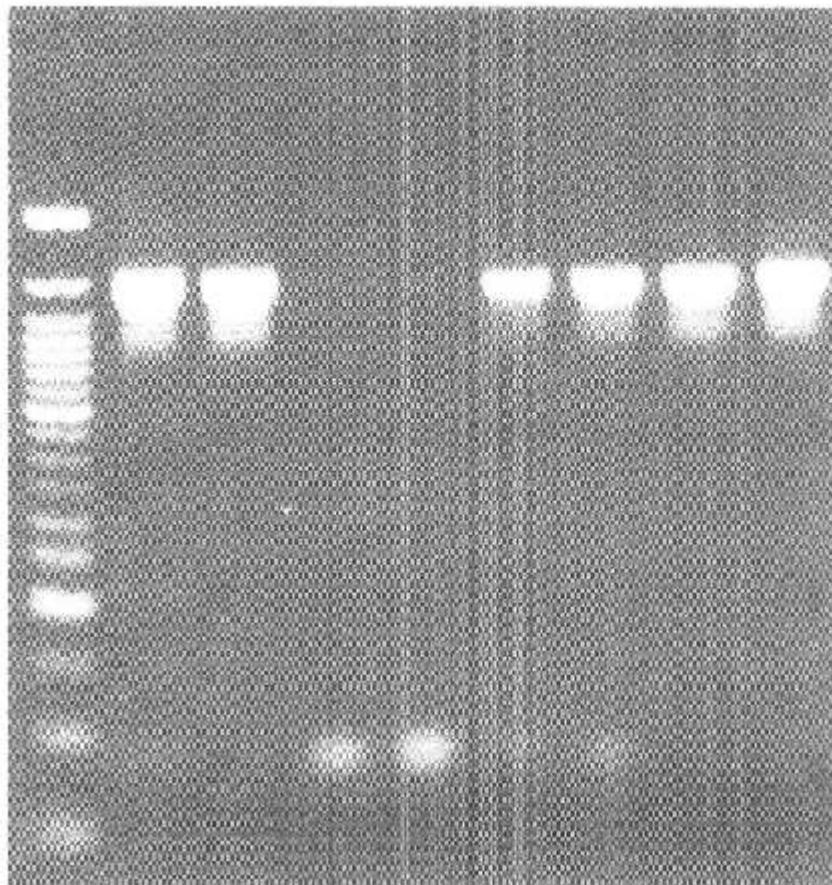


Figure 2: *icaD* genes in isolates, absent in 3 and 4

4. DISCUSSION

The result obtained from this study was out of 20 samples after conducting the biochemical tests, 19 of the isolates were confirmed presumptively as *Staphylococcus*' spp. and 1 was identified as *E. coli*. Therefore, in this study, among the isolates, the most predominant bacteria were *Staphylococcus* spp. This is anticipated as it is a major component of the normal flora of the human skin which the bathroom towel is used for. The findings of other researchers (Nworie *et al.*, 2012; Ducel *et al.*, 2002; Brooks *et al.*, 2007), is in accordance with this finding.

The result of this study is also consistent with Jalalpoor et ah, (2009) who reported that *Staphylococcus* species (54.7%) was the most frequent bacteria isolated in bathroom towels and particularly bathroom environment. In contrast, the result of this study did not agree

with the work of Orji *et al*, (2005) which showed that *Staphylococcus aureus* was the least isolated bacteria.

Gram-positive bacteria are found more in the bathroom towels than Gram negative one. This can become dangerous as Gram positive bacteria are causing more infections than ever before especially in surgical patients, who are increasingly aged, ill and debilitated (Barie, 1998).

Isolation of more Gram positive bacteria than Gram negative can be explained, as they are members of the body flora of both asymptomatic carriers and sick persons. These organisms can be spread by the hand, expelled from the respiratory tract or transmitted by animate or inanimate objects (Chikere *et al.*, 2008). Their main source(s) of colonization on the bathroom towel might likely be nasal

carriage by individuals (Graham *et al.*, 2006), likely facilitated by hand-to-mouth or hand-to-nose contact while using these fabrics (ASM, 2005). Isolation of *Staphylococcus aureus* from almost all the bathroom towels indicates their ubiquitous nature. Additionally, they can be sources of infection to humans as previously noted (Hartmann *et al.*, 2004; Inwergbu *et al.*, 2005; Ikeh and Isamade, 2011).

From the findings in this study, it was observed that most of the isolates obtained were resistant to most commonly used antibiotics. These antibiotics are ceftazidime (100%), cefuroxime (100%), gentamycin (20%), ceftriaxone (100%), erythromycin (90%), cloxacillin (100%), ofloxacin (10%) and augmentin (100%). The resistance to these antibiotics which is in accord with the research carried out by Adewoyin *et al.* (2013), who reported that antibiotic resistant microorganism contaminates fabric surfaces such as bathroom towels. Moreover, reported that most of the isolates obtained in their study were resistant to commonly used antibiotics such as ceftazidime, gentamycin, augmentin and erythromycin.

The biofilm producing ability of the isolates was also studied using the CRA plate test method (Handke *et al.*, 2004; Oliveira *et al.*, 2006). All the isolates (1-20) produced biofilm. In particular, isolates 3, 5, 12, and 13 produced the most biofilm (strong). On the other isolates 15, 16, 18, 19 were moderate biofilm formers. Isolates 1, 2, 4, 6, 7, 8, 9, 10, 11, 14, 17, 20 were weak producers of biofilm. There is a significant difference between the three groups ($p < 0.05$). This is consistent with the findings by Stewart and Costerton, (2001) and Ito *et al.*, (2009) who documented that the structure of biofilm in *Slaphylococcus* spp including the robustness and its components show association with antibiotic resistance. Also, Arciola *et al.*, (2015) reported that intercellular adhesion (*ica*) genes encode

PIAs which in turn regulate the biofilm formation since *icaA*. and *icaD* genes are associated with biofilm formation. Biofilm production was shown by isolates on Congo Red Agar and presence of *icaD* gene.

CONCLUSION

Recently, infections from bathroom fabrics particularly towels are rising at an alarming rate. The causes of these infections can be connected to increased microbial load of bathroom fabric including bathroom towels. The findings from this study indicate that there is a high level of bacterial contamination on bathroom towels. This is of tremendous clinical significance, because of its potential to cause epidemics in school hostels. Moreover, the antibiotic susceptibility of isolates showed resistance to at least three antibiotics. Furthermore, it indicated a similar scenario in other places. The rise of antibiotic resistance in microbes, especially pathogenic organisms can lead to lethal outcomes. Therefore, it should be tackled with high importance. However, this problem is not limited to this area of study alone. Thus, this will require combined effort of governmental, private organizations and individuals to educate the population on personal and environmental hygiene.

REFERENCES

- Alice, N. and Matthew, P. (2000). Survival of entrococci and *Staphylococci* on hospital fabrics and plastic. *Journal of Clinical Microbiology*: 38(2), 724-726.
- Aminu M., Usman S. H. and Usman M. A. (2014). Characterization and determination of antihijotic susceptibility pattern of bacteria isolated from some fomites in a teaching hospital in northern Nigeria. *Afri J Microbiol Research*.8(8): 814-818.
- Barker, T. and Jones, M. (2005). Antibiotic-resistant Gram-positive cocci: implications for surgical practice. *Wld. J. Surg.* 22(2):118-126.
- Boone, S.A., Gerba, C.P. (2007). Significance of fomites in the spread of respiratory and enteric viral disease. *Applied and Environmental Microbiology*, 73: 1687-1696.
- Brunsimma, N., J.M. Hutchinson, A.E. van den Bogaard, H. Giamarellou, J. Degener and E.E. Stobberingh. (2003). Influence of

- population density on antibiotic resistance. *J Antimicrob. Chemother.* **51**:385–390.
- Bures S, Fishbain JT, Uyehara CF, et al. (2000). Computer keyboards and faucet handles as reservoirs of nosocomial pathogens in the Intensive Care Unit. *Am J Infect Cont.* **28**(6):465–471.
- Campion, J., P. McNamara and M. Evans. (2005). Pharmacodynamic modeling of ciprofloxacin resistance in *Staphylococcus aureus*. *Antimicrob. Agents. Chemother.* **49**:209–219.
- Chaidez, H. and Gerba, R. (2000). Sahly H, Podschun R. Clinical, bacteriological, and serological aspects of *Klebsiella* infections and their spondylarthropathic sequelae. *Clin Diagn Lab Immunol.* **4**(4):393–399.
- Clauditz, A., Resch, A., Wieland, K.P. Peschel, A. and Gotz, F. (2006). Staphyloxanthin plays a role in the fitness of *Staphylococcus aureus* and its ability to cope with oxidative stress. *Infection and Immunity*, **74**(8): 4950 - 4953.
- Cogan, T.A., Slader, J., Bloomfield, S.F. and Humphrey, T.J. (2009). Achieving hygiene in the domestic kitchen: The effectiveness of commonly used cleaning procedure. *J Applied Microbiol.* **92**:885–892
- Conly, J. (2002). Antimicrobial resistance in Canada. 2002. *Can Med Assoc J.* **167**:885–891.
- Courvalin, P. (2004). Mini-review: Transfer of antibiotic resistance genes between gram-positive and gram-negative bacteria. *Antimicrob. Agents. Chemother.* **38**:1447–1451.
- Crabtree, T.D., Pelletier, S.J. and Pruett, T.L. (2001). Surgical antisepsis, In Block SS (ed), *Disinfection, sterilization, and preservation*, 5th ed. Lippincott, Philadelphia, PA.: Williams & Wilkins.
- Depardieu, F., I. Podglajen, R. Leclercq, E. Collatz and P. Courvalin. (2007). Modes and modulations of antibiotic resistance gene expression. *Clin. Micro. Rev.* **20**:79–114.
- Dodrill, L., Schmidt, W.P., Cobb, E., Donachie, P., Curtis, V., De-Barra, M. (2011). The Effect of Hand washing with Water or Soap on Bacterial Contamination of Hands, *International Journal Environmental Public Health Resource*, **8**(1): 97-104.
- Edson, R.S., Bundrick, J.B. and Litin, S.C. (2011). Clinical pearls in infectious diseases. *Mayo Clin Proc* **86**:245–248
- Enriquez, C. E., Enriques-Gordillo, R., Kennedy, D. I., and Gerba, C. P. (2016). Bacteriological survey of used cellulose sponges and cotton dishcloths from domestic kitchens. *Dairy Food Environ. Sanitat.*, **17**, 20-24.
- Erasmus, V., Daha, T.J., Brug, H., Richardus, J.H., Behrendt, M.D., Vos, M.C. and van Beeck E.F. (2010). Systematic review of studies on compliance with hand hygiene guidelines in hospital care. *Infect Control Hosp Epidemiol* **31**: 283–294.
- Fan, F., K. Yan, N.G. Wallis, S. Reed, T.D. Moore, S.F. Rittenhouse, W.E. DeWolf Jr., J. Huang, D. McDevitt, W.H. Miller, M.A. Seefeld, K.A. Newlander, D.R. Jakas, M.S. Head and D.J. Payne. (2002). Defining and combating the mechanisms of triclosan resistance in clinical isolates of *Staphylococcus aureus*. *Antimicrob. Agents. Chemother.* **46**:3343–3347.
- Francesco Zinzaro (2010) <http://ezineartides.com?Normal Microbial flora and Id=4121703>. April 16, 2010.
- Gerhardts, K., Graham P, Lin S, Larson EA (2012). US population based survey of *Staphylococcus aureus* colonization. *Ann. Internal Med.* **144**:318-325.
- Gilbert, P. and A. McBain. (2003). Potential impact of increased use of biocides in consumer products on prevalence of antibiotic resistance. *Clin. Micro. Rev.* **16**:189–208.
- Glaser, A. (2004). The ubiquitous triclosan: a common antibacterial agent exposed. *Pesticides and You* **24**:12–17.
- Gorman, R., Bloomfield, S. and Adley, C.C. (2002). A study of cross-contamination of food-borne pathogens in the domestic kitchen in the Republic of Ireland. *Int J Food Microbiol.* **76**(1-2):143–150.

- Haas, J. and Larson, E. (2007). Measurement of compliance with hand hygiene. *J Hosp Infect* **66**:6–14.
- Harrison, W.A., Griffith, C.J., Ayers, T., Michaels, B., 2003). Bacterial transfer and cross-contamination potential associated with paper-towel dispensing. *Am. J. Infect. Control* **31**, 387–391.
- Itah, J. and Ben, A.E. (2004). Incidence of Enteric Bacteria and *Staphylococcus aureus* in day care centers in Akwalbom State, Nigeria. The Southern Asian Journal of Tropical Medicine and Public Health, 202 - 209.
- Kamiya A. Oie S. and Hosokawa I. (2002). Contamination of room door handles by methicillin –sensitive / methicillin- resistant *Staphylococcus aureus*. *JHos.infect.* **51**(2):140-3.
- Kampf, G. and A. Kramer. (2003). Epidemiologic background of hand hygiene and evaluation of the most important agents for scrubs and rubs. *Clin. Micro. Rev.* **17**:863–893.
- Kendall D, Viator C, Karns S, et al., (2003). *Modeling the effects of food handling practices on the incidence of foodborne illness*. Washington, DC, USA.
- Kramer, A., Schwebke, I. and Kampf, G. (2006). How long do nosocomial pathogens persist on inanimate surfaces? A systematic review. *BMC Infect Dis.* **6**:130.
- Kusumaningrum, H.D., van Putten, M.M., Rombouts, F.M., et al., (2002). Effects of antibacterial dishwashing liquid on foodborne pathogens and competitive microorganisms in kitchen sponges. *J Food Prot.* **65**(1):61–65.
- Lee, S., Cho, J., S. and Cho, G. (2008). Antimicrobial and blood repellent finishes for cotton and nonwoven fabrics based on chitosan and fluoropolymers, *Textile Res. J.* **69**(2):104-113
- Lynn, M., Vivian, O. and Wasa, A. (2013). The prevalence of bacterial organisms on toilet door handles in secondary school in Bokkos L. G. A., Jos, Plateau State, Nigeria. *IOSR J Pharm Biological sci;* **8**(4); 85-91.
- Maori, L., Agbor, V. O., and Ahmed, W. A. (2013). Neckties as vectors for nosocomial infection. *Intensive care med* **26**(2), 250.
- Martinez, J. and F. Baquero. (2002). Interactions among strategies associated with bacterial infection: pathogenicity, epidemicity, and antibiotic resistance. *Clin. Micro. Rev.* **15**:647–679.
- McNeil, E. and Greenstein, M. (2011). Control of Transmission of bacteria by textile and clothing, In: proc.47th mid-year Meet.Chern.Spec.Mfg.Ass.pp134-141
- Moayad B., David K., Humayun A., Chinh D. and Allan T. (2011). Distribution and prevalence of bacteria found on the door handles of olinhall, drake university. *Conference Poster*.
- Montville R, Chen Y, Schaffner DW. (2001). Glove barriers to bacterial cross-contamination between hands to food. *J Food Prot.* **64**(6):845–849.
- Moore, JE, Heaney N, Millar BC, et al. (2002). Incidence of *Pseudomonas aeruginosa* in recreational and hydrotherapy pools. *Communicable Disease and Public Health*, **5**(1):23–26.
- Namias N, Widrich J, Martinez OV, et al. (2000). Pathogenic bacteria on personal pagers. *Am J Infect Cont.* **28**(5):37–388.
- Narneen S, Jaladet M. (2009). Isolation and identification of *Staphylococcus aureus* using classical and molecular methods. *The 2nd Kurdish Conference on Biological Sciences*, **12**(1):10–16.
- Neely AN, Maley MP (2000). Survival of enterococci and staphylococci on hospital fabrics and plastic. *J. Clin. Microbiol.* **38**(2):724-726.
- Nworie, A., Ayeni, J. A., Eze U. A., and Azi, S. O. (2012). Bacterial contamination of door handles/knobs in selected public conveniences in Abuja metropolis, Nigeria; a public health threat. *Continental J Med Res:* **6**(1): 7-11.
- O'Boyle C, Henly S, Larson E. (2001). Understanding adherence to hand hygiene recommendations: the theory of planned behavior. *Am J Infect Control* **29**:352-360.
- Ono, S., T. Muratani and T. Matsumoto. (2005). Mechanisms of resistance to imipenem and ampicillin in *Enterococcus faecalis*.

- Antimicrob. Agents Chemother.* **49**:2954–2958.
- Orskov, I., Orskov, F., Jam, B., and Jann, K. (2017). Serology, chemistry and genetics of O and K antigens of *Escherichia coli*. *Bacteriology Review*, **41**(3): 667-710.
- Peng JS, Tsai WC, Chou CC. Surface characteristics of *Bacillus cereus* and its adhesion to stainless steel. *Int J Food Micro.* 2001;65(1-2):105-111.
- Pittet D, Dharan S, Touveneau S, Sauvan V, Perneger TV. (2009). Bacterial contamination of the hands of hospital staff during routine patient care. *Arch Intern Med* **159**:821–826.
- Rusin, P., Maxwell, S., & Gerba, C. (2016). Comparative surface to hand and fingertip to mouth transfer efficiency of gram positive bacteria, gram negative bacteria and phage. *Journal of Applied Microbiology*; **25**, 75-81.
- Rutala W. A., Gergen M. F. and Weber D. J. (2006). Efficacy and functional impact of disinfectants. *Infect Control HospEpidemiol*; **27**(4):372-377.
- Sabra S. M. (2013). Bacterial public Health Hazard in the public Female Restrooms at Taif, KSA, *Middle-East JScientific Res*; **14**(1):63-68.
- Sattar, S. A., Springthorpe, S., Mani, S., Gallant, M., Nair, R. C., Scott, E. and Kain, J. (2001). Transfer of bacteria from fabrics to hands and other fabrics development and application of quantitative method using *staphylococcus aureus* as a model, *Journal of Applied Microbiology*, **962**, Vol(90).
- Sickbert-Bennett, E.E., D.J. Weber, M.F. Gergen-Teaque, M.D. Sobsey, G.P. Samsa and W.A. Rutala. (2005). Comparative efficacy of hand hygiene agents in the reduction of bacteria and viruses. *Am. J. Infec. Cntrl.* **33**:67–77.
- Scott, R, Scott, E., and Bloomfield, S. F. (2010). Investigations of the effectiveness of detergent washing, drying and chemical disinfection on contamination of cleaning cloths. *J. Appl. Bacteriol.*, **68**, 279-283.
- Teufel, L., Pipal, A., Schuster, K. C., Staudinger, T. and Redl, B. (2009). Material dependent growth of human skin bacteria on textiles investigated using challenge tests and DNA genotyping, *Journal of applied microbiology*,**108**,450-461.
- Thomson, C. (2009). The global epidemiology of resistance to ciprofloxacin and the changing nature of antibiotic resistance: a 10 year perspective. *J. Antimicrob. Chemother.* **43**:31–40.
- Todd E, Greig J, Michaels B, Bartleson C, Smith D, Holah J. (2010). Outbreaks where food workers have been implicated in the spread of foodborne disease, part 11: use of antiseptics and sanitizers in community settings and issues of hand hygiene compliance in health care and food industries. *J Food Prot* **73**:2306 –2320
- Treake, A.M., Thom, K. A., Furuno, J.P., Strauss, S. M. , Harris, A. D. and Perencevich, E. N. (2009). Bacterial contamination of health care workers white coats, *American journal of infection control*,**37**,101-105. 21
- Tunc K, Olgun U. (2006). Microbiology of bathroom towels. *J Hyg.* **53**(2):140–143.
- Wassmer, G., J. Kipe-Nolt, and C. Chayko. (2006). Why finish your antibiotics? *The American Biology Teacher* **68**:476–480.
- Watutanrige R. A., Premalatha P., Lum W. S. and Evelyn C. X. (2012). A Study on Hand Contamination and Hand Washing Practices among Medical Students. ISRN public Health; 2012 Article ID 251483;1- 5.
- Wong, D., Nye, K. and Hollis, P. (2011). Microbial flora on doctors white coats, *British medical journal*,**303**,1602-1603.

FROM THE DEAN'S DESK:

THE FACULTY OF NATURAL SCIENCE & ENVIRONMENTAL STUDIES (FNSES)

The name of the administrator of the Faculty is Prof. Dr. Chidi Uhuegbu, a Professor of Physics. He studied at University of Nigeria, Nsukka where he got his B.Sc., M.Sc., PGDE and Ph.D. at Covenant University Ota, Specialising on Solid State and Solar Energy Physics.

As The Dean, He Wants The Faculty To Have An Outlook Of The Following:

- i. Decent dressing as stipulated by the GOUni
- ii. Embellished behaviours
- iii. Doing the right thing at the right time (Age quod ages).
- iv. Being a good ambassador of the first Catholic University owned by a Diocese in Africa

For the lecturers, the dean wants:

- i) an exceptional good behaviours.
- ii) the lecturers to be industrious
- iii) the lecturers to be publishing and in reputable journals.
- iv) The Dean advises the lecturers to employ modern methods of teaching like hybrid approach (Modern Technological Approach).
- v) He advises the lecturers to expel in their persons random musing, trial & error, guess work and gossip in their workplace relationship with their co-workers and students.
- vi) Finally, he foresees building the future, best faculty of natural science in Africa.

Culled by the Editor in Chief

