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**PRELIMINARY ETHNO-BOTANICAL SURVEY OF SOME MEDICINAL PLANTS OF OBAH VILLAGE IN IKPOBA-OKHA LOCAL GOVERNMENT AREA OF EDO STATE**

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**ABSTRACT**

The preliminary ethno-botanical survey of some medicinal plants of Obah village in Ikpoba-Okha local government area of Edo State was carried out from the month of November 2022 to January 2023. Questionnaires were administered and useful information about 20 common medicinal plants was extracted from the inhabitants. The information obtained include common names, botanical names, family names, plant part used for medicine, preparation and use of individual medicinal plants. The results showed that the males (75.00%), married men and women (62.50%), illiterate (50.00%), aged men and women that are 71years and above (37.50%), indigenes (87.50%) and unemployed (62.50%) are respondents that are responsible for the highest medicinal plant use. The results also showed the common plants used for medicine and they include *Aframomum melegueta* (Alligator pepper), *Allium sativum* (Garlic), *Ananas comosus* (Pineapple), *Azadirachta indica* (Neem), *Carica papaya* (Pawpaw), *Citrus aurantifolia* (Lime), *Cocos nucifera* (Coconut), *Cola nitida* (Kola), *Cymbopogon citratus* (Lemon grass), *Garcinia kola* (Bitter kola), *Gossypium hirsutum* (cotton), *Mangifera indica* (Mango), *Manihot esculentum* (Cassava), *Musa paradisiaca* (Plantain), *Newbouldia laevis* (Tree of life), *Nicotiana tabacum* (Tobacco), *Ocimum gratissimum* (Scent leaf), *Talinum triangulare* (Water leaf), *Vernonia amygdalina* (Bitter leaf) and *Zingiber officinale* (Ginger)

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**Keywords:** Ethno-botanical survey, Medicinal plants, Obah village, Questionnaires, Inhabitants.

**INTRODUCTION**

Ethno-botany is the study of useful plants prior to commercial exploitation and eventful domestication. It is based on the knowledge of plants by the local people and their usefulness as understood by the people of a particular ethnic group, since information concerning a particular plant

varies from one ethnic group to another (Igoli *et al.*, 2005). Several workers have conducted ethno-botanical surveys among various tribes of the African continent and the rest part of the world (Rashid, 2001; Gbolade, 2000; Ajaiyeoba *et al.*, 2006; Khan and Rashid, 2006) in search of plants

with medicinal properties. The medicinal values of these plants lie in some chemical substances they contain that produce a definite physiological action on the human body (Edeoga *et al.*, 2002). Ethno-botanical surveys are important in order to understand the social-cultural and economic factors influencing ideas and actions concerning health and illness and also to get information on type of diseases and health problems prevalent among the people of a particular locality (Lawal *et al.*,2010). Such studies, as suggested by Lawal *et al* (2010), may help to provide the basic health care services needed to improve health challenges of the rural

population. Olajide (2003) reported that Nigerian vegetation are naturally endowed with arrays of floristic composition of different plant forms including trees, shrubs, herbs and other non-wood forest resources. Within the natural forest abound several valuable non-timber resources of edible and highly nutritious plants whose fruits, twigs, barks, roots, gum, latex or dyes are of medicinal value (Owonubi and Otegbeye, 2004).\

It is the aim of this study to carry out a preliminary ethno-botanical survey of some medicinal plants of Obah village in Ikpoba-okha local government area of Edo State.

## **MATERIALS AND METHODS**

### **The Study Area**

Obah village is located in Ikpoba-Okha local government area of Edo state. The area's dwellers are members of the Bini ethnic division. The Bini language is predominantly spoken in the area while Christianity and Traditional religion are commonly practiced. Farming is a prominent feature of the economic life of the indigenes with crops such as yam, plantain, banana and vegetables grown in the area. Other important economic activities in Obah village include hunting

and lumbering. Ikpoba-okha local government area has an average temperature of 28 degrees centigrade. The average humidity level of the area is 69% while the average wind speed in the local government area is 11km/h. Trade also flourishes in Ikpoba-okha local government area with the area hosting several markets such as the Oka and the Oregbeni markets which provide platforms for the exchange of a variety of goods and services for the area's inhabitants.

### **Field Trips and Questionnaire Administration**

Field trips were made to the study area to extract information from the inhabitants on some medicinal plants commonly used in the area. Questionnaires were administered from the month of November, 2022 – January, 2023. The respondents were purposely sampled for the study due to the fact that they have knowledge of the relevance of plants as a result of their occupation. The information required of

all the respondents include sex, age, educational background, place of origin, marital status, employment status and the names of plant species preferred for treating various ailments. The local names of the various plant species commonly found in this area were obtained in Bini and the botanical names were taxonomically verified from an indigene of the local government area who is a plant biologist and a staff of the local government area secretariat.

### **Determination of Frequency of Medicinal Plant Use**

Frequency of use of medicinal plant in the study area was determined as a percentage

of the number of respondents using a medicinal plant species in relation to the

total respondents that use the medicinal plant.

## RESULTS AND DISCUSSION

Table 1: Bio-data Frequency of the Respondents to the Questionnaires

<b>Respondents</b>		<b>Frequency(%)</b>
Gender	Male	75.00
	Female	25.00
Age	30-40	6.25
	41-50	12.50
	51-60	18.75
	61 -70	25.00
	71 and above	37.50
Educational Background	No formal education	50.00
	Secondary	25.00
	College of education	18.75
	University	6.25
Place of origin	Indigenes	87.50
	Non-indigenes	12.50
Marital status	Single	37.50
	Married	62.50
Employment status	Employed	37.50
	Unemployed	62.50

Table 1 shows the bio-data frequency of the respondents to the questionnaires. The people of Obah village in Ikpoba-okha local government area of Edo state are not left out of the use of medicinal plants for preventing and curing various ailments and diseases. This result is in agreement with the observation of UNESCO (1996) which states that the use of medicinal plants in most developing countries as a normative basis for the maintenance of good health

has been widely observed. Males, married men and women, illiterate, aged men and women (71 and above), indigenes and unemployed are respondents that are responsible for the highest medicinal plant use. It is clearly seen that the aged men and women, married men and women, unemployed men and woman with secondary education or no formal education at all are the major actors in the use of medicinal plants.

Table 2: Uses of Some Medicinal Plants in Obah Village in Ikpoba-Okha Local Government Area of Edo State.

<b>Plant Species/ Common Names/ Plant Part Used</b>	<b>Family Names</b>	<b>Uses</b>
<i>Aframomum melegueta</i> (Alligator pepper)/Seed	Zingiberaceae	Treatment of gastrointestinal disorders, cough and chest pain.
<i>Allium sativum</i> (Garlic)/Clove	Liliaceae	Improvement of blood pressure. Treatment of diabetes, hypertension and stomach ache.

<i>Ananas comosus</i> (Pineapple)/Fruit	Bromeliaceae	Used as a Purgative.
<i>Azadirachta indica</i> (Neem)/Leaves ,Stem bark	Meliaceae	Treatment of inflammation, skin disease, dental disorders and malaria.
<i>Carica papaya</i> (Pawpaw)/Leaves	Caricaceae	Treatment of stomach ache and diabetes.
<i>Citrus aurantifolia</i> (Lime)/Young leaves	Rutaceae	Treatment of bad breath and sore throat.
<i>Cocos nucifera</i> (Coconut)/Roots	Arecaceae	Treatment of mouth ulcers and sore throat.
<i>Cola nitida</i> (Kola)/Leaves	Sterculiaceae	Prevention of boils and treatment of eye trouble such as night blindness.
<i>Cymbopogon citratus</i> (Lemon grass)/Leaves	Poaceae	Treatment of jaundice, yellow fever and malaria.
<i>Garcinia kola</i> (Bitter kola)/Fruit	.Guttiferae	Anti-parasitic, anti-microbial, purgative and prevent vomiting.
<i>Gossypium hirsutum</i> (Cotton)/Leaves	Malvaceae	Treatment of convulsion and dysentery
<i>Mangifera indica</i> (Mango)/Leaves	Anacardiaceae	Improvement of blood pressure and treatment of malaria fever.
<i>Manihot esculentum</i> (Cassava)/Leaves	Euphorbiaceae	Treatment of wounds.
<i>Musa paradisiacal</i> (Plantain)/Leaves	Musaceae	Treatment of cough, wound, dermatitis, insect bite and malaria.
<i>Newbouldia laevis</i> (Tree of life)/Bark, Leaves	Bignoniaceae	Treatment of migraine and sore eyes.
<i>Nicotiana tobacum</i> (Tobacco)/Leaves	Solanaceae	Treatment of ringworm and eye (Irritation).
<i>Ocimum gratissimum</i> (Scent leaf)/Leaves	Lamiaceae	Treatment of diabetes and nasal bleeding.
<i>Talinum triangulare</i> (Water leaf)/Leaves	Portulacaceae	Treatment of inflammation and boil
<i>Vernonia amygdalina</i> (Bitter leaf)/Leaves	Asteraceae	Treatment of amoebic dysentery, stomach pain and diabetes.
<i>Zingiber officinale</i> (Ginger)/Rhizome	Zingiberaceae	Treatment of malaria fever.

Table 2 shows the uses of some medicinal plants in Obah village of Ikpoba-Okha local government area of Edo state. The seed extracts of *Aframomum melegueta* can be used for treating gastrointestinal disorders such as stomach pain, diarrhoea,

ulcer and intestinal worms (Odugbemi and Akinsulire, 2006). The seeds are chewed, sometimes with *Garcinia kola* to cure cough and chest pain. High doses of *Allium sativum* appear to improve blood pressure for those with known high blood pressure (hypertension) (Gomez, 2004). It

is washed, peeled and eaten raw to cure diabetes, hypertension and stomach ache. The fruit of *Ananas comosus* is packed with nutrients, antioxidants and other helpful compounds such as enzymes that can fight inflammation and disease (Odugbemi and Akinsulire, 2006). The fruit is washed and sliced for consumption. The unripe fruit is eaten and often taken as a purgative. All parts of *Azadirachta indica* (leaves, flowers, seeds, fruits, roots and bark) have been used traditionally for the treatment of inflammation, infections, fever, skin disease and dental disorders (Gill, 1992). The leaves and bark are washed, boiled and drunk to treat malaria. The infusion of the leaves of *Carica papaya* is used to treat stomach ache (Ross, 1999). The leaves are crushed in water, mixed with *Ocimum gratissimum* leaves and drunk to treat diabetes. The young leaves of *Citrus aurantifolia* are chewed for bad breath (Gill, 1992). The young leaves are pulverized and its juice mixed with gin and little quantity of alum and drunk to cure sore throat (Ross, 1999). The decoction of the roots of *Cocos nucifera* is effective for mouth ulcers or ulcerative mouth lesions (Gomez, 2004). Liquid preparation is obtained by boiling the root in water. It is used as gargle for sore throat. The leaves of *Cola nitida* are used to prevent boils and used as a stimulant (Idu and Onyibe, 2007). The leaves are heated and the juice squeezed from it is dropped into the eyes to treat eye trouble such as night blindness. The leaves of *Cymbopogon citratus* are used to make medicine (Odugbemi and Akinsulire, 2006). The leaves are boiled in water to make decoction and drunk to treat yellow fever, jaundice and achy joints (rheumatism). *Garcinia kola* is said to be anti-parasitic, anti-microbial and purgative in nature (Bhat *et al.*, 1990). It is washed, peeled and eaten raw. The fruits are chewed by pregnant women during the first three months to prevent vomiting. The leaves, roots and seeds of *Gossypium hirsutum* are used for the treatment of

convulsion, dysentery, asthma, hypertension, ulcers and ease labour (Gill, 1992). The leaves are squeezed to extract the juice. The juice is drunk to relieve convulsion. The leaves of *Mangifera indica* helps to lower the blood pressure as they have hypotensive properties (Adodo, 2004). The leaves together with *carica papaya* leaves and *Anacardium occidentale* leaves are boiled and drunk to treat malaria fever. The leaves of *Manihot esculentum* help to heal wounds. The presence of various nutrients in the leaves help to heal the injuries fast (Soma and Batra, 1997). *Musa paradisiaca* has long been considered by herbalists to be a useful remedy for cough, wounds, inflamed skin or dermatitis, and insect bites (Gill, 1992). Dried leaves with *Mangifera indica* leaves is boiled and drunk for treatment of malaria. The bark of *Newbouldia laevis* is used for the treatment of migraine (Persistent headache) (Adodo, 2004). The leaves are squeezed and the juice from it is dropped into the eye. The young fresh leaves are crushed in little amount of water and the extract is dropped into the eye to cure eye inflammation and redness. The decoction of the leaves is used to treat sore eyes and young fresh leaves are used to cure eye inflammation and redness. The powdered leaves of *Nicotiana tabacum* are used for curing ringworm and to expel worms (Idu *et al.*, 2005). Leaves are squeezed and juice from it is dropped into the eyes for eye treatment (Irritation). The leaves of *Ocimum gratissimum* are used for the treatment of diabetes (Idu *et al.*, 2003). They are also used as a remedy for chest pain, diarrhoea, catarrh, to prevent miscarriage, stop nasal bleeding, relieve cold, headache and bronchitis (Idu *et al.*, 2007). The leaves are squeezed and the juice from it is dropped into the nostrils. Fresh leaves are used to stop nasal bleeding. The leaves of *Talinum triangulare* helps to soothe inflammations (Okeke, 2003). The leaves are blended until it becomes paste-like. The paste is

applied to boil until it disappears. *Vernonia amygdalina* has gained wide application in the treatment of amoebic dysentery (Jadeja *et al.*, 2006). It is washed in water and squeezed to extract the juice. The juice is drunk to stop stomach pain and cure diabetes. *Zingiber officinale* can be used for a variety of food

or medicinal items such as vegetables and alcoholic beverages (Soma and Batra, 1997). The rhizome is cut and added to other ingredient to make pepper soup. It is drunk to treat fever. A paste of *Aloe vera* gel and crushed cassava leaves is rubbed to heal wounds.

## CONCLUSION AND RECOMMENDATIONS

The preliminary ethno-botanical survey of some medicinal plants used for the treatment of various diseases and ailments in Obah village of Ikpoba-Okha local government area of Edo state revealed an array of plants that could be investigated, and if found useful, such plants could be harnessed and used as potential drugs. Medicinal plants are gaining global awareness owing to the fact that the herbal drugs are cost-effective, easily available

and most importantly, with negligible side effects. It is recommended that further studies should be carried out on the listed plants to validate their efficacy in the treatment of various ailments. It is therefore important to conserve this cultural heritage by scientifically evaluating the biological activities of these medicinal plants. It is also important to encourage the cultivation of these plants for sustainable utilization.

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## **APPENDIX I**

Please tick ( ) and answer the appropriate questions

### **SECTION A: PERSONAL INFORMATION**

- (1) Gender: Male ( ) Female ( )
- (2) Age: 30-40 ( ) 41-50 ( ) 51-60 ( ) 61-70 ( ) 71 and above ( )
- (3) Education level: No formal education ( ) Secondary education ( ) College of education ( ) University education ( )
- (4) Place of Origin: Indigene ( ) Non-Indigene ( )
- (5) Marital status: Single ( ) Married ( )
- (6) Employment status: Employed ( ) Unemployed

### **SECTION B: KNOWLEDGE OF MEDICINAL PLANTS**

- (7) Are you familiar with medicinal plants used in your community? Yes ( ) No ( )
- (8) Which medicinal plants do you commonly use for treatment in Obah village?
- (9) What parts of the plants mentioned above are used for medicine?
- (10) For each plant part mentioned above, please mention its medicinal use
- (11) How do you prepare each of the medicinal plants mentioned above for use?
- (12) How effective do you find these medicinal plants in treating ailments? Very Effective ( ) Effective ( ) Somewhat Effective ( ) Not Effective ( ) Don't Know ( )

## GROWTH-RATE OBSERVATION OF *ARACHIS HYPOGAEA* AND *ABELMOSCHUS ESCULENTUS* ON AUCHI METROPOLITAN WASTE DUMPSITE SOIL REPLICATES

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### ABSTRACT

This study was conducted to investigate the effect of soil obtained from Auchi metropolitan waste dumpsite on the growth of *Arachis hypogaea* (Groundnut) and *Abelmoschus esculentus* (Okra). Three (3) soil treatments (100%, 50% and 25% concentration) with three (3) replicates per treatment were used for the study. The dumpsite soil represented 100% concentration. Fifty percent (50%) concentrated soil was obtained by mixing the dumpsite soil with pristine soil in the ratio 1:1, while twenty-five percent (25%) concentrated soil was obtained by mixing Fifty percent (50%) concentrated soil with pristine soil in the ratio 1:1. These soil treatments (100%, 50% and 25% concentration) were placed separately in 26.50cm by 25.50cm perforated plastic buckets. Viable seeds of *Arachis hypogaea* and *Abelmoschus esculentus* were sown separately to a depth of 3cm in the soil samples. Five (5) seeds per bucket were used and the entire set-up was left under the prevailing environmental condition for 28 days. The results showed that growth parameters (seedling emergence, plant height, leaf number, leaf area and Root length) decreased with increase in soil concentration in *Arachis hypogaea* while in *Abelmoschus esculentus*, no growth was observed in 50% and 100% soil concentration. Soil containing non-biodegradable waste should be exempted from agricultural cultivation of crops.

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**Keywords:** Waste dumpsite, pristine soil, growth parameters, *Arachis hypogaea*, *Abelmoschus esculentus*.

### INTRODUCTION

Soil is a precious natural resource upon which economic activity like agriculture and existence of life depend. The properties and quality of soil can be adversely affected by the over-concentration of waste released from agriculture, industry, municipality and individual household (Soffianian *et al.*, 2014). Waste disposal whether domestic, commercial or industrial in the world is a problem that continues to grow with human civilization and no method so far is completely safe. Experiences have shown that all forms of waste disposal have

negative effects on the environment, public health and local economics (Abdus-Salam, 2009). Studies have shown that soils at refuse dumpsites contain different kinds and concentrations of heavy metals, depending on the age, content and location (Udosen *et al.*, 1990; Odukoya *et al.*, 2000). In recent times, it has been reported that heavy metals from waste dumpsites can accumulate and persist in soils at an environmentally hazardous level (Alloway, 1996; Amusan *et al.*, 2005). In Nigeria, Leachates from refuse dumpsites constitute a source of heavy metal pollution to both soil and aquatic

environment (Odukoya *et al.*, 2000; Oni, 1987). Nevertheless, most abandoned waste dumpsites in Nigeria have been used extensively as fertile grounds for cultivating varieties of vegetables even though research works have indicated that some common vegetables are capable of accumulating high levels of heavy metals from contaminated and polluted soils (Cobb *et al.*, 2000; Benson and Ebong, 2005). This constitute serious health and environmental concern because of the

## MATERIALS AND METHODS

### Plant Materials

The plant materials used for this study were seeds of *Arachis hypogaea* (Groundnut) and *Abelmoschus*

### Dumpsite Location and Description

The waste dumpsite is located in the forest area along new Igarra road at Auchi, Edo State. It spreads over an area of approximately 1,000,000 square meters

### Soil Collection and Treatment

Pristine soil (Top Soil) was obtained from the Biological garden of the Department of Science Laboratory Technology Auchi Polytechnic, Auchi. Three (3) soil treatments (100%, 50% and 25% concentration) with three (3) replicates per treatment were used for the study. The soil collected from the dumpsite represented 100% concentration. Fifty percent (50%) concentrated soil was obtained by mixing the dumpsite soil with pristine soil in the ratio 1:1 while Twenty-five percent (25%)

### Seed Viability Test

The seeds were placed in a bowl of water and left for 20 minutes. Submerged seeds

### Seedling Emergence

Percentage seedling emergency was the total number of seedlings per bucket

**phytotoxicity of these metals to the plants** and the potential health implications to humans and animals consuming such vegetables (Ellis and Salt, 2003; Pillay *et al.*, 2003; Micieta and Murin, 1998).

It is the aim of this study to find out the effect of soil obtained from Auchi metropolitan waste dumpsite on the growth of *Arachis hypogaea* (Groundnut) and *Abelmoschus esculentus* (Okra).

*esculentus*(Okra). The seeds were purchased from a local market in Auchi in one purchase.

and the waste fill height vary from 2metres to 4metres. The waste dumped at this site includes papers, kitchen waste, metals, plastics, batteries and glass.

concentrated soil was obtained by mixing fifty percent (50%) concentrated soil with pristine soil in the ratio 1:1. These soil treatments (100%, 50% and 25% concentration) were placed separately in 26.50cm by 25.50cm perforated plastic buckets. Viable seeds of *Arachis hypogaea* and *Abelmoschus esculentus* were sown separately to a depth of 3cm in the soil samples. Five seeds per bucket were used and the entire set-up was left under the prevailing environmental condition for 28 days.

were collected and used while the ones that remained afloat were discarded.

divided by the total number of seeds sown (5) and multiplied by one hundred. This

was taken daily up to the 10<sup>th</sup> day. Seeds which failed to sprout after 10 days were regarded as non-viable.

**Measurement of Plant Height**

The height was measured with a plastic ruler from the soil level to the terminal bud. Measurements were taken on a 7 day interval up to 28 days after sowing.

**Measurement of Leaf Number**

The number of leaves per plant was physically counted on a 7 day interval up to 28 days after sowing.

**Measurement of Leaf Area**

The leaf area was determined by measuring the length and width (at the widest point of each leaf. The product of this was multiplied by a correction factor of 0.75 to cater for leaf shape (Watt, 1973).

**Measurement of Root Length**

The length of the root was measured with a plastic ruler from the soil level to the tip of the root after uprooting the plant at the end of the experiment (28 days after sowing).

**RESULTS AND DISCUSSION**

Table 1a: Seedling emergence of *Arachis hypogaea* in varying concentration of soil.

Soil Concentration	Seedling emergence (%) in days				
	2	4	6	8	10
100%	0.00	0.00	0.00	20.00	30.00
50%	0.00	0.00	10.00	40.00	50.00
25%	0.00	0.00	30.00	40.00	60.00

Table 1b: Seedling emergence of *Abelmoschus esculentus* in varying concentration of soil

Soil Concentration	Seedling emergence (%) in days				
	2	4	6	8	10
100%	0.00	0.00	0.00	0.00	0.00
50%	0.00	0.00	0.00	0.00	0.00
25%	0.00	0.00	30.00	30.00	30.00

Table 1 shows the seedling emergence of *Arachis hypogaea* and *Abelmoschus esculentus* in varying concentration of soil. Appearance of epicotyl above the soil

level occurred six days after sowing. At ten (10) days after sowing of *Arachis hypogaea*, it was observed that seedling emergence decreased with increase in soil concentration. The highest value was

observed in 25% soil concentration (60.00%) while the lowest value was observed in 100% soil concentration (30.00%) (Table 1a). At ten days after sowing of *Abelmoschus esculentus*,

seedling emergence was observed only in 25% soil concentration (30.00%). No growth was observed in 50% and 100% soil concentration (Table 1b).

Table 2a: Height of *Arachis hypogaea* in varying concentration of soil.

Soil Concentration	Height (cm) in days			
	7	14	21	28
100%	7.50	12.50	18.50	23.30
50%	7.50	13.60	19.00	25.50
25%	9.00	19.10	22.30	27.00

Table 2b: Height of *Abelmoschus esculentus* in varying concentration of soil.

Soil Concentration	Height (cm) in days			
	7	14	21	28
100%	0.00	0.00	0.00	0.00
50%	0.00	0.00	0.00	0.00
25%	1.40	3.70	12.20	13.40

Table 2 shows the height of *Arachis hypogaea* and *Abelmoschus esculentus* in varying concentration of soil. At 28 days after sowing of *Arachis hypogaea*, it was observed that plant height decreased with increase in soil concentration. The highest value (27.00cm) was observed in 25% soil concentration while the least value (23.30

cm) was observed in 100% soil concentration (Table 2a). At 28 days after sowing of *Abelmoschus esculentus*, plant height was observed only in 25% soil concentration (13.40cm). No growth was observed in 50% and 100% soil concentration (Table 2b).

Table 3a: Leaf number of *Arachis hypogaea* in varying concentration of soil

Soil Concentration	Leaf number in days			
	7	14	21	28
100%	20.00	36.00	45.00	86.00
50%	24.00	36.00	75.00	102.00
25%	36.00	44.00	96.00	136.00

Table 3b: Leaf number of *Abelmoschus esculentus* in varying concentration of soil.

Soil Concentration	Leaf number in days			
	7	14	21	28
100%	0.00	0.00	0.00	0.00
50%	0.00	0.00	0.00	0.00
25%	2.00	3.00	6.00	6.00

Table 3 shows the leaf number of *Arachis hypogaea* and *Abelmoschus esculentus* in varying concentration of soil. At 28 days after sowing of *Arachis hypogaea*, it was observed that leaf number decreased with increase in soil concentration. The highest value (136.00) was observed in 25% soil concentration while the lowest value

(86.00) was observed in 100% soil concentration (Table 3a). At 28 days after sowing of *Abelmoschus esculentus*, Leaf number was observed only in 25% soil concentration (6.00). No growth was observed in 50% and 100% soil concentration (Table 3b).

Tables 4a: Leaf area of *Arachis hypogaea* in varying concentration of soil.

Soil Concentration	Leaf area (cm <sup>2</sup> ) in days			
	7	14	21	28
100%	0.05	0.40	1.21	5.54
50%	0.10	0.64	1.49	6.60
25%	0.13	0.67	1.54	8.03

Table 4b: Leaf area of *Abelmoschus esculentus* in varying concentration of soil.

Soil Concentration	Leaf area (cm <sup>2</sup> ) in days			
	7	14	21	28
100%	0.00	0.00	0.00	0.00
50%	0.00	0.00	0.00	0.00
25%	2.13	10.40	75.60	83.90

Table 4 shows the leaf area of *Arachis hypogaea* and *Abelmoschus esculentus* in varying concentration of soil. At 28 days after sowing of *Arachis hypogaea*, it was observed that the leaf area decreased with

increase in soil concentration. The highest value (8.03cm<sup>2</sup>) was observed in 25% soil concentration while the least value (5.54cm<sup>2</sup>) was observed in 100% soil concentration (Table 4a). At 28 days after

sowing of *Abelmoschus esculentus*, leaf area was observed only in 25% soil concentration (83.9cm<sup>2</sup>). No growth was

observed in 50% and 100% soil concentration.

Table 5a: Root Length of *Arachis hypogaea* in varying concentration of soil at 28 days after sowing.

Soil Concentration	Root Length (cm)
100%	11.60
50%	15.60
25%	19.80

Table 5b: Root length of *Abelmoschus esculentus* in varying concentration of soil at 28 days after sowing.

Soil Concentration	Root Length (cm)
100%	0.00
50%	0.00
25%	21.00

Table 5 shows the root length of *Arachis hypogaea* and *Abelmoschus esculentus* in varying concentration of soil. At 28 days after sowing of *Arachis hypogaea*, it was observed that root length decreased with increase in soil concentration. The highest value (19.80cm) was observed in 25% soil concentration while the least value (11.60cm) was observed in 100% soil concentration (Table 5a). At 28 days after sowing of *Abelmoschus esculentus*, root length was observed only in 25% soil concentration (21.00cm). No growth was observed in 50% and 100% soil concentration (Table 5b)

#### CONCLUSION AND RECOMMENDATION

This study showed that the waste dump at Auchu metropolitan waste dumpsite inhibited the growth of *Arachis hypogaea* and *Abelmoschus esculentus*. Growth parameters (seedling emergence, plant height, leaf area, leaf number and root length) of *Arachis hypogaea* decreased with increase in soil concentration. No growth of *Abelmoschus esculentus* was observed in 50% and 100% soil concentration. This observation may be due to the presence of heavy metals. It is recommended that soil containing non-biodegradable waste should be exempted from agricultural cultivation of crops.

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## **EVALUATION OF THE LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SOME SELECTED GRILLED, ROASTED AND SMOKED DELICACIES IN NORTHERN PART OF EDO STATE**

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### **ABSTRACT**

Polycyclic aromatic hydrocarbon (PAHs) are carcinogenic and mutagenic pollutants which get into foods during processing in spite of this, only a few studies have been carried out on some Nigerian delicacies. Therefore, this study investigated the levels of PAHs in some selected food samples which included roasted maize, roasted yam, roasted unripe plantain, roasted ripe plantain, smoked cat fish, mackerel fish, smoked herring fish, grilled chicken and grilled beef. The analysis was carried out using the Gas chromatography (GC) with Flame Ionization Detector (FID) for identification and concentration levels of PAHs in various samples. The result revealed the presence of PAHs in different food samples with varying concentrations. The result showed that roasted yam, unripe plantain and grilled chicken had the least trace of PAHs of 3.62, 0.19 and 4.91mg/kg respectively. Also, the roasted maize, roasted ripe plantain and grilled leaf had some quantity of total PAHs of 7.85, 9.28 and 9.88mg/kg respectively while the smoked cat fish, mackerel and herring had the highest concentration of total PAHs of 79.62, 69.95 and 99.04 respectively. Higher values were found in benzo (a) pyrene (BaP) for smoked herring and catfish as 10.13 and 9.20mg/kg respectively. The BaP is highly carcinogenic and with higher total PAHs concentration for the smoked fish; the food samples may pose some health risk on humans. This study therefore compliment monitoring information on the levels of Polycyclic Aromatic Hydrocarbons (PAHs) occurrences in the different food samples under study.

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**KEYWORDS:** Polycyclic Aromatic Hydrocarbons (PAHs), delicacies, carcinogenic, pollutants, Gas chromatography, concentrations

### **INTRODUCTION**

Most of this stable food enjoyed by the populace are prepared by either roasting, grilling, or smoking method. The health risk associated with the use of these methods in food preparation, especially meat prepared amines (HCAs) which are formed when amino acids, sugars and creatine (a protein) react at high temperatures and polycyclic aromatic hydrocarbons (PAHs) which are formed when fat and juices from meat grilled directly over an open fire drip onto the fire which then causes flames. The flames contain PAHs that can then adhere to

at high temperature is that it can generate carcinogenic chemicals (Eze *at al.*, 2019). The two process that are thought to be responsible are the formation of heterocyclic

the surface of the meat (Cathy, 2017). Hence, PAHs are formed as a result of thermal decomposition of the

\*JIMAH, A., SULEIMAN, M. and JIMAH, K. B.. EVALUATION OF THE LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SOME SELECTED GRILLED, ROASTED AND SMOKED DELICACIES IN NORTHERN PART OF EDO STATE  
organ the fats (AmosTautua *et al.*, 2013).

Chemically, the term PAHs refers to compounds consisting of two or more

benzene rings bounded in linear, cluster or angular arrangement (Silva *et al.*, 2011) or compound that have two or more fused aromatic rings with a pair of carbon atoms shared between rings in their molecules. PAHs containing up to six fused aromatic rings are often known as “small” PAHs, and those containing more than six aromatic rings are called “large” PAHs (IARC *et al.*, 2010).

In general, PAHs are not present individually but in mixtures. Sixteen PAHs that have been extensively monitored are the compounds included in the United States

Polycyclic aromatic hydrocarbons (PAHs) are pollutants which get into foods during processing. One of the major routes of human exposure to PAHs in non-smoking people is food. It has been found that raw food does not usually contain high level of PAHs (plaza-Bolanos *et al.*, 2010). Presence of PAHs uncooked foods such as vegetables, seeds and grains have been found to accumulate on the waxy surface of many

Environmental Protection agency (USEPA) list of priority organic pollutant (USEPA, 1994). Of these 16 PAHs, benzo (a) pyrene is probably the most studied and has been described by the International Agency for Research on cancer (IARC) as probable human carcinogen in 1987 (IARC 1987). Thus, the determination of benzo (a) pyrene (BaP) has been widely used in environmental analysis as a marker for the entire PAHs content. These compounds show clear evidence of mutagenicity and carcinogenic effect in various types of bioassays in experimental animals (SCF, 2002).

vegetables and fruits. On the other hand, PAHs are found in foods as a result of certain industrial food processing methods such as smoke curing, boiling, roasting and grilling over open fire or charcoal, which permit the direct contact between foods and combustion products (silva *et al.*, 2011). Therefore, the analysis of PAHs in food is a matter of concern.\

## MATERIALS AND METHODS

### Collection of Materials

Samples of food for study were collected from three randomly selected sales spots in northern part of Edo state of Nigeria. The samples were obtained at Uchi market. The samples were immediately taken to the laboratory for analysis

### Preparation of Samples

The maize, yam, unripe and ripped plantains were peel to remove the bark and roasted by

2g of each of the homogenized food samples was thoroughly mixed with anhydrous  $\text{Na}_2\text{SO}_4$  salt to absorb moisture and then

the open charcoal pot flame method. Cat fish, mackerel and herring fish were smoked in an open fire drum method as used by the traditional people by placing the fish over a grid of flame from firewood, while the chicken and the beef were grilled by placing them on grill over a smoky flame of firewood (Amos-Tautua *et al.*, 2013).

### Extraction of Food Samples for PAHs Analysis

extracted with a quantity of analytical grade dichloromethane ( $\text{CH}_2\text{Cl}_2$ ). The dichloromethane extract was cleaned up by passing

through a column packed with anhydrous Na<sub>2</sub>SO<sub>4</sub> salt. The resulting extract was concentrated on a rotatory evaporator to give

### Analysis of Sample Extract for PAHs Concentration

The gas chromatography (GC) used was Hewlett packed 589 O series 11, coupled with flame ionization detector (FID) (Hewlett Packard, Wilmington DE USA). INL was injected into the G C for analysis. The Identification of PAHs was based on comparison of the retention times of the peaks with those obtained from standard mixture of PAHs (Standard are supplies by

an oily residue which was again dissolved in 1ml CH<sub>2</sub>Cl<sub>2</sub> to be used for analysis. (Amos-Tautua *et al*, 2013)

instrument manufacturer). Quantification was based on external calibration curves prepared from the standard solution of each of the PAHs (Amos-Tautua *et al*, 2013)

## RESULTS AND DISCUSSION

### Results

The result of the study is showed in the table 1 below:

**Table1:** concentration level of PAHs in some selected delicacies (mg/k

PARAMETER	SAMPLE								
	Roasted unripe	Roasted yam	Grilled chicken	Roasted maize	Roasted ripe plantain	Grilled beef	Smoked mackerel	Smoked catfish	Smoked
Napthalene	—	0.62	—	1.73	—	0.02	1.11	1.13	1.72
Acenaphthylene	—	—	—	0.70	0.50	0.02	4.26	4.30	15.60
Acenaphthene	—	—	0.12	1.12	—	0.05	6.84	2.12	0.95
Flourene	—	1.51	0.24	0.85	0.78	—	4.84	0.34	3.02
Phenanthrene	—	0.14	—	0.16	0.26	—	1.64	1.29	1.46

Anthracene	0.11	0.35	0.87	—	0.66	1.03	12.94	1.21	16.72
Fluoranthene	—	—	—	0.61	0.67	—	3.73	22.08	6.89
Pyrene	—	0.45	—	0.35	0.65	2.15	7.39	12.40	16.77
Benzo(a)anthracene	—	0.16	0.89	0.07	0.61	0.01	5.78	4.43	2.62
Chrysene	—	0.07	—	0.05	0.61	5.12	1.42	6.94	6.25
Benzo(b)fluoranthene	0.08	0.31	0.63	0.37	1.31	0.06	6.63	2.48	6.73
Benzo(k)fluoranthene	—	—	0.71	0.28	0.67	0.02	1.91	5.60	1.45
Benzo(a)pyrene	—	—	0.53	—	—	—	2.90	9.20	10.13
Dibenzo(a,h)anthracene	—	—	—	1.56	1.40	0.01	1.81	2.01	1.44
Benzo(g,h,i)pyrene	—	—	0.74	—	0.56	1.19	2.43	2.33	2.73
Indeno(1,2,3cd)pyrene	—	—	0.18	—	0.60	1.20	5.04	1.76	4.56
<b>TOTAL PAHs</b>	<b>0.19</b>	<b>3.61</b>	<b>4.91</b>	<b>7.85</b>	<b>9.28</b>	<b>9.88</b>	<b>69.95</b>	<b>79.62</b>	<b>99.08</b>

g)

### Discussion

A summary of the occurrence of various PAHs present in all the food samples is shown in table 1. It showed the 16 PAHs and the total PAHs for all the samples. They were reasonably detected in the fish samples, while trace quantities were found

in roasted yam, roasted unripe plantain and grilled chicken and some quantities were found in roasted maize, roasted ripe plantain and beef (suya). After thorough research, we found that these observations agreed with other inference made by other researchers

that these PAHs are formed during the processing of food (Amos-Tantua *et al.*, 2013).

In table 1, the concentration of the PAHs in the smoked fishes ranged between 69.95mg/kg and 99.08mg/kg, while the grilled chicken and beef ranged between 4.91mg/kg to 9.88mg/kg. From the observation, the average total PAHs level of suya (9.88mg/kg) was far lower than that of smoked herring fish (99.08mg/kg). This could be ascribed to the high fat content of the fish samples as compared to the chicken and the beef. Akpan *at al.*, (1994) reported that strong correlation exists between fish liquid and PAHs compounds; since the PAHs compounds are stored in the fatty fish tissue. The PAHs with the maximum concentration, flourathene (22.08mg/kg) was detected in catfish. As for the other food samples; roasted maize, roasted yam, roasted unripe plantain and ripe plantain were having lower PAHs values of 7.85, 3.61 ,0.19 and 9.28mg/kg respectively.

Benzo(a) pyrene (BaP) is the most studied carcinogenic PAHs (Collins *et al.*, 1991). The levels of BaP found in smoked cat fish, mackerel and herring with the concentration 9.20, 2.90 and 10.13mg/kg were for higher than the recommended maximum

- ii. Indirect cooking methods should be used with foods placed in a chamber heated from the outside.
- iii. Direct cooking methods can be done with heat from a clean combustion.
- iv. Moderate cooking temperature of about 80-100°C should be used in other to avoid pyrolysis.
- v. Public enlightenment should be used to sensitize people about the potential risks of PAHs.
- vi. Further studies should be carried out on these pollutants.

## REFERENCE

permissible concentration of 5.0µ/kg or 0.005mg/kg fixed for BaP in smoked meat, fish and fishery products (JECFA, 2005). Surprisingly, BaP was not detected in other samples including the beef (suya) in our study. This, the smoke fish may pose some health risk to the people of Edo state North of Edo state Nigeria

## CONCLUSION

From this study, since benzo (a) pyrene which is considered as a marker of carcinogenic PAHs is not detected in many of the food samples, it can be assumed that those foods do not represent health risk for human. However, it should be noted that the benzo (a) pyrene of the fish samples and the total PAHs concentrations are relatively too high. This call for some concern that they may pose some health risk.

## RECOMMEDATION

Considering the carcinogenic potential of the PAHs and there is the need to reduce the levels of PAHs in foods; the following recommendation are made:

- i. Special attention must be given to smoked, roasted and grilled foods.

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## **TROPICAL HERBS AS FEED SUPPLEMENT FOR GRASSCUTTER FARMING**

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### **Abstract**

The importance of tropical herbs in animal nutrition cannot be undermined. In recent years, there has been a series of discoveries about applicability of tropical herbs in various areas of life including agriculture, medicine and industrial sector. Tropical herbs such as moringa oleifera shown successful uses in broiler chicken, rabbit and cow, pigs and sheep nutrition, the leaf meal of ocimum gratissimum have significant treatment effects on the hematopoietic system of grasscutters, Extract from the leaves of gongromema latifolium has anti-inflammatory activities against various pathogens, while vernonia amygdaline could serve as source of invaluable nutrients especially crude protein and fiber in grasscutter nutrition. It could also improve the overall health of the animal through supply of phytochemicals.

*Keywords: tropical herbs, feed supplements, grasscutters, farming.*

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### **INTRODUCTION**

The need for adequate and cheap sources of animal protein has brought attention to the rearing of wild animals. One of the successfully reared wild animals today is grasscutter (Akinloye 2005). Grasscutter has been identified as one of the unconventional livestock that is capable of solving the problems of low protein intake in the tropics. The roles presently played by grasscutter in terms of contribution to nutritional values need to be sustained because its production is one of the ways to ensure sustainable production of bushmeat through captive and ranching wild animals that are tractable and easy to handle (Fatokunet et al 2010). However, the survival of grasscutter outside their natural habitat has created a lot of concern for scientists in the field of wild life farming all over the world. Thus, there is a need to encourage domestication by making breeding and fattening stock readily available for intending farmers (Henry 2010). One cheap source of protein for grasscutter production is the leaf meal of some tropical browse plants. Leaf meals do not only provide protein source to farm animals but also some essential vitamins such as vitamin A and C, minerals and oxycarotenoids. The constraints to enhancing utilization of leaf meals resides

mainly on factors such as fibre content, the presence of anti-nutritive compounds and deficiency of certain amino acids.

Sarwatt et al, (2004) reported that moringa foliage is a potential inexpensive protein source for livestock feeding. Moringa leaves have quality attributes that makes it a potential replacement for groundnut cake, soyabean and fish meal in non-ruminants diet. The leaves contain high concentration of crude protein, essential vitamins, minerals and proteins (Makkar and Bekker, 1997; Gidamis et al, 2003). Moringa leaves have been used as feed for stock animals and even in fishery application in order to provide more nutrition. Promising results have been made on inclusion of moringa oleifer leaf meal with diet of fish feed (Ritcher et al, 2003).

Gongronema latifolia Benth is commonly called “utazi” and “arokeke” in south eastern and south western Nigeria respectively. It is used as a leafy vegetable and spice in south eastern Nigeria (Agbo et al, 2005). The crop has been identified to be nutritionally high in iron, zinc, vitamins, proteins and amino acids (Agbo et al., 2009).

Vernonia amygdalina popularly called bitter leaf is a nutritious and medicinal



herb that offers several benefits for grasscutter. It contains high protein content (10-15%), rich in fiber (15-25%), good source of vitamins A, C and E and minerals like calcium, phosphorus and potassium.

In Nigeria, *O. gratissimum* is described by different local names but it is popularly known as “scent leaf” in most parts of the country. The plant is used as a condiment and spice in most part of the World including Nigeria. It is also used widely in traditional medicine for the treatment of several ailment including fever, cough and respiratory disorders, headache, stress etc. studies have also shown that the leaf extract of *O. gratissimum* contains potent bioactive components like saponins,

#### **ORIGIN OF GRASSCUTTER**

Grasscutter is a wild herbivorous rodent in the sub-Sahara region of Africa. It is the biggest after porcupine in the rodent class (Hoffman, 2008). It is referred to as cane rat or cutting grass by many. Scientifically, it is referred to as *Thryonomys swinderianus*. Its sub-order is that of *Hystricomorpha* (porcupine relatives) and the super family is *pefromurodia* (Rock rat-like) with the genus *Thryonomys* (Wood, 2005).

kingdom: Animalia

phylum: Chordata

sub phylum: vertebrata

class: mammalia

order: Rodentia

sub order: *Hystricomorpha*

family: *Thryonomyidae*

genus: *Thryonomys*

species: *Thryonomys swinderianus*

The species are of two types namely *Thryonomys swinderianus* termminck and *Thryonomys gregorianus*.

#### **PHYSICAL DESCRIPTION**

Cane rats can measure from head-body length 43-60cm (17-24in) with the tail measuring 16-19.5cm (6.3-7.7in). Typical weight is weight is 3.2-5.2kg (7.1-11.5lb) in males averaging 4.5 (9.9lb) and females at 3.4-3.8kg (7.5-8.4lb). In some cases,

alkaloids e.t.c (Matasyll et al, 2007). These phytochemicals possess antibacterial, antifungal antihelmintics properties (Odukoya et al., 2005, Aprioku and Obianne,2008). Additionally, the toxicological effect of the plant of the hematopoietic system have been studied, showing that it causes reduction in PCV and its values, with proliferation in leucocytes (Ephraim et al, 2000; Jimoh et al., 2008; Obianne et al 2010). Nutritional importance of the plant centers on its usefulness as a seasoning because of its aromatic flavor.

The high cost of supplementary sources of vitamins and minerals in grasscutter feed motivated this research.

cane rats can weigh to approximately 7-9kg (15-20lb). They are considered one of the largest rodents in Africa, behind only the *Hystrix* porcupines (Merwe, et al 2007; Mustapha et al, 2020; Smithers et al, 2012). It has rounded ears, a short nose and coarse bristly hair. Its small feet are smaller than the hind feet, each with three toes.

#### **CONFINEMENT AND SOCIAL BEHAVIOUR OF GRASSCUTTER**

Grasscutters can be subdivided into two categories characteristically the docile and indocile grasscutters. The docile grasscutter adapts well to life in confinement and becomes accustomed to man quickly, whereas the indocile grasscutter panics when people approach and tries to escape from its cage or pen and the individual who takes care of them. The animals communicate with each other and produce different sounds that indicate well-being, warnings as well as submission.

The *Thryonomys swinderianus* is a semi nocturnal animal and they live in colonies comprising of one male and several females in each colonies and the young ones from more than one generation. Even though it possess digits equipped with power and sharp claws, it does not crawl

on vertically erect wall or objects unlike African giant rats, it burrows into the ground but can temporarily shelter in hollows made by other animals. It is sensitive to noise and almost very frightened when it senses danger. The animal always shelter itself with dry grass to provide warmth since it is allergic to cold weather (Abioye et al, 2008).

#### **FEEDING**

The food supply should meet all the animal's daily requirements in captivity, grasscutter can eat fresh or dried food although their diet comprise mainly of green forage. It can be supplemented by feed with high energy value or added proteins and minerals. Forage alone is unable to meet the animal's requirement for efficient productivity (Adu and Wallace, 2003). Supplementing with a formulated diet has proved successful. Some authors (Adeniji, 2008; Karikari and Nyameabem, 2009; Wogar, 2011)) have conducted various researches using compounded feed as supplements for grasscutter. Some tropical herbs suitable

#### **MEDICINAL USE OF HERBS**

##### **OCIMUM GRATISSIMUM**

The essential oil of *Ocimum gratissimum* contains eugenol and shows some evidence of antibacterial activity ((Celso et al, 2002). A study of goats revealed that the essential oil has antihelmintics activity (Pressoa et al, 2002). A test on guinea pig revealed evidence that a leaf extract of the plant prevented diarrhea (Veronica and Unoma, 1999). The ocimum oil is active against several species of bacterial (*Echeria coli*, *Shigella*, *salmonella* and *proteus*) and fungi (*Trichophyton nebrum* and *Trichophyton metagrophytes*) (Oboh et al, 2009). A previous screening of crude extract of plants used in traditional medicine showed that the essential oil of *Ocimum gratissimum* inhibited growth of *Herpettomonassamuel pessoai* (Holetz et al., 2002).

*Ocimum gratissimum* is used for variety of reasons. In culinary, it is used in salads,

for tending grasscutters (also known as cane rats or *Thryonomys*) are:

##### **A. Nutritional herbs**

1. *Panicum maximum* (Guinea grass)
2. *Brachiaria ruziziensis* Ruzi grass)
3. *Penniselum purpureum* (Elephant grass)
4. *Andropogon gayenus* (Gamba grass)
5. *Cynodon dactylon* (Bermuda grass)

##### **B. Medicinal herbs**

1. *Vernonia amygdalina* (Bitter leaf) – antioxidant and anti-inflammatory properties
2. *Ocimum gratissimum* (Africa basil) – antimicrobial properties.
3. *Chromolaeria odorata* (Siam weed) – anti-inflammatory properties
4. *Moringa oleifera* (Moringa) – rich in vitamins and minerals.
5. *Azadirachta indica* (Neem) – anti-parasitic properties

##### **C. Other suitable herbs**

1. *Ipomoea batatas* (Sweet potato leaves)
2. *Mannihot esculenta* (Cassava leaves)
3. *Solanum macrorpon* (Africa egg plant leaves)
5. *Amaranthus hybridus* (Amaranth).

soups, pastas, vinegars, jellies in many parts of the world. In traditional medicine, the leaves has been used as a general tonic and as anti-diarrhea agent and for the treatment o conjunctivitis by instilling directly into the eyes; the leaf oil when mixed with alcohol is applied as lotion for infections, and taken internally for bronchitis. The dried leaves are inhaled to alleviate headache and fever among other uses. Although, conventional antibiotics have been very useful in orthodox medicine, it has been argued by many that concomitant use, with herbal extract is not desirable as one normally antagonizes the activity of the other. Considering the fact that *Ocimum gratissimum* is used in most dishes or foods to achieve different purposes, there is a need to ascertain if its characteristics antagonizes or acts as a synergy when used together with

conventional antibiotics. In addition, the various extracts of *Ocimum gratissimum* have been tested in vitro and shown to be active against some bacterial and fungal isolates (Lemoset et al, 2005; Nakamura et al, 2004; Silva et al, 2005), specific strain differences supposes that a lot more status of bacteria and fungi across other regions be tested to ascertain in vitro activity against this spice. *Ocimum gratissimum* L (Lamiaceae) is commonly used in traditional medicine to treat different ailments e.g. upper respiratory tract infections, diarrhea, headache, ophthalmic infection, skin disease, pneumonia and also a treatment for cough,

**FEEDING GUIDELINES,  
PRECAUTIONARY USES AND  
RECOMMENDED DAILY INTAKE  
OCIMUM GRATISSIMUM AS  
GRASSCUTTERS FEED  
SUPPLEMENTS.**

**FEEDING GUIDELINES**

1. Dosing: 1-2% of total feed mixture (dry matter basis)
2. Fresh or dried leaves can be used
3. Mix with field staples like grasses, grains or concentrates.
4. Gradual introduction (0.5% initially, increasing to 1-2% over 1-2weeks)

**PRECAUTIONARY USES**

1. Avoid excessive consumption (>2% of feed)
2. Monitor for signs of toxicity (rare): vomiting, diarrhea and lethargy
3. Pregnant or lactating gasscutters: consult veterinarians
4. Lacteration with medication: consult veterinarians

**RECOMMENDED DAILY INTAKE**

Grasscutter weight (kg)/recommended intake (g/day)

1-2kg	2-4g
2-3kg	4-6g
3-4kg	6-8g4-5kg
8-10g	

despite the fact that fever and conjunctivitis (Onajobi, 1986). The whole plant and the essential oil have many applications in traditional medicine especially in Africa and India. Preparations from the whole plant are used in treating sunstroke, headache and influenza. The seeds have laxative properties and are prescribed against gonorrhoea. The essential oil is applied against fever, infection of the throat, ears or eyes, stomach pain, diarrhea and skin diseases. It is being tested as an antibiotic. The essential oil is also an important insect repellent (Iwu, 1993).

**GONGRONEMA LATIFOLIUM**

*G. latifolium* is an edible rainforest climbing plant native to South-Eastern, Nigeria an Asclepiadaceae (Morebise et al, 2002). It is used widely as a staple vegetable spice in trado-medicine (Morebise and Fatunso, 1998; Morebise et al, 2002) for healthy glycemic control and to support the pancreas (Ugochukwu et al, 2003).

Earlier reports on extract of this plant have focused mainly on their medicinal properties (Nwinyi et al, 2003; Morebise, 2008) with attempts at investigating their food preservative potentials. It has been used in traditional system of medicine to treat various gastrointestinal disorders such as diarrhea, dysentery, ulcer and dyspepsia, and in the management of diabetes mellitus and blood pressure (Nwinyi et al, 2008). The leaves has been reported to have hypoglycemic effect (Ugochukwu et al, 2003; Ogundipe et al, 2003) by decreasing the activity of glycolysis enzyme and levels of hepatic glycogen.

The ethanoic extract of *Gongronema latifolium* leaves are reported to possess antioxidant activity by increasing superoxide dismutase and glytathione oxidative activities and also reduces renal and hepatic oxidative stress, lipid

peroxidation and to treat bilharzia, viral hepatitis and as a gentle antimicrobial agent (Ugochukwu and Cobourne, 2003). Ethanoic extract of *Gongronema latifolium* increases white blood cell count and haemoglobin concentration in normal condition (Antail, 2009) while the leaves has a strong modulatory effect against hepatocellular damage induced carbon tetrachloride (Etim et al, 2008)

The plant also has anti-inflammatory properties (Morebise et al, 2002) and also exhibit antimicrobial activities against various microbial pathogens (Osuala et al, 2005). The extract of the leaves may be used to prevent or reduce weight loss, growth-depression and haematotoxicity in diabetes subject (Edet et al, 2011). *Gongronema latifolium* has beneficial effect in diabetes mellitus due to its hypoglycemic and antioxidant properties ( Nwanjo et al, 2006).

**FEEDING GUIDELINES,  
PRECAUTIONARY USES AND  
RECOMMENDED DAILY INTAKE  
OF GONGRONEMA LATIFOLIUM  
AS GRASSCUTTER FEED  
SUPPLEMENT**

**FEEDING GUIDELINES**

1. Dosing: 5-10% of total feed mixture (dry matter basis)
2. Fresh or dried leaves can be used.
3. Mix with feed staples like grasses, grains or concentrates.
4. Gradual introduction (2-5% initially, increasing to 5-10% over 1-2weeks)

**PRECAUTIONARY USES**

1. Avoid excessive consumption (>10% of feed)
2. Monitor for signs of toxicity (rare): gastrointestinal upset, allergic reactions
3. Pregnant or lactating grasscutters: consult veterinarian
4. Interaction with medication: consult veterinarian

**RECOMMENDED DAILY INTAKE**

Based on 5-10% of total feed mixture:

Grasscutter weight (kg)/recommended intake (g/day)	
1-2kg	
25-50g	2-3kg
50-75g	3-4kg
75-100g	
4-5kg	100-125g

**MORINGA OLEIFERA**

*Moringa oleifera* belongs to family Moringaceae. *Moringa oleifera* is native to India and introduced into the tropics (Mabruk et al, 2010). It is a multipurpose tree that is grown in semi- and tropical areas. It is mainly used for human nutrition and for correction of malnutrition of kids in india and southern America. The description of moringa tree as a miracle tree coincides with its nutritive value as human food besides it different medicinal uses.

Recent studies has shown successful uses of *M. oleifera* in broilers chicken, rabbits and cow, pigs and sheep nutrition (Gadzirayi et al, 2012; Portugaliza and Fernandez, 2012; Bonatene et al, 2011; Odeyinka et al, 2008; Bryan et al, 2007) respectively. At present, the scientists are working to improve feed efficiency and growth rate of livestock using useful herbs (Bunya praphatsara, 2007). *Moringa oleifera* can be used as growth promoter and reproductive enhancement but the mechanism of action as growth promoter and reproductive enhancemen is yet to be adequately researched in livestock such as grasscutter.

Hence, this present study was therefore to investigate the effect of *M. oleifera* on the growth, reproductive performance and

survival of *T. swinderianus* (Isaac et al, 2015).

Moringa leaves provides excellent raw materials for production for biogas and are used in alley cropping system, due to their rapid growth, long tap roots, minimal shade and large production of high protein biomass (Fugile, 2001). Juice extracted from the leaves can be used to make foliar nutrient capable of increasing crop yield up to 30%, therefore serving as growth hormones for crops while the gum produced from the cut tree trunk can be used in calico printing, in making medicine as a bland tasting condiment. The powdered seeds can be used to clarify honey and sugar cane juice without boiling. Powdered seeds also act as natural flocculent, able to clarify even the most turbid water and the seed kernel contains about 40% edible oil, similar in quality to olive oil. Moringa trees are planted in gardens and along avenues as ornamental trees. The bark of the tree can be beaten into a fiber for production of ropes or mats (Fugile, 2001).

**FEEDING GUIDELINES,  
PRECAUTIONARY USES AND  
RECOMMENDED DAILY  
INTAKES OF MORINGA OLEIFERA  
AS GRASSCUTTER SUPPLEMENT  
FEEDING GUIDELINES**

1. Dosing: 2-5% of total feed mixture (dry matter basis)
2. Fresh or dried moringa leaves
3. Mix with feed staples like grasses, grains or concentrates
4. Gradual introduction (1% initially, increasing to 2-5% over 1-2 weeks).

**PRECAUTIONARY USES**

1. Avoid excessive consumption (>5% of feed)
2. Monitor for signs of toxicity (rare): gastrointestinal upset and allergic reactions

3. Pregnant or lactating grasscutters: consult veterinarians
4. Interaction with medication: consult veterinarian

**RECOMMENDED DAILY INTAKE**

Based on 2-5% of total feed mixture:  
grasscutter weight (kg)/recommended intake (g/day)

1-2kg
10-20g
2-3kg
20-30g
3-4kg
30-40g
4-5kg
40-50g

**VERNONIA AMYGDALINA**

*Vernonia amygdalina* popularly called bitter leaf grows in the humid tropics of Africa and is among several herbs used by traditional healers in Western Nigeria to treat bacterial infections. Moreover, *Vernonia amygdalina* has been used in traditional medicine as an antihelminthic, antimalaria and laxative herb (Jisaka et al, 1992; Akinpelu, 1999; Abosi and Raseroka, 2003). A wide array of phytochemicals which include tannin, oxalate, phytate, saponnin, flavonoid, luteolin and glucoside has been shown to be present in *Vernonia amygdalina* (Harbone, 1973; Ohigashi, 1994; Igile et al, 1995; Tona et al, 2004; Ejoh et al, 2007; Eleyinmi et al, 2008; Njan et al, 2008). These phytochemicals are believed to be responsible for plethora of bioactivities possessed by the plants.

In addition, *Vernonia amygdalina* contains 18% protein, 8.5% fibre (dry matter) and a good composition of macroelements (Partenen and Mroz, 1999; Ezekwe and Obidoa 2001). Due to its nutritional qualities, it could serve as source of invaluable nutrients especially crude protein and fiber in grasscutter nutrition. It can also improve the overall health of the animal through supply of phytochemicals.

**FEEDING GUIDELINES,  
PRECAUTIONARY USES AND  
RECOMMENDED DAILY INTAKE  
OF VERNONIA AMYGDALINA AS  
GRASSCUTTERS FEED  
SUPPLEMENT**

**FEEDING GUIDELINES**

1. Provide fresh bitter leaves as a supplement (5-10% of total diet)
2. Mix with other herbs and grasses to ensure variety
3. Avoid overfeeding as bitter leaf can be toxic in excess
4. Ensure access to clean water at all times.

**PRECAUTIONS  
CONCLUSION**

Conclusively, tropical herbs should be used as feed supplement in grasscutter diets. They supply the necessary nutrients (proteins, vitamins and minerals) in grasscutter diets; they are also used as organic drugs in prevention and treatment of diseases i.e. antimicrobial, anti-inflammatory and anti parasitic.

**RECOMMENDATION**

It is therefore recommended that there should be public enlightenment and campaigns to educate grasscutter farmers on the feeding guidelines, precautionary uses and recommended daily intake of the tropical herbs.

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1. Wash bitter leaf thoroughly before feeding
2. Remove any toxic or spoiled leaves
3. Avoid bitter leaf roots or seeds, as they contain higher level of toxic compounds

**RECOMMENDED DAILY INTAKE**

1. Juvenile grasscutters (0-6months): 5-10g of bitter leaf per kg of body weight
2. Adult grasscutters: 2-5g of bitter leaf per kg of body weight.

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## **AN OVERVIEW OF THE CHALLENGES OF SUSTAINABILITY OF TOURISM DEVELOPMENT IN RURAL AREAS (A REVIEW)**

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### **Abstract**

*One of the most important aspects of tourism management in the modern world is in devising ways of improving environmental performance. This research explains sustainable development concept and its link with sustainable tourism practice. The research equally highlights the challenges of sustainability in tourism and sustainable tourism position. Finally the Article indicates six steps to be taken to enable tourism stakeholders move closer to achieving sustainable tourism goal.*

**Keywords:** Challenges, Tourism, Sustainability, Development

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### **Introduction**

As the impacts of tourism in tourist attraction become apparent, concern about the quality of the environment and the future of tourism industry begin to emerge. Increasingly, wide recognition of the negative environmental effects of tourism development and its activity has led to a focus on the alternative forms of tourism and improved environment practice. The principle which underlies this focus is called sustainable development, translated to tourism; it is known as sustainable tourism (page, 2022). A large amount of literature exists on the topic of sustainable tourism, in the academic arena, the journal dedicated to the topic the 'journal of sustainable tourism'. Page (2018) has argued that this has been one of the most researched areas of tourism since the 1990s.

The consumer oriented interest in such issues has been framed in terms of green consumer, and the media have also focused on sustainability with television travel shows (the British airways tourism for tomorrow awards televised on the ITV travel programme "wish you were here" in the UK). According to Prosper (2021) One of the most important aspects of tourism management in the twenty-first

sustainable tourism seeks to sustain the quality, quantity and productivity of both human and natural resource systems overtime, while respecting and accommodating the dynamics of such systems. This is based on the idea of optimizing returns while protecting the resource base. Prior to exploring the concept and practice of sustainable tourism, it is necessary to gain some understanding of the context in which the concept of sustainably developed. This is best accomplished by considering the evolution of development in environmental thinking.

It is a commonly held views that the green movement is a recent invention. However the roots of concern about the human impact on the environment can be traced back to ancient civilizations (Cooper, 2015). Ancient Greek literature reveals the philosophy of the earth being viewed as a living goodness. In Roman times, written evidences exists of concerns about land degradation and soil erosion through intensive use and even the effect on human health from using lead cooking vessels.

century is in devising ways of improving environmental performance. Tourism

managers and decision-makers need to be fully conversant with the need to minimize impacts on host community and the natural environment while at the same time ensuring the existence of a viable tourism industry and maximum local benefits.

The objective of this research is centred on the need to create awareness amongst tourism stake holders; the principles of sustainable development and link with tourism development. The research also outline the principles and a range of a global sustainable tourism practice, while emphasizing on the difficulties or challenges of achieving sustainable tourism development in tourist location across developing countries of the world.

**Study Methodology**

The researcher adopted a review method, where secondary literature on sustainable tourism was harnessed, with insights on the problems and objective of the study highlighted above.

**Conceptual and Theoretical Study Literature**

It is on record that in Roman times, written evidence exists of concerns about land degradation and soil erosion through intensive use and even the effect on human health from using lead cooking vessels. Through the sixteenth and seventeenth centuries, the dominant view of the environment in European was centred

around humans, mastery of nature-that people could conquer the environment and use its resources for human progress. This tends to be viewed as the imperial or anthropocentric perspective on the environment and it has dominated human thinking on the present day. Conversely the scientific study of nature around the late 1700s onwards gave rise to the notion of the interrelationships of the natural world and a valuing of the flora and fauna-the Arcadian or Eco-centric perspective. This is illustrated in fig1.1 below.

Many researchers critics began to realize the negative implications of growth (in industry and population) and challenged the notion of this dominant world view. One of the early critic was Thomas Malthus (2021) who stated that human population growth was increasing at a rate which would outstrap food production. The rapid social and economic changes of the nineteenth century brought about a need for resource management and preservation, best exemplified by the emergence of wilderness preservation societies and early proponents of the national parks movement North America. Ecology as an Academic discipline became recognized from 1850 and gave rise to a new era in environmental thinking which is built on the foundations of the Arcadians.

<b>Ecocentrism</b>	<b>Anthrocentrism</b>
<ul style="list-style-type: none"> <li>- Concern for preservation of Natural Environment</li> <li>- Emphasis on quality of environment which is vital for human progress</li> </ul>	<ul style="list-style-type: none"> <li>- Humans area dominant force</li> <li>- Mastery of the Natural Environment for maximum human gain.</li> </ul>

Fig 1:1 – A simplified illustration of environmental thinking (source: Thomas Mallthus, 2021).

The early part of the twentieth century demonstrated a despondence of groups dedicated to preserving and conserving

habitats, species, built heritage and access to open areas. However the environment became high profile in a social and

political sense in the 1960s. Policies for economic growth post-1945 worked on the premise that the more goods the industrial system produced, the more satisfied consumers would be (the greatest happiness for the greatest number of people or maximum utility). The age of consumerism and the industrial processes that gave rise to it did not recognize any environmental responsibilities and production continued while environmental pollution began to increase.

Tourism, while not an industrial process must be seen to be part of this production process, as it requires resources and produces pollution in a number of different forms. From 1960s, the conversations of economic growth began to be questioned and this along with several high profile environmental catastrophes such as the Torrey Canyon Oil disasters in 1967, sparked off the beginning of the contemporary environmental movement. Many environmental groups such as friends of the earth, green evolution club also originate and gained recognition from this period.

### **The Development of the Sustainability Concept**

Early proponents of a new approach to the economy and the environment came in the form of authors and researchers in the field of economics such as J.K. Galbraith to biologists such as Rachel Carson as well as pressure groups concerned with micro and macro issues.

Concern focused on both environmental and societal issues, discussion at international governmental level was also apparent. The 1962 United national conference promoted the idea of a balance between social and economic development and from then on instigated several long term subgroups to examine areas of concern (e.g. the research institute for social development, environment

programme). Representatives from the Government and non-governmental organization of 119 countries met in 1972 at Stockholm, United Nations Conference on the Human Environment). In an attempt to consider environmental problems. The conclusion reached by the conference was that development and the environment could exist together in mutual benefit but no indication was given as to how this might be achieved.

### **Defining Sustainability and Sustainable Tourism**

The most widely accepted definition of sustainable development is that cited in our common future; Development that meets the needs of the present without compromising the needs of future generations. (World Commission on Environment and Development, 1987)

While this provides a relatively neat summary, the meaning and application of the concept is more problematic. Sustainable development allows for economic development, but within the parameters of resource conservation.

Sustainability as a concept may be viewed from opposites; at one extreme is economic sustainability, where that is being sustained, is the economy at whatever cost; dramatically opposed to this is ecological sustainability, where the natural environment takes priority over any economic development. In addition to defining sustainability, there is a need to consider degree of sustainability. Turner Peace and Bateman (2020), produced a spectrum of sustainable development, defining positions ranging from very weak, sustainability to very strong sustainability as illustrated in fig. 1.2.

### **The Challenges of Sustainability in Tourism**

Recognition of the damaging effects of tourism had led to a focus on encouraging alternative tourism. Alternative tourism raises the question.

Alternative to what? Most scholars in tourism agree that it refers to an alternative to mass tourism. If viewed in this way, then sustainable tourism becomes a niche market. In reality, this what seems to have occurred. A variety of niche market with alternative theme have emerged and terms such as ‘ecotourism’, green ‘tourism’ ‘sustainable tourism’, ‘nature tourism’, ‘soft tourism’ and ‘adventure tourism’ to name but a few have become part of international and domestic tourism markets. Growth in these areas has been particularly marked since the beginning of the 1990s.

To some extent, the pattern of product is contrary to the ideals of sustainable development. The reason for this is that the diversity of tourism products and environments has increased (as alternative tourism favourless exploited areas, environmentally sensitive or rural areas and culturally different regions which are prone to negative impacts if properly managed), while mass tourism destination continue to exist within the traditional management framework. The conclusion to this argument is that sustainable tourism should be viewed more as an echos than a product or niche market. The ideal of sustainability needs to infiltrate the entire tourism system if environment and people are to be protected from the negative forces of charge.

There are signs that this is beginning to happen attention to environmental management is becoming more widespread. Large companies such as tour operators, hotel chains and archives are starting to demonstrate an awareness of the consequences of tourism development and activity as noted in the tour operators initiative. There are some criticism that

this type of reaction is merely ‘Lip-Service’ but it is at least a step in the right direction. In addition it is impossible to imagine any kind of tourism activity being developed and then operating without in some way, reducing the quantity or quality of natural resources somewhere.

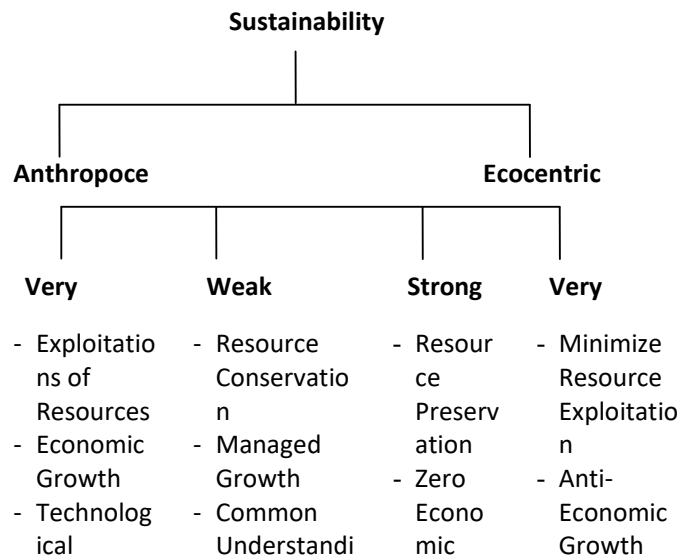


Fig. 1.2: Degree of Sustainability (Peace Turner & Pateman, 2016).

**Sustainable Tourism Concept**

Sustainable tourism is a nebulous concept and to some extent has become moulded to fit the needs of conservationists, governments, communities and developers. Thus there is no universally accepted definition, but in 2004 the WTO did attempt to address this was range of definition by establishing that sustainability principles apply to environmental economic and sociocultural aspects of tourism so that a suitable balance needs to be achieved between these interconnected elements to guarantee the long-term sustainability of tourism. The WTO outlined that sustainable tourism should;

- vii. Make optimal use of environmental resources (while maintaining the

essential ecological processes while helping to conserve the natural heritage and biodiversity).

- viii. Respect the socio cultural authenticity of host communities (helping to conserve the cultural heritage and traditional values as well as seeking to engender intercultural understanding and tolerance.
- ix. Ensure viable long-term economic operations, providing socio-economic benefits to all the stakeholders.

Achieving the above requires the involvement of all stakeholders as well as ongoing monitoring of the impacts of tourism. This allows for preventive or connective measures to be taken when needed, as well as seeking to maintain high levels of tourist satisfaction and their awareness of sustainability issues. What this confirms is that the main remit of sustainable tourism is to strike a balance between the host (local community) the guest (visitors) and the environment. The three (3) way relationship stated above is at the core of sustainable tourism principles and requires careful consideration to maximize positive benefits and minimize negative effects. It is clear that sustainable tourism does not imply a 'no-growth' policy, but it does recognize that limits to growth exist and that environments must be managed in a long term way.

### **Conclusion**

Despite the challenges associated with sustainable tourism practice in most tourist destinations, it is clear that protection of the resources which tourism depends on is central to sustainable tourism development. Its implementation however involves a very complex process in different localities. It is vital to recognize this complexity and not to be fooled into

thinking that sustainable tourism can be achieved by devising a policy statement or undertaking one aspect of environmental management. In reality sustainable tourism is somewhat of an oxymoron;

- While appropriate management is achievable at the site level, it cannot be achieved overall because of the need for travel.
- The best that the tourism industry as whole can do is move towards better environmental practice. May (2019) provides six steps that can be taken to move closer to achieving sustainable tourism goal.
- Better understanding of the value of environments
- More complete information about environment, local value, and susceptible to outside influence.
- Greater attention to the regional effect of development
- Use of environmental economics in relation to assessing development.
- Improved measurement of Environmental factors for use in environmental development
- Developments should be designed to meet long term environmental quality need.

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## **AN EFFICIENT TRANSFER LEARNING MODEL FOR SKIN CANCER DETECTION AND CLASSIFICATION**

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### **ABSTRACT**

Skin cancer represents one of the most prevalent forms of cancer that can cause a variety of dermatological challenges. It can be categorized into many kinds according to morphological traits including texture, structure, and color. To enable skin cancer patients and dermatologists make an informed decision, the first step in pre-diagnosing the disease is to identify the lesions from skin images. Consequently, this study sought to create a deep learning model for the classification and early detection of skin cancer to enhance the application of artificial intelligence in health sector. The HAM10000 skin cancer dataset obtained from the Kaggle data repository had 10015 images and seven (7) classes. The three variants of the EfficientnetV2 were fine-tuned with different hyper-parameters to obtain an accuracy of 0.96 for EfficientnetV2B0, which outperforms the other two variants of efficientnetv2 used in this study.

**Keywords:** *Skin Cancer, EfficientnetV2, transfer learning, Deep learning model, dermatologist.*

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### **INTRODUCTION**

In recent decades, skin cancer has emerged as a prevalent health concern, with the number of cases steadily increasing (Perez *et al.*, 2022). According to Michielin *et al.* (2019), skin cancer can be brought on by ultraviolet radiation (UVR) from tanning beds or the sun. UVR induces skin cells to proliferate and can result in malignant tumors. Melanoma, Squamous Cell Carcinoma (SCC), and Basal Cell Carcinoma (BCC) are the three main types of skin cancer (Tokez *et al.*, 2022). Since BCC and SCC are malignant epidermal tumors that start in the skin's epidermis, these are categorized as non-melanoma skin cancers. Different treatments are used for other uncommon forms of skin cancer. These consist of Kaposi sarcoma, Merkel cell cancer, and cutaneous (skin) lymphoma. Sarcomas and skin adnexal tumors, which are tumors that originate in skin glands or hair follicles. The bulk of incidence skin malignancies were non-melanoma, with basal cell carcinoma accounting for around 80% of cases and squamous cell carcinoma for 20%. Melanoma makes up approximately 1% of

every instance of skin cancer (Abdalla & Abdalla, 2023), yet it has a higher death rate than skin cancer that is not melanoma (National Cancer Institute, 2019). An estimated 132,000 melanomas and two to three million non-melanoma skin cancers (NMSC) are identified each year (Ahachi *et al.*, 2016). Several traditional methods of physical screening and visual inspection of lesions for skin cancer identification and classification have been used in the past. These traditional procedures are complicated and time-consuming. Recently, there has been a lot of interest in skin cancer screening applications that utilize artificial intelligence (AI) and computer vision. AI systems are required to support doctors and the increasing number of patients with skin lesions as a result of the global population's low knowledge, the increasing incidence of skin cancer, and the lack of clinical experience and resources. Consequently, this study sought to build a deep learning model to detect and classify skin cancer.

### **Related Work**



Karthik *et al.*, (2022) developed a method using a convolution neural network (CNN) for the detection of skin disorders. Built on top of EfficientNetV2 and the Efficient Channel Attention (ECA) block, Eff2Net is the proposed model. This work aims to substitute the ECA block for the conventional EfficientNetV2 architecture's Squeeze and Excitation (SE) block. A noteworthy decrease in the overall count of trainable parameters was noted. In comparison to the current deep learning methods described in the literature, the suggested CNN learned around 16 million parameters to categorize the disease. Acne, actinic keratosis (AK), melanoma, and psoriasis are the four groups of skin lesions used for the classification of skin diseases. An overall testing accuracy of 84.70% was attained by the model. Using a Diabetic Retinopathy Debrecen Data Set from the UCI machine learning repository, Gundluru *et al.*, (2022) created a deep learning model with principal component analysis (PCA) for dimensionality reduction. The Harris Hawks optimization algorithm is then used to further optimize the classification and feature extraction process to extract the major features. In comparison to the current systems, the deep learning model's outcomes in terms of specificity, precision, accuracy, and recall are highly satisfactory. A modified version of MobileNetV2 was proposed by (Naik, Annappa, & Dodia, 2022) to classify skin cancer images into seven categories. In comparison to current algorithms, the study uses transfer learning and several data augmentation strategies to classify skin lesions more accurately. Data augmentation techniques are applied to the "HAM10000" (Human Against Machine) dataset in order to classify seven distinct types of skin cancer and enhance the performance of the classifier. Training accuracy for the suggested model was 96.56%, and testing accuracy was 93.11%. Moreover, compared to current approaches, it contains less parameter. The study's objective is to help dermatologists

in the clinic identify skin lesions more accurately and detect skin cancer early. Folorunso *et al.*, (2023) focuses on the use of transfer learning techniques for the evaluation of Breast cancer image classification and detection. The ML classification models and pretrained neural network designs of EfficientNets were developed through hands-on testing. The Breast Cancer dataset was used to train the support vector machine and eXtreme Gradient Boosting (XGBoost). The outcome demonstrated that XGBoost and EfficientNetB4 performed similarly but better. The results for XGBoost are 84%, 0.80, 0.83, and 0.81 based on accuracy, recall, precision, and F1\_Score, respectively.

### **Methodology**

This study focuses on computer vision generic framework. Several approaches were taken into account, including the gathering of data, the extraction, the training and testing of the model, the model architecture, and the assessment of the model's performance. Nevertheless, the Google Colab Jupyter Notebook and a few Python libraries Pandas, NumPy, Scikit-Image, SciPy, PIL, Mahotas, Pgmagick, and sklearn were used to create the model. This platform is suitable for this type of research since it provides free access to computational resources like GPUs and TPUs.

### **Acquisition of Dataset**

A large dataset of 10,015 dermoscopic images of skin-pigmented tumors, categorized into seven groups, makes up the "Human Against Machine with 10000 images" (HAM10000)<sup>1</sup> skin cancer dataset gathered from the Kaggle data repository. This dataset was made accessible in 2018 as a result of Canfield Scientific's International Skin Imaging Collaboration (ISIC) Challenge, a benchmarking program that assigns research community members to tasks related to diagnosis, detection, and segmentation. The dataset

comprises seven classes of skin cancer. namely: Actinic keratoses and intraepithelial carcinoma (Akiec), basal cell carcinoma (Bcc), benign keratosis (Bkl), dermatofibroma (Df), melanoma

**Data Pre-processing**

The down sampling technique was employed to balance the majority and minority classes due to data imbalance of the dataset. Melanocytic Nevi (NV), Benign Keratosis-like Lesions (bkl), Melanoma (Mel), Basal Cell Carcinoma (BCC), and Actinic Keratoses (akiec) were reduced to 115 to match the minority class (Dermatofibroma).

**.Model Architecture**

(Mel), melanocytic nevi (Nv), and vascular lesion (Vasc) are the classes of skin that were covered in the dataset collection stages.

**Feature Extraction**

A pixel-wise operation was carried to extract features edge detection using convolutional filters which highlight intensity changes in the image. **The image was** converted to grayscale. This simplifies the operations and reduces the computational load

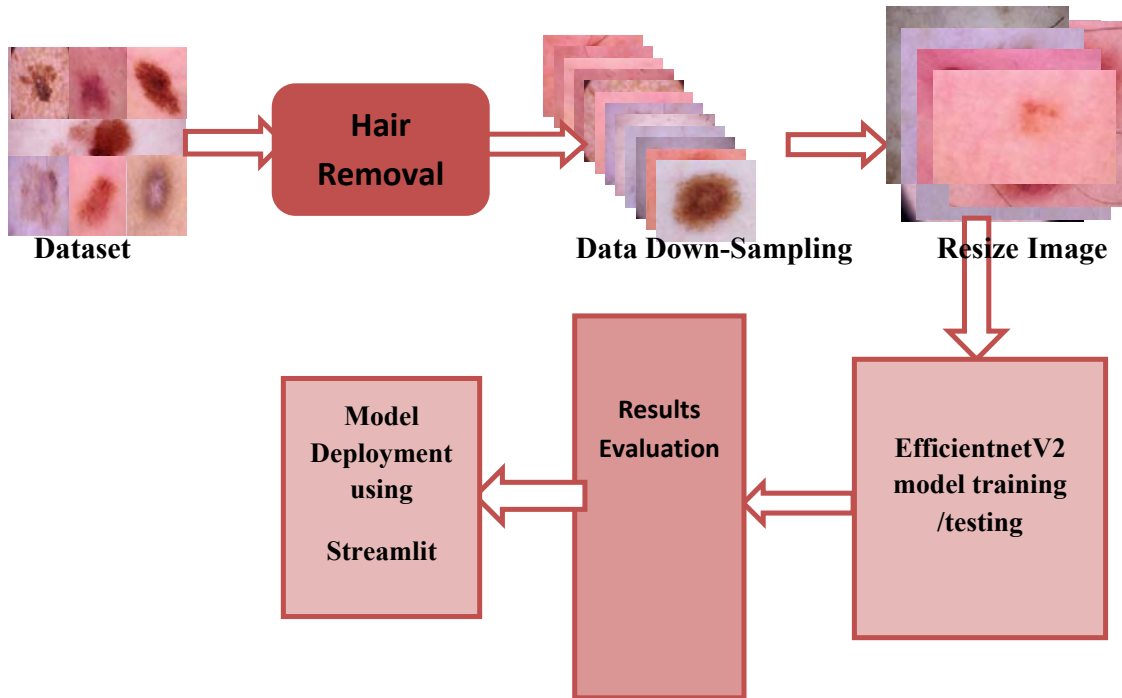


Fig 1: Showing the Model Architecture

**Exploratory Data Analysis (EDA)**

This is a basic outline for performing exploratory data analysis (EDA) on the HAM10000 skin cancer dataset using

Python and widely-used libraries, including Matplotlib, and Seaborn.

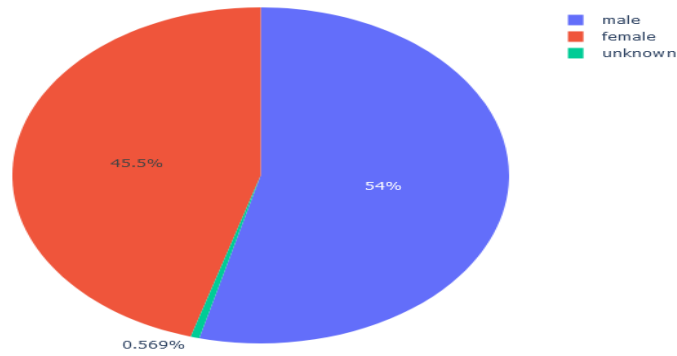


Fig 2: Depicting the Patient Gender Distribution

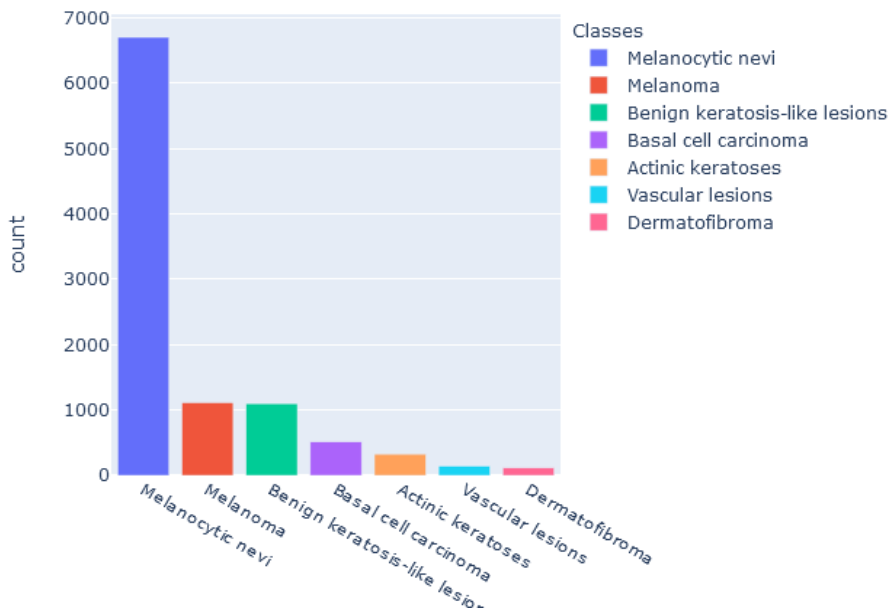


Fig 3: Depicting Classes of the Skin Lesion

## RESULTS AND DISCUSSION

### Model Implementation

The model implementation phase of this research begins with the acquisition of dataset from the Kaggle repository. In this study, three variants of EfficientNetV2 transfer learning model namely EfficientNetV2 B0, EfficientNetV2 B1 and EfficientNetV2S were used to train and test the dataset. To avoid data imbalance, data down-sampling technique was adopted. The model was trained on given inputs of batch size and the number of epochs was set to 20. The performance of the model was tuned with certain hyper-parameters with multiple trial-and-error approaches.

### Model Training and Testing

The variants of transfer learning models considered in this study are EfficientNetV2B0, EfficientNetV2B1 and EfficientNetV2S. The train\_test\_split was used to allocate 80% of the dataset for training, while the remaining 20% was shared equally between testing and validation. The image's height and width were set to 256 pixels, with the image size set to the efficientnetv2 default size of 224. The learning rate, epochs, batch size, and optimizer parameters that yielded the most efficient results were 0.001, 20, 4,

and adamax. For the skin disease classification, at the conclusion of epochs 20, all efficientnetv2 variation utilized in this study showed greater than 90% training accuracy and less than 2% training loss. Table 4.1 and Table 4.2 shows the Table 1: Showing Training and Val\_Acc

training and validation accuracy, training and validation loss obtained after training the three variants of the efficientnetv2. It can be observed that the performance of efficientnetV2B0 outperformed the other two variants of the efficientnetv2 model.

Models	Training Acc	Validation Acc
EfficientnetV2 B0	95.78	75.2
EfficientnetV2 B1	83.9	70.4
EfficientnetV2 S	92.3	67.2

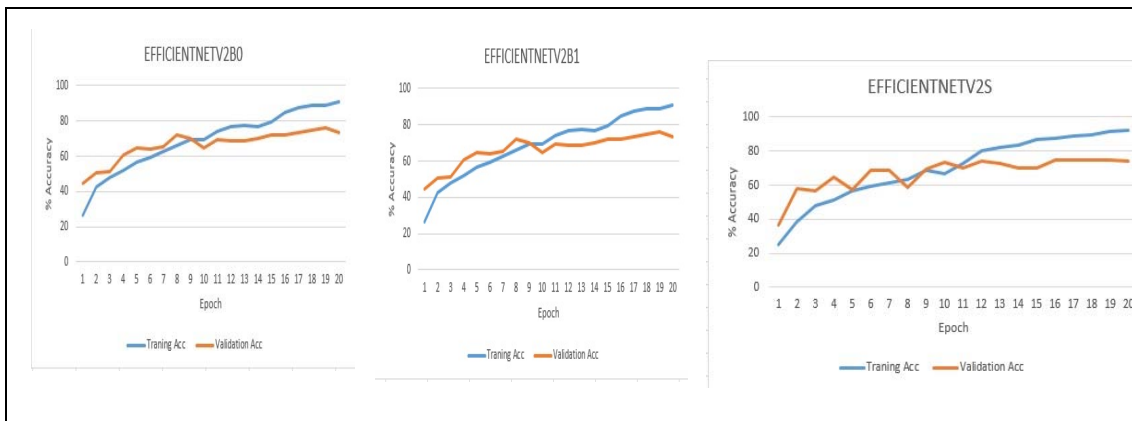


Fig 4: Depicting the Training and Validation Accuracy of the Three Variants of Efficientnetv2 used in this study. Table 2: Showing Training and Val\_Loss

Models	Training Loss	V_Loss
EfficientnetV2 B0	1.25	1.82
EfficientnetV2 B1	2.62	2.98
EfficientnetV2 S	1.35	2.16

Fig

5:

Depicting Training and Validation loss of the Three Variants of Efficientnetv2 used in this research

**Results**

**Model Classification Report Evaluation**

Table 3 shows the classification report for the three variants of efficientnetv2 transfer learning models adopted in this study. Since the majority classes of the dataset were down-sampled to level with the minority class for the classification, the accuracy, precision, and recall were considered as the metrics to evaluate the classification model. For skin cancer Table 3: Showing Model Evaluation Report

classification, the accuracy of EfficientNetV2B0, EfficientNetV2B1, and EfficientNetV2-S are 0.96, 0.92 and 0.91 respectively. EfficientNetV2B1 showed 100% recall for Basal Cell Carcinoma, Dermatofibroma and Vascular lesions. Also, EfficientNetV2B0 and EfficientNetV2-S 100% recall Dermatofibroma and Vascular lesions. Overall, the EfficientNetV2B0 demonstrated a better performance in all the classes for skin cancer classification compared to the other two variants of EfficientNetV2 used in this study.

Model	Accuracy	Precision	Recall	F1-Score
Efficientnetv2B0	0.96	0.57	0.96	0.61
		0.79	0.96	0.96
Efficientnetv2B1	0.92	0.58	0.81	0.62
		0.80	0.72	0.75
Efficientnetv2-S	0.91	0.55	0.80	0.59
		0.78	0.71	0.73

**Confusion Matrix**

The three variations of the efficientnetv2 transfer learning model's confusion matrix used for the skin disease classification is shown in Fig 6. The misclassification rates of EfficientNetV2B0, EfficientNetV2B1, and EfficientNetV2-S are 0.24, 0.28 and 0.29 respectively. The classification accuracy of EfficientNetV2B0 outperforms the other two variants of efficientnetv2 used in this study. The EfficientNetV2B0 and EfficientNetV2-S classified all the samples of Dermatofibroma and Vascular lesions correctly, while EfficientNetV2B1

classified all the samples of Basal cell carcinoma, Dermatofibroma and Vascular lesions correctly. Also, the EfficientNetV2B0 classifies larger samples of Melanocytic nevi correctly. Overall, EfficientNetV2B0 shows less misclassification rate and the highest accuracy for all the classes in the skin cancer classification compared to the other two variants of efficientnetv2 used in this study, this indicates that the EfficientNetV2B0 is more effective in the classification of skin cancer disease.

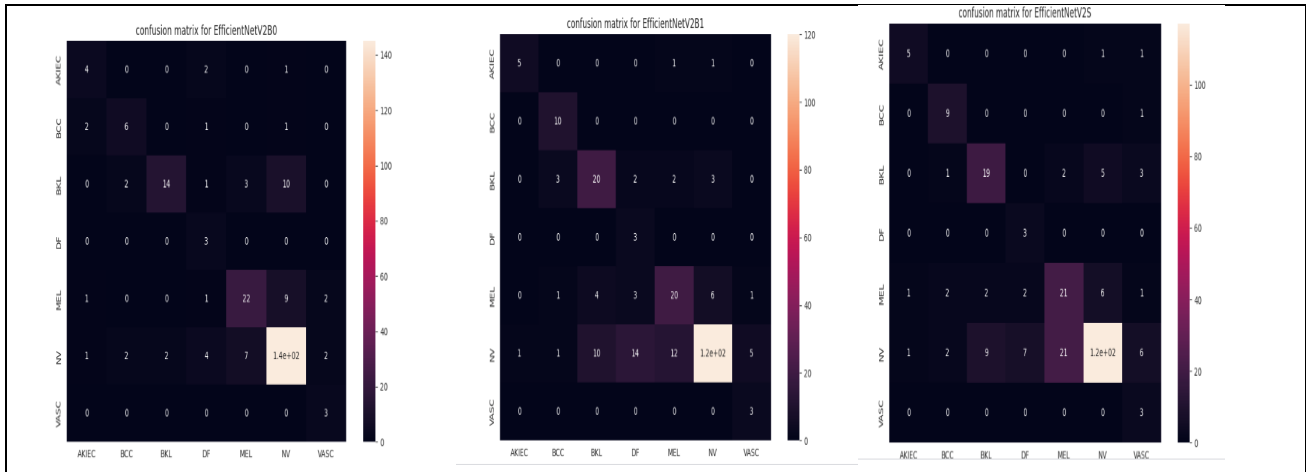


Fig 6: Showing the Confusion Matrix for the Three Variants of Efficientnetv2

### Discussion

The research employs three variants of the EfficientNetV2 transfer learning models for skin cancer classification. Notably, the down-sampling of the majority class aligns the dataset for a balanced evaluation due to data imbalance. The accuracy, precision, and recall metrics were considered. EfficientNetV2B0 demonstrates the highest accuracy (0.96) and outperforms other variants across all classes. EfficientNetV2B1 achieves 100% recall for Basal Cell Carcinoma, Dermatofibroma, and Vascular lesions. Also, the EfficientNetV2B0 and EfficientNetV2-S achieve 100% recall for Dermatofibroma and Vascular lesions. EfficientNetV2B1 achieves 100% recall for specific classes but slightly lower accuracy (0.92). For the confusion matrix, the EfficientNetV2B0 indicates the lowest misclassification rate (0.24) which is superior performance compared with other variants of the EfficientNetV2 used in this study. The EfficientNetV2B0 demonstrates effective classification of larger samples of Melanocytic nevi. While the efficientNetV2B1 and EfficientNetV2-S show slightly higher misclassification

rates (0.28 and 0.29, respectively). The findings consistently highlight EfficientNetV2B0 as the most effective model in skin cancer classification, exhibiting higher accuracy, lower misclassification rates, and strong performance across all classes.

### Conclusions

Combining computer vision, transfer learning and healthcare in the development of classification model is an exceptionally significant research area. The study offers an automated method for classifying skin cancer, thereby addressing a vital demand in the medical field. Furthermore, using image analysis to predict skin cancer early could possibly enhance patient outcomes. The use of efficientnetv2 transfer learning model for training skin cancer dataset demonstrates the impact of artificial intelligence in medical diagnostics. Also, the variants of efficientnetv2 transfer learning model adopted in this study can effectively learn intricate patterns in skin lesion images and image classification due to the considerable accuracy of the efficientnetv2BO, efficientnetv2B1 and efficientnetv2S gathered in the study

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## **Digital Safety for the Grassroots: An Exploratory Analysis of Local Initiatives in Promoting Cybersecurity Awareness**

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### **ABSTRACT**

In the current era of digitalization, cybersecurity remains one of the important considerations to guarantee security at both personal and community levels. However, at the grassroots level, awareness has mainly been unexploited, especially in rural and less-educated populations. The study will, therefore, establish how local initiatives enhance the reception of cybersecurity awareness amongst selected rural areas in Ogun State, Nigeria, and further establish the level of awareness that exists on cybersecurity and possible gaps in prevailing digital safety measures. This research investigates the current state of awareness related to cybersecurity, common digital behaviors, and perceived online risks by way of a mixed-method approach: surveys, interviews, and focus group discussions among community members and local leaders. These findings reveal that there is fair awareness of simple practices to inculcate good cybersecurity practices; hence, targeted educational input is urgently needed. This study uses Ogun State as a case study to establish the fact that cybersecurity education at both the grassroots and uneducated levels must be a pan-Nigerian activity if Nigeria must have a safer digital space. This contribution to the larger discussion of inclusive cybersecurity education identifies grassroots mobilization as a pathway that could help mitigate cyber threats.

**Keywords:** Cybersecurity Awareness, Grassroots Communities, Digital Safety

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### **INTRODUCTION**

As the digital landscape continues to expand globally, the rise in cyber threats has become an alarming concern for both developed and developing nations. This has therefore made the expansion of the digital space around the world bring about a disturbing rise in cyber threats for both developed and developing nations. While many countries have indeed started making efforts toward cybersecurity policies and educational programs, developing countries have special conditions that make grassroots cybersecurity awareness highly important yet underemphasized. Sometimes, in Nigeria, Ruhl, (2022). This digital divide makes the easy target for cyber threats to the rural population, especially among those

with low levels of formal education. This work considers a need to raise awareness on cybersecurity at the grassroots level, taking Ogun State as a reference. It is supposed to find out the current state of cybersecurity awareness in Ogun State rural areas and also analyze the effectiveness of any local campaigns in promoting digital security. The results of such research would give an insight into whether a large-scale policy of cybersecurity awareness should be introduced throughout Nigeria to ensure grassroots resilience against cyber threats.

The increased access to the internet and mobile technologies has been associated with a number of accrued

benefits to hitherto unserved communities in Nigeria, David-West,(2022). Paradoxically, however, such digital access opens the floodgates to many forms of cybersecurity risks that unprepared populations are usually ill-equipped to recognize or manage. Identity theft, online scams, and even privacy breaches through social media platforms are examples of cyber risks

and the digital vulnerabilities that have arisen from this, thus showing the imperative need for cybersecurity awareness at the grassroots level.

This study is motivated by the realization that rural and illiterate people in Nigeria are usually left behind in discussions related to digital safety and cybersecurity. Rural communities also have misconceptions and lacuna in awareness about cyber threats, where awareness campaigns normally launched in cities lack focus Adisa, (2023). The study focuses on how local initiatives with a community-oriented education can further cybersecurity awareness among these more susceptible populations. This research will seek an understanding of the current levels of knowledge about digital safety, common online behaviors, and perceptions of cybersecurity in the subject communities and will try to raise awareness regarding the gaps that currently exist, as well as the cultural influences driving those gaps. Results from this will give insight into how grassroots communities are interacting with the digital world and how these grassroots communities can be equipped with the knowledge to protect themselves online.

It mainly seeks to determine the level of awareness on cybersecurity in rural Ogun State and provide insights for the construction of a more inclusive and effective cybersecurity education for

in rural areas Hamid et al, (2020). The low level of cybersecurity awareness in these communities is further exacerbated by the limited information they have concerning digital safety practices, which would obviously increase their vulnerability to different kinds of cyber-related threats. The research has, therefore, highlighted the situations in rural areas of Ogun State

all parts of Nigeria. These are to establish the current state of awareness about cybersecurity threats among the grassroots population; to identify selected challenges and misconceptions they encounter regarding digital safety; and to discuss possible contributions local initiatives might make to enhanced cybersecurity awareness (Hussain et al., 2024). This study tries to assess how far such a grassroots level of cybersecurity education programs can be viable in rural areas and gives recommendations on how these initiatives could be structured for maximum impact.

According to Ibrahi et al (2024) the increment of digitization in Nigeria's economy and infrastructure, cybersecurity awareness should not stop with individual users but extend to communities. Outside the urban areas, basic knowledge of cybersecurity has the power to transform generally lower educational attainment settings. This paper, therefore, focuses on Ogun State in order to discern the grassroots realities in terms of digital access and risks while seeking to illustrate whether existing levels of cybersecurity awareness are sufficient or if there is an urgent need for intervention. This study tries to make sense of how cybersecurity is perceived by these communities and whether they do anything to enhance digital safety through surveys, interviews, and focus group

discussions with residents of rural Ogun State.

Meeting the cybersecurity needs at the grassroots level is about securing individuals, but it is also one avenue through which to contribute to broader economic and social development goals in Nigeria. Unchecked, cyber threats have the potential to reach outwards in ripples from rural communities, touching everything from agricultural data and personal finances to local governance. Insofar as cyber attackers increasingly target unsuspecting populations, awareness-raising at the grassroots level becomes an important step in securing Nigeria's digital future. Hitherto, cybersecurity awareness among untaught populations has been a relatively underexplored field, with a lack of tailored educational programs across the board. This research has, therefore, underlined current gaps in cybersecurity awareness in rural areas in Ogun State and highlighted the need for local solutions taking into consideration unique needs and cultural contexts of these communities.

A mixed-method approach will combine quantitative surveys, interviews, and focus groups. This will present a holistic approach to cybersecurity perceptions, behaviors, and awareness in targeted rural communities. Where the survey data provide a statistical overview of the level of awareness in the selected communities, interviews and focus groups delve into more detailed cultural and social factors that influence the practice of cybersecurity. This will be realized through a mixed-method approach, which will integrate quantitative and qualitative data by furnishing numerical data with personal points of view to enrich the findings of how rural Nigerians are engaging in cybersecurity issues.

Cybersecurity awareness at the grassroots level is key towards developing a digitally secure Nigeria where people in all regions can confidently navigate the digital world irrespective of their educational background, AbdulKareem, and Oladimeji, (2024). A focus on Ogun State provides a mini-laboratory to test the broader necessity of cybersecurity education throughout the whole nation of Nigeria. The findings from this research could help policymakers, educators, and community leaders in crafting cybersecurity awareness programs that better reach local people and ultimately help to create a safer online environment for all citizens of Nigeria.

### Research Hypotheses

This research explores the relationship between grassroots cybersecurity awareness and digital safety practices among rural populations in Ogun State, Nigeria. Based on the aim and objectives of the study, the following hypotheses have been formulated:

1. **H1:** There is a significant lack of cybersecurity awareness among grassroots communities in rural Ogun State.
2. **H2:** Local initiatives and community-based education significantly improve cybersecurity awareness and digital safety practices among rural, uneducated populations.
3. **H3:** Increased cybersecurity awareness at the grassroots level in Ogun State can contribute to a nationwide model for cybersecurity education in Nigeria.

Increased globalization of internet diffusion, cybersecurity awareness is increasingly becoming an important aspect, particularly in developing countries

that generally have increased levels of digital access, albeit with a lower level of digital literacy. Essentially, cyberspace awareness is gaining relevance for targeted education at the grassroots levels, especially among communities living in rural areas where levels of formal education are normally low. Though several researches have been carried out, awareness on cybersecurity programs remains one of the highly relevant methods of reducing the incidence of digital threats against under-resourced and marginalized communities lacking in knowledge and means to protect against cyber threats. In Nigeria, the impact of the digital divide has fallen heavily on rural communities; therefore, there is a growing need for educational programs which factor in the unique cultural and socio-economic characteristics of these communities.

Some of the major challenges include complete and utter unawareness and misunderstanding of the cyber threats among the uneducated masses. Hassan(2022). note that rural Nigerians have rapidly become users of the Internet, considering the increase in mobile technology diffusion, yet many of them lack realization concerning simple cybersecurity practices pertaining to password management, phishing, and data privacy. Such an attack is particularly worrisome because it takes advantage of the low levels of digital literacy among such populations, mostly through social engineering methods to access personal information. In this perspective, it is prudent that grassroots cybersecurity education should be focused on creating awareness in addition to equipping communities with ways of protecting their digital identities.

According to Kroeller (2023), Community-driven initiatives on cybersecurity education have shown some promise in grassroots population engagement. A contextual program,

appropriately catering for the needs and learning capabilities of rural dwellers, can significantly increase awareness levels, as has been seen through experiences in other emerging economies. Such a program can be made to include culturally relevant examples, local languages, and engagement with trusted community leadership in communicating cybersecurity concepts. With increasing recognition, local governments and community-based organizations are indispensable players in the building up of digital literacy and cybersecurity awareness, because they directly engage the rural populations in Nigeria.(KAGE and SALAKKI, 2024).

The grassroots level of cybersecurity awareness, therefore, provides a much-needed fill to the gaps in digital safety activities of Nigeria, Otieno, (2021). Lu, (2021), said that Uneducated and rural population masses would allow community-based initiatives to close the divide in digital knowledge and reduce resultant risks associated with poor cybersecurity awareness. Thus, studies emphasize the need for a collaborative approach through government, local organizations, and educational institutions to create inclusive practices in digital safety across the nation.

## **METHODOLOGY**

### **Data Collection**

There are various methods of collecting data to be used in research, but one has to select an appropriate method that can answer specific research needs. The selected method of data collection must avail an full opportunity where data could be gathered to directly address the research questions. In addition, the sources of data must be high quality since the use of unreliable, outdated, or incomplete data sources can nullify the findings of any research. Therefore, data integrity takes precedence in determining the quality of research output.

Extended Form: A detailed structured survey would, therefore, be found appropriate for collecting data on the variables under study. However, this exploratory research involves the collection of personal data directly from people in rural areas, including educated and uneducated individuals from different towns in Ogun State, such as *Ijebu-Igbo*, *Ijebu-Ode*, *Water-side*, *Ijebu-North*,

*Shagamu*, *Ifedeh*, *Okeagbo*, *Imala*, and *Ado-Odo*. A series of interviews and questionnaires was conducted in order to collect suggestions from the respondents themselves-a multidimensional insight into the level of awareness about cybersecurity at a grassroots level. This ensures that with this multimethod approach, diversity of views is catered for and adds depth and reliability to the data collected.

**TABLE 1: Demographic Data of Respondents**

Demographic Variable	Total Respondents (N = 450)	Educated Respondents (N = 225)	Non-Educated Respondents (N = 225)
<b>Gender</b>			
Male	250 (55.6%)	130 (57.8%)	120 (53.3%)
Female	200 (44.4%)	95 (42.2%)	105 (46.7%)
<b>Age Group</b>			
18-24	150 (33.3%)	80 (35.6%)	70 (31.1%)
25-34	120 (26.7%)	70 (31.1%)	50 (22.2%)
35-44	90 (20.0%)	50 (22.2%)	40 (17.8%)
45 and above	90 (20.0%)	25 (11.1%)	65 (28.9%)
<b>Occupation</b>			
Student	80 (17.8%)	80 (35.6%)	0 (0.0%)
Farmer	150 (33.3%)	30 (13.3%)	120 (53.3%)
Artisan	100 (22.2%)	50 (22.2%)	50 (22.2%)
Unemployed	120 (26.7%)	65 (28.9%)	55 (24.4%)
<b>Location</b>			
Ijebu-Igbo	90 (20.0%)	45 (20.0%)	45 (20.0%)
Ijebu-Ode	80 (17.8%)	40 (17.8%)	40 (17.8%)
Water-side	60 (13.3%)	30 (13.3%)	30 (13.3%)
Ijebu-North	70 (15.6%)	35 (15.6%)	35 (15.6%)
Shagamu	50 (11.1%)	25 (11.1%)	25 (11.1%)
Ifedeh	40 (8.9%)	20 (8.9%)	20 (8.9%)
Okeagbo	30 (6.7%)	15 (6.7%)	15 (6.7%)
Imala	30 (6.7%)	10 (4.4%)	20 (8.9%)
Ado-Odo	50 (11.1%)	30 (13.3%)	20 (8.9%)

In this research, a total of 450 respondents were surveyed, consisting of an equal split between educated (N = 225) and non-educated individuals (N = 225) from various rural areas in Ogun State. The demographic distribution reveals a majority of male respondents, with a significant portion in the age group of 18-24 years. Occupation varied widely, with farmers and students being the most represented groups. This data provides a comprehensive overview of the respondent profiles, setting a foundation for analyzing the level of cybersecurity awareness and the effectiveness of local initiatives in promoting digital safety within these communities. The findings will inform future strategies aimed at enhancing cybersecurity education across different demographics in Nigeria.

**DATA ANALYSIS**

The collected data will be analyzed to provide a comprehensive overview of cybersecurity awareness levels among grassroots communities in selected rural areas of Ogun State. This analysis aims to highlight the existing gaps in knowledge and understanding of digital safety

**Hypothesis Tables**

**TABLE 2: Hypothesis 1 - Cybersecurity Awareness Level**

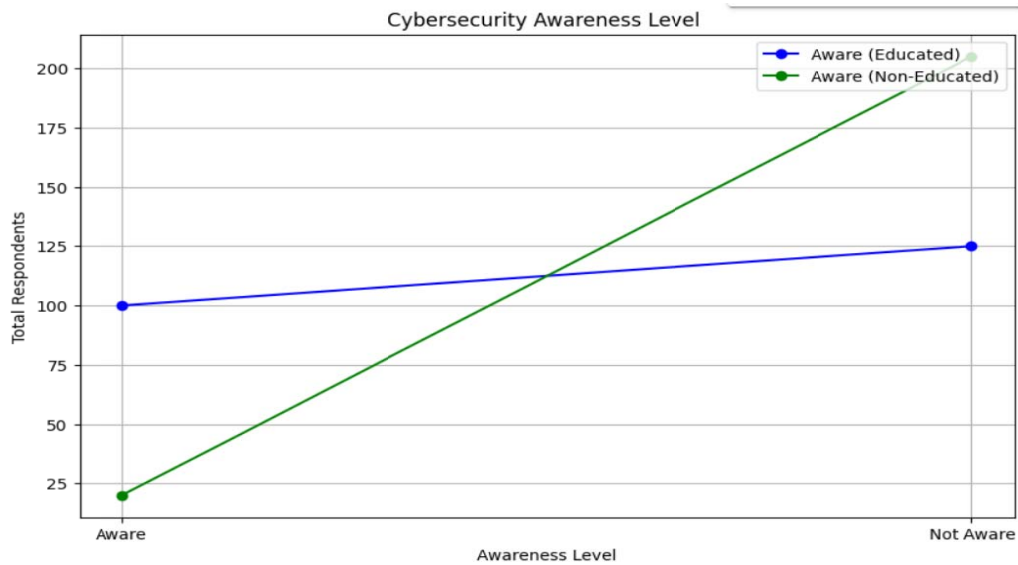
Awareness Level	Total Respondents (N = 450)	Educated Respondents (N = 225)	Non-Educated Respondents (N = 225)
<b>Aware</b>	120 (26.7%)	100 (44.4%)	20 (8.9%)
<b>Not Aware</b>	330 (73.3%)	125 (55.6%)	205 (91.1%)

practices among both educated and uneducated populations. By examining the demographics and responses from participants, the research seeks to identify key areas where local initiatives can effectively enhance cybersecurity awareness.

Data analysis will be conducted using Python, leveraging its powerful libraries for statistical analysis and data visualization. This approach will enable the extraction of meaningful insights from the data, including awareness levels, participation in local initiatives, and the perceived effectiveness of these programs. By categorizing responses based on these criteria, the analysis will provide a clear picture of the current state of cybersecurity awareness in the communities surveyed.

In addition to assessing awareness levels, the analysis will focus on the impact of community-based education efforts and local initiatives on improving digital safety practices. The goal is to generate actionable insights that can inform future strategies for promoting cybersecurity education at the grassroots level.





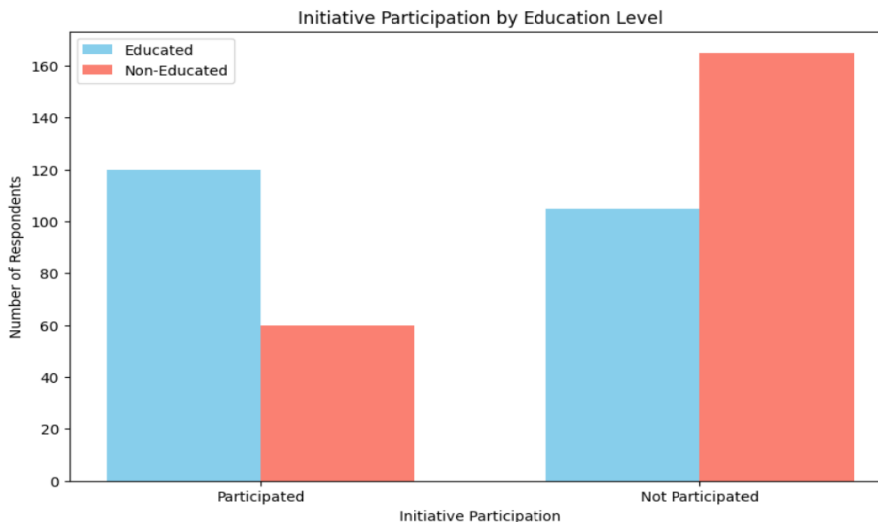
**Fig 3.1** show graphical analysis of awareness

**Summary for H1:** The data indicates a significant lack of cybersecurity awareness, particularly among non-educated respondents, with 91.1%

reporting that they are not aware of cybersecurity principles. This highlights the urgent need for targeted educational initiatives in rural communities.

**TABLE 3: Hypothesis 2 - Impact of Local Initiatives on Cybersecurity Awareness**

Initiative Participation	Total Respondents (N = 450)	Educated Respondents (N = 225)	Non-Educated Respondents (N = 225)
<b>Participated</b>	180 (40.0%)	120 (53.3%)	60 (26.7%)
<b>Not Participated</b>	270 (60.0%)	105 (46.7%)	165 (73.3%)



**Fig 3.2 showing non-participation in communal interaction**

**Summary for H2:** Participation in local initiatives is notably higher among educated respondents, suggesting that community-based education efforts could significantly improve cybersecurity

awareness among uneducated individuals. This underlines the potential effectiveness of localized educational programs in addressing knowledge gaps

**TABLE 4: Hypothesis 3 - Contribution to a Nationwide Model for Cybersecurity Education**

Support for Nationwide Model	Total Respondents (N = 450)	Educated Respondents (N = 225)	Non-Educated Respondents (N = 225)
<b>Support</b>	360 (80.0%)	200 (88.9%)	160 (71.1%)
<b>Do Not Support</b>	90 (20.0%)	25 (11.1%)	65 (28.9%)

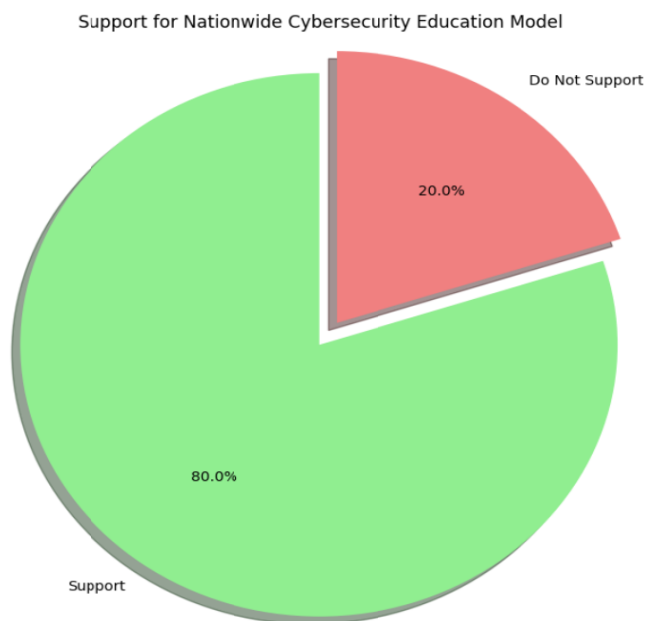


Fig 3.3 shows the need for implementing a nationwide model education for cyber security

**Summary for H3:** A large majority of respondents (80.0%) support the idea of implementing a nationwide model for cybersecurity education, indicating a strong foundation for future educational

programs in Nigeria. This suggests that successful grassroots initiatives could serve as a blueprint for enhancing digital safety across the nation. Findings

**1. Low Levels of Cybersecurity Awareness:** The analysis may find a huge shortage in the levels of grassroots cybersecurity awareness in rural Ogun State. Most respondents, a majority of whom come from uneducated backgrounds, will exhibit a shallow level of understanding of basic concepts of cybersecurity. Critical areas relating to password management, phishing threats, and safe online practices will be misunderstood, especially, hence highlighting the critical need for comprehensive campaigns on awareness.

not participated, indicative of effective targeted community engagement.

**3. Demographic Differences:** The findings may reveal dramatic divides in levels of cybersecurity awareness between the educated and uneducated. In this regard, educated people may be said to have a reasonably good grasp of the concept and principles of cybersecurity, whereas uneducated ones are very dependent on local initiatives in terms of valid information and advice. This underlines the role of education in cybersecurity knowledge.

**4. Effectiveness of Community Engagement:** The analysis may reveal that strategies toward the interactive engagement of the community, through workshops, hands-on training, and seminars, actually prove more effective in raising the level of cybersecurity awareness compared to merely passive ways of disseminating information, such as flyers or social media posts. It would, therefore, follow that more active modes of participation and experiential learning result in better retention and application of cybersecurity practices.

**5. Needs for Tailor-Made Programs:** Results may indicate that cybersecurity awareness programs are designed to cater

**2. Impact of Local Initiatives:** Data from this research might show that local initiatives and community-based educational programs are crucial drivers in raising cybersecurity awareness and enabling digital safety practices. Similarly, there is a likelihood that respondents who have participated in such programs will report substantially higher levels of knowledge and confidence in the recognition and reaction to cybersecurity threats compared to their peers who have

to the diverse sets of needs and literacy levels in various communities. The messaging developed locally is more apt to the culture and social environment of the participants, making their comprehension and dissemination of the practices in cybersecurity more feasible.

**6. Potential for Nationwide Model:** Increased awareness in grassroots cybersecurity in Ogun State may well create a model that the rest of the country could follow as far as Nigeria's cybersecurity awareness is concerned. Success at the local levels may influence decision-makers and other stakeholders to act similarly in other parts of the country, growing citizens who are more knowledgeable and secure about their digital environment.

## Conclusion

The research, therefore, shows the vital need to create awareness in grassroots communities about cybersecurity in rural Ogun State. The findings presented reveal a dire need for an informative education in digital safety practices, highly lagging in knowledge, especially among the uneducated. Community-based interventions have been seen to be effective in fostering awareness and confidence; hence, community

engagement remains key to addressing cybersecurity literacy. Thus, the educational content will be in tune with the cultural and social contexts for more effective learning experiences. This is because Ogun State represents a microcosm of challenges faced by rural areas generally in Nigeria, hence, the potential to use identified successful strategies at a national level in implementing cybersecurity education. It is, in other words, the building of a bottom-up cybersecurity culture that will enable people to feel more confident while navigating the complexity of the online world.

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## A MACHINE LEARNING APPROACH FOR OFF-CAMPUS STUDENT'S HOSTEL PRICE PREDICTION SYSTEM

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### ABSTRACT

The demand for securing off-campus hostel accommodation within Ijebu Igbo, Ogun State has increased as a result of several factors that contributed to the limited accommodation to meet the needs for high number of tertiary institution student's within the environment, among these factors are: lack of campus hostel facility within the institution, increased number of students and institution within the study area. As a result, predicting the price of off-campus hostel with closer proximity to this institution's campus and conducive environment has become a popular challenge among prospective, returning and current students. Consequently, this research sought to build a machine learning model to predict off-campus hostel prices within Ijebu-Igbo, Ogun State. Raw dataset were gathered within the study area with parameters such as area in square feet, location, no of bedrooms and no of bathrooms in that particular property. Python programming language was adopted to build the model for the Off-Campus Students hostel Price Prediction System, Random Forest and Linear Regression model were used to train the model. The best model was Random Forest, which had a low MSE of 2763.1, an RMSE of 5257.3, and an MAE of 4296.2. This was better than linear regression, which had an MSE of 39870942.7, an RMSE of 6314.3, and an MAE of 4713.2.

Keywords: *Hostel Accommodation, off-campus, Random Forest, Linear Regression, Machine Learning Model.*

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### INTRODUCTION

The demand for renting an off-campus accommodation in the student's environment has increased as a result of limited accommodation to meet the needs for high number of tertiary institution student's within the student's environment. Emmanuel, (2019) affirms that global housing units are acknowledged to be insufficient, defective, and trailing in terms of appropriateness, this is most likely require a change. Nonetheless, housing promotes social interaction, economic growth, human health, and a number of other aspects of human well-being (Mbazor, 2018). According to Olanrewaju, Garba & Onigbogi (2022), Nigerian student housing Universities have seen a number of policy changes, yet the problems with satisfaction and deficit still exist. It was found that the problems with student housing in Nigeria were inextricably linked to the opening of new

institutions and a rise in student enrolment. The biggest challenge faced by many students is how to efficiently and accurately search for good accommodation conducive for their learning. According to Aigbavboa (2015), student housing has long been recognized as a crucial part of the amenities offered by educational institutions in order to support students in developing their intellectual abilities. Living off-campus housing, gives students a chance of attaining independence toward their personal development (Ghani et al., 2018). This is because they are not under the control of either parents or institution's rules and regulations more or less on their own freedom and independent. According to Kobuea, Oke, & Aigbavboa (2017), students benefit socially and intellectually by living in a cozy, secure, and well-run house. As a result, any educational institution should prioritize

providing well-maintained student housing. According to Mohd, T. (2014) indicates that hostel rental expenses are crucial for assessing housing preferences when sub-market groups' (off-campus students') limited income sources have a major impact on multi-occupational homes, where residents typically live in large numbers and sacrifice comfort to reduce rental costs per person. However, this study sought to build a machine learning model to predict off-campus hostel prices within Ijebu-Igbo, Ogun State.

### LITERATURE REVIEW

The lack of proper infrastructure at many public institutions in Nigeria, especially in the student hostel, forces many students to live in the local areas surrounding education providers. The rise in population of student causes of shortage of student accommodation ranging from inadequate infrastructure facilities to overcrowding (Kobue et al., 2017; Ghani & Sulaiman, 2017).

### METHODOLOGY

This study focuses on a supervised learning algorithm to develop prediction model that can predict off-campus student's hostel price. The model was designed on python Anaconda Navigator which has multiple data science packages embedded in it. The Anaconda Navigator package allows user to install, run, and update library packages like Numpy, Pandas, Matplotlib, Seaborn, Sci-kit learn, StandardScaler, etc. The model used in this study were linear regression and random forest model, the model were

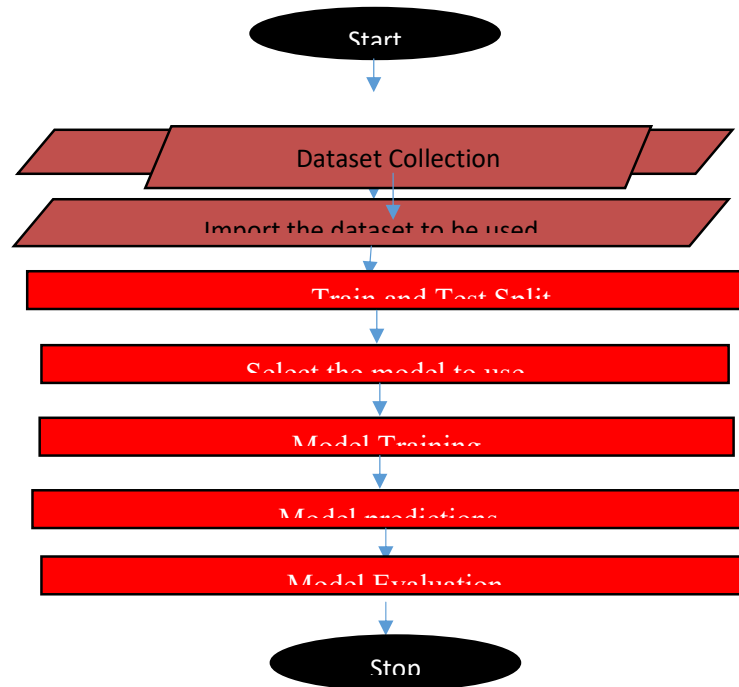
### Flowchart

System Flowchart plays an important role in the development of a predictive model, the flowchart design for this study is shown in **Fig 1 below**.

live off campus or rent homes outside of the school grounds and pay for transportation each day (Jacob, Elizabeth & Ahaotu, 2020). Moreover, the majority of Nigerian institution hostels are in greater needs for repair than they were ten years ago and do not align with students' academic goals. The amenities of good hostels have a positive impact on academic studies, but the atmosphere of inferior hostels limits the learning process (Odefadehan, et al., 2022). According to Duangpracha (2019) the housing shortage and the large increase in property prices and therefore rental accommodation availability and access has led to a large problem for all institutions in meeting housing needs. The intake in tertiary institutions is considered as one of the trained, tested, and evaluated to achieve the evaluation performance for the study.

### Dataset Acquisition

A primary dataset was gathered within the study area with parameters such as area in square feet, location, no of bedrooms and no of bathrooms in that particular property. Renting price is a dependent variable on several other independent variables. Also, some data attributes were considered such as Number of Bedrooms, Number of Kitchen, Cost per rent of the apartment, Size of the apartment in Square Feet, Type of Flooring either tiles and concrete, Names of the Hostel and **Location** where the apartments were located.



**Fig1: Depicting the Model Flowchart**

### Exploratory Data Analysis (EDA)

The EDA was implemented majorly to have a detailed understanding of the dataset, it enhances data cleaning and supports decision-making. The dataset employed for this study contains 199 data row and 13 columns, no missing data were while Odoraboyeji has a count consistent with the dataset used for the study. Fig 3 illustrates the locations where students can secure off-campus hostels within the study area. Notably, Oke Ife comprises 38.4% of the rental options, followed by OkeAgbo at 20.7%. Other significant areas include Sopen (11.1%), OkeSopen (7.58%), and Oke Alafia (6.06%). Additional locations include Egbe (5.56%), Station (4.55%), Ojowo (2.02%), Ojo (1.52%),

detected in the dataset. Bar-chart and Pie-chart were adopted to show the major information of the dataset. In **fig 2** below, It was observed that, Okeife has the highest count of hostel rent, nearly 75%, followed by OkeAgbo (40%) and Sopen (20%),

Odorasanyin (1.01%), Bogije (1.01%), and lastly, Odoraboyeji, which accounts for 0.505%. These statistics indicate that Oke Ife is the most favorable option for students seeking hostels in Ijebu Igbo, both in terms of availability of hostel and proximity to the institution's main campus.

```
1: sns.displot( dataset_new['LOCATION'])
plt.xticks(rotation=40, fontsize=8, ha="right")
plt.figure(figsize=(10, 6))
1: <Figure size 1000x600 with 0 Axes>
```

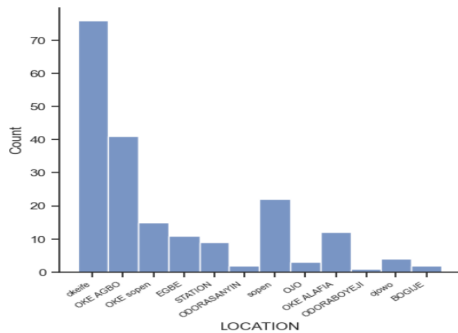


Fig 2: Showing the Location Bar-Chart

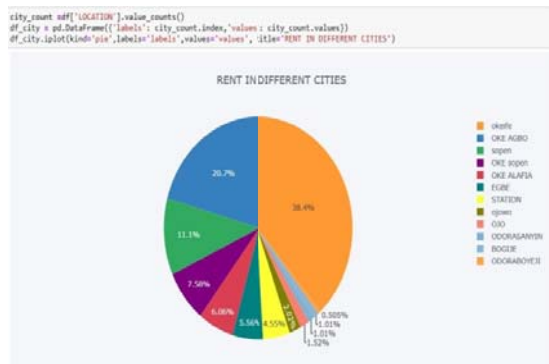


Table 1: Showing Model Report

MODEL	EVALUATION METRICS		
	MSE	RMSE	MAE
<b>LINEAR REGRESSION</b>	39870942.661757	6314.3441988663	4713.178362315
<b>RANDOM FOREST</b>	27639423.076923	5257.3209029812	4296.153846153

**DISCUSSIONS**

The study was implemented using Intel Core i5, 2.6 GHz processor; 8GB RAM, 1 terabyte hard disk drive (HDD), and Windows 8.1, a 32-bit operating system, the models were developed on **python Anaconda Navigator**. Fig4. illustrates the variation in hostel rental prices across different locations. In Okeife, the price range for accommodations is between 50000 and 120000 Naira. In OkeAgbo, the range is 50000 to 125000 Naira, while for OkeSopen, it is between 50000 and 115000 Naira. Egbe offers a similar range of 50000 to 115000 Naira. Other notable areas include the Station, with prices

Fig 3: Showing Hostel Vacancy Using Pie- Chart

**RESULTS AND DISCUSSION**

```
plt.figure(figsize=(20, 30))
sns.barplot(x=df['LOCATION'], y=df['RENT'], ci=None)
<AxesSubplot: xlabel='LOCATION', ylabel='RENT'>
```

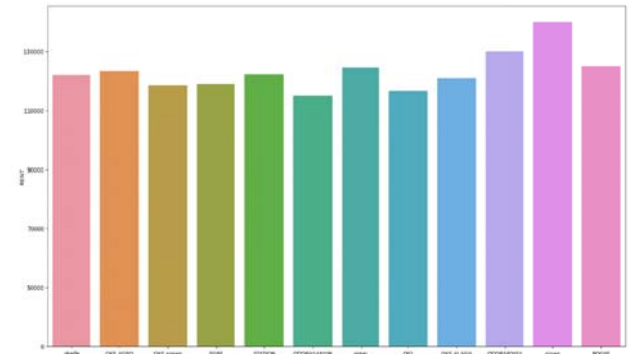


Fig 4: Showing Hostel Price Bar-Plot

ranging from 50000 to 123000 Naira, and Odo Babajide, where the range is 50000 to 112000 Naira. Sopen's range is between 50000 and 125000, and for Ojo, it varies from 50000 to 112000 Naira. In Oke Alafia, prices range from 50000 to 120000, while Odo Babajide ranges from 50000 to 128000 Naira. Ojo's range falls between 50000 and 140000 Naira, and lastly, Bogije has prices from 50000 to 128000 Naira. The accompanying bar plot provides further insights into how rent varies across these locations. Notably, Ojo has been identified as the most expensive area for securing hostel accommodation within the student



community in Ijebu Igbo. Also, from the two machine learning models adopted for this study. Random Forest outperforms linear regression which had an MSE of

### **CONCLUSION**

The study indicates that Oke Ife is the most favorable location for students seeking hostels in Ijebu Igbo, both in terms of availability of hostel and proximity to the institution's main campus.

Notably, Ojowo has been identified as the most expensive area for securing hostel accommodation within the student community in Ijebu Igbo. Also, from the two machine learning models adopted for this study. Random Forest outperforms linear regression which had an MSE of

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39870942.7, an RMSE of 6314.3, and an MAE of 4713.2. compared to a low MSE of 2763.1, an RMSE of 5257.3, and an MAE of 4296.2 of Random forest.

39870942.7, an RMSE of 6314.3, and an MAE of 4713.2 compared to a low MSE of 2763.1, an RMSE of 5257.3, and an MAE of 4296.2 of Random forest. It is recommended that this research gap should be extended to several student environment to give students updated information on suitable environment to secure off-campus hostel with possible price. Also, future researcher should adopt different machine learning on this research field.

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## PHYTOCHEMICAL ANALYSIS, ANTIMICROBIAL AND ANTIOXIDANT OF N- HEXANE EXTRACT OF *FISCUS EXASPERATA* VAHL

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### ABSTRACT

Plants have been utilized to treat a variety of diseases from ancient times; people from all continents, particularly Africa, have this long tradition. Medicinal plants have been extensively used as a source of several active ingredients for treating human ailments and they also have a high therapeutic value. *Ficus exasperata* is widely utilized in traditional medicine. The root is used to treat urinary tract infections, gonorrhoea, asthma, Tuberculosis (TB), cough, eye issues, and as a worm repellent. This study investigates the antioxidant and phytochemical properties of the *n*-hexane leaf extract of *Ficus exasperata*. The antioxidant potential was assessed using the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay, which revealed a concentration-dependent increase in free radical scavenging activity. The highest inhibition was recorded at 500 µg/mL ( $67.27 \pm 0.12\%$ ), while the lowest inhibition was observed at 31.25 µg/mL ( $35.85 \pm 0.07\%$ ). Phytochemical analysis confirmed the presence of bioactive compounds, including flavonoids, alkaloids, and phenols, which are known to contribute to the antioxidant activity. The antimicrobial analysis indicate that *Ficus exasperata* leaf extract is particularly effective against *Staphylococcus aureus* (S.a), *Bacillus subtilis* (B.s), *Escherichia coli* (E.c), and *Trichophyton rubrum* (T.r). These findings highlight the potential of *Ficus exasperata* as a natural source of antioxidants that could play a role in combating oxidative stress and related health conditions. The study concludes that *Ficus exasperata* holds promise for further pharmacological and nutraceutical applications.

**Keywords:** *Ficus exasperate*, Antioxidant, Antimicrobial, phytochemical properties, *n*-hexane, leaf extract.

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### INTRODUCTION

Plants have been utilized to treat a variety of diseases from ancient times; people from all continents, particularly Africa, have this long tradition (Ansari, 2021). Medicinal plants have been proved to have genuine uses, and approximately 80% of the rural population relies on them for primary health care (Giannenas *et al.*, 2020., Dar *et al.*, 2023). Despite considerable development in synthetic organic pharmaceutical products over the twentieth century, more than 25% of prescribed medicine in developed countries is produced directly or indirectly from plants (Giannenas *et al.*, 2020). Plants provide a diverse spectrum of

natural compounds classified as phytochemicals.

Medicinal plants have been extensively used as a source of several active ingredients for treating human ailments, and they also have a high therapeutic value (Dar *et al.*, 2023). The African continent is one of the world's most biologically diverse. It has an abundance of edible plants utilized as herbs, health foods, and therapeutic uses. Over 5000 distinct plant species have been identified in these areas, with many of them proving effective in traditional medicine for disease prevention and treatment (Grinin& Korotayev, 2023).

*Ficus exasperate* is one of the many different plant species.

The plant *Ficus exasperata* belongs to the family *Moraceae*. The plant has traditional names such as Gamji in Hausa, Ewepin in Yoruba, Kawuse in Nupe and Anwerenwa in Igbo (Abubakar *et al.*, 2020).

*Ficus exasperata* is widely spread in West Africa in all kinds of vegetation. It is a deciduous shrub or small medium-sized tree up to 20-30m tall. Leaves are distichous and alternate, sometimes opposite, simple, stipules free, lanceolate, up to 0.5cm long covered with stiff hairs. Flowers are unisexual; male flowers with 3-6 lobed perianth and 1-3 stamens; female flowers with 4-6 tepals (Sawadogo *et al.*, 2024). The rough leaves are commonly used as sandpaper to polish wooden, metal, or ivory items such as cooking utensils, gourds, sticks, bowls, spear shafts, chairs, boards, and bracelets. The wood is used to build canoes, houses, pots, furniture, stools, utensils, containers, and drums, as well as fuel wood for charcoal production (Tameye *et al.*, 2021).

*Ficus exasperata* is widely utilized in traditional medicine. The root is used to treat urinary tract infections, gonorrhea, asthma, TB, cough, eye issues, and as a worm repellent. The stem is used to treat leprosy, wounds, sores, abscesses, and stomach aches (Godwin *et al.*, 2021). When feeling dizzy, a cool bark extract is consumed. Phytochemical and toxicological examinations of the plant's leaf and stem extracts revealed the presence of flavonoids, tannis, saponins, alkaloids, and cyanogenic glycosides (Awuchi, 2020). In ethnomedicine, the plant's leaf extract has been used to treat individuals with hypertension, hemostatic ophthalmia, coughs, and hemorrhoids (Obode *et al.*, 2020).

Phytochemicals, sometimes referred to phytonutrients, are naturally occurring compounds found in plants (Saadullah *et al.*, 2023). These chemicals have been shown to be advantageous to human health as well as having antioxidant properties

(Parcheta *et al.*, 2021). Many common plant-based meals and herbs include potent phytochemicals that can benefit human health. Phytochemicals can also protect us from certain diet-related diseases. Phytochemicals have antioxidant and anti-inflammatory properties. It is essential for detoxifying the body's toxic and detrimental substances (Szabo *et al.*, 2021).

Antioxidants are essential for human health because they combat oxidative stress, which is caused by an imbalance of free radicals and antioxidants in the body. Oxidative stress is a major factor to many chronic diseases, including cancer, cardiovascular disease, and neurological disorders (Chaudhary *et al.*, 2023). Antioxidants counteract this by scavenging free radicals and thereby reducing cellular damage. Plants, which include antioxidant chemicals such as flavonoids, phenolics, and carotenoids, provide a natural alternative to synthetic antioxidants. Given the growing worry about the harmful effects of synthetic antioxidants, researchers are increasingly turning to plants such as *Ficus exasperata* for natural antioxidant sources.

The rising prevalence of oxidative stress-related disorders has increased the demand for efficient antioxidant treatments. Despite the availability of synthetic antioxidants, research have shown that long-term usage of synthetic substances can offer health hazards, including carcinogenic effects. This has fuelled the search for safer, natural alternatives with effective antioxidant properties. *Ficus exasperata*, a plant with ancient medical uses, may be a natural source of antioxidants (Sharifi-Rad *et al.*, 2020).

However, while its pharmacological effects have been investigated, little scientific research has been conducted on the antioxidant and photochemical characteristics of its non-polar components in n-hexane extract (Sharma *et al.*, 2021). A detailed research of *Ficus exasperata*'s antioxidant qualities could help uncover

natural chemicals that can reduce oxidative damage in biological systems. Furthermore, studying the photochemical elements of this plant may lead to the identification of new plant-based antioxidants with broad-spectrum activity, which could address the limits of current synthetic alternatives (Adeyemi *et al.*, 2024).

## MATERIALS AND METHODS

### Plant preparation and extraction

#### Materials

Distilled Water, Olive Oil, Acetic Anhydride, H<sub>2</sub>SO<sub>4</sub>, Meyer's Reagent, HCl, Ammonia, NaOH, Lead Acetate, Ferric Cyanide, Ferric Chloride, Potassium Ferrocyanide, Filter Paper, KMNO<sub>4</sub>, Ethyl acetate, Chloroform, Ethanol, and Na<sub>2</sub>CO<sub>3</sub>.

#### Sample collection

The leaves of *Ficus exasperata* Vahl. were collected from Ijebu-Igbo, Ijebu North L.G Area, Ogun State Nigeria. The plant was authenticated in Federal Research Institute of Nigeria (FRIN), Ibadan with voucher specimen FHI number 114125. The fresh leaves of the plant were spread and air dried in the Science Laboratory Technology Department of Abraham Adesanya Polytechnic, (AAP). Then powdered using mortar and pestle and stored in nylon bag until its ready for use.

#### Preparation of extract

1000g air dried *Ficus exasperata* Vahl. was extracted by maceration. The pulverized samples were soaked in ethyl acetate for a period of 72h. It was stirred at 6h interval and kept in a cupboard overnight. It was decanted and filtered and kept the residue to dry for two days before it was soaked again in methanol for 72h and decanted again. The resulting extracts were weighed and stored in clean sample tubes in a refrigerator until it is required for analysis.

### Antioxidant and Phytochemical Analysis

#### DPPH Scavenging Activity

The molecule 1, 1-diphenyl-2-picrylhydrazyl (2,2-diphenyl-1-picrylhydrazyl; DPPH) is characterized as a stable free radical by virtue of the delocalization of the spare electron over the molecule as a whole, so that the molecule does not dimerize, as would be the case with most other free radicals. The delocalization of electron also gives rise to the deep violet color, characterized by an absorption band in methanol solution centered at about 517 nm (Adegbolagun *et al.*, 2018).

#### Alkaloid Determination

1 g of the sample was weighed into a 250 ml beaker and 200 ml of 10% acetic acid in ethanol was added and covered and allowed to stand for 4 h. This was filtered and the extract was concentrated on a water bath to one-quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the precipitation was complete. The whole solution was allowed to settle and the precipitated was collected and washed with dilute ammonium hydroxide and then filtered. The residue is the alkaloid, which was dried and weighed (Harborne, 1973., Shamsa *et al.*, 2008).

#### Saponin Determination

The method used was that of Obadoni and Ochuko (2001). The samples were ground and 2g of each were put into a conical flask and 100 cm<sup>3</sup> of 20% aqueous ethanol were added. The samples were heated over a hot water bath for 4h with continuous stirring at about 55°C. The mixture was filtered and the residue re-extracted with another 200 ml 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90°C. The concentrate was transferred into a 250 ml separatory funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. 60 ml of n-butanol was added. The combined n-butanol extracts were washed twice with 10 ml of 5% aqueous sodium chloride. The remaining solution was heated in a water

bath. After evaporation the samples were dried in the oven to a constant weight; the Saponin content was calculated as percentage.

#### Determination of Total Phenolic Content

The concentration of phenolic in plant extracts was determined using spectrophotometric method. Folin-Ciocalteu assay method was used for the determination of the total phenol content. The reaction mixture consists of 1 ml of extract and 9 ml of distilled water was taken in a volumetric flask (25 ml). One milliliter of Folin-Ciocalteu phenol reagent was treated to the mixture and shaken well. After 5 minutes, 10 ml of 7 % Sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) solution was treated to the mixture. The volume was made up to 25 ml. A set of standard solutions of gallic acid (20, 40, 40, 60, 80 and 100  $\mu\text{g}/\text{ml}$ ) were prepared in the same manner as described earlier. Incubated for 90 min at room temperature and the absorbance for test and standard solutions were determined against the reagent blank at 550 nm with an Ultraviolet (UV) /Visible spectrophotometer. Total phenol content was expressed as mg of GAE/gm of extract.

#### Determination of Tannin Content

The tannins were determined by Folin - Ciocalteu method. About 0.1 ml of the sample extract was added to a volumetric flask (10 ml) containing 7.5 ml of distilled water and 0.5 ml of Folin-Ciocalteu phenol reagent, 1 ml of 35 %  $\text{Na}_2\text{CO}_3$  solution and dilute to 10 ml with distilled water. The mixture was shaken well and kept at room temperature for 30 min. A set of reference standard solutions of gallic acid (20, 40, 60, 80 and 100  $\mu\text{g}/\text{ml}$ ) were prepared in the same manner as described earlier.

Absorbance for test and standard solutions were measured against the blank at 725 nm with an UV/Visible spectrophotometer. The tannin content was expressed in terms of mg of GAE /g of extract.

#### Determination of Total Flavonoid Content

Total flavonoid content was measured by the aluminum chloride colorimetric assay. The reaction mixture consists of 1 ml of extract and 4 ml of distilled water was taken in a 10 ml volumetric flask. To the flask, 0.30 ml of 5 % sodium nitrite was treated and after 5 minutes, 0.3 ml of 10 % aluminum chloride was mixed. After 5 minutes, 2 ml of 1M Sodium hydroxide was treated and diluted to 10 ml with distilled water. A set of reference standard solutions of Quercetin (20, 40, 60, 80 and 100  $\mu\text{g}/\text{ml}$ ) were prepared in the same manner as described earlier. The absorbance for test and standard solutions were determined against the reagent blank at 510 nm with an UV/Visible spectrophotometer. The total flavonoid content was expressed as mg of QE/g of extract.

## RESULTS AND DISCUSSION

### Results

#### Phytochemical Screening Results

Tables 1 and 2 below show the results of the qualitative phytochemical screening for the hexane leaf extract of *Ficus exasperata*. It reveals the presence of various bioactive compounds such as saponins, alkaloids, flavonoids, tannins, phenols, coumarins, terpenoids, steroids, anthraquinones, quinones, and diterpenes. However, cardiac glycosides were not found.

**Table 1: Qualitative Phytochemical Screening Results**

Phytochemical Parameter	Test Method	Observation (+/-)
Saponin	Froth's Test	+
Alkaloid	Hager's Test	+
Flavonoid	Lead Acetate Test	+

Tannin	Braymer's Test	+
Phenol	Ferric Chloride Test	+
Coumarin	Reaction with 10% NaOH	+
Terpenoid	Salkowaski's Test	+
Steroid	Salkowaski's Test	+
Anthraquinone	Bontrager's Test	+
Quinone	Bontrager's Test	+
Diterpenes	Copper Acetate Test	+
Cardiac Glycosides	Legal's Test	-

Keyword: + **(Positive):** Indicates the presence of the phytochemical in the hexane leaf extract of *Ficus exasperata*.  
 - **(Negative):** Indicates the absence of the phytochemical in the hexane leaf extract of *Ficus exasperata*.

**Phytochemical Content Analysis of *Ficus exasperata* Hexane extract**  
 Table 2 presents the phytochemical content of *Ficus exasperata*, emphasizing the presence of saponin, alkaloid, flavonoid, phenol, and tannin.

**Table 2: Phytochemical Content Analysis of *Ficus exasperata***

Parameter	1.000	2.000	3.000	Mean	SD	Mean ± SD
% Saponin	5.770	5.800	5.790	5.790	0.020	5.79 ± 0.020
Alkaloid	14.600	14.510	15.130	14.750	0.340	14.75 ± 0.340
Flavonoid (QE/mg/g)	41.583	41.542	41.499	41.541	0.042	41.541 ± 0.042
Phenol (GAE/mg/g)	62.997	62.583	62.168	62.583	0.415	62.583 ± 0.415
Tannin (GAE/mg/g)	38.941	38.865	38.788	38.865	0.077	38.865 ± 0.077

**Antimicrobial Effect of Hexane Leaf Extract of *Ficus exasperata* on Various Microorganisms**

Tables 3 and 4 below represents the antimicrobial potential of hexane leaf extract of *Ficus exasperata* on several bacterial organisms at varying concentration.

concentrations (100%, 50%, and 25%). The results demonstrate that the extract exhibits varying degrees of antimicrobial activity against different organisms, with the most significant effect observed at the highest

**Table 3: Antimicrobial Effect of Hexane Leaf Extract of *Ficus exasperate***

Organism	100%	50%	25%
<i>S. aureus</i> (S.a)	14	13	12
<i>Bacillus subtilis</i> (B.s)	12	10	10
<i>Escherichia coli</i> (E.c)	12	10	8
<i>Pseudomonas aeruginosa</i> (PS.a)	10	0	0
<i>Klebsiella pneumoniae</i> (Kleb)	10	0	0
<i>Trichophyton rubrum</i> (T.r)	16	14	13

**MIC and MBC result of Hexane Leaf Extract of *Ficus exasperate***

Table 2b below summarizes the Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) values for Hexane Leaf Extract of *Ficus exasperate* against different microorganisms. It reveals varying levels of antimicrobial activity exhibited by the extract and compares it to standard control agents, Ciprofloxacin (CIP) and Ketoconazole (KET), in terms of MIC and MBC values.

**Table 4: Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of Hexane extract Against Various Microorganisms and Control**

Organisms	MIC	MBC	MIC (Ciprofloxacin)	MBC (Ciprofloxacin)	MIC (Ketoconazole)	MBC (Ketoconazole)
<i>Staphylococcus aureus (S.a)</i>	3.125	3.125	5	NA	NA	NA
<i>Bacillus subtilis</i>	25	50	5	NA	1%	0.25%
<i>Escherichia coli</i>	25	50	10	NA	0.25%	5%
<i>Pseudomonas aeruginosa (Ps.a)</i>	50	>50	>10	NA	NA	NA
<i>Candida albicans</i>	>50	>50	NA	NA	1%	0.25%
<i>Trichophyton rubrum</i>	12.5	12.5	10	NA	NA	NA

**DPPH Antioxidant Assay Results**

The DPPH (2,2-diphenyl-1-picrylhydrazyl) antioxidant assay measures the free radical scavenging activity of Hexane leaf extract of *Ficus exasperate* at different concentrations (µg/mL). The percentage inhibition (%IH) for three replicates was recorded, and the mean, standard deviation (SD), and mean ± SD

were calculated. The data indicates a concentration-dependent increase in antioxidant activity, with the highest inhibition (67.27 ± 0.12%) observed at 500 µg/mL and the lowest (35.85 ± 0.07%) at 31.25 µg/mL, demonstrating the sample's potent antioxidant properties as shown in table 3 below.

**Table 5 DPPH Antioxidant Assay of the Hexane leaf extract of *Ficus exasperata***

Conc(µg/ml)	%IH 1	%IH 2	%IH 3	Mean	SD	Mean±SD
500.00	67.17	67.25	67.40	67.27	0.12	67.27±0.12
250.00	60.16	60.23	60.39	60.26	0.12	60.26±0.12
125.00	52.88	52.72	53.07	52.89	0.18	52.89±0.18
62.50	47.16	47.23	47.20	47.20	0.04	47.20±0.04
31.25	35.84	35.92	35.78	35.85	0.07	35.85±0.07

**DISCUSSION**

The qualitative phytochemical screening of the hexane leaf extract of *Ficus exasperata* reveals the presence of several bioactive compounds, including saponins, alkaloids, flavonoids, tannins, phenols, coumarins, terpenoids, steroids, anthraquinones, quinones, and diterpenes. Saponins are known for their ability to lower blood cholesterol levels and possess antifungal and antimicrobial properties. Their presence in *Ficus*

*exasperata* indicates potential therapeutic uses, particularly for cardiovascular and infectious diseases.

Alkaloids are bioactive compounds widely studied for their analgesic, anti-inflammatory, and antitumor properties. Their detection in this extract suggests the potential for medicinal applications targeting pain management and cancer therapy. Flavonoids are antioxidants with anti-inflammatory, antiallergic, and

anticancer effects. The positive test for flavonoids supports the potential antioxidant and anti-inflammatory properties of *Ficus exasperata*. Tannins are astringent compounds with antimicrobial, antiviral, and anti-inflammatory activities. Their presence further supports the plant's use in treating infections and inflammation.

Phenols are recognized for their antioxidant activity, which helps in neutralizing free radicals and reducing oxidative stress. This characteristic could be significant in protecting against degenerative diseases. Coumarins are known for their anticoagulant, anticancer, and anti-inflammatory effects, suggesting additional therapeutic applications. Terpenoids and steroids are compounds linked to anti-inflammatory, anticancer, and antimicrobial activities. The presence of both in *Ficus exasperata* suggests a broad range of therapeutic potential, especially in inflammatory conditions. Anthraquinones and quinones are bioactive compounds with proven anticancer and antimicrobial activities, which may support the plant's medicinal uses for treating infections and tumors. Diterpenes are compounds found to possess anti-inflammatory and anticancer properties, indicating additional health benefits from the plant. The absence of cardiac glycosides, which are typically used in the treatment of heart failure and arrhythmias, suggests that this particular extract of *Ficus exasperata* may not possess significant effects on cardiac function. This finding could guide future studies into the plant's safety profile for cardiovascular health. Previous studies on *Ficus exasperata* and other *Ficus* species have highlighted the presence of many of these bioactive compounds and their corresponding pharmacological activities. For example, a study by Odebiyi and Sofowora (1997) reported the presence of flavonoids, tannins, and saponins in *Ficus exasperata*, which were linked to antimicrobial and anti-inflammatory activities. Similarly, Oluduro *et al.* (2014) found alkaloids and terpenoids in various

parts of the plant, reinforcing the potential for antidiabetic and anti-inflammatory applications. In a comparative analysis, *Ficus exasperata* exhibits a phytochemical profile similar to that of other *Ficus* species, such as *Ficus carica*, which has been extensively studied for its anticancer, anti-inflammatory, and antioxidant activities. Babalola *et al.* (2012) showed that *Ficus carica* leaf extract contains flavonoids, tannins, and saponins, which align with the findings of this study, suggesting that *Ficus exasperata* may share similar therapeutic properties.

The phytochemical analysis of *Ficus exasperata* hexane extract (Tables 1 and 2) indicate the presence of five key bioactive compounds: saponin, alkaloids, flavonoids, phenols, and tannins. The results show the concentration of these compounds as follows: Saponin: The mean content of saponin in the extract was found to be  $5.79 \pm 0.02\%$ . Saponins are known for their surfactant properties, as well as their potential to exhibit antimicrobial, anticancer, and immune-boosting activities. The relatively consistent presence of saponin across the samples (with minimal standard deviation) suggests its stable composition in *Ficus exasperata*. Alkaloids: With a mean value of  $14.75 \pm 0.34\%$ , alkaloids were found to be present in significant amounts. Alkaloids are widely studied for their pharmacological effects, including analgesic, antimalarial, and antidiabetic properties. The observed concentration of alkaloids in this study correlates well with previous research which has highlighted their potential therapeutic applications in traditional medicine. Flavonoids: The flavonoid content in *Ficus exasperata* was measured as  $41.541 \pm 0.042$  QE/mg/g. Flavonoids are known for their antioxidant, anti-inflammatory, and anti-cancer properties. The high levels of flavonoids in this extract are indicative of the plant's potential as a natural source of antioxidants, aligning with studies that have reported significant antioxidant activity in similar plants. Phenols: The



phenol content was  $62.583 \pm 0.415$  GAE/mg/g. Phenolic compounds are recognized for their strong antioxidant activities, which are beneficial in preventing oxidative stress-related diseases. The concentration found in this study is comparable to those in other medicinal plants with known health benefits, such as *T. chebula* and *C. sinensis*. Tannins: Tannin content was measured at  $38.865 \pm 0.077$  GAE/mg/g. Tannins are known for their astringent properties and have been associated with various health benefits such as antimicrobial, anti-inflammatory, and anticancer activities. The concentration found in *Ficus exasperata* supports the idea that this plant could be utilized in treating diseases related to microbial infections or inflammation.

The consistency of compounds across different species of *Ficus* further highlights the genus's medicinal potential, particularly in treating diseases associated with oxidative stress and microbial infections (Adonu *et al.* 2017).

The study investigates the antimicrobial activity of hexane leaf extract of *Ficus exasperata* on various microorganisms, with concentrations of 100%, 50%, and 25%. The results, as presented in Table 4, suggest that the extract exhibits varying degrees of antimicrobial activity against a range of bacterial and fungal organisms. Notably, the extract displayed the highest efficacy at the 100% concentration for most organisms, with a significant reduction in antimicrobial activity observed at the 50% and 25% concentrations. The results indicate that *Ficus exasperata* leaf extract is particularly effective against *Staphylococcus aureus* (S.a), *Bacillus subtilis* (B.s), *Escherichia coli* (E.c), and *Trichophyton rubrum* (T.r). For instance, the extract exhibited the greatest inhibition of *S. aureus* at 14 mm, which decreased to 13 mm and 12 mm at the 50% and 25% concentrations, respectively. Similarly, *Trichophyton rubrum*, a fungal organism, showed a reduction in inhibitory activity

from 16 mm at 100% to 13 mm at 25%, indicating that the extract retains some antimicrobial potency even at lower concentrations. However, *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* showed no significant inhibition at the 50% and 25% concentrations, suggesting that the extract has minimal or no activity against these organisms at reduced concentrations. This finding suggests that the antimicrobial activity of *Ficus exasperata* is concentration-dependent, with higher concentrations providing stronger inhibition. The antimicrobial properties of *Ficus exasperata* have been previously reported, with some studies noting its effectiveness against both gram-positive and gram-negative bacteria. For instance, a study by Oluwaseun *et al.* (2020) demonstrated that aqueous and methanol extracts of *F. exasperata* exhibited significant antimicrobial activity against *S. aureus*, *E. coli*, and *P. aeruginosa*, although the potency was often stronger in methanol extracts compared to aqueous forms. The results from the current study align with these findings but further suggest that hexane extract may offer a comparable antimicrobial effect, albeit with a different spectrum of activity or strength across various microorganisms. In another study by Ogunlesi *et al.* (2018), the antimicrobial activity of *F. exasperata* was evaluated against a range of bacteria and fungi, and it was observed that higher concentrations of the plant extract resulted in stronger inhibition, which is consistent with the results in Table 3, where 100% concentration showed the greatest antimicrobial effect.

The Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) results of the hexane leaf extract of *Ficus exasperata* revealed that the extract exhibits varying degrees of antimicrobial activity against the tested microorganisms. The activity of the hexane extract was compared with standard antimicrobial agents, Ciprofloxacin (CIP) for bacterial

organisms and Ketoconazole (KET) for fungal organisms. Against *Staphylococcus aureus*: The extract demonstrated significant antimicrobial activity, with both MIC and MBC values of 3.125 mg/mL. This is notably lower than the MIC of Ciprofloxacin (5 mg/mL), indicating that the extract exhibits stronger activity against this Gram-positive bacterium compared to the standard antibiotic. Against *Bacillus subtilis* and *Escherichia coli*: The MIC and MBC values for the extract were 25 and 50 mg/mL, respectively, which are less potent than Ciprofloxacin (5 mg/mL for *B. subtilis* and 10 mg/mL for *E. coli*). This suggests that while the extract has antimicrobial activity, it is weaker against these organisms compared to the standard control. Against *Pseudomonas aeruginosa*: The extract exhibited relatively low activity, with an MIC of 50 mg/mL and an MBC greater than 50 mg/mL, which is consistent with the known resistance of *P. aeruginosa* to many antimicrobial agents. The MIC of Ciprofloxacin (>10 mg/mL) indicates that the hexane extract is less effective than Ciprofloxacin against this Gram-negative bacterium. Against *Candida albicans* and *Trichophyton rubrum* (Fungal Pathogens): The extract exhibited antifungal activity, particularly against *T. rubrum* (MIC and MBC values of 12.5 mg/mL), which is comparable to Ketoconazole. However, the extract was less effective against *C. albicans* (MIC and MBC >50 mg/mL) (Table 4). This suggests selectivity of the antifungal activity towards dermatophytes over yeasts. The antimicrobial properties of *Ficus exasperata* align with previous studies that have reported its traditional use in treating microbial infections. Olowokudejo *et al.* (2008) reported that *Ficus exasperata* leaves possess phytochemicals like flavonoids, alkaloids, and saponins, which are known to exhibit antimicrobial activities. Adonu *et al.* (2017) demonstrated the antibacterial activity of methanol extracts of *Ficus exasperata* leaves against Gram-positive and Gram-negative bacteria, although the

MIC values were slightly lower than those observed for the hexane extract in this study. This difference may be due to variations in the extraction solvents and methodologies used. Oyedeji *et al.* (2011) highlighted the antifungal properties of *Ficus exasperata*, with particular activity against dermatophytes such as *Trichophyton* species, corroborating the findings of the present study. The observed antimicrobial activity of the hexane leaf extract suggests its potential use as an alternative or complementary agent to synthetic antimicrobials, particularly against drug-resistant strains. The significant activity against *S. aureus* and *T. rubrum* is noteworthy, as these organisms are common pathogens in skin and soft tissue infections. However, the relatively higher MIC and MBC values for Gram-negative bacteria and *C. albicans* indicate a need for further optimization, such as fractionation or combination therapy.

The DPPH antioxidant assay was performed to assess the free radical scavenging activity of the hexane leaf extract of *Ficus exasperata* at different concentrations ranging from 31.25 µg/mL to 500 µg/mL. The results indicate a concentration-dependent increase in antioxidant activity, with the highest percentage inhibition recorded at  $67.27 \pm 0.12\%$  at the maximum concentration of 500 µg/mL, while the lowest inhibition was  $35.85 \pm 0.07\%$  at the minimum concentration of 31.25 µg/mL (Table 5). This observation aligns with the common understanding that antioxidant activity generally increases with concentration, as higher concentrations of the extract are likely to contain more active compounds that can scavenge free radicals. These results are in agreement with previous studies that have documented the antioxidant potential of various plant extracts. The research on the antioxidant activity of different plant extracts also demonstrated a similar concentration-dependent increase in antioxidant activity. Additionally, *Ficus* species, including *Ficus exasperata*, have been recognized for

their antioxidant properties in numerous studies. A study conducted by Chukwu *et al.* (2021) found that *Ficus exasperata* leaf extracts exhibited significant scavenging activity against DPPH radicals, which supports the current findings. The strong antioxidant properties observed in *Ficus exasperata* may be linked to its bioactive compounds, such as flavonoids and polyphenols, known for their ability to scavenge free radicals. Research by Zhao *et al.* (2020) further emphasizes the significance of these compounds in offering protection against oxidative stress and related diseases. Overall, the DPPH antioxidant assay results indicate that the hexane leaf extract of *Ficus exasperata* shows considerable free radical scavenging ability, with activity increasing at higher concentrations.

## CONCLUSION AND RECOMMENDATIONS

### Recommendations

This study recommends further research to isolate and identify the specific antioxidant compounds in *Ficus exasperata* using advanced analytical techniques. Additionally, *in vivo* and clinical studies are needed to validate its efficacy and safety for therapeutic applications. Comparative investigations with other solvent extracts could enhance understanding of its antioxidant potential, while toxicological assessments are essential to ensure safe use. Finally, sustainable cultivation and harvesting practices should be adopted to support future research and industrial applications.

### Conclusion

The study demonstrates that the *n*-hexane leaf extract of *Ficus exasperata* possesses significant antimicrobial and antioxidant activities, as evidenced by its ability to inhibit microbial growth and scavenge free radicals in a concentration-dependent manner. This activity can be attributed to the bioactive compounds identified in the phytochemical analysis, such as flavonoids, alkaloids, and phenolic compounds. This plant extract may have potential applications in preventing

oxidative stress-related conditions, such as cardiovascular diseases, cancer, and neurodegenerative disorders.

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