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FOREWORD

Compliment of the season to all our contributors, well-wishers and world of Academia in general. I respectfully appreciate and welcome you all to the volume 3 issue 2 of Federal Polytechnic – Journal of Pure and Applied Sciences (FEPI-JOPAS) which is a peer reviewed multi-disciplinary accredited Journal of International repute. It is imperative to re-affirm that FEPI-JOPAS publishes full length research work, short communications, critical reviews and other review articles. In this issue, readers will find a series of manuscripts of top-rated significance in pure and applied sciences, engineering and built environment. This issue is the last of its kind for 2021 calendar year which features findings from basic and applied researches of high societal impacts from the seasoned authors. These articles have been reviewed and packaged for wider readership through the collective efforts of our managing editor, publishing editors, our valuable reviewers and editorial board members.

In this particular issue, you will find that Ilelaboye and Jesusina evaluated the quality of biscuits and chin-chin made from okara enriched plantain-sorghum flour blends. Ojo and Ebisin utlilized convolutional neural network for gender classification through facial analysis. Omotayo and Fafioye investigated antimalarial potential of ethyl acetate fraction of Phyllanthus niruri while Olubodun and Adetona examined landscaping as a strategy for combating air pollution in Lagos megacity. Buoye and Ojuawo provided imperative dataset on Covid-19 crisis management in Nigeria and Brazil. Obun-Andy and Banjo investigated effective communication as a tool for good governance in Nigeria. Yusuff and co-workers conducted a field survey on fish hatcheries in Yewa South and Yewa North Local Government of Ogun State. Akinlade and co-workers meticulously expatiated on the effect of aqueous blend of three herbs on haemato-biochemical indices of broiler chicken at starter phase. Ajeigbe, Sangosina, Ogunseitan, Lawal, & Yusuff analysed the Effects of Neem Leaves (Azadirachta Indica) and Cassava Peels on the Performance of West African Dware Goat. Abdussalam & Adewole in their paper carefully explained the Formulation of Natural Products Repellents for the Control of Cockroaches (Periplaneta americana). Elesin & Obafunmiso gave as Assessment of Public Toilets Facilities Provision and Management in Tertiary Institutions in Nigeria- An Overview of The Federal Polytechnic, Ilaro, Ogun State. Ajayi and Adegbola Removal of Pb^{2+} And Zn^{2+} from Aqueous Solution using Eggshell Powder as Adsorbent: Kinetics and Equilibrium Studies

I would like to deeply appreciate and extend my profound gratitude to my co-editors, editorial board members, reviewers, members of FEPI-JOPAS, especially the Managing Editor, as well as all the contributing authors for making the production and publishing of this volume 3 issue 2 a reality. I will like to appreciate the authors in this issue for allowing their works to be subjected to our thorough and rigorous peer-review processes and for taking all the constructive criticism in good fate. The authors are solely responsible for the information, date and authenticity of data provided in their articles submitted for publication in the Federal Polytechnic Ilaro – Journal of Pure and Applied Sciences (FEPI-JOPAS). I am looking forward to receiving your manuscripts for the subsequent publications.

You can visit our website (https://fepi-jopas.federalpolyilaro.edu.ng) for more information, or contact us via e-mail us at fepi.jopas@federalpolyilaro.edu.ng.

Thank you and best regards.

Prof. Olayinka O. AJANI

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Physicochemical Evaluation and Pasting Properties of Flours, Biscuit and Chinchin Prepared from Okara Fortified Plantain – Sorghum Blends.

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Abstract

This study evaluated the quality of biscuits and chin-chin made from okara enriched plantain-sorghum flour blends. The flours of plantain(P), Sorghum (S) and Okara (O) blended in per cent ratios: T1 (100 plantain :0 sorghum); T2 (75 plantain:25 sorghum); T3 (50 plantain:50 sorghum); T4(25 plantain: 75 sorghum); T5 (0 plantain: 100 sorghum:); 5 % okara flour was added to 95 % of each plantain – sorghum flour blend to give samples T6 to T10. Standard analytical procedures were utilized to analyse the flours' proximate composition, energy, functional properties and pasting properties, and sensory attributes of the biscuit and chin-chin were also analysed. The proximate composition results of composite flour, biscuit and chin-chin showed that sample T1 possessed the lowest moisture and fat content and the highest carbohydrate. Sample T10 has the highest protein content, sample T6 has the highest ash and fibre content, and sample T8 has the highest energy value. Substantial variation occurred in functional properties: sample T10 has the highest values of the bulk density, water and oil absorption capacities and the least value in sample T1. Swelling power and solubility index show no significant difference having sample T10 with the highest value and sample T1 having the least value, and foaming stability varied significantly between the samples, with T6 possessing the maximum value and the minimum observed in T10. This study showed that the nutritional results qualities of the biscuit and chin-chin produced from plantain-sorghum composite flour are enhanced by fortification with okara.

Keywords: biscuits, chin-chin, functional properties, okara, physicochemical, pasting properties

INTRODUCTION

Enrichment of food products such as confectioneries can boosts their nutritional and functional components, thereby providing extra benefits to meet consumers' demands (Świeca, Gawlik-Dziki, Dziki, & Baraniak, 2017.). The rapid increase in population and development in many countries have significantly promoted snack consumption, which caters for many consumers' daily nutritional requirements, and played a positive role in every nation's economy (Awoyale, Maziya-Dixon, Sanni, & Shittu, 2011; Lasekan & Akintola, 2002; Ugwuanyi, Eze, & Okoye, 2020). Cereal-based snacks are extensively consumed due to low nutrient density. Snacks are easy to eat, cheap, and effortlessly accessible in public places (Ugwuanyi et al., 2020).

Man has been consuming biscuit and biscuit-like products for many hundreds of years. Their beneficial eaten attributes informed the enrichment of their nutritional quality with protein, especially for children and low-income groups (Banureka & Mahendran, 2009). Chin chin is a sweet snack made from wheat flour either by frying or baking and is common in

West African countries, especially Nigeria. (Akubor, 2004; Mepba, Achinewhu, & Aso, 2007).

Plantain (*Musa paradisiaca)* originated from India, a leading food crop and energy source in Africa. Commonly called '*Ogede agbagba'* (Yoruba), *'Ayaba'* (Hausa) and *'Ogadejioke'* (Igbo), in Nigeria, and usually eaten boiled, fried or roasted. Also, various processed foods are prepared from unripe plantain flour, containing carbohydrates, minerals, amino acids, fibre, and carotenoids (Ilelaboye & Ogunsina, 2018). Sorghums constitute a significant staple food providing the nutritional needs for over 500 million of people in sub-Saharan Africa and Asia (ICRISAT, 2018). This cereal is mainly regarded as a life-given crop due to its exceptional tolerance to drought and acclimatisation to dry tropical and subtropical environments.

Wheat flour has been the principal raw material for the preparation of snacks (e.g., biscuit and chin chin). In order to reduce the production cost of snacks due to high importation cost of wheat, there is need to explore the suitability of an inexpensive, nutritious

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and functional composite flours made from readily available agricultural materials for the production of snacks. Therefore, the research aspired to prepare and enrich plantain-sorghum composite flours with okara. To analyse the flours' physical, chemical, functional properties and pasting characteristics, and also to assess the proximate composition and sensory evaluation of biscuit and chin-chin made from okara enriched plantain - Sorghum flour blends.

MATERIALS AND METHODS

In this study, all the ingredients used to produce the flours, biscuit, and chin were purchased from a market in Ilaro, Ogun State, Nigeria. Ilaro is a town in Nigeria, positioned at a North latitude of 6.89°, East longitude of 3.02° and altitude of 68 m. Ilaro ambient temperature ranges between an average of 23° C to 34.2°C.

Plantain and sorghum flours' production

For the production of plantain flour, green plantain fingers (20 kg) were manually peeled, cut into the water to prevent browning and subsequently oven-dried at 80 ºC for 6 hr. The dried slices were milled (Bentall Superb, Model 200L 09) into a fine powder of 75µm particle size and kept in airtight polythene bags at room temperature before use.

Thoroughly cleaned non- tannin sorghum grains (5 kg) were ground using a hammer mill (Bentall Superb Model 200L 09) into a powder of 75 µm particle size and stored at room temperature in airtight plastic containers before use.

Soymilk residue (Okara) flour's production

The thoroughly washed soybean was blanched at 100ºC for 25 min and dehulled. One kilogram (1 kg) of dehulled cotyledons in 5.0 L of water was milled, and the milk was separated from the soybean residue (okara) with a cheesecloth. The residue was oven-dried at 70ºC, ground into a powder of 75µm particle size, and saved in sealed plastic containers at 4 ºC for further use. (Li, Qiao & Lu 2011)

Formulation of composite flours

Ten flour samples were formulated following the formulation in Table 1.

Table 1. Ratio (%) of Plantain, Sorghum and Okara Flour

FLOUR	PLANTAIN(P)	SORGHUM(S)	OKARA(O)
T1	100	0	0
T2	75	25	0
T3	50	50	0
T4	25	75	0
T5	0	100	0
T6	95	0	5
T7	371.25	23.75	5
T8	47.5	47.5	5
T9	23.75	71.25	5
T10	0	95	5

Biscuit Preparation

Biscuits were made using the procedure of AOAC (2016) with some alterations in the recipe. The flour, salt, and baking powder were carefully blended in a bowl for 3 min, eggs and water were added, and the mix was kneaded. The batter was rolled and sliced into small cubes. The cubes were arranged on oiled baking trays at 25 mm intervals in between and oven-baked at 200 ºC for 25min. After attaining ambient temperature, the biscuits were put in polythene bags and saved for subsequent analysis and sensory evaluation (Peter-Ikechukwu et al., 2017).

Table 2. Recipe for Biscuit Production

Ingredient	Quantity
Composite flour	100 g
Salt	2.02 g
Fat	9.64 g
Yeast	3.48 g
Baking Powder	0.16g
Water	50 ml

Production of chin-chin

Using the recipe shown in Table 1, the flour, salt and ground nutmeg were put in a bowl, and a batter was prepared by manually mixing the sugar, powdered milk, baking powder margarine together. The batter was then mixed with the bowl's content, and water was added to the blend and kneaded to form a stiff dough. The dough was pressed to 1 cm thickness and sliced into uniform cubes, fried in vegetable oil at 180 ºC for 8 min to a golden brown. The residual oil on the chin-chin was removed, allowed to cool and packed in an airtight bag for analysis. (Akubor 2004).

Table3. Recipe for chin-chin production

Ingredient	Amount
Composite flour (g)	100

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Sugar (g)	5
Fat (g)	3
Egg (g)	10
Baking Powder (g)	10
Water (ml)	70

Chemical analysis

The flours' proximate composition was determined with the Association of Official Analytical Chemists' methods (AOAC, 2016), and the Atwater factor described by Kent (2006) was used to calculate the energy value. The functional properties of the flours were assessed with standard methods (Julianti, Rusmarilin, & Yusraini, 2015; Oyeyinka et al., 2014) technique.

Determination of pasting properties

The flour blends' pasting properties was assessed with the rapid visco analyser (RVA) according to the manufacturers' procedures (Newport scientific, Narrabeen Australia) and reported by Ikegwu, Nwobasi, Odoh and Oledinma (2009).

Sensory evaluation

The organoleptic properties of the biscuit and chinchin were analysed by 20 trained panellists selected from students and staff of the Federal Polytechnic, Ilaro, Ogun State, Nigeria. The 9-points Hedonic scale ranging from 1(most preferable) to 9 dislikes extremely (least preferable) was used (Iwe, 2002).

Statistical analysis

Triplicate analyses were performed, and data were subjected to one-way analysis of variance (ANOVA) to establish statistical significance. Mean comparison and separation were done using Duncan Multiple range (DMR) test at $p \leq 0.05$, described by the SPSS 20.0 statistical package. (SPSS, 20, 2020).

RESULTS AND DISCUSSION
Proximate composition of floors

Tables 4 shows the per cent proximate compositions of the composite flours. The increase in sorghum proportion and the inclusion of okara powder in the mixed flour caused a significant ($p < 0.05$) increase in the flours' moisture content. T1 had the lowest moisture content (5.61%), while T10 had the highest value (7.51%). The composite flours shelf life was stable because their moisture contents were below the recommended maximum limit (15 %) for flours, hence no spoilage through chemical changes or by microorganisms (Shahzadi, Butt, Reh man, & Sharif, 2005; Akomolafe, & Aborisade, 2007; Codex, 2016.).

The flour blends protein content varied significantly ($p< 0.05$), ranging from T1(2.81%) to T10 (6.11%) and are lower than the value reported by Nneka & Charles (2016) for wheat flour (10.12%). Also, the okara supplement in the flour blends improved their protein content. A rise in the per cent ratio of sorghum

and the okara supplementation in the flours caused a rise in fat content. Flour with low-fat content impacts low calories on the product and has longer shelf stability because rancidity is reduced (Fasasi, 2009). A significant (P< 0.05) decline in the flour blends' fibre content occurred with the rise in sorghum quantity, but adding 5 % okara raised the fibre content. The highest per cent fibre in T6 (4.01 %) is caused by the high fibre content in plantain and okara (Kiin-Kabari, Eke-Ejiofor & Giami, 2015). The composite flours ash content varied significantly ($p < 0.05$), ranging from T5 (1.71 %) to T6 (2.62%). A rise in the sorghum level of the flour blends caused a reduction of its ash content. The inclusion of okara slightly increased the ash content, and this observation agrees with the findings of Porcel (2017). T6 sample will have the highest mineral content. because the per cent ash of food indicates the number of minerals present in the product.

The flour blends' carbohydrate content in this study differed significantly ($p< 0.05$), ranging from T10 (79.34 %) to T1 (83.91 %) and higher than the carbohydrate content of wheat (76.30%) recorded by Nneka and Charles (2016). The blends' carbohydrate contents are reduced by okara enrichment and an increase in sorghum level. The calorific value of the composite flours of the current study increased significantly ($p< 0.05$) with the okara supplementation and rise in sorghum level in the flours. The energy value of the flour blends ranged from T1 (360.11 .24 kcal/100g) to T10 (370 kcal/100 g). Wheat flour energy value (382.64 kcal/100 g) is more than this study results (Nneka, & Charles, 2016)

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Table 4: The proximate composition (%) and energy (kcal/100g) values of the okara fortified plantain-sorghum composite flour blends

Sample	Moisture	Protein	Fat	Fibre	Ash	Carbohydrate	Energy
T1	5.61 [a]±.22	2.81 [a]±.06	2.01 [a]±.08	3.91 [g]±.16	2.41 [e]±.06	83.91 [i]±.02	360.11 [a]±09
T2	6.11 [c]±.09	2.98 [a]±.28	2.21 [b]±.05	3.41 [e]±.15	2.11 [d]±.08	83.51 [h]±.05	362.41 [a]±.07
T3	6.51 [d]±.06	4.01 [c]±.05	2.31 [c]±.06	3.11 [c]±.11	1.91 [c]±.05	82.81 [g]±.06	367.61 [b]±.04
T4	6.91 [e]±.08	4.51 [de]±.08	2.31 [c]±.14	2.91 [b]±.02	1.71 [ab]±.02	82.31 [f]±.09	364.31 [ab]±.20
T5	7.81 [g]±.03	5.71 [f]±.09	2.41 [cd]±.12	2.61 [a]±.07	1.6 [a]±.15	80.51 [c]±.05	364.81 [ab]±.09
T6	5.65 [a]±.05	3.31 [b]±.10	2.56 [e]±.09	4.01 [g]±.03	2.62 [e]±.07	82.73 [g]±.03	365.16 [ab]±.04
T7	5.91 [b]±.10	4.32 [cd]±.11	2.73 [ef]±.07	3.71 [f]±.04	2.11 [d]±.11	81.72 [e]±.04	366.29 [ab]±.08
T8	6.54 [d]±.12	4.71 [e]±.13	2.82 [fg]±.02	3.51 [e]±.09	1.91 [c]±.04	81.17 [d]±.012	367.26 [b]±.07
T9	6.89 [e]±.04	5.81 [fg]±.15	2.92 [gh]±.06	3.31 [d]±.05	1.81 [bc]±.13	80.31 [b]±.11	369 [b]±.06
T10	7.51 [f]±.07	6.11 [g]±.05	3.00 [h]±.08	2.91 [b]±.08	1.71 [ab]±.03	79.34 [a]±.15	370.24 [b]±.05

Means with the same superscripts in a column are not significantly different ($p \leq 0.05$)
Sample Key = T1 [[100P:0S]; T2 [75P: 25S]; T3 [50P: 50S] T4 [25P: 75S]; T5 [0P: 100S]; T6 [95P:0S: 5O]; T7 [71.25P:23.75S:0.05O]; T8 [47.5P: 47.5S: 5O]; T9 [23.75P:71.25S: 5O]; T10 [0P :95S: 5O] P [Plantain Flour], S [sorghum Flour], O[Okara]

Functional properties

Table 5. The functional properties of the composite flour

Samples	BD (g/cm^3)	WAC (%)	OAC (%)	SP (g/g)	SI (%)	FC (%)	FS (%)	EC (%)	ES (%)
T1	0.51±0.02 [a]	198.29±6.63 [i]	185.51±4. 35j	5.05±0.98 [a]	35.83±0.74 [a]	3.77±0.15 [b]	51.9±0.29 [f]	37.75±0.29 [a]	39.12±0.28 [a]
T2	0.55±0.02 [b]	184.02±4.17 [g]	168.30±6.70 [g]	5.94±0.40 [b]	36.06±0.89 [b]	4.4 ±0.06 [c]	54 ±0.29 [g]	39.20±0.29 [b]	41.25±0.28 [b]
T3	0.58±0.04 [c]	176.99±4.55 [e]	152.88±6.45 [e]	6.21±0.70 [bc]	37.41±1.60 [c]	5.65±0.13 [d]	56.1±0.29 [h]	41.12 ±0.29 [c]	43.32±0.28 [c]
T4	0.61±0.02 [d]	166.52±1.42 [c]	131.11±7.04 [c]	6.55±0.90 [c]	38.21±0.94 [d]	6.6 ±0.06 [e]	58.5±0.29 [i]	43.25±0.29 [d]	45.57±0.28 [d]
T5	0.65±0.03 [e]	151.15±1O.73 [a]	120.37±3.46 [a]	7.12±0.30 [d]	39.97±2.02 [e]	7.9 ±0.06 [f]	59.7±0.29 [j]	44.31±0.29 [de]	49.15±0.28 [e]
T6	0.59±0.03 [ab]	201.41±10.41 [j]	183.59±8.65i	7.84±0.60 [e]	41.28±1.02 [f]	4.0±0.006 [f]	48.1±0.29 [e]	54.25±0.29 [e]	43.53±0.28 [c]
T7	0.62±0.04 [bc]	187.78±9.42 [h]	170.79±9.00 [h]	8.18±0.5 [ef]	42.24±1.47 [g]	5.5 ±0.06 [a]	45.9±0.29 [d]	56.75±0.29 [f]	44.55±0.28 [cd]
T8	0.65±0.02 [cd]	180.06±5.34 [f]	156.56±5.92 [f]	8.56±0.13 [f]	44.34±1.03 [h]	10.07 ±0.16 [h]	42.3±0.29 [c]	59.5 ±0.29 [g]	46.15±0.28 [d]
T9	0.69±0.03 [de]	170.52±3.18 [d]	134.85±5.53 [d]	9.04±0.30 [fg]	47.49±1.53 [i]	12.13 ±0.16 [j]	39.06±0.29 [b]	61.25±0.29 [h]	50.00 ±0.25 [e]
T10	0.72±0.01 [ef]	158.45±2.12 [b]	125.49±4.49b	9.68±0.23 [g]	49.07±1.85 [j]	14.55 ±0.16 [g]	30.9 ±0.29 [a]	65.75±0.29 [i]	54.45±0.25 [f]

Means with the same superscripts in a column are not significantly different ($p \leq 0.05$)
Sample
Key = T1 [[100P:0S]; T2 [75P: 25S]; T3 [50P: 50S] T4 [25P: 75S]; T5 [0P: 100S]; T6 [95P:0S: 5O]; T7 [71.25P:23.75S:0.05O]; T8 [47.5P: 47.5S: 5O]; T9 [23.75P:71.25S: 5O]; T10 [0P :95S: 5O] P [Plantain Flour], S [sorghum Flour], O[Okara]

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Table 5 shows the functional properties of okara enriched plantain–sorghum flour blends. Functional attributes of flour are crucial determinants for the behaviour and suitability of a flour product to substitute conventional flour in specific systems (Kaur, & Singh, 2006; Siddiq, Nasir, Ravi, Dolan, & Butt, 2009). The bulk density values reported by other workers (Abioye, Ade-Omowaye, Babarinde & Adesigbin, 2011; Kiin-Kabari, Eke-Ejiofor & Giami, 2015) were comparable with the values obtained in the present study (0.51 g/cm^3 to 0. 72 g/cm^3). The rise in sorghum flour proportion and the inclusion of okara in the flour mix led to high bulk density. Bulk density governs the packaging materials price and selection for flour. Also, the flour bulk density influenced its treatment and usage in the food industry (Ajanaku, Edobor-Osoh & Nwinyi, 2012). Flour T10, having the highest bulk density, will be most suitable for feeding a recuperating child because it can quickly disperse and form a less viscous paste.

The water absorption capacity (WAC) of the experimental flour varied significantly ($p>0.05$), ranging from T5 (151.15 g/100 g) to T6 (201.41 g/100 g). The result signified that a high proportion of sorghum flour in the blends reduced their WAC due to its starch polymer structure (Oladipupo & Nwokocha, 2011). Also, the presence of okara improved the flours WAC, which corroborated the reports of Uzo-Peters and Ola (2020); Butt and Batool (2010) and Kiin-Kabari et al. (2015) because its protein content controls the WAC of flours. Sample T6 with the highest WAC will be more suitable for bakery products that need moisten to enhance dough handling qualities. The okara fortified plantain-sorghum composite flours' oil absorption capacity (OAC) followed the same pattern. The flours' protein content and oil content positively influence their OAC (Uzo-Peters, & Ola 2020). Hence, sample T6 will be most suitable for making food products because high OAC conveys better flavour retention and improved mouthfeel to the product (Adegunwa, Adebowale, Bakare, Adelekan, & Alamu, 2017).

The swelling power of flour depends on its per cent protein, which enhances the affinity of starch granules to water (Aprianita, Purwandari, Watson, & Vasiljevic, 2009). Also, the flour's swelling power was regulated by the proportion of amylose to amylopectin and the bonding forces within the granules. (Onitilo, Sanni, Daniel, Maziya-Dixon, & Dixon 2007). The swelling power of the okara fortified plantain – sorghum blends increased significantly (P>0.05), from T1 (5.05g/g) to T10 (9.68g/g), which has the highest per cent protein. The swelling power reported for sole plantain flour (8.22g/

g) by Abioye, Ade-Omowaye, Babarinde and Adesigbin (2011) is higher than the value obtained in this study. The solubility index of the flour mix exhibited a similar trend ranging from T1(35.83 %) to T10 (49.07 %). Starch solubility of most starch-based products resulted from the leaching of starch amylose, which is increased by hydrolysis of starch to amylose during soaking (Ikegwu, Okechukwu, Ekumankama, & Egbedike. 2009).

The flour blends' foaming capacity and foam stability, as presented in Table 5, differed significantly ($p<0.05$). T10 has the highest foam capacity (14.55 g/100 g), while T1 gave the lowest value (3.77 g/100 g). The foam stability of T1(30.9 g/100 g) was the lowest, and the highest was obtained in T5 (59.7 g/100 g). This study revealed a rise in sorghum proportion, and the inclusion of okara in the mix increased the foaming capacity, while the opposite was the case for foam stability. The surface tension of the air-water interfacial film formed by protein inversely affects the foamability of flours (Mepba et al., 2007). The values of emulsion capacity (37.75 g/100 g - 65.75 g/100 g) and emulsion stability (39.12 g/100g - 54.45 g/100 g) of the composite flours in this research work is directly proportional to the flour blends' protein, a surfactant that forms and stabilizes the emulsion by creating electrostatic repulsion on oil droplet surface (Kaushal et al. 2012). The flour samples produced in this study could serve as an excellent emulsifier because they possess moderate to high emulsion capacity.

Pasting properties.

 Its starch pasting properties assess the aptness of flour usage as an efficient raw material in food and other industries (Iwe, Linus-Chibuezeh, Ngadi, Asumugha, & Obasi, 2017). Table 6 depicted the pasting properties of okara enriched composite flours, which varied significantly ($p < 0.05$). The peak viscosity of the flour mix varied from T10 (426.00 RVU) to T1 (3282.50 RVU) and showed that both sorghum substitution and okara addition to the flour blends reduced the peak viscosity. Peak viscosity signifies the starch swelling capability before its physical breakdown and is often evaluated with the final product quality (Sanni, Adebowale, Maziya – Dixon & Dixon 2008). The trough or hot paste viscosity was the minimum viscosity when the samples were subjected to a period of constant temperature and mechanical shear stress. (Kiin-Kabari, et al., 2015). Sample T1 possessed the highest holding capacity (2473.50 RVU), while the lowest trough value (336.50 RVU) was observed in sample T10. Hence

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sole plantain flour can resist breakdown during cool-ing. (Jude-Ojei , Lola, Ajayi. & Ilemobayo 2017).
The stability of starch pastes or the extent of its granule's disintegration is determined by breakdown viscosity, which is the peak viscosity minus trough viscosity. (Newport Scientific, 1998). The breakdown viscosity values in this study ranged between samples T10 (89.50 RVU) and T1 (809.00 RVU), and this shows that 100 % plantain flour had the highest starch stability.

As depicted in Table 6, final viscosity reduced significantly ($p>0.05$) with a rise in sorghum substitution and okara inclusion in the flour mix. It indicates that flours with high protein content have a lower ability to form a gel or viscous paste during processing (Offia-Olua, 2014). Setback viscosity is the retrogradation of starch molecules, which happens when the flour paste temperature is reduced to 50 °C. It also signifies the tendency of the starch particles to diffuse in a hot paste and re-combine quickly during cooling (Chinma, Abu, & Ojo, 2010). The flour samples setback values ranged from T10 (580.00) to T1 (1344.50), showing that the lower the level of sorghum substitution, the less the retrogradation during cooling. The peak time (min) evaluates the cooking time and when the peak viscosity occurred (Adebowale, Adeyemi, & Oshodi, 2005). Slight significant variation was observed in the composite flours peak time ranging from 5.00 min – 5.17 min.

The pasting temperature is the time initial gelatinisation occurred, and noticeable thickness is observed during processing due to the swelling of the starch (Alamu, Therese, Mdziniso, & Bussie, 2017). The pasting temperature value of sole plantain flour was the least (82.28 ˚C), and the highest was observed in okara fortified sorghum flour (88.40 ˚C), which is similar to Awolu, (2017) report on the pasting temperature (89.60 °C) of pearl millet-based composite flour.

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Table 6: Pasting properties of okara fortified plantain – sorghum flours

SAMPLE	Peak	Trough	Breakdown	Final Viscosity	Setback	Peak Time	Pasting Temp
T1	3282.50±146.37[i]	2473.50±20.51[i]	809.00±125.87[e]	3818.00±203.65[g]	1344.50±183.1[de]	5.17±05[c]	82.28±.11[a]
T2	2443.50±4.95[g]	1778.00±2.83[h]	665.50±2.12[d]	3307.00±202.63[f]	1529.00±19.80[g]	5.00±.00[a]	82.73±.60[ab]
T3	1879.00±164.05[e]	1378.50±103.94[e]	500.50±60.10[c]	2864.00±239.00[e]	1485.50±135.0[ef]	5.00±.00[a]	83.10±.07[ab]
T4	934.50±7.78[c]	750.50±4.95[c]	184.00±2.83[a]	1853.50±14.85[c]	1103.00±9.90[c]	5.07±.00[ab]	83.60±.57[b]
T5	497.00±.00[a]	380.00±1.41[a]	117.00±1.41[a]	1145.00±2.83[a]	765.00±4.24[b]	5.00±.00[a]	86.35±.00[c]
T6	2988.50±84.15[h]	2220.00±46.67[h]	768.50±37.48[e]	3489.50±94.05[f]	1269.50±47.38[c]	5.07±.00[ab]	82.75±.57[ab]
T7	2109.50±27.58[f]	1587.00±28.28[f]	522.50±.71[c]	2811.00±33.94[e]	1224.00±5.66[cd]	5.04±.05[ab]	83.08±.04[ab]
T8	1378.50±7.78[d]	1064.50±21.92[d]	314.00±14.14[b]	2186.00±56.00[d]	1121.50±21.92[c]	5.07±.00[ab]	83.20±.00[ab]
T9	766.50±.71[b]	619.00±1.41[b]	147.50±.71[a]	1489.00±7.07[b]	870.00±5.66[b]	5.10±.04[bc]	83.90±1.06[b]
T10	426.00±11.31a	336.50±12.02[a]	89.50±.71[a]	916.50±6.36[a]	580.00±5.66[a]	5.10±.04[bc]	88.40±.49[d]

Means with the same superscripts in a column are not significantly different (p≤0.05)
Sample
Key = T1 [[100P:0S]; T2 [75P: 25S]; T3 [50P: 50S] T4 [25P: 75S]; T5 [0P: 100S]; T6 [95P:0S: 5O]; T7 [71.25P:23.75S:0.05O]; T8 [47.5P: 47.5S: 5O]; T9 [23.75P:71.25S: 5O]; T10 [0P :95S: 5O] P [Plantain Flour], S [sorghum Flour], O[Okara]
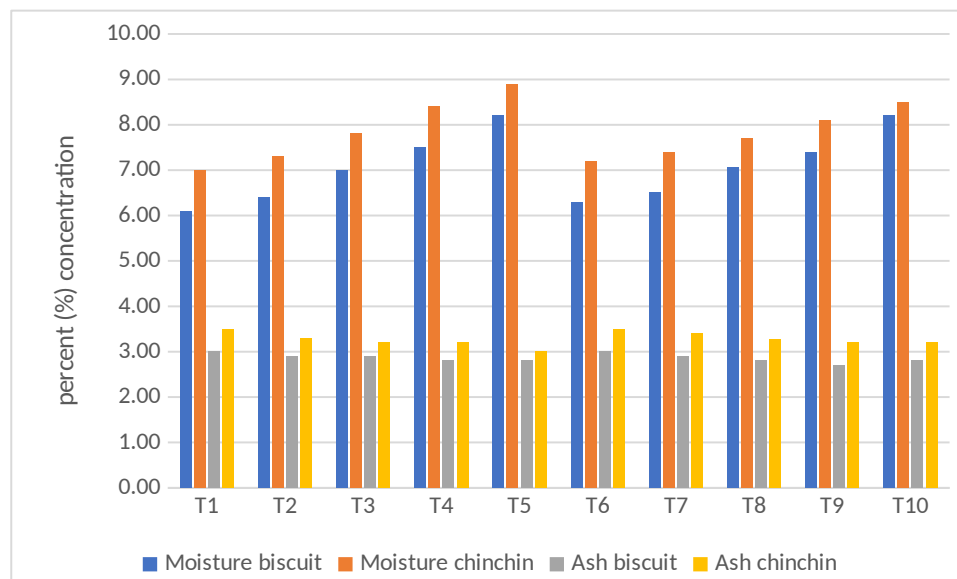
Figure 1: Moisture and Ash content of Biscuit and Chin-chin

As depicted in Figure 1, the moisture (6.10 - 8.20 %) and the per cent ash (2.80 - 3.00 %) of the biscuits and chin chin prepared from the experimental composite flour is higher than that of wheat biscuit (3.65 %) and wheat chin chin (4.9 %), as recorded by Ajibola, Oyerinde and Adeniyan (2015). These observed results might be credited to the high per cent moisture of sorghum and okara in the composite flour (Adegunwa, Ovie, Bakare & Adebowale, 2014). The products prepared using the composite flours will

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have good shelf stability because snacks with moisture contents below 10% will not be destroyed by microorganisms on the shelf (Udensi & Akaniyo, 2004; Okpala, & Okoli, 2013). The percentage of ash in the biscuits (2.70 - 3.00%) is lower than that of chin chin (3.00 - 3.50 %), and these values decrease significantly as the quantity of sorghum flour increases. In contrast, the addition of okara in the flours mix has no significant impact on the biscuits and chin-chin (Figure 1). Adegunwa et al. (2014) reported higher ash content (4.97%.) wheat chin-chin, while wheat biscuit ash content (2.31%.) recorded by Ajibola et al. (2015) is lower than this study result.

The amount of protein and fat in the biscuits and chin-chin increased significantly ($p < 0.05$), with the increase in the composite flours' sorghum proportion. Also, the okara addition raised the protein and fat contents of the products; however, the chin-chin possessed higher protein and fat content than the biscuit (Figure 2). The per cent fat and protein of chin-chin made in this experiment are lesser than those recorded by Adegunwa et al. (2014) for wheat chin-chin (8.13 % protein and 19.99 % fat). Ajibola et al. (2015) reported higher values for wheat biscuit fat (14.39 %) and protein (10.99 %) than the amount observed in the biscuit produced in this study.
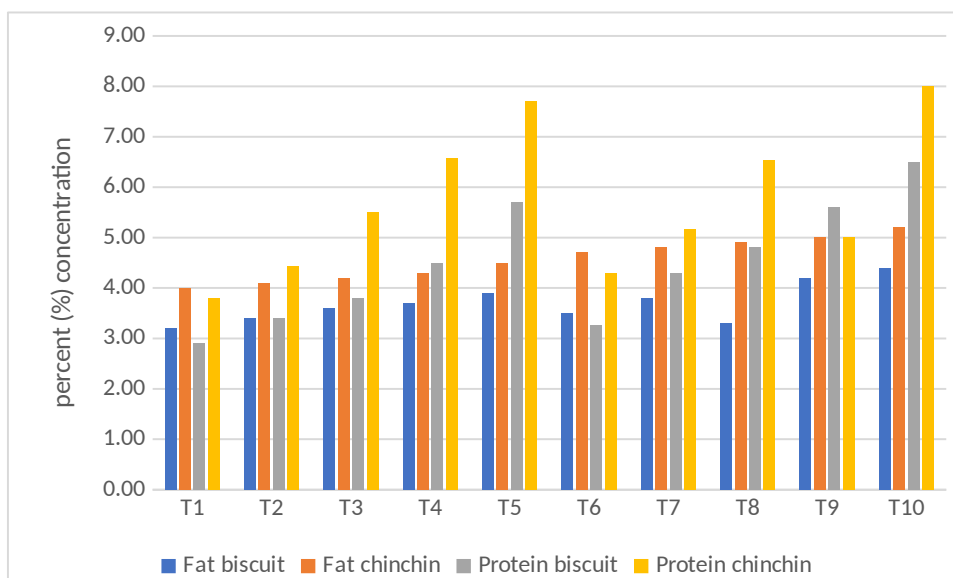
Figure 2: Fat and Protein content of Biscuit and Chin-chin
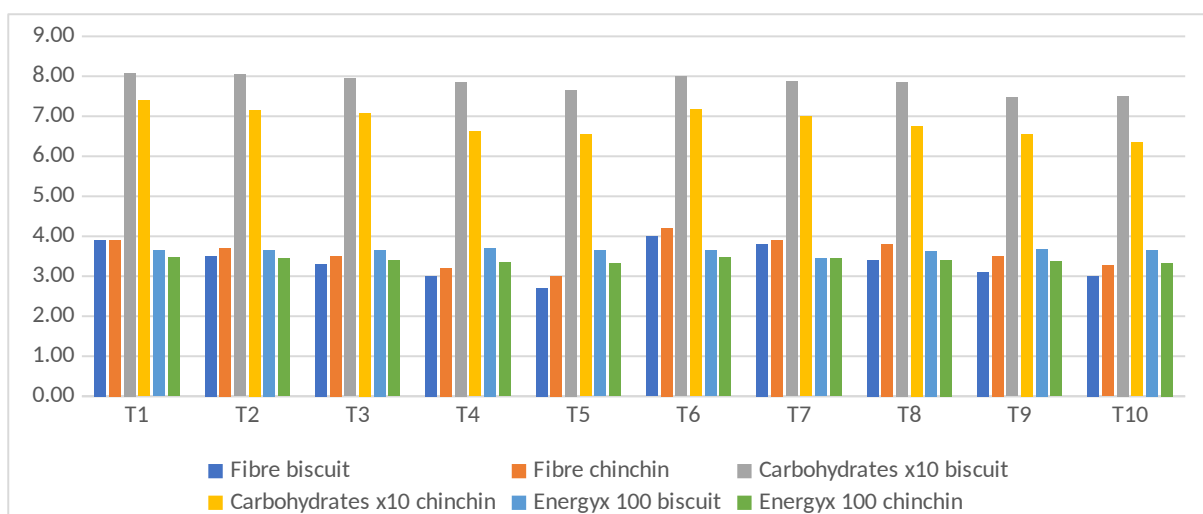
Figure 3: fibre and carbohydrate content, and energy value of Biscuit and Chin chin

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The chin-chin fibre content is higher than biscuits' fibre content (Figure 3); however, both products exhibited a significant ($p < 0.05$) reduction in per cent fibre with a rise in sorghum level. Also, the inclusion of okara in the flours resulted in the elevation of chin-chin and biscuits' fibre content because of the okara high fibre contents (Kiin-Kabari et al, 2015). Adegunwa et al. (2014) reported higher fibre content (5.23 %) of wheat chin-chin, while Ajibola et al., 2015, found lower per cent fibre (2.45 %) in wheat biscuits than the results obtained in this study.

Increasing the amount of sorghum flour in the mix and adding okara to the flour blend reduced the per cent carbohydrate in the biscuit and chin-chin. Biscuit carbohydrate (75.1 -80.8 %) is higher than chin-chin carbohydrate (63.5 -74.0 %). The energy value of chin chin made from the okara fortified plantain – sorghum flours range from 333.16 to 347.2 kcal/100 g, while that of biscuit is 363.3 to 370.5 kcal/100 g. Food energy derivable from biscuit is higher than chin-chin energy (Figure 3) and similar to that of Okoye, Ojimelukwe and Ukom, (2016).

Sensory evaluation

Sample	Colour	Texture	Aroma	Taste	After Taste	Overall Acceptability
biscuit						
T1	3.55±0.31[abc]	3.55±0.28[a]	1.40±0.11[a]	3.15±0.46[a]	3.45±0.53[a]	3.60±0.21[a]
T2	4.00±0.2[8bc]	3.55±0.52[a]	4.00±0.49[d]	3.80±0.48[b]	4.05±0.39[b]	4.50±0.41[b]
T3	4.60±0.23[c]	6.35±0.62[cd]	4.95±0.43[de]	3.25±0.24[a]	3.60±0.35[a]	4.90±0.34[c]
T4	4.05±0.52[bc]	6.95±0.40[d]	5.15±0.52[e]	4.05±0.21[b]	3.85±0.35[a]	5.10±0.39[d]
T5	4.45±0.27[c]	5.45±0.17[bc]	2.90±0.48[b]	5.10±0.34[c]	4.90±0.59[c]	5.00±0.34[cd]
T6	3.20±0.34[ab]	5.10±0.5[bc]	3.50±0.34[c]	4.00±0.42[b]	3.90±0.37[a]	5.00±0.36[cd]
T7	3.95±0.38[bc]	4.90±0.38[b]	3.30±0.33[bc]	4.05±0.03[b]	3.75±0.50[a]	5.20±0.33[d]
T8	4.20±0.32[bc]	5.15±0.48[bc]	3.20±0.32[bc]	3.20±0.19[a]	3.75±0.46[a]	4.70±0.37[bc]
T9	3.25±0.32[ab]	5.85±0.43[bcd]	3.60±0.44[c]	3.60±0.40[ab]	4.15±0.44[b]	4.05±0.29[b]
T10	22.75±0.31[a]	44.95±0.51[b]	33.55±0.38[c]	33.55±0.44[ab]	33.50±0.48[a]	44.95±0.31[c]
chinchin						
T1	4.80 ±0.35[ab]	5.55±0.34[a]	6.15±0.15[bcd]	6.20±0.30[a]	5.65±0.27[bc]	5.80±0.25[a]
T2	4.60 ±0.31[a]	5.58c±0.30[b]	5.45±0.18[abcd]	6.25±0.22[a]	5.79±0.15[d]	6.50±0.21[ab]
T3	5.30 ±0.39[ab]	5.60±0.30[a]	5.20±0.32[cd]	6.30±0.22[a]	6.00±0.16[cd]	6.30±0.33[ab]
T4	5.10±0.30[ab]	5.69±0.39[abc]	5.16±0.28[d]	6.45±0.34[a]	6.30±0.25[bcd]	6.50±0.28[ab]
T5	5.05±0.26[ab]	5.80±0.31[a]	5.00±0.22[ab]	6.55±0.27[a]	6.60±0.20[d]	6.50±0.27[ab]
T6	4.50±0.30[a]	5.70±0.18[ab]	6.20±0.30[abcd]	6.27±0.22[a]	5.00±0.31[a]	5.90±0.25[a]
T7	5.25±0.38[ab]	5.75±0.26[a]	5.59±0.26[abc]	6.32±0.19[a]	5.30±0.23[b]	6.80±0.19[b]
T8	5.20±0.40[ab]	6.30±0.17[abc]	5.45±0.39[a]	6.45±0.14[a]	5.55±0.21[d]	6.55±0.31[ab]
T9	5.55±0.26[ab]	6.70±0.21[bc]	5.32±0.33[abcd]	6.50±0.37[a]	6.15±0.28[bcd]	6.55±0.29[ab]
T10	5.85±0.26[ab]	6.95±0.18[c]	5.10±0.31[abcd]	6.55±0.32[a]	6.90±0.30[bcd]	6.95±0.23[b]

Table 7:   Sensory evaluation of biscuit and chinchin from okara-fortified plantain-sorghum composite flours

Means with the same superscripts in a column are not significantly different (p≤0.05)
Sample

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Key = T1 [[100P:0S]; T2 [75P: 25S]; T3 [50P: 50S] T4 [25P: 75S]; T5 [0P: 100S]; T6 [95P:0S: 5O]; T7 [71.25P:23.75S:0.05O]; T8 [47.5P: 47.5S: 5O]; T9 [23.75P:71.25S: 5O]; T10 [0P :95S: 5O] P [Plantain Flour], S [sorghum Flour], O[Okara]

Sensory property is an important determinant of food approval since consumers often examine detailed sensory attributes of food. The food product may have adequate proximate composition and high energy value, but without good sensory quality, such a product is likely to be unacceptable. The results of the organoleptic test carried out on the biscuit and chin chin made from the experimental flours, as presented in Table 7, revealed a significant variation in all the parameters assessed. The 20 – member panellists recorded better sensory scores for biscuit (colour 3.55 – 4.3; texture 3.05 -4.09; aroma 1.40 – 3.95; taste 3.25 – 4.35; aftertaste 3.5 – 3.6; overall acceptability 4.6 – 5.35) than chin-chin (colour 4.8 – 5.25; texture 5.58 -6.95; aroma 4.8 – 5.82; taste 4.2 – 4.55; aftertaste 5.65 –6.41; overall acceptability 5.8 – 6.95). Also, an increase in sorghum substitution and the addition of okara in the flour mix reduced the products' sensory quality. Biscuit made with 100 % plantain flour was most acceptable in terms of colour, texture, aroma, taste, after taste, and overall acceptability.

CONCLUSION

The okara enriched plantain-sorghum flours and their corresponding biscuit and chin-chin in this study are nutritionally better in protein, fat, and crude fibre than wheat flour. The fortification of the plantain - sorghum with 5% okara shows a notable increase in protein content. As revealed in the results above, highly nutritious food can be produced from a plantain-sorghum blend fortified with okara. The composite flours could serve as a substitute for wheat flour in making baked products that can fight protein malnutrition in developing countries. The study reveals that the inclusion of okara flour in the plantain-sorghum blend increase the protein level, hence, enhance the functional properties of the flours, which are required attributes for the production of starchy meals, and could serve as an advantage in both the domestic and industrial use of these crops.

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Framework Model of Facial Analysis for Gender Classification Using Convolutional Neural Network

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Abstract

Classification is a technique used for solving problems. Several problems are solved with this technique. Gender classification is gaining ground due to different areas of applications such as surveillance, security, and monitory, etc. Different authors have presented different research articles in the domain of gender classification and adopted several methods for analysing facial images in other to predict or classify the images. These methods adopted are either traditional algorithms, hybridised techniques, or neural networks to obtain better accuracy and reliability. This article is aimed at developing a model where gender can be classified. Successful classification needs a robust method with good experimental analysis that is why we present a gender classification using a Convolutional Neural Network for reliability and accuracy using a local dataset. Although, most of the articles in this research area made use of popular datasets such as FERET, AT & T, FACE94, AR to mention but few and/or compare two or more datasets to know the one with the best performance accuracy. Our state of heart method was used on local data set where sizable numbers of images (490 images) were captured and five different augmentations such as blur, top hat, lightening, etc were carried out on the images. The dataset was divided into two with 70% of the images used for training and the remaining 30% for testing. This was done with the use of a random selection algorithm. Required 227by227by3 image size was pre-trained by AlexNet a CNN. The experimental results generated several tables, Area under Curve (AUC) and Confusion Matrix. Our proposed ConvNet on our local dataset improves gender classification accuracy. In conclusion, the parameters for evaluation of performance were calculated and their Average performance scores were highlighted in bold. For **Precision (89.6272); Recall (89.6276); Accuracy (92.8094) and F1-score (89.6237).** The best performance average score was **92.8094** under the Accuracy.

Keywords: Gender, Facial Images, Facial Analysis, Classification, Convolutional Neural Network.

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INTRODUCTION

Biometrics verification acts as a measure for security and safety, it has gained popularity over decades in the area of image verification and identification. Biometric which is used for identity authentication takes biological input which may be informed of scanning or capturing of some parts of the human body such as the face, voice, palm, iris, and finger features.

Images such as animals, objects, and human beings are captured through biometric devices or any other capturing devices. Facial images datasets are tremendous on the internet in recent times; this has brought a large research area in the face recognition and verification domain (Sharma, Jain, and Mishra, 2018).

Face recognition system is one of the ways people display their emotions and it is a fundamental biometric system that proves effective, efficient, and highly authenticated (Dahghan, Ortiz, Shu, and Masood, 2017). Several important information is expressed through human faces such as emotion, race, gender, age, etc. (Yang, Chen, Ricanek and Sun, 2011).

These expressions can be processed in other to be able to detect or classify facial images by the means of a digital computer and with the use of machine learning algorithms. Classification as a technique is widely used in fields such as medical, security, etc. Every image has features to be extracted; these features are extracted from the shape, colour, edge, etc. of an image. Also, all images have picture elements (pixels) that are represented with values. Some values that are closer to 0 are denoted with black while those values closer to 255 are denoted with bright colour.

Gender classification is easily carried out by human beings but it is problematic for a machine. The gender classification will help to identify, authenticate and control access of people from some restricted areas such as security zone by allowing individual face as an identifier instead of using password, username, or even key. This paper presents a novel way of classifying gender using a convolutional neural network (ConvNet or CNN) as a deep machine learning algorithm that can multi-task and learn robust features for different tasks(Ranjan, Sankaranarayanan, Castillo, and Chellappa, 2016)

LITERATURE REVIEW
Gender Classification

According to Makkinen and Raisamo (2008); Khan, Nazir, Akram, and Riaz (n.d), gender classification dated back to early 1990 with the use of features-based based and appearance-based methods where a multi-layer neural network approach was used. Several algorithms have been used in the area of facial analysis such as facial detection algorithms, features extraction algorithms, or classifying algorithms. The lists below are the popular algorithms and classifiers used for face analysis.

i. Discrete Cosine Transformation (DCT): is an algorithm used to change e illumination condition of the facial images (Haider, Bashir, Sharif, Sharif, and Wahab 2014). This algorithm applied the captured images by keeping the coefficient in a zigzag form in other to convert the 2D images to vector (Hemalatha, 2014).

ii. Local Binary Pattern (LBP): is an algorithm used in the area of face detection localization that produced the highest-ranking matching level (Haider, et al. 2014). According to Gaur, Dixit, Hasan, Wani, Kaz, I, and Rizvi (2019) LBP has form been ally used in face texture investigation but now it is used for outward appearance extraction and opposes the variation to illumination with an easy way of computing. There is an extension of LBP which is VLBP (Volume Local Binary Pattern) which augmented LBP).

iii. Elastic Bunch Graph Map (EBGM): This algorithm is used for distance optimization amongst facial images. It helps to locate the nodes in the facial landmarks which include the corner of the eyes, nose tip, mouth, etc. The face graph is constructed by feature matching and manual correction which compares the graph. (Haider, et al. 2014)

iv. Linear Discriminant Analysis (LDA): This is a facial recognition algorithm used for high dimensional data (Haider, et al. 2014) where faces and non-faces are categories into some different parts (Mishra, and Dubey, 2015). It is used to represent the face vector space by using the class information which is referred to as Fisher's faces Delac, Grgic, Lintsis, (2005). The problem which limits the success of PCA was achieved with LDA. (Bhele and Mankar, (2012) mentioned that the LDA is mostly used for feature selection and use to optimise the discriminating power of the feature selection.

v. Principal Components Analysis: This algorithm was first developed by Turk and Pentland in 1991 as recorded by (Bhele and Mankar 2012; Gan, 2018). The algorithm was used to extract the main components of the individual face in the database and combine the largest eigenvectors (Mishra and Dubey, 2015). Delac et al. (2005) in their paper explained PCA as a technique used to represent a collection of sample points and dimensionality reduction of the description by projecting points onto the major parts and compressing the data. The reduced data space is used for recognition due to the elimination of the information that is not needed. The major challenge with this algorithm is the poor discriminating power coupled with the large computation and small size of the dataset.

vi. Independent Components Analysis: This algorithm is used for searching the essential components from the multi-level statistical data. The imperative use of ICA for face images with distinguishing orientation and illumination conditions is overwhelming. The distinction in ICA is that it examines a component that is statically independent and non-Gaussian (Bhele and Mankar 2012; Sutara, Rokadiab, and Shah 2016).

vii. Support Vector Machine (SVM): This is an algorithm used for classifying and recognising emotions (Gaur, et al 2019). Bhele and Mankar (2012) explain that SVM can only be used where there is no omission in the feature vectors defining sample. It also attains good generalisation performance. SVM finds the hyperplane that distinguishes the largest probable fraction point on the same area of the same class (Chawngsangpuii and Singh, 2015). This technique is popularly used for forecasting (Kumar et al., 2019).

viii. Artificial Neural Network: This is a classifying algorithm popularly used for harmonising the facial feature extraction which moves muscles. There is a hidden layer in NN that is likened to the parts of the face (Gaur, et al 2019). This classifier which is popularly used in object recognition and likes is used to extract the complex class of face features or patterns (Chawngsangpuii and Singh, 2015). There are a series of layers which is made up of neurons; neurons are connected by weighted combinations of all other neurons in the group (Shehina and Joseph, 2017).

Convolutional Neural Network in History

Convolutional Neural Network as a Classifier

Coskun (n.d) and Kamencay (2017) defined CNN as an artificial neural network that extracts features from input data. It was developed by Lecum and was first used for handwriting recognition. It is a feed-forward network that consists of multiple layers where the output of the previous layer enters the next layer as an input.

The multitasking ability of CNN has made it an appreciative algorithm in several areas of applications

and couple with its recognisable performance (Sharma et al., 2018).

CNN Layers

Convolutional Neural Network (CNN or CovNet) is a learning algorithm for image classification and recognition with a deep learning architecture. There are layers that datasets have to pass through when using the CNN algorithm before faces are recognised. According to Sharma et al., 2018) there are five layers that CNN goes through. These are;

i. Input Layer: This is the layer that takes captured images, resizes them, and later passes it to the second stage for feature extraction.

ii. Convolution Layer: This is the second layer; this layer is used to filter images and to extract the features which are used to determine the match feature point during testing.

iii. Pooling Layer: This is a layer where all images are resized to a reduced shape while protecting the useful information in them. It keeps the useful features within the window where the maximum value is kept. The related features of each training test are combined (Zafar, Ghafoor, Zia, Ahmed, Latif, Malik, and Sharif 2019).

iv. Rectified Linear Unit Layer (ReLU): This layer swaps all negative numbers to zero which makes the CNN stable.

v. Fully Connected Layer: This layer takes highly filtered images and classified those using labels. It makes sure that each layer is fully connected.

Several pre-trained CNN datasets such as GooLeNet, AlexNet, and ResNet meaning Residual Network, etc. are mentioned by (Sharma et al., 2018) these algorithms have proofed powerful and have effectively been used for image or object classifications, this is because it reduces the time for feature selection because convolution filters that convolve around the images to extract features that are called feature map (Zhang, Dind, Shang, Shao and Fu 2018).

Typical Convolutional Neural Network Architectures
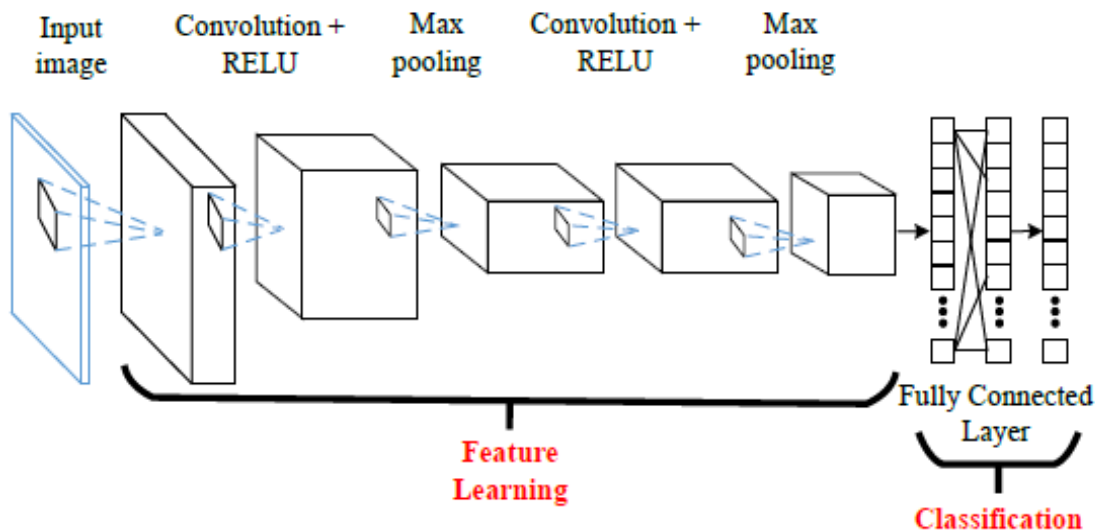
Figure 1: Typical CNN Architecture
Source: Kamencay P et. al. (2017).

MATERIALS AND METHOD
Image Acquisition

The image dataset consists of 490 images that involve males and females of different age brackets. Figure 3.1 shows the samples of images from the local dataset.
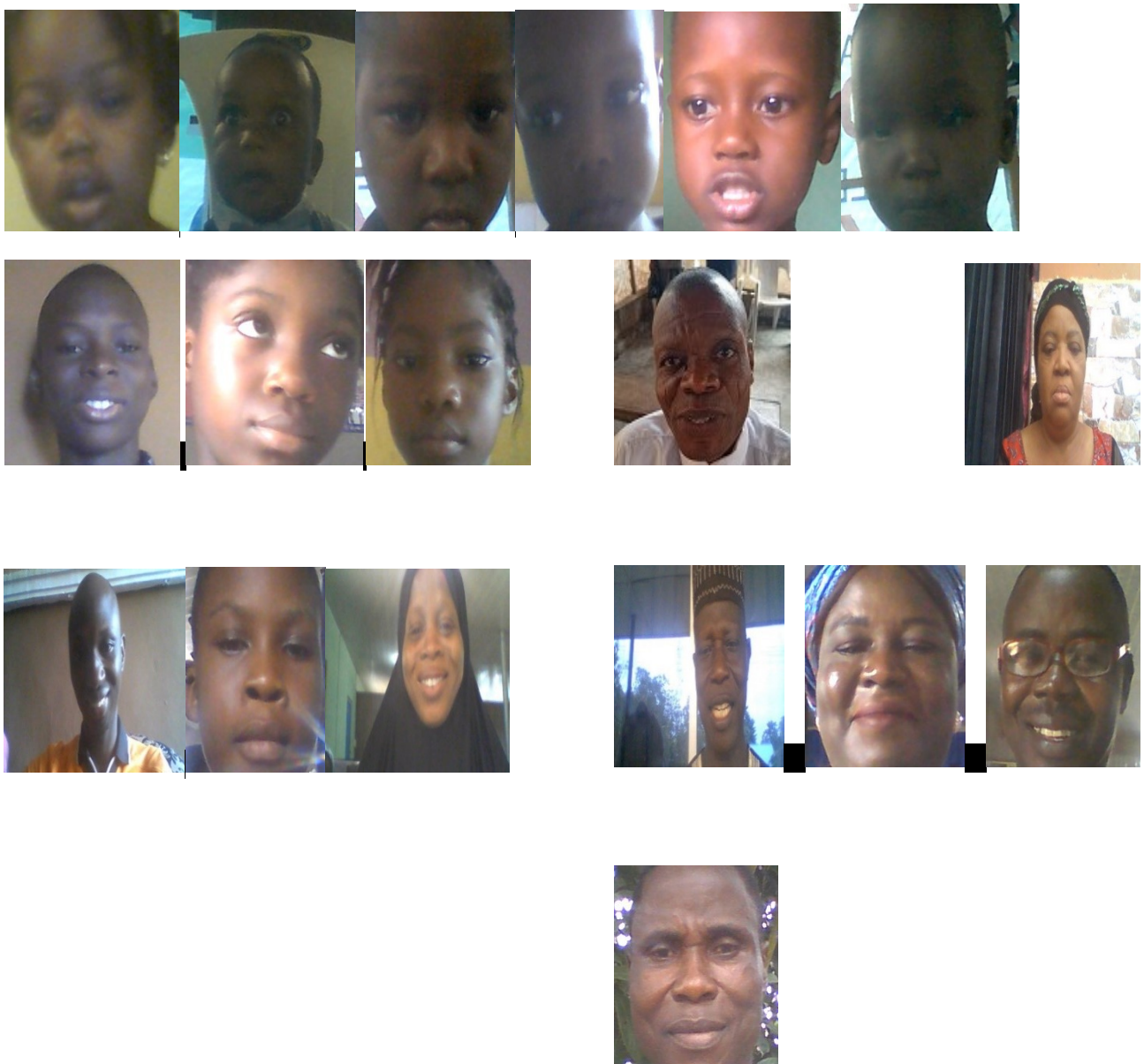
Fig. 3.1 Some Images from the Local Dataset Gender Recognition

The MTL-CNN model is to recognize the gender of the facial images. The loss function also known as error function is a function that maps the values of one or more variables onto a real number automatically representing some cost associated with an event. It describes how well an algorithms model dataset.

The loss function used for gender classification, L_g, is the cross-entropy loss given as:

$$L_g = -(1-G)\log(1-P_G) - G\log(P_G)$$

(3.1)

where $G=0$ for male and 1 for females. The P_G is the predicted probability that the facial image is a female.

Overview of the System Setup

For the sake of deep learning, the variables used were discrete values of (0 and 1) where 0 is used for male and 1 is used for female. All images are reduced to the dimension of 227by227 which is allowed by our model program to work with. The entire dataset was randomly divided by the CNN algorithm into two: the training and testing dataset.

The input layer of the CNN consists of filters. The filters are applied to the input image to produce feature map output. The feature map produced by the CNN layer ConvL1 is passed as input to the second layer ConvL2 for learning. The learned features from ConvL2 become the inputs for the next layer ConvL3. The process is repeated up to the final Fully Connected (FC) layer. Finally, the learned features become a trained CNN model as the classifier.
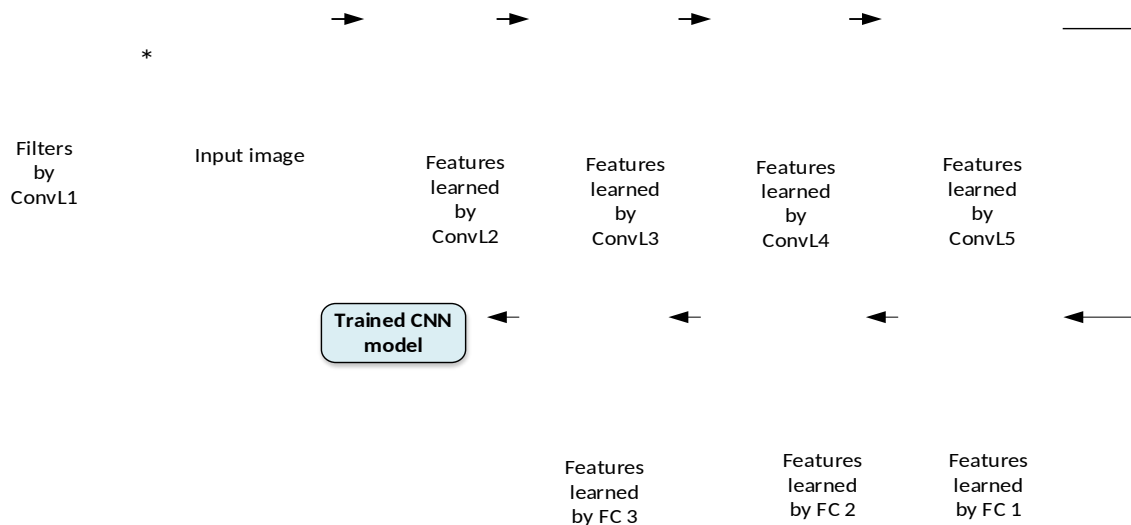
Figure 2: Architectural overview of the Model
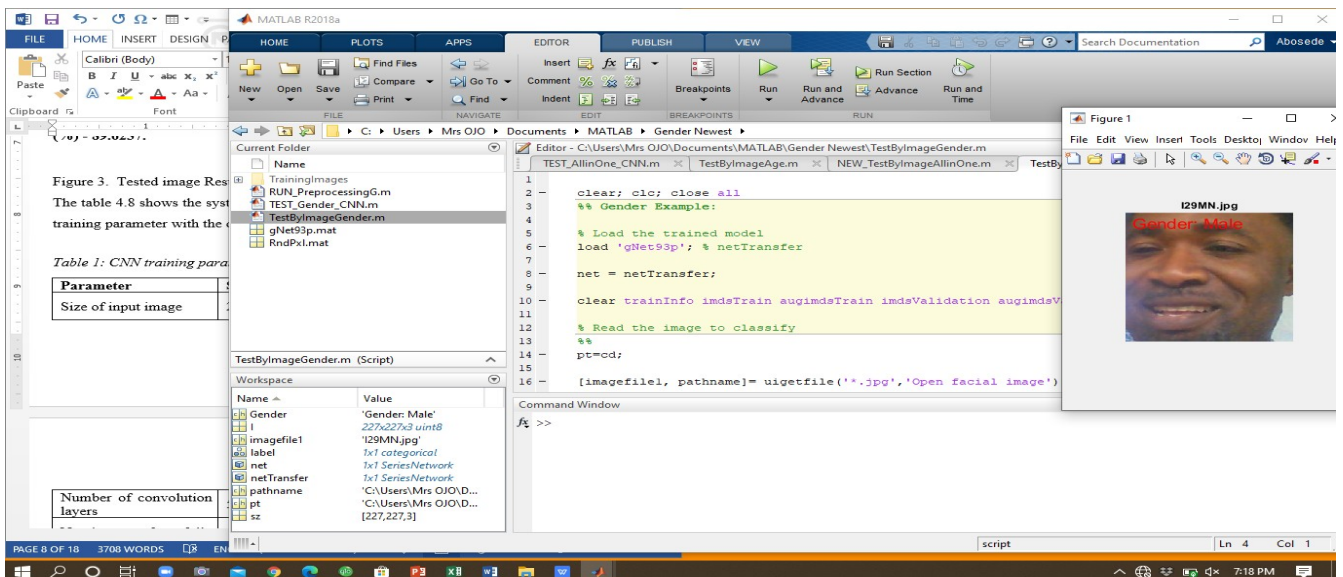
Figure 3: Tested image Result of the Implemented Gender Classification using MATLAB

Table 1 shows the system requirements for the PC used for the simulation and the CNN training parameter with the description of each of the parameters.

Table 1: CNN training parameters for Gender and its description

Parameter	Specification	Description
Size of the input image	227-by-227-by-3	The acceptable dimension required by the pre-trained algorithm (AlexNet)
Number of convolution layers	5	These are building blocks used in convolutional neural network
Number of fully connected layers	3	These are layers where all the inputs from the previous layer are connected to every activation unit of the next layer.
Activation function	Softmax	This is used to transform the unnormalised elements of a fully connected layer into a normalised output
Optimizer	Stochastic gradient descent	This is an iterative method used to optimise an objective function with appropriate smoothness properties.
Momentum	0.9	This is a designed method or technique used as a group of tricks to speed up the convergence of the first-order optimisation methods.
Maximum epoch	23	This is the maximum number of times the algorithm sees the entire dataset
Learning rate	0.0001	This is the parameter that controls how much we are adjusting the weights of our network concerning the loss gradient
PC used for simulation	64-bit OS, Core i5-5200U CPU @ 2.2GHz, 4GB RAM	PC Specifications for the simulation

Table 2: Testing of the created CNN model for Gender detection

Test Image ID	Gender (Actual or ground truth) Female/Male	Gender (Predicted by CNN) Female/Male
1	Male	Male
2	Male	Male
3	Male	Male
4	Male	Male
5	Male	Male
6	Male	Male
7	Male	Male
8	Male	Male
9	Male	Male
10	Male	Male
....	....	....
420	Female	**Male**
421	Female	Female
422	Female	Female
423	Female	Female
424	Female	Female

425	Female	Female
426	Female	Female
427	Female	Female
428	Female	Female
429	Female	Female
430	Female	**Male**
....	....	....
598	Female	Female

Table 3: Results of the created CNN model for Gender detection

	Training set	Testing set
Number of images	1394	598
Testing time (s)	3952	40.7549

Table 4: Comparison of the training set and testing set

Gender	Number of images tested	Correct classification	Misclassification	Precision (%)	Recall (%)	Accuracy (%)	F1-score (%)
Female (1)	292	260	32	89.0411	90.2141	92.8094	89.6237
Male (0)	306	295	11	90.2141	89.0411	92.8094	89.6237
Average				**89.6276**	**89.6276**	**92.8094**	**89.6237**
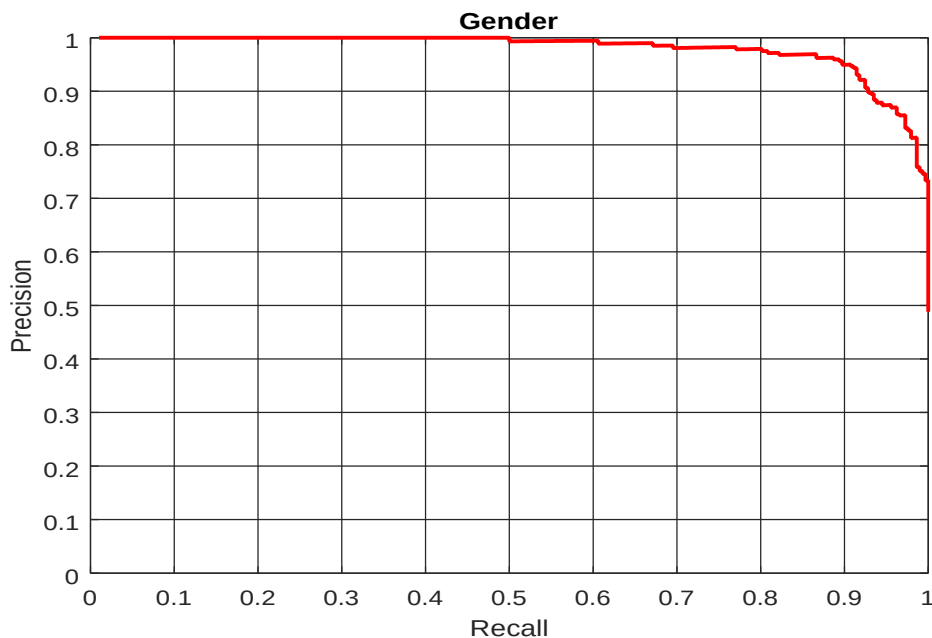
Figure 4: Precision vs. Recall on Gender
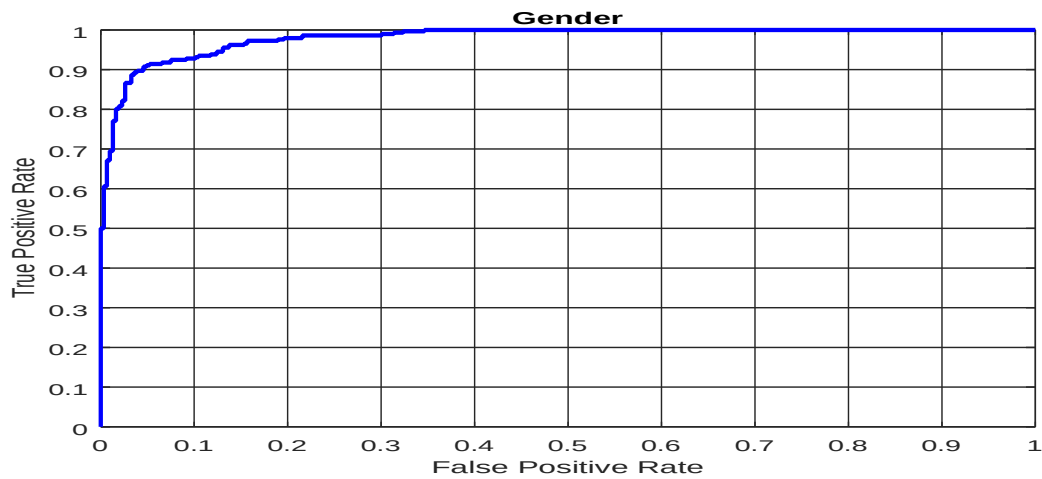
Figure 5: True Positive Rate vs. False Positive Rate on Gender

Table 5: Accuracy and Loss versus Epoch

Epoch	Training Accuracy	Testing Accuracy	Training Loss	Testing Loss
0	65.6250	52.6756	0.6817	0.7148
1	60.9375	57.3579	0.6944	0.6816
2	71.8750	69.2308	0.5731	0.5687
3	73.4375	73.9130	0.5512	0.4989
4	68.7500	75.0836	0.5553	0.4908
5	82.8125	81.1037	0.4502	0.3876
6	82.8125	85.2843	0.4297	0.3408
7	90.6250	84.4482	0.2804	0.3511
8	81.2500	85.7860	0.3915	0.3335
9	93.7500	82.7759	0.2320	0.3704
10	85.9375	87.7926	0.3609	0.2895
11	90.6250	85.1171	0.1984	0.3305
12	84.3750	88.7960	0.3241	0.2714
13	81.2500	80.1003	0.4224	0.4309
14	89.0625	90.4682	0.2998	0.2375
15	85.9375	90.1338	0.2947	0.2209
16	89.0625	92.1405	0.2768	0.2188
17	93.7500	91.4716	0.1494	0.2278
18	95.3125	90.9699	0.1025	0.2238
19	82.8125	93.3110	0.2345	0.1703
20	98.4375	93.6455	0.1144	0.1653
21	92.1875	91.8060	0.1372	0.2076
22	84.3750	92.8094	0.2340	0.1861
23	89.0625	92.8094	0.2602	0.2039
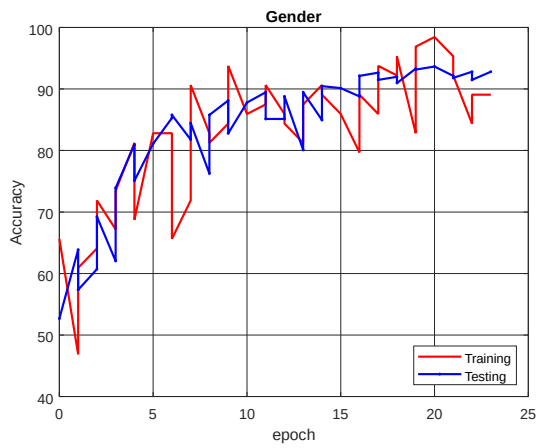
Figure 6: Accuracy vs. Epoch
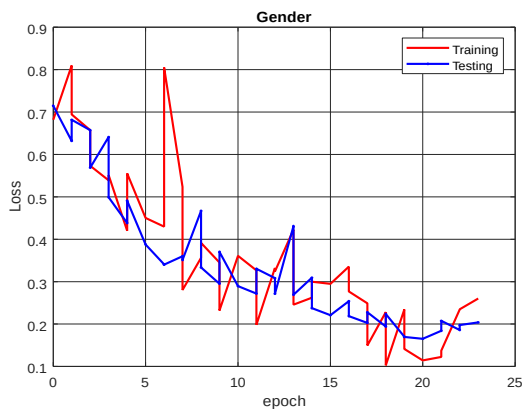
Figure 7: Loss vs. Epoch

Table 6: Confusion Matrix for Gender Classification

Figure 8: Sample of trained images - "Female" is denoted by digit 1 while "Male" is denoted by digit 0
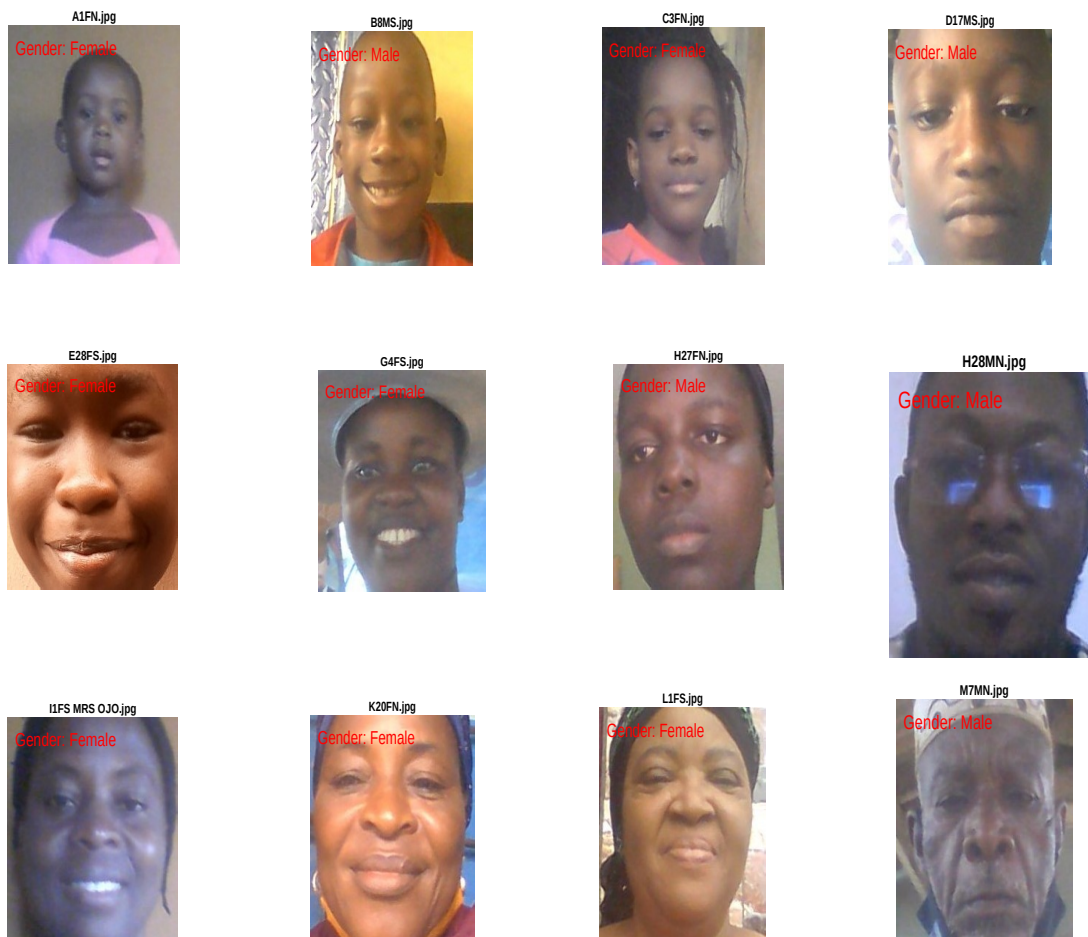
Figure 9 Tested input samples for Gender classification

DISCUSSION

Discussion on Gender Classification

Table 2 represents the result of testing the CNN model for gender detection where 598 images were tested with a brief discussion.

1. Test Image ID: the Test imageId column represents the total number of Images tested. These images were randomly selected from the testing images using random selection algorithms.
2. The Gender Actual or ground truth: is the column that shows the true sex of the image selected where digit 1 denotes female and digit 0 denotes male.
3. Gender Predicted by CNN: This column shows what the CNN classifier classified on the Test ImageId.

The Precision, Recall, Accuracy, and F1-score which are parameters for evaluation of performance were calculated and their Average performance scores were highlighted in bold. For **Precision (89.6272); Recall (89.6276); Accuracy (92.8094) and F1-score (89.6237).** The best performance average score was **92.8094** under Accuracy with two different epoch that is epoch 22 and epoch 23.

Table 4 shows the comparison of the number of training images and testing images with their testing time. A total number of 1394 images were used for training and 598 images were used for testing with 3952(s) for training and 40.7549(s) for testing with the use of an algorithm called random selection algorithm. The total number of the figure for both the training and the testing images was gotten from the number of the images stored as a dataset which was 490 images multiplied with the five different augmentations performed on each image.

Table 5 shows the Recall vs. Precision and False Positive rate vs. True Positive Rate with their graphs. While table 4.6 shows the training/testing Accuracy vs. the Training/ Testing Loss. With a cursory look at the table, there is a stable increase in the training accuracy column from epoch 0 to epoch 3. But, at epoch 4 there was a decrease in the accuracy that later increase in epoch 5 with an obvious increase. On the other hand, a steady increase was observed under the testing accuracy from epoch 1 to 12 with a decrease in epoch 13. All these fluctuations were a result of the update in the weights at every epoch iteration and these resulted in different validation errors and invariably the network accuracy during the training.

Finally, the Confusion Matrix for the Gender Classification represents the result of the gender classification. From table 3, it was observed that the total percentage number of correctly classified images

In table 2, the first Test imageId (1) which represents the first image was male on the ground truth and correctly predicted as male by the CNN classifier. But a cursory look at the Test ImageId (420) which was female and was misclassified by CNN classifier. So also the Test ImageId (430) was female but predicted as male.

Table 3 shows the result of created CNN models for gender detection where the total number of 598 images was tested. With 292 images females (1) and 306 images males (0). 260 images from 292 female images were correctly classified, while the remaining 32 images were misclassified. Also, 295 male images (0) out of the 306 images were correctly classified while 11 images were misclassified.

for females (0) was 260 out of 292 images with a percentage score of (89.0%) and 32 misclassified as male with a percentage score of 11.0%. 295 out of 306 images trained were correctly classified with a percentage score of 96.4% while 11 images were misclassified as female with a percentage score of 3.6%. The overall average **accuracy was 92.8%** and the overall average loss was 7.2%.

CONCLUSION

We implemented our state–of–the–art gender classification using MATLAB R2018a where we used a local dataset of 490 images. These images were cropped to the required dimension of 277by277 as required by the

AlexNet pertained architecture. Five different augmentations were performed on the images in other to populate the dataset and to be able to enhance the classification process. Finally, the CNN model has very high accuracy with significantly better performance where we have **89.6276** for **Precision (%); 89.6276** for **Recall (%); 92.8094** for **Accuracy (%)** and **F1-score (%)** is **89.6237.**

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A Survey of Fish Hatcheries in Yewa South and Yewa North Local Government Areas of Ogun State, Nigeria

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Abstract

Fish culture today is hardly possible without the artificial propagation of fish seeds of preferred culturable fish species. This has led to this research work to determine the number of fish hatcheries in the immediate local environment and assess the constraints encountered in this sub-sector of agriculture. A field survey through the use of well structured questionnaire was conducted in two local government areas of Ogun State namely Yewa South and Yewa North LGAs. The study revealed that there are 57 fish hatcheries in the two Local Governments. Majority of the respondents (89.5%) were males in their active youthful age. Out of these, 94.7% are privately owned (sole ownership), 3.5% are on partnership and 1.8% are government owned with majority having annual production above 100,000 fingerlings. The intensity of hatchery in each town under the study area are Ilaro (16), Owode (13), Ilobi (1), Imasai (10), Oke –Odan (2), Oja-Odan (14) and Ibese (1), with Ilaro having the highest number of fish hatcheries. This study has revealed that the quantity and quality of fish hatcheries in Yewa South and Yewa North LGAs of Ogun State need to be increased.

Keywords: Aquaculture, Fish hatchery, Yewa South LGA, Yewa North LGA

INTRODUCTION

Fish is a vital source of quality protein needed by the public. Fish is a source of rich food for the indigent and plays an important role in stabilizing food security and the nutritional status of the people, most especially those in Africa and other developing part of the world (Ayoola 2010). More focus has been shifted in increasing fish production in Nigeria through aquaculture, because of the immense economic and nutritional benefits of fish to the populace.

Nigeria is a country deficient in protein (FAO, 2006). Protein from animal sources is inadequate in Nigeria due to the current surge in the nation's population. This situation has led to a considerable increase in the request for fish to complement the much needed animal protein intake. FAO (2006) explained that to maintain the current per capital fish consumption level of 13 kg per year, 2.0 million metric tons of food fish would be needed. It was noted by some workers that the only way of meeting up with this annual fish demand for the country would be through an action-oriented option of intensive fish farming (Ezeri, Olaoye, and Agbon, 2009).

The steadily growing importance of fish farming has compelled improvement in the technologies necessary for securing the initial and basic requirement for productive aquaculture, namely: the production of fish seed for stocking. Aquaculture today is impossible without the artificial propagation of fish seeds of preferred culturable fish species (Olaoye and Oke, 2012). A rearing environment that assures optimum and rapid growth which allow harvest in the shortest possible period is quintessential with the stocking of fish fingerlings or juveniles for the production of marketable fish. Fish hatchery is the solid foundation through which fish farming can be sustained (Madu, 2004). However, unavailability and scarcity of fingerlings and juvenile has been a major setback to the development of aquaculture especially during the non-breeding season. It is oblivious to know that the demand for aquaculture product is always on the rise both locally and globally. This has led to this research work to discover the number of fish hatcheries in the immediate local environment, obtain the socio-demographic characteristics of fish hatcheries owners, investigate the process of fish hatchery operations and assess the constraints encountered in this sub-sector of agriculture as the challenge to increase protein consumption in Nigeria appears to be more urgent now than ever.

MATERIALS AND METHOD
The Research Study Area

The research was conducted in Ogun State in South-Western Nigeria. The state has a total population of 3,751,140 according to National Population Commission (NPC, 2004). The state is bounded in the west by Benin Republic, in the south by Lagos State and Atlantic Ocean, in the east by Ondo State, and in the north by Oyo State. It covers a land area of 16,409.28 km^2, less than two percent (2%) of the country's landmass (Olaoye, Adekoya, Ezeri, Omoyinmi, and Ayansanwo, 2007). The state has

marine and riverine biotopes and is well endowed with natural water bodies such as springs, perennial flowing rivers, lakes and brackish waters. Ogun State has twenty Local Government Areas with her capital in Abeokuta. The Local Government Areas are Abeokuta North, Abeokuta South, Ado-Odo/Ota, Ewekoro, Ifo, Ijebu North East, Ijebu North, Ijebu Ode, Ijebu East, Ikenne, Imeko Afon, Ipokia, Obafemi Owode, Odeda, Odogbolu, Ogun Waterside, Remo North, Sagamu, Yewa North and Yewa South. Ogun state has four main political zones; Ijebu, Remo, Egba and Yewa. The last zone which is Yewa was the area of study.

Fig. 1 showing map of Ogun State

Sampling Procedure and Sample Size

Purposive sampling technique was used; due to the proximity of the local government areas to the institution. The Federal Polytechnic, Ilaro herself is located within Yewa South LGA. Fish hatchery owners; either private or government owned located in Yewa South and Yewa North LGAs were sampled. Primary data were collected through the distribution of 150 well-structured questionnaire. Questionnaires were administered through physical interview with fish hatchers and visual observation of facilities in each farm. Respondents (Fish hatchery operators from the two Local Government Areas) were located and selected through snow ball technique and from reports obtained from OGADEP and Ministry of Agriculture (OGADEP 2009). Out of the 150 questionnaires budgeted, only 57 were administered due to the low population of the targeted respondents in the study area. This gives 38.7% serving as the sample size.

Data Analysis

Data obtained from the field were subjected to descriptive analysis using Statistical Package for Social Sciences (SPSS) and inferential statistical analysis. Frequency counts, percentages, charts and tables were used to describe the socio-demographic characteristics of respondents.

RESULTS AND DISCUSSION

The study carried out on fish hatcheries in Yewa South and North Local Government Areas in Ogun State indicates that majority of the respondents (89.5%) were males. The number of female into hatchery business are very few with a percentage of 10.5% (Table 1). 50.9% were within the age range of 30-39, 28.1% within age 40-49, 20.5% within age 20-29, while 7.0% and 3.5% occupy the age range of 50-59 and above 60years respectively. This shows that a good population of the respondents are within their active youthful age. Among the respondent 75.4% were married and 24.6% were single. The educational level attained by the fish hatchers surveyed indicated that a lofty percentage of the fish farmers, 66.6% had their tertiary education certificate, 28.1% with secondary school certificate while 5.3% only had primary level of education. Among the respondents, 73.7% were Christians with the remaining population of 26.3% being Muslims. This can be related to the fact that the Yewas are predominantly Christians. 45.6% are full-time fish farmers, those have trading as secondary occupation are 19.3%, those who are artisans are 19.3% while civil servants into hatchery operations are 15.8%.

Table 1: Biodata of respondents

Data	Frequency	Percentage %
Sex		
Male	51	89.5
Female	6	10.5
Age		
20-29	6	10.5
30-39	29	50.9
40-49	16	28.1
50-59	4	7.0
≥60	2	3.5
Marital Status		
Single	14	24.6
Married	43	75.4
Religion		
Christianity	42	73.7
Islam	15	26.3
Educational level		
Primary	3	5.3
Secondary	16	28.1
Tertiary	38	66.7
Secondary occupation		
None	26	45.6
Trading	11	19.3
Artisan	11	19.3
Civil servant	9	15.8

Source: Field work, 2020

The survey uses 57 questionnaires out of 150 budgeted for this study, signifying there are about 57 fish hatcheries in Yewa South and North Local Government Area of Ogun State. Out of these hatcheries, 94.7% are privately owned (sole ownership), 3.5% are on partnership and 1.8% are government owned with majority having annual production above 100,000 fingerlings. The intensity of hatchery in each town under survey area are Ilaro (16), Owode (13), Ilobi (1), Imasai (10), Oke –Odan (2), Oja-Odan (14) and Ibese (1), with Ilaro as town with the highest fish hatcheries in Yewa South and North Local Government Area of Ogun state (Fig. 3). 47 hatcheries (82.5%) breed as well as culture fish to table size while the remaining 17.5% operate fish hatchery alone (Fig.2).
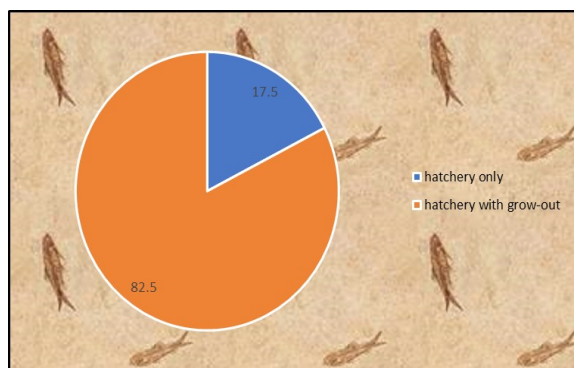
Fig 2: Type of fish farm
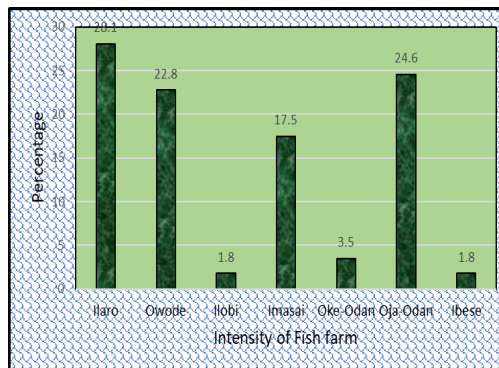
Fig 3: Intensity of fish farm per town

Figure 4 reveals that majority (82.5%) of the fish hatchery operators don't belong to any association while 17.5% belong to one association or the other. They believe that

registering with relevant associations will create some form of financial responsibility on them, as this may later result in financial burden

on the fish farm operators. This had led to a small percentage of the fish hatchery operators registering with the relevant association. Fig. 5 shows the fish tank mostly used in the study area with concrete and plastic users having the highest percentage (24.6%).
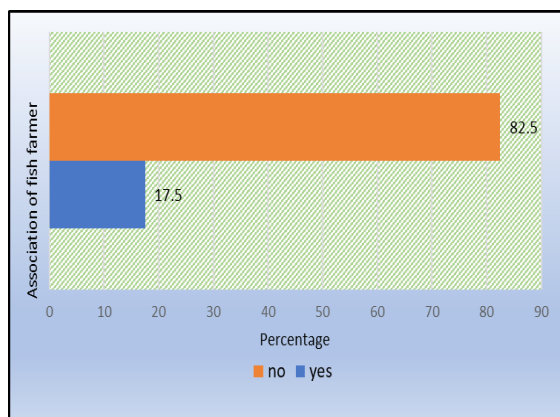
Fig 4: Association of fish farmers
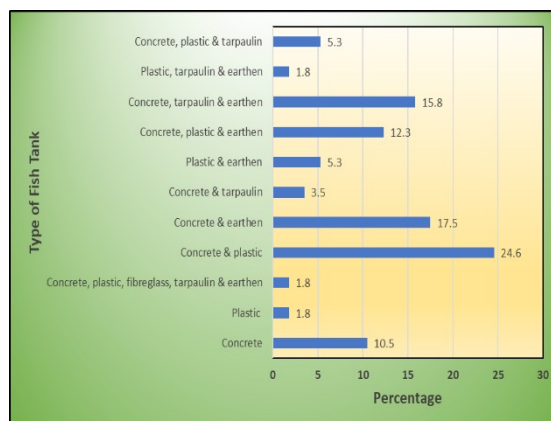
Fig 5: Type of fish tanks used in each farm
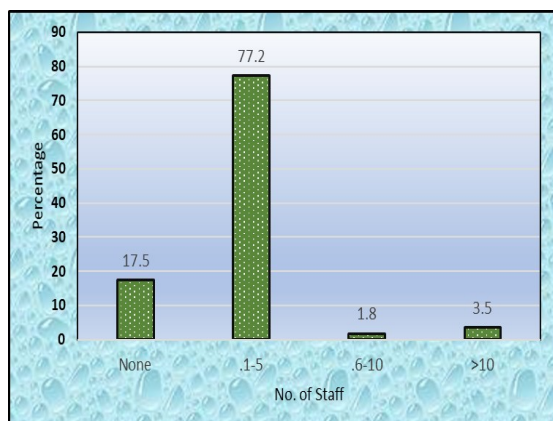
Fig. 6: Number of staff
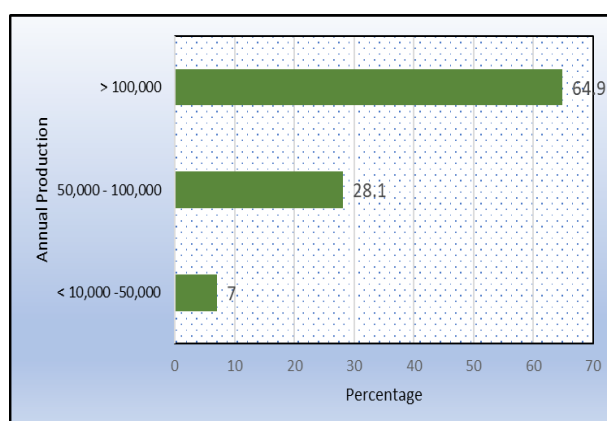
Fig. 7: Annual production of fingerlings

Hatcheries with farm attendants of 1 to 5 were most dominant, followed by those without staff (Figure 6). This is an indication that the hatcheries are just weathering the storm of establishment as a private ownership. Despite having low number of farm attendants, majority of the fish hatcheries are able to produce more than 100,000fingerlings per annum. An indication of this is shown in Figure 7.

As most of the hatchery are still at their formative stage, the study revealed that a good percentage of the hatchery have the arrangement/set-up of their farm as being

satisfactory. A few exception have an excellent organization. Table 2 further describe several methods used in the breeding process, type of feeds given to fish fry and fingerlings, type of hormones used for artificial induced breeding, number of breeding cycles done per annum, etc. It is quite surprising that all the fish farms located within the research study area are into the culture of catfish. In spite of several challenges faced by the respondents and the willingness of a few (14%) to quit the job if there's an alternative, a 100% fish farmer agreed that fish hatchery business is highly lucrative and profitable.

According to Olanrewaju, Agbelege, Daddy, and Okoye, (2010), effective aquaculture development has been identified as a critical remedy to improving local fish production in Nigeria in order to reduce the current deficit in fish demand. For maximum production of aquaculture to be attained, the quantity and quality of fish hatcheries need to be increased. Akankali Seiyaboh, and Abowei, (2011) also stated that the vital requirement of fish hatchery, nursery, rearing and production ponds which includes hormone, brood-stocks, water and feed, serving as the basic essentials in fish production need to be adequately addressed. Fish hatchery usually encounter challenges hindering production efficiency. Some of the major challenges faced in production are capital in expanding the business, sudden fluctuating weather condition and disease infection resulting in low survival or high mortality of fish seeds (Olanrewaju *et al.,* 2010), lack of electricity supply in pumping water, posing a huge financial burden on farmers by using generators as substitute and immediate access to market among others.

Table 2: Fish Breeding Methods cum Level of Production

Parameter	Frequency	Percentage %
Hatchery organization		
Excellent	7	12.3
Satisfactory	50	87.7
Breeding method		
Artificial induced breeding	55	96.5
Natural induced breeding	2	3.5
Source of broodstock		
In situ	22	38.6
Other farms	8	14.0
Wild	1	1.8
In situ & open market	1	1.8
In situ & other farms	25	43.9
Fingerlings feed		
Commercial feeds	51	89.5
Natural live feeds	1	1.8
Commercial and others	1	1.8
Commercial & live feeds	2	3.5
All the above	2	3.5
Fry feed		
Artemia	24	42.1
Artemia and others	28	49.1
Plankton and others	5	8.8
Type of hormone		
Pituitary gland	10	17.5
Ovaprim	4	7.0
Pituitary gland & ovulin	7	12.3
Pituitary gland & ovatide	9	15.8
Pituitary gland & ovaprim	15	26.3
Pituatiary gland, ovulin & ovaprim	4	7.0
Ovuline	5	8.8
Pituitary gland, ovatide & ovaprim	3	5.3
Challenges in production		
Financial challenge	17	29.8
Weather	4	7.0
Disease	2	3.5
Electricity	12	21.1
Mortality	3	5.3
Brood stock	3	5.3
Accessibility to market	5	8.8
Weather and others	11	19.3
Production cycle/annum		
1-4	4	7.0
5-10	18	31.6

11-15	6	10.5
≥ 16	29	50.9
Abandoning profession		
Yes	8	14
No	49	86

Source: Field work, 2020

CONCLUSION

The outcome of this research work has revealed that catfish is the major fish cultured in Yewa South and North LGAs. Most of the respondents were interested in fish farming and understood that fish hatchery has a paramount role to play in the rejuvenation of aquaculture by producing required amount of fish seeds for fish culture. As fish hatchery is a solid foundation upon which a sustainable aquaculture can be built and for aquaculture to be a great unique remedy to declining capture fisheries, several landmines as mentioned above faced by fish hatchery operators need to be focused upon. These challenges pose a major constraints to successful hatchery operation in Yewa South and North LGAs, Ogun State. In order to sustain fish hatchery, the following recommendations may be of great benefit.

Recommendations

- Fish farmers within a community should collaborate to form an e-platform providing vital information such as accessible markets, source of broodstock, agriloans from government etc.
- Hatchery operators should embark on further training on induced breeding activities and hatchery management to combat challenges such as disease outbreak and sudden weather changes.
- Hatcheries should always get some of their broodstock from other farms to avoid in-breeding.
- All the arms of the government (local, state and federal) should assist in sourcing for a cheap and constant alternative to electricity supply.

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Effect of Aqueous Blend of Three Herbs on Haematobiochemical Indices of Broiler Chicken at Starter Phase

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Abstract

This research was centered on the effects of aqueous blend of three herbs on hematobiological indices of broiler chickens at the starter phase. Newly hatched Cobb 500 broiler chicks totaling 120 were allotted to 4 groups randomly. The groups namely Treatment 1 serves as the control without aqueous blend, other three treatments received 50 mL of; Scent leaf aqueous blend (SLAB), Ginger aqueous blend (GIAB) and Garlic aqueous blend (GAAB) to 1 litre of drinking water respectively. At 7 and 21 days of the experiment, blood samples were taken for heamatology and biochemical analysis. The observed values of RBC, WBC, Hb, and PCV (red blood cell, white blood cells, packed cell volume and hemoglobin) were significantly different from the control group at $p < 0.05$ with the fourth group having the highest value. It was observed on day 21 that the group fed garlic aqueous blend had levels of AST and ALT reduced than other groups. The low level of AST and ALT means that Garlic has hepatoprotective ability. Garlic aqueous blend group shows significantly high values ($p < 0.05$) of albumin, total serum protein, and globulin in contrast to other groups. Consequently, all values observed are within the reference range of broiler chicken. This results shows that the aqueous blends can be used at a safety dose 50 mL / liter of drinking water as an alternative to conventional growth promoters.

Keyword: Herbal blends, Broiler, Garlic, Ginger, Scent leaf

INTRODUCTION

The contributions of poultry production to the advancement of countries cannot be denied, because they provide animal protein that is cheap, at a shorter duration (5-8 weeks) and at a considerably reduced price to the customer when compared to other animal protein sources (Bosun, Kagya-Agyemang, Kwenin, and Zanu, 2012).

Aduku, (2004) reported that more than 50 billion chickens are raised annually for meat, this figure accounts for thirty percent of the protein consumed by humans as compared to other domestic animals.

The administration of antibiotic growth promoters (AGPs) in livestock sector spans over the last 50 years (Torun et al., 2018). However, public awareness is on the rise of human health challenges coupled with environmental risks caused by the excessive use of these AGPs (Torun et al., 2018) because of the presence of these antibiotics' residues in poultry meat and other poultry products beyond maximum permissible level (Muaz, Riaz, Akhtar, Park, and Ismail, 2018, Akinlade, Obi, and Lawanson, 2020).

Cao. Li, Lu and Zhao (2004) reported that synthetic feed additives contain trace level of vitamins, micro-minerals, anti-oxidants thus having great effect on the hormonal and immune system and increasing blood lipid concentration.

The outcome of serum and hematology analysis has been generally accepted as a means to evaluate the physiological and health status of livestock, changes in their values are indications of livestock response to varying physiological situations (Khan and Zafar, 2005).

The utilization of plants, their seed, bark, root and leaf aqueous extracts in animal production is becoming popular around the globe and has been scientifically and commercially accepted as a means of preventing and curing diseases, as well as enhancing the growth of poultry birds (Djkalia, Guichard, and Soumaila, 2011). Zhang, Yang, Wang, Jiang, and Gai, (2009) reported several medicinal plants that have proved useful in promoting efficiency in animal production, they include Moringa, Bitter leaf, Neem, Scent leaf, Gallic, Ginger, teak leaves among others. Scent leaf, Garlic and Ginger are available in large quantities and are scattered around

the tropics of Africa. They are easily accessible and can conveniently substitute synthetic growth promoters thereby reducing the price of chicken.

MATERIALS AND METHODS

Experimental Site
The experiment took place at the Poultry Unit of Agricultural Technology Department, The Federal Polytechnic, Ilaro. Ilaro is located in Yewa South Local Government area of Ogun State. It has coordinates of Latitudes 6°37′46″N and 6°55′42″N and Longitudes 2°47′24″E and 3°6′48″E.

Preparation of Experimental Aqueous Blends
Fresh Scent leaf, Ginger and Gallic were purchased from Sayedero market, Ilaro. They were rinsed to remove debris, sand and afterward drained. The Scent Leaf was weighed and blended (using a blender "Pyramid® PM-B999") with water at a ratio of 100 g to 1000 mL. The mixture was filtered using a muslin cloth to get scent leaf aqueous blend (SLAB) (Okhale, Bolaji and Bello-Onaghise, 2019). Garlic and Ginger were peeled separately, cut into small pieces. 100 g each of fresh Ginger and Gallic was blended with 1000 mL of water for 2-3 minutes (Kumari, Venkateshwarlu, Choukse, and Anandan, 2014). The mixture was sieved with a muslin cloth, the liquid part of the separation gave the herbal blends (Ginger aqueous blend 'GIAB' and Gallic aqueous blend 'GAAB') which were kept in the fridge and used for the experiment. Fresh extracts were prepared at five (5) days interval (Okhale, et al., 2019).

Experimental Animal and Management.
120 (Cobb 500) newly hatched broiler chicks were purchased from a commercial Hatchery in Ibadan. They were kept in the brooding pen for seven days for acclimatization. After which they were shared to Four (4) treatments in a completely randomized design (CRD) (Akinlade and Okusanya, 2020). The treatments were replicated three times with ten (10) birds per replicate. The birds were fed with a popular commercial broiler diet throughout the starter phase. All essential vaccines were administered.

Treatment 1 serves as the control, Treatment 2, 50 mL of SLAB, Teatment 3, 50 mL of GIAB and Treatment 4, 50 mL of GAAB to 1 litre of drinking water respectively. Feeding and watering was done ad-lib all through the starter period. Heat and ventilation was done according to proper management procedures (Akinlade and Okusanya, 2020).

Parameters measured

Hematological Studies
2 ml of blood was taken from six marked birds from each treatment at the beginning of the experiment and at the last day of the experiment (day 7 and 28 respectively). The blood was collected through the brachial vein in ethylene diaminetetra- acetic acid (EDTA) vials. The Hb, PCV, RBC, WBC analysis were carried out using procedure outlined by (Schalm Jain, and Carroll, 1975)

Serum Indices
2 ml of blood was taken from six marked birds from each treatment at the beginning of the experiment and at the last day of the experiment (day 7 and 28 respectively). The blood was collected through the brachial vein into sterilized test tubes and was centrifuged using a macro centrifuge to separate the serum which was used for biochemical analysis. Biuret method was used to evaluate Total serum protein, Albumin was done using BCG dye binding method, globulin, AST (aspartate aminotransferase), ALT (alanine aminotransferase) and serum creatinine was carried out using alkaline picrate method. The globulins were calculated by subtracting the values of albumin from total serum proteins.

Statistical Analysis.

All data were carefully inputted on Excel Microsoft 2015 and were analyzed with SPSS software (version 19.0, SPSS Inc) using analysis of variance (ANOVA) and the treatment means was separated using Duncan range test. Statistical significance was assumed at $P < 0.05$ (Oleforuh-Okoleh, Ndofor-Foleng, Olorunleke, and Uguru, 2015).

RESULTS AND DISCUSSION

Results

Tables 1 and 2 show the hematological values of the blood samples on day 7th and 28th day respectively. Table 1 shows no statistical difference (p<0.05) in the value of Hb, PCV, RBC, and WBC observed on the 7th day. In contrast, table 2 shows that Hb, PCV, RBC, and WBC values were statistically different on the 28th day.

Table 1: Haematological parameters of broilers before administration of experimental blends

Parameters	Control	50 mL/Lit (SLAB)	50 mL/ Lit (GIAB)	50 mL/Lit (GAAB)	±SEM
PCV	26.00^d	28.33^c	30.33^b	32.00^a	0.705
Hb	8.600^c	9.433^b	10.300^a	10.800^a	0.2662
RBC	2.200^d	2.367^c	2.533^b	2.700^a	0.0597
WBC	12.433^b	13.200^{ab}	14.767^a	14.433^a	0.3549
HET	29.33^a	28.33^a	28.00^a	29.67^a	0.458
LYM	69.33^a	70.00^a	70.33^a	69.67^a	0.534
EOS	0.33	0.67	0.67	0.00	0.515
BAS	0.33	0.67	0.33	0.67	0.522
MONO	0.67	0.33	0.67	0.00	0.515
MCV	118.200	119.733	119.733	118.533	1.4311
MCH	39.067^b	39.867^{ab}	40.667^a	40.000^{ab}	0.7198
MCHC	33.067^b	33.267^b	33.967^a	33.733^a	0.4166

Table 2: Effect of aqueous blends of the experimental herbs on Hematological parameters of Broilers

Parameters	Control	50 mL/Lit (SLAB)	50 mL/ Lit (GIAB)	50 mL/Lit (GAAB)	±SEM
PCV	26.50	24.50	25.00	24.75	0.839
Hb	9.100	8.350	9.550	8.400	0.2702
RBC	2.275	2.050	2.425	2.175	0.093
WBC	12.700	13.575	14.025	11.375	0.5074
HET	28.25	28.25	28.25	28.50	0.384
LYM	69.50	68.50	69.75	68.25	0.398
EOS	0.25	0.25	1.25	1.25	0.233
BAS	0.75	1.50	1.00	1.00	0.17
MONO	1.25	0.50	0.75	1.00	0.18
MCV	116.850	119.825	115.300	116.125	1.7795
MCH	40.100	41.025	39.350	39.450	0.6805
MCHC	34.350	34.200	34.125	33.975	0.2271

Means on with the same superscript on a row are not significantly different (P>0.05)

Means on with the same superscript on a row are not significantly different (P>0.05)

Tables 3 and 4 presents the serum analysis of the blood samples. Group fed garlic aqueous blend had decreased levels of ALT and AST than other groups in table 4.

Values of albumin, total serum protein, and globulin of Garlic aqueous blend group are higher than other groups in Table 4.

Table 3: Serum parameters of broilers before administration of experimental blends

LABEL	Control	50 mL/Lit	50 mL/ Lit	50 mL/Lit	±SEM
T.PROT (g/dl)	5.5	7.6	5.3	5.5	0.544
ALB (g/dl)	4.3	5.8	3.8	4.3	0.433
GLOB (g/dl)	1.2	1.8	1.5	1.2	0.144
AST (U/L)	89	104	75	103	6.836
ALT(U/L)	19	22	23	21	0.854
CREAT (mg/dl)	2.6	2.2	0.8	1	0.443

Means on with thesame superscript on a row are not significantly different (P>0.05)

Table 4: Effect of aqueous blends of the experimental herbs on serum biochemistry of Broilers

LABEL	Control	50 mL/Lit (SLAB)	50 mL/ Lit (GLAB)	50 mL/Lit (GALAB)	±SEM
T.PROT (g/dl)	4.6[b]	5.2[b]	4.8[b]	6.9[a]	0.523
ALB(g/dl)	3.2	3.5	3.5	3.6	0.867
GLOB(g/dl)	1.4	1.7	1.2	3.4	0.503
AST(U/L)	101	126	115	100	5.930
ALT(U/L)	24[a]	24[a]	20[b]	19[b]	1.315
CREAT(mg/dl)	0.7b	0.9[ab]	0.8[ab]	0.5[a]	0.854

Means on with the same superscript on a row are not significantly different (P>0.05)

DISCUSSION

The RBC (Red Blood Cell) aids the transportation of oxygen from the lungs to body tissues and removes carbon dioxide from the same for exhalation through the hemoglobin. Hematology indices are not only used to decide pathological and physiological statuses of an animal but are also a useful indicator of toxicity effects of a feed, supplemented herbs and its extract on animals (Oloruntola, Ayodele, Agbede, and Oloruntola, 2016).

The hematological indices in this study were found to be within normal ranges as illustrated by (Thrall, Weiser, Allison, and Campbell, 2012). Onyimonyi Chukwuma, and Igbokwe, (2012) also reported that incorporation of phytobiotic into the ration of broiler chickens did not affect their hematological integrity. In table 2, the study findings show an increase in RBC and WBC counts, and that of PCV and Hb of the groups fed herbal blends as compared to the control group. The result corroborates the findings of (Reis, *et al*., 2018) who reported that the

inclusion of herbs and their extracts in the diet of chicken resulted in an increase in the erythrocyte counts and haemoglobin value as against the control group. A similar result was observed by (Krauze Abramowicz, and Ognik, 2020) in their study where they reported an improvement in the immune system and parameters such as RBCs and Hb of broiler chicken fed experimental diet as compared with the control group. Also in the experiment of (Gilani, Zehra, Galani, and Ashraf, 2018) there was observed significant increase in the values of the blood parameters of broiler chickens fed herbal growth promoters.

The observed increase in value of the blood parameters of the birds fed herbs indicates enhanced oxygen-carrying ability of the cells which will translate better well-being of the birds. This is in harmony with the findings of Oleforuh-Okoleh et al. (2015) who reported an increase in Hb, PCV, WBC, and RBC values of garlic

and ginger fed birds compared to the control birds. Consequently, the group fed 50 mL/Lit of GAAB had higher values for RBC, WBC, PCV and Hb this result correlates with the report of (Eid and Iraqi, 2014) that group fed on a diet of Garlic Powder (GP) 200 had the highest count of WBC, followed by group fed on GP 150. A similar observation was gotten from means of RBC which was highest in the group fed GP 200 diet and the lowest in the group fed on GP 0 diets.

The rank of ALT and AST are regarded as investigative tools used to determine toxicity in the liver (Króliczewska *et al*., 2017). The liver is a vital organ and plays important role in removal of toxins, metabolism, and elimination of exogenous plus endogenous substances (Paul *et al.,* 2016). The group fed garlic aqueous blend had decreased levels of ALT and AST than other groups. The decreased values obtained for AST and ALT show the hepatoprotective ability of Garlic. This is in agreement with the findings of Dkhil Abdel-Bakia, Wunderlicha, Siesa, and Al-Quraishy, (2011) and Gedik *et al*., (2005) where they reported that garlic has protective functions because it decreases oxidative damage in the liver.

Values of albumin, total serum protein and globulin of the garlic aqueous blend group are significantly higher (p>0.05) than other groups. These results corroborate Hassan *et al*., (2009) and Jafari, Jalali and Kiani, (2012) who said there was an increase in total serum proteins and globulins in broiler chicken and Albino rats fed herbal supplements respectively. This observed increase in the garlic group may be due to its strong anti-inflammatory, hepato-renal and immunomodulatory properties. The presented data in this report are in harmony with those reported by Oleforuh-Okoleh et al. (2015) where there were increases in the total protein, albumin, and globulin of garlic or ginger fed birds (p < 0.05) when compared with the control group.

CONCLUSION

Based on this study, it can be concluded that the addition of 50 mL of SLAB, 50 mL of GIAB and 50mL of GAAB to 1 litre of drinking water shows no negative effect on the hematological and biochemical parameters of broiler birds as compared with the control group. The aqueous blends of the herbs significantly improve the health status of the birds although the group fed GAAB performs better.

Recommendation

The addition of aqueous blend of these phytogenic substances (Scent leaf, Ginger and Garlic at 50 mL to 1

litre of drinking water can serve as an effective growth promoter in broiler chicken.

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Effective Communication as a Tool for Good Governance in Nigeria

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Abstract

A critical element of governance is how citizens, leaders and public establishments relate to one another in order to make things work. Without a structure communication systems and procedures which permit the two-way communication between nation and citizens, it is sensitive to assume how nations may be responsive to public requirement and prospects. The ability to communicate effectively with citizens is one of the major functions of good governance. This study investigates effective communication as a tool for good governance in Nigeria. The survey research method was adopted and questionnaire was used as data collection instrument. Using the convenient sample of 500 respondents. Findings showed that the flow of information between the government and the citizens was not adequate and the extent to which the media have discharged their duties towards ensuring adequate flow of information between the government and the citizens. The study recommends that journalists should show more prominent obligation toward objectivity, stability and collective accountability in the inclusion as well as information dissemination.

Keywords: Effective communication, Mass media, Good governance

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INTRODUCTION

Communications can be regarded as indispensable to the development of state capability, accountability, and responsiveness. Governments in advanced countries are acutely awake to the wish of the people to communicate, impact, and keep their legitimacy, and often construct elaborate buildings of press offices, and information ministries to carry out their functions. But in many developing countries, governments lack communications capacity, and the development of the communications function is hampered by a combination of weak incentives lack of professional training and communication infrastructure, and lack of supportive legal framework (Ihola as cited in Isabelle, 2015).

(Gap, 2009) Governance has been defined as the structures and processes that ensure accountability, openness, receptivity, public order, solidity, value and integrity, empowerment, and broad participation (Mcloughlin, & Scott, 2010). Governance also refers to the standards, qualities, and rules of the game that are used to monitor public affairs in a direct, participatory, comprehensive, and responsive manner.
.http://www.ibe.unesco.org/en/geqaf/technical-notes/concept-governance. Good governance is referred to not only as government but also as justice, political parties, parliament, media and civil society according to The UK Department for International Development (DFID, 2016). Access to information and government transparency are very important for enabling voters to watch and hold government to account for its actions. But in many developing countries, governments lack

communications capacity, and the development of the communications function is hampered by a combination of weak incentives lack of professional training and communication infrastructure, and lack of supportive legal framework. http://www.gsdrc.org/docs/open/commgap1.pdf

Communication drives better governance, including improving communities and the ability to communicate their needs and good performance (Mike, 2012). It can help people understand their freedoms and shape their ability to speak openly, and it can also give the masses direct information about the government's portrayal and the facts needed to hold the government accountable. Better communication between citizens and government has also been recognized for promoting responsiveness to people's requests, resulting in good public services. The media are generally set up as a key, which can change or block the provided reform. The proponents of communication maintained that, the media could be an area of relatively sub-installed state reform, which development experts may identify and recognize the role of the media regardless of whether in print style, television, radio or web print. If the media serve as effective agenda setter, watchdog and gatekeeper effectively, it will contribute to democratic governance and be accounted for.

Since the emergence of the first newspaper in Nigeria in 1859, through the anti-colonial struggle in political independence, the era of military rule in Nigeria, up until the current Fourth Democratic Republic, media have reamined critical in Nigeria's democratic

processes. For this reason, (Onyisi, 2016) believes that exercising of opinion is only through communication via the mass media. Okon, (2014), listed standards that characterized governance in cutting-edge societies, particularly that:

- The thrust of governance nowadays is no longer founded on the will of the people however on private greed and the self-aggrandizement of political actors.
- Governance in its existing nation has deepened poverty and widened inequality.
- Elections and campaigns are marked with the aid of sizable violence.
- The residents are grossly disappointed and appear to have misplaced belief in the Nigeria.

In an attempt to bring good governance in Nigeria, past government have organized tour in which officials from the Federal Ministry of Information along with press from different media houses, assessed the development of the projects of difference Federal and state authorities (Dunu, 2013). The tour was used by the media to evaluate the performance of elected officials at the federal and state levels. The arrangement for such exercise was made in Section 22 of the 1999 Nigerian constitution, subsequently: The press, radio, television and other broad communications organizations will always be allowed to maintain the major objectives outlined in this section as well as the public authority's obligation and responsibility to individuals.

Statement of Problem
Good administration centered on the prerequisite of all commitment of its people based on the dynamic development of information and trade between individuals, government and various players, including liability and responsiveness (DFID, 2006; Kaufman, 2007; Zeitel, 2013). By putting correspondence, data distribution, as major parts of administration and good connection among correspondence as well as adequate organization as anticipated. However, little has been known as to whether or not citizens are actively involved in government decision makings and electoral matters as it concerns their personal affairs and that of the nation in general; and whether the media perform their functions of ensuring adequate flow of communication between government and citizens. In this context, the study sought to find out whether there is an adequate flow of communication between the government (elected representatives) and the citizens (masses); To determine whether Nigerian citizens participate in the decision-making process on political issues and the extent to which the Nigerian media has fulfilled its legal duties to ensure an adequate flow of communication between the government and citizens.

Research Questions

The following research questions served as guide in this investigation

1. What is the extent of communication flow between the government and the citizens?
2. What is the level of awareness about the programme and activities of government
3. What is the extent of citizen participation in ensuring good governance?
4. What is the perception of respondents on the level of effectiveness of the media in discharging their duties towards ensuring flow of communication between electorates and elected officers?

Review of Related Literature

The media system is incredibly pivotal and precious during a popular society. Hence, McNair (2002) stresses that "in popular political systems, the media function as transmitters of political communication appearing outside the media institution itself and as transmitters of political communication created by journalists. McNair (2002) enumerates 5 media functions in a popular society.

- They should inform residents about what is happening around them (media "detection" or "observation" elements).

- They need to be educated about the meaning and significance of" current realities" (the significance of   this skill shows the soberness with which intelligencers insure their
     Neutrality,   as
     their value as preceptors involves   a
     professional separation of
     the subjects dealt with).
- The media must provide a stage for public political dialogue, work on the elaboration of the "global assessment" and transmit this assessment to the population. In general, where it comes from, this should include providing spaces for expression of contradiction, without which the popular concept would have no value.

The media have to provide a level for public political converse, paintings at the improvement of the "usual evaluation" and bring this evaluation to the people. In general, this encompasses the availability of space for the expression of the contradiction, without which the idea of famous junction could have no value. (McNair, 2002). To use Mikhail Gorbachev's famous phrase, there must be a certain degree of "openness" to the activities of the political class if the "public opinion" of the people is to influence decision-making. McNair (2002) points out that the advocacy function of the

media can also be viewed as a persuasive function in which people can participate in decision-making and have access to the media and other information networks through which the advertising is carried out.

Communications Role in Governance

The Department of International Development (DFID, 2006) and the World Bank (2006) promoted the concept of governance as foremost on the development agenda. This acknowledges that citizens, civil society, and political groups have a right to have a say in how society is governed, how state resources are distributed and spent, and the ability to hold government accountable for policies and their outcomes. Citizens and their representatives will require knowledge to make educated decisions, as well as open communication channels in both directions - from the government to the people and from the citizenry to the government. According to Kaufman's (2007), there is a strong link between communication and governance, and media serve as monitors.

The World Bank (2006) defines Communication for Development as a process that facilitates the exchange of knowledge to achieve positive change in people's lives and promotes two-way communication between citizens and government, which is a democratic approach to which defines governance as "the methods and structures by which a country's authority is exercised". It is the process of selecting, holding accountable, monitoring and replacing governments; it also includes the government's ability to effectively manage resources and deliver services, and the formulation and implementation of appropriate laws and regulations, and respect for institutions who control economic and social relations. The positive benefits of communication are most evident when the basic requirements for democracy and good governance are in place; for example, when there are mechanisms in place to hold the government accountable, such as elections, and when the government is willing to listen. There is also a need to ensure that conducive factors are in place to ensure that voices are heard and that citizens are given the means to hold the government accountable.

Communication therefore has a number of roles in promoting good governance. It can improve communities' ability to identify and articulate their needs and measure government performance. It can enhance the responsiveness of governments by improving citizens' understanding of their rights and increasing their ability to participate in public dialogue. Therefore, communication is considered essential to all components of government capacity, accountability and responsiveness to citizens. Besley and Burgess (2012) found that in areas where the circulation of newspapers in the local language is higher,

governments are more receptive, leading to increased political pressure, competition and higher voter turnout.

Theoretical Framework

This study was based on the social responsibility theory, which assigns six basic roles to the press, highlighted by (Cassata and Asante, 2019, p.78), include:

- Providing information, conversation and discussion on open issues.
- Instructing and illuminating the general population to make it equipped for self-government.
- Protecting the privileges of the person against government through its guard dog role.
- Maintaining the financial harmony of the framework by uniting purchaser, merchant and promoter.
- Providing showbiz.
- Remaining autonomous of outside pressures by keeping up with its own monetary independence.

Great administration and popular government blossom with the rule of informed electorate settling on mindful decisions and choices. The press are not just key roads for giving the necessary information; they likewise figure out what is accessible in the public area through their social obligation work.

Therefore, the mass media, as the fourth estate of the realm, have a responsibility to function independently and act as a watchdog by serving as a link between the government and the ruled (citizens). In other words, it is the duty of the media to monitor government activities and policies and relate them to the masses thereby enhancing equal participation of all citizens in the affairs of the country. Media check the excesses of the government as well as ensure accountability and transparency in activities and policies of government so as to achieve sustainable national development. Therefore, the media can help with standardizing popularity based culture in Nigeria assuming they viably discharge their social responsibility.

MATERIALS AND METHODS

This study adopted the survey design, with the use of questionnaire as the major instrument for data collection. The study population comprised residents of Yewa South Local Government Area of Ogun state, Nigeria. Yewa South Local Government is indeed gifted with huge area of land area of 629 km² and a population of 168,850 going by census population

(NPC, 2006). Using the convenience sampling technique, a sample size of 500 respondents was drawn from the population.

RESULTS AND DISCUSSION

Findings
The researcher distributed a total of 500 copies of the questionnaire to the respondents, but 476 were returned, giving a response rate of 95.2% and a loss of (27) 4.8%. Hence, data presentation, analysis and interpretation were based on the 476 copies that were duly retrieved.

Research Question One: What is the level of awareness about the programme and activities of government?

Table 1: Respondents views on the level of awareness about the programme and activities of government

Item	Frequency	Percentage%
Yes	383	81%
No	93	19%
Undecided	0	0%
Total	**476**	**100%**

Source: Field survey, 2021

Table 1 above shows that 383 (81%) of respondents revealed that they were aware of the programmes and activities of government while 93 (19%) said No.

Research Question Two: What is the extent of communication flow between the government and the citizens?

Table 2: Respondents views on whether information flow between the government and the governed.

Item	Frequency	Percentage
Yes	127	26.7%
No	241	50.6%
Undecided	108	22.7%
Total	476	100%

Source: Field survey, 2021

Table 2 above shows that 127 (26.7%) of respondents agreed that there is flow of information between government and the citizens and 241 (50.6%) majority of the respondents said there is no flow of information while the remaining 108 (22.7%) were undecided.

Research Question Three: What is the extent of citizen participation in ensuring good governance?

Table 3: Respondents views on the extent of participation in decision-making concerning political matters

Item	Frequency	Percentage %
Very high	205	43.1%
High	123	25.8%
Low	148	30.1%
Very Low	0	0%
Total	476	100%

Source: Field Survey, 2021

Table 3 above shows that (43.1%) participated very high and (25.8%) participated high, while (31.1%) participated low in political matters and governance.

Table 4: Respondents views on Citizens participation in electoral matters and governance.

Item	Frequency	Percentage %
Most often	116	24.4%
Often	247	51.9%
Rarely	113	23.7%
Very Rare	0	0%
Total	476	100%

Source: Field Survey, 2021

Table 4 above revealed that (24.4%) of respondents participated Most often and the majority of the respondents (51.9%) indicated to have participated often in the electoral processes while (23.7%) of respondents indicated rarely.

Research Question four: What is the perception of respondents on the level of effectiveness of the media in discharging their duties towards ensuring flow of communication between electorates and elected officers?

Table 5 Respondents' views on the level of effectiveness of the media in discharging their duties

Item	Frequency	Percentage %
Very high	130	27.3%
High	208	43.7%
Low	138	29.0%
Very low	0	0%
Total	**476**	**100%**

Source: Field Survey, 2021

Table 5 above revealed that, (27.3%) of respondents said the effectiveness of the media in discharging their duties is Very high, and (43.7%) said it was high while (29%) said it was low.

Discussion

The study examined effective communication as a tool for good governance in Nigeria. Both communication and administration work together instead of as tactful cycles - correspondence can serve to stir the populace and the public authority to their individual responsibilities. Similarly, further developed administration can give the opportunity and space essential for further developed correspondence. From the data presented above, although majority of the respondents affirmed that they are well-informed about programmes and activities of government, they were also quick to observe that the flow of information between government and citizens was insufficient. This could be attributed to the nature of communication that exists between government and the masses through the media which is top-down instead of top-down and down-top. Accordingly, participation in decision-making was also low.   The result further shows that the media need to do more in the discharged of their duties towards ensuring sufficient flow of information between the government and the citizens. This could be as a result of unfavourable conditions which hinder the media from performing their duties.

Conclusions and Recommendations

It can be concluded that discussion and information between the government and its people is seen as not sufficient enough. Meanwhile, top-down and down-top communication will be better than vertically trickled top-down approach. This can be achieved through a responsible mass media. For the media to effectively carry out their responsibility and act as intermediary between the government and the governed, they must operate in a free and conducive environment. Based on the findings, the following recommendations are necessary:

1. The government should ensure there is good governance, there should be active and frequent participation of Nigerian citizens (masses) in decision-making concerning political matters. This can be enhanced by establishing local media through which the masses make their views known to government and also measure government performance.

2. The government should ensure enough flow of information between elected leaders and citizens should be top-down and down-top (two-way) and not vertically tricked top-down approach.

3. The media need to show a greater commitment to fairness, balance and social responsibility in their reporting and dissemination of information, especially towards government and citizens.

4. For the media to effectively carry out their responsibility, they must be allowed to operate freely by the government.

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In Vivo Antiplasmodial Effect of the Ethyl Acetate Fraction of Crude Extract of Phyllanthus Niruri.

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Abstract

This research was designed to study the effect of ethyl acetate fraction of *Phyllanthus niruri* on *Plasmodium berghei* infected mice. *P.niruri* is known to have antimalaria properties. Crude extract was fractionated with ethyl acetate. 50, 100, 200 and 400mg/kg body weight of the ethyl acetate fraction was dosed to albino mice infected with *Plasmodium berghei*. The Plasmodium count, packed cell volume and body weight were measured before, during and after the experiment. Result showed that all doses of the extract exhibited parasitemia inhibition at 88.88%, 85.23%, 79.68%, and 82.54 % which was not statistically significant (P<0.05) when compared with the positive control chloroquine of (90.37%). The Packed cell volume was observed to reduce across group after treatment when compared to before the treatment. However, weight gain was observed in treated groups. Result shows that the ethyl acetate fraction of *P. niruri* has a curative effect on *Plasmodium berghei* and can be utilized to treat malaria after further purification to isolate the chemical responsible for the activity.

Keywords; Malaria, Ethyl acetate, Curative, Phyllanthus

INTRODUCTION

Malaria parasites have killed and sickened more people than any other eukaryotic illness (Chinsembu, 2015). Malaria caused around 411 000 deaths and 229 million infections worldwide in 2019, with children under the age of five continuing to be the most vulnerable population. (WHO, 2020). Despite the fact that malaria is curable, it continues to have a devastating impact on mankind. The poor and underprivileged are disproportionately afflicted by the disease since they have inadequate access to health care and cannot pay for the prescribed treatment in most nations. (WHO, 2020).

Artemisinin combination therapy has significantly aided in the reduction of malaria mortality. However, treatment failures and parasite resistance, as well as the fact that current antimalarial drugs are costly in disadvantaged areas, underscore the need for safe and affordable antimalarial therapies (Fairhurst & Dondorp, 2016).

Natural products play an important role in the treatment of malaria, as a source of lead compounds for the creation of new and effective antimalarial medications. (Boyom et al, 2011). Plant extractions are still used in Nigerian daily life to combat malaria and a range of other ailments, especially in areas where Western medications are unavailable.

The extensive and diverse flora of Nigeria is a potential source of powerful antiplasmodial natural compounds, and ethnopharmacological techniques to their study might be useful in the fight against malaria. In the exploration for new natural plant derived antimalaria, *invitro* and *invivo* antimalaria activity testing are required at the early stages.

Phyllanthus niruri is also known as kidney stone crusher (Micali et al., 2006). *P. niruri* is used to treat problems related to the gastrointestinal tracts (Karuna, Reddy, Baskar, & Saralakumari, 2009). *P. niruri* was also reported to display anticarcinogenic (Rajeshkumar et al., 2002), hepatoprotective (Amin, Alshawsh, Kassim, Ali, & Abdulla, 2013), and anti-inflammatory (Obidike, Salawu, Ndukuba, Okoli, & Osunkwo, 2010). *In vivo* and *in vitro* research have demonstrated that this herbal extract has antidiabetic (Okoli, Obidike, Ezike, Akah, & Salawu, 2011) and antioxidant effects (Colpo et al., 2014). In a bit to identify the active component of *P. niruri,* we investigated the effects of the ethyl acetate fraction of *P. niruri* plant extract on *Plasmodium berghei*-infected mice.

MATERIALS AND METHOD
Plant Collection and Identification
Phyllanthus niruri whole plant were collected from Bosso, Nigeria and was identified by a botanist at the Department of Biological Sciences, F. U. T. Minna.

Experimental Animals

For this investigation, 18 albino mice weighing 24-30g purchased from the National Institute for Pharmaceutical Research and Development Abuja, Nigeria. They were fed a conventional meal and given water, and they were kept in standard circumstances.

Extract Preparation

The plant was thoroughly washed, dried, and ground into powder, and was soaked in 80% methanol of 24hours. This was filtered through Whatman filter paper grade 1. The filtrate was evaporated with a rotary evaporator and concentrated using a water bath. The crude extract was placed into a separating funnel, and dissolved in 50ml of distilled water. In order of polarity, n-hexane, chloroform, and Ethyl Acetate were used to partition the methanol extract. The Ethyl Acetate fraction was collected and used for this investigation.

Parasite Inoculation

Plasmodium berghei was received from the National Institute for Pharmaceutical Research and Development, Idu, Abuja, Nigeria, where it was kept alive in mice for a week. On day 0, each mouse was given 0.2ml of contaminated blood containing *P. berghei* parasitised red blood cells intraperitoneally. In addition, the freshly injected animals were checked on a daily basis for parasitemia.

Evaluation of the Curative Effect

Six groups of three mice were formed from the eighteen animals. To collect the blood, a mouse infected with *P. berghei* was anesthetised with chloroform and slaughtered. The blood was diluted with normal saline to provide a volume of 0.2ml. Each of the eighteen mice was given 0.2ml diluted blood intraperitoneally. The extract was given orally once daily for six days after 72 hours of inoculation at dosage levels of 50, 100, 200, and 400mg/kgbw, respectively (D0, D1, D2, D3, D4 and D5). In the fifth group, a similar test with Chloroquine (5 mg/kgbw) acts as a positive control. The sixth group was not given any treatment and functioned as a control group. Thin films were produced from D0-D5 tail blood, treated with methanol, and stained for 20 minutes with 4 percent Giemsa (PH 7.2) before being studied under the microscope. On each slide, five fields were inspected, and the number of infected red blood cells (RBC) was counted and the mean was calculated. (Kabiru et al., 2013).

%Parasitemia Inhibition =

A= Basal Parasitemia count,
B = Day 5 Parasitemia count

Estimation of Packed Cell volume.

By capillary action, blood was collected from each mouse's tail with a capillary tube. One end of the tube was plastestrine-sealed. After that, the closed capillary tubes were placed on the hematocrit centrifuge and spun for five minutes at 1200 rev per min. The PCV was measured and recorded using a hematocrit reader.

Data Analysis

The data was analysed using Graph Pad Prism6. Data are presented as mean ± SD, One-way Anova were carried out to determine significant difference in parasitemia count across groups.

RESULT AND DISCUSSION

Table 1: Curative test result of ethyl acetate fraction of *P. niruri*.

Groups	Treatment	Basal Parasitemia	DAY5 Parasitemia	% Parasitemia inhibition
1	50 mg/kg PnEtF	12.6 ±2.27	1.4 ±0.53*	88.88
2	100 mg/kg PnEtF	11.5 ±1.60	1.7 ±1.13*	85.23
3	200 mg/kg PnEtF	12.3 ±2.31	2.5 ±0.50*	79.68
4	400 mg/kg PnEtF	12.6 ±3.86	2.2 ±0.28*	82.54
5	5 mg/kg Chq	13.5 ±0.83	1.3 ±1.33*	90.37
6	NC	11.3 ±1.17	12.3 ±0.31	-8.85

*   There is significant difference at $P < 0.05$ Compared to Negative Control group

*
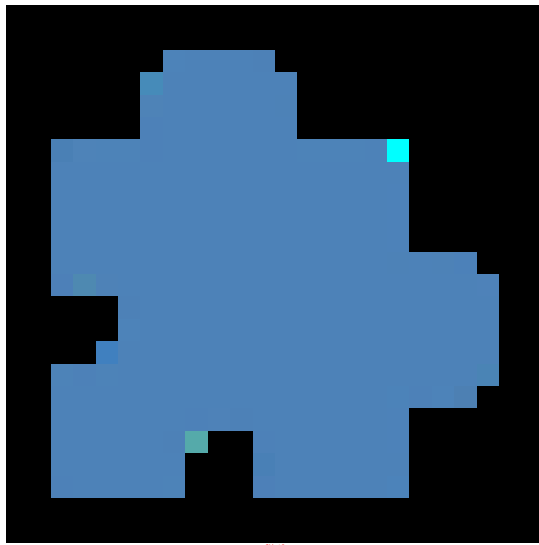
Figure 1: Effect of ethyl acetate fraction of *P.niruri* on the parasitemia of infected mice.
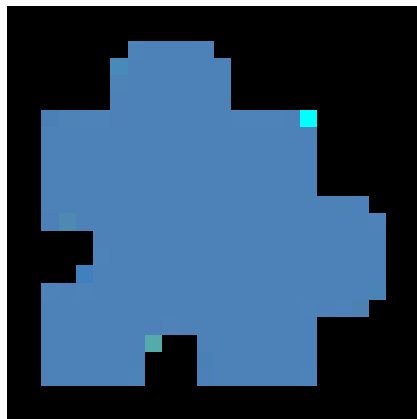
Figure 2: Effect of ethyl acetate fraction of *P.niruri* on the weight.

  Data Presented as Mean ± SD, n=3
  * There is significant difference at P < 0.05
  Between Day 0 and Day 5

Int(Infected not treated), Chq(Chloroquine)
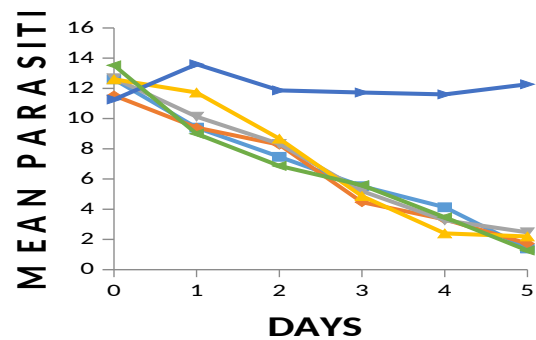
Figure 3: Effect of ethyl acetate fraction of *P.niruri* on Packed cell volume.

  Data Presented as Mean ± SD, n=3
  * There is significant difference at P < 0.05
  Between Day 0 and Day 5

Int(Infected not treated), Chq(Chloroquine).

DISCUSSION

The phytochemicals found in the crude extract of *P. niruri* in a literature study indicate that it has pharmacological activities (Kabiru et al.,2013). The mice infected with *plasmodium burgei* and dosed with the ethyl acetate fraction from the result in Fig 1 showed a strong curative effect when compared with the positive control group treated with chloroquine.

The effects of ethyl acetate extracts on percent PCV (percentage Packed Cell Volume) after therapy was found to decrease though not statistically significant, these corroborates the findings of (Kabiru et al., 2013 and Nardos and Makonnen, 2017). This is a common occurrence owing to the extract's action on infected blood cells, particularly red blood cells (RBCs). Days following therapy, the cells continue to progressively divide, and this situation is generally transient.

The impact of the ethyl acetate extracts on weight was also considered, and it was discovered that, as shown in figure 3, there was weight gain after treatment, and progressively increased days following treatment. The Initial weight loss might be due to the disease's (malaria) signs and symptoms, which include weight loss. The plant extract however during and after treatment improved on the weight.

CONCLUSION

The ethyl acetate fraction of *P. niruri* has a curative effect on *Plasmodium burgei* and can be utilized to treat malaria after further purification to isolate the active compound responsible for the activity.

It is also recommended that the ethyl acetate fraction be subjected to further fractionation, such as vacuum liquid chromatography and column chromatography, in order to better exploit the active components in the fraction, increase yields, and serve as templates for the

development of therapeutically more effective antimalarial drugs.

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Assessment of Public Toilets Facilities Provision and Management in Tertiary Institutions in Nigeria- An Overview of The Federal Polytechnic, Ilaro, Ogun State.

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Abstract

Open defecation is a common occurrence in developing countries, particularly in Nigeria. However the importance of public conveniences at Nigerian higher institutions cannot be overstated since they help to improve the hygiene of the campus environment. The harmony of campus environment would not be completed without provision of standard public toilets facilities A detailed examination of the environment of tertiary institutions reveals that the absence of suitable public toilet facilities in crucial areas is a hindrance to the institution's adoption of a full-fledged academic environment. The aim of this study is to assess the provision and management of public toilet facilities in tertiary institutions using the Federal Polytechnic Ilaro, Ogun State as a case study. Both primary and secondary sources of data collection were used for the study whereby convenience and purposive sampling techniques were also used for the selection of respondents (students) and available public toilet facilities in the study area with 350 structured questionnaires administered to the selected respondents in the study area. Findings revealed improper usage and lack of effective management of the available public toilet facilities in the study area despite adequacy in its provision by the school management considering the number of users while the study concludes that proper monitoring culture should be adopted on the use of the facilities through a time to time checking and appropriate sanctions to any defaulter who misuse the facilities.

Keywords: Public Toilets, Facilities, Provision and Management.

INTRODUCTION

Nigerian tertiary institutions are significant resource in national development since they are the source of the nation's progress. Tertiary institutions are equipped with both resources in terms of human and technological know-how, which are used to produce individuals who are knowledgeable enough to fulfill the country's public and industrial consumption demands, as well as international requirements (JAMB, 2010). However, tertiary institutions in Nigeria have been severely neglected and left to fend for their own basic requirements for environmental sanitation in terms of public toilet facility supply, planning, and administration. Despite the fact that higher institutions in Nigeria house the vast significant number of the country's educated citizens.

Toilet is a vital connection between order and chaos, as well as between aesthetically pleasing and terrible environments, because the desire to urinate and defecate is insatiable. (Pathak, 1995). This has spurred several researches on the provision and management of public toilets.

Pathak's (1995) research indicated that adequate provision and management of public toilets help improve public hygienic conditions and sanitation difficulties in heavily populated areas. As a result, Pathak(1995) proposed that public conveniences are necessary because excremental filth poses a public health threat since our environment may become a "vast mass privy."

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Similarly, study conducted by Ayee and Crook (2003), shows that a lack of effective coordination and upkeep of public restrooms has significant environmental and health concerns. Despite political intrigues and municipal failures, Ayee and Crook (2003) argued appropriate management of public toilet will promote and protect public health. In the United Kingdom, Hanson (2004) emphasizes the importance of inclusive, accessible, and well-managed public toilets. Still in the UK, Greed (2005) lamented the scarcity of public toilets as a consequence of closure, bad management that has led in disease transmission, and a distinct professional subculture that has choked meet all wants and objectives in public conveniences provision.

allAfrica.com (2011) observed that, open defecation was identified as the "riskiest sanitation practice" in a survey conducted by the WHO/UNICEF Joint Monitoring Programme for Water Supply (JMP) entrusted with monitoring progress toward MDG goal 7c on drinking water and sanitation. According to a research conducted by the Water and Sanitation Program (WSP 2012), 34 million Nigerians perform open defecation. Open defecation as a result of a lack of or inadequate sanitary facilities has significant social costs, including loss of dignity and privacy, as well as the possibility of physical attack and sexual abuse, which are difficult to quantify in monetary terms. The study further revealed that Nigeria loses US$3.5 million (#455 billion) every year owing to sanitary problems. To reach the Millennium Development Goals (MDGs) 7 on water, sanitation, and sustainable hygiene by 2015, Nigeria would need to construct over 8,000,000 public restrooms (Asabia, 2009). Many Nigerians drink, cook, and wash using polluted water that has not been treated, this, however, increase their exposure to illnesses like as cholera and dysentery (Osinubi, 2003).

Furthermore, diarrheal diseases have been identified as the country's second leading cause of newborn death (Asabia, 2009). A desk research conducted by the Water and Sanitation Program (WSP) in Nigeria revealed that faecal pollution of the environment is responsible for approximately 5,400 cases of cholera yearly in the country. Osinubi (2003) research on urban poverty in Agege, Lagos, 73 percent of inhabitants use pit toilets and almost three-fourths (72%) source water from a well or purchase it from water vendor, which, is sometimes contaminated by open defecation and urination, this has major health repercussions. According to the Water and Sanitation Program Africa (WSP Africa (2004), poorly handled human excreta poses severe hazard to the environment and public health .Human waste is the basis of both widespread illnesses and loss of civic and personal dignity and worth. The Lagos State Government's decision to build additional public conveniences to combat cholera became required because improper excreta disposal, insufficient sanitary facilities, poor drainage, and improper waste disposal contribute 20% of children below five years mortality (Asabia, 2009). The understanding of the critical importance of public conveniences prompted the State Government to approve and commission 100 solar-powered toilets for communities around Lagos (WASH, 2009). According to the record, the absence of toilet facilities and open defecation in several regions of Lagos influenced the State Government's decision to provide public toilet facilities throughout the state.

Furthermore, the current lack of standard and adequate public toilets in a state like Lagos and many other states in the country may have forced more than 34 million Nigerians to involve in open defecation, "depositing almost 1.7 million tonnes of feces into the environment annually" (WSP,2012).

This unsual practice of open defecation had also informed the management of the Federal Polytechnic, Ilaro to take sole responsibility of providing public toilet facilities in different strategic locations within the campus to eradicate and stop open defecation, urination and unhygienic behavior among the students and other visitors within the institution premises. This research therefore, is an attempt to identify the number of available public toilet facilities provided in the study area, examine its adequacy and locational distribution within the campus, examine the management effectiveness of the facilities by the authority in-charge, examine the users attitudes and suggesting ways of improvement for the usage and effective management for sustainable public toilet facilities in the study area.

LITERATURE REVIEW

Toilets are significant components of the Goal 7(target 3) of the Millennium Development Goals(MDGs) and Goal 6 of the Sustainable Development Goals(SDGs)

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whose aim is to halve the proportion of the universal population without sustainable access to clean and safe drinking water and sanitation(UN,2000; Dodds, 2015). The significance of the provision of adequate, safe and accessible public toilets have been recognized by Makama(2015) who noted that toilets are not just sanitary facilities but that they are also a symbol of the level of development. However, the task of achieving this target has assumed a Herculean nature. In spite of being a right, more than 30% of the global population experience lack of access to clean, hygienic and functioning toilets (UN, 2010; UNICEF, 2014). This poses a great number of health risks to the users of public toilets; UNICEF (2014) has also observed the danger of lack of clean, safe and accessible public toilets. For example, FMWR & UNICEF (2016) traced 90% of infant mortality in Nigeria to water, sanitation and hygienic problems.

The World Bank (2012) cited in FMWR & UNICEF (2016) observed that the risk of diarrhoeal-related deaths reduces by about 36% with an improvement in toilet facilities. The situation becomes worse in urban areas where alternative means of convenience is usually by open defecation and urination (WHO, 2011; UNICEF, 2014). Open defecation and urination is usually with a plethora of health issues such as air pollution through bad odour. This menace was clearly captured by Awoyinfa(2012) who observed that inadequate provision and poor maintenance of toilet facilities is a serious problem in Nigeria Urban areas, arguing that this has led to the adoption of open defecation practices by those who are pressed. Also, Oyinloye and Oluwadare(2015) maintained that most, if not all, urban centres in Nigeria experiences lack of improved public convenience facilities, emphasizing that this is responsible for open defecation. This is in consonance with World Bank (2012) observation that more than 46 million Nigerians defecate in the open space (cited in FMWR & UNICEF, 2016). It is against this background that the study tries to assess the provision and management of public toilets facilities in the Federal Polytechnic, Ilaro, Ogun State.

MATERIALS AND METHODS

Sources and methods of data collection

The data for this study were collected from primary and secondary sources. The secondary sources include data obtained from books, journals, conference proceedings and reports on the global state of sanitation as well as the state of sanitation in Nigeria. The primary data, on the other hand, were collected directly from the field through a well-structured questionnaire, interview guide as well as direct/personal observation.

Sampling technique

Convenience sampling technique was adopted to sample 350 respondents (students) for the study. The choice of convenience sampling was based on the fact that people who pressed exhibit similar characteristics and this is necessary since there is no available register of the population of the users of the available public toilet facilities in the study area. On the other hand, purposive sampling technique was adopted for the selection of the available public toilet facilities by sampling all the available 15 public toilet facilities in the study area as well.

Methods of Data Analysis

The data collected for the study were presented using frequency tables, percentile and discussion analysis for better understanding of the readers.

List of available public toilet facilities, categories and location in the study area.

Table 1, shows the number, categories and locations of the available public toilet facilities in the study as identified by the researchers during the course of carrying out the study. It was discovered that there are 15 numbers of public toilet facilities in the study area which was also grouped into two (2) categories namely (i) detached public toilets and (ii) semi-detached public toilets respectively and all these facilities were equally located at different strategic areas in the study area.

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Table 1: List of public toilet facilities, categories, location, number of block and room

S/N	Facility	Categories	Location	Number of Block	Number of Room
1	Public toilet	Detached	Beside CCL	2(1Male); (1Female)	14
2	Public toilet	Detached	Beside SLT laboratory	2(1Male); (1Female)	10
3	Public toilet	Detached	Poly Primary	2(1Male); (1Female)	10
4	Public toilet	Detached	Poly Mosque	2(1Male); (1Female)	10
5	Public toilet	Detached	Beside BE block	2(1Male); (1Female)	10
6	Public toilet	Detached	Beside BB block	2(1Male); (1Female)	10
7	Public toilet	Detached	Beside AG block	2(1Male); (1Female)	10
8	Public toilet	Detached	Opposite AF block	2(1Male); (1Female)	10
9	Public toilet	Detached	Mini Market	2(1Male); (1Female)	12
10	Public toilet	Semi-detached	Inside AUD 1	2(1Male); (1Female)	4
11	Public toilet	Semi-detached	Inside AUD 2	2(1Male); (1Female)	6
12	Public toilet	Semi-detached	Inside AUD 3	2(1Male); (1Female)	6
13	Public toilet	Semi-detached	Inside AH block	-	4
14	Public toilet	Semi-detached	Inside AJ block	-	4
15	Public toilet	Semi-detached	Inside AF block	-	2

Source: Authors' Field Survey, 2021

RESULT AND DISCUSSION

Gender distribution of respondents

Table 2, shows gender distribution of selected respondents based on the questionnaire administration. It was discovered that female students has highest number 185 (53%) while their male counterpart has 165(47%) in terms of users proportion in related to the facilities in the study area.

Table 2: Gender Distribution of Respondents

S/N	Gender	Frequency	Percentage (%)
1	Male	165	47
2	Female	185	53
	Total	**350**	**100**

Source: Authors' Field Survey, 2021

Users' perception on the adequacy of available public toilet in the study area

Table 3, shows users' perception on adequacy of provided facilities. Out of 350 respondents selected for interview, 280 respondents representing about (80%) were of the opinion that the available public toilet facilities readily present in the study area are adequately provided while only 70 respondents (20%) said the facilities provided were not adequate based on their own opinion.

Table 3: Users' perception on the adequacy of available public toilet facilities provision in the study area.

S/N	Users' Perception on Adequacy	Frequency	Percentage (%)
1	Adequate	280	80
2	Not Adequate	70	20
	Total	**350**	**100**

Source: Authors' Field Survey, 2021

Users' perception on condition of available public toilet in the study area.

Table 4, shows users' perception on condition of the available public toilet facilities provided. From collected data, 20% agreed that the condition of the available public toilet facilities are very good, 28.60% users agreed the condition are good, while 38.60% and 8.60% users respectively were of the opinion that the condition are fair and poor with only 4.20% users who have the perception that the available facilities are bad.

Table 4: Condition of available public toilet facilities in the study area.

S/N	Users' Perception on Condition	Frequency	Percentage (%)
1	Very Good	70	20.00
2	Good	100	28.60
3	Fair	135	38.60
4	Poor	30	8.60
5	Bad	15	4.20
	Total	**350**	**100**

Source: Authors' Field Survey, 2021

Challenges faced by users in using available public toilet in the study area.

Table 5, shows various challenges faced by the users in using available facilities. Results indicates that 20% respondents attributes dirty environment as challenges faced in using the facilities, 25.70% users said bad odour is the challenges they faced, 30.00% users were of the opinion that nuisance from flies is the major challenge faced by them in using the available facilities while 24.30% respondents submitted that poor maintenance of the facilities is the challenge faced by them in using the facilities.

Table 5: Challenges faced by users in using available public toilet facilities in the study area.

S/N	Users' Perception on Challenges	Frequency	Percentage (%)
1	Dirty Environment	70	20.00
2	Bad Odour	90	25.70
3	Nuisance from Flies	105	30.00
4	Poor Maintenance	85	24.30
	Total	**350**	**100**

Source: Authors' Field Survey, 2021

Users' perception on reasons for using public toilet facilities in the study area

Table 6, shows users' perception for using available public toilet facilities. It was discovered that 37.10% respondents uses the facilities based on proximity to classrooms, 10.00% respondents ascertained free accessibility to the facilities, 4.30% users uses it because they don't have any alternative, 17.10% users attributed cleanliness as reason, while 25.70% and 5.70% respondents uses the facilities for both privacy and pleasure respectively

Table 6: Reasons for using available public toilet facilities in the study area.

S/N	Users' Perception on Usage Reasons	Frequency
1	Proximity to Classrooms	130
2	Free Access	35
3	No Alternative	15
4	Cleanliness	60
5	Privacy	90
6	Pleasure	20
	Total	**350**

Source: Authors' Field Survey, 2021

Management and Maintenance Characteristics of the Public toilet facilities in the study area.

Investigation revealed that the available public toilet facilities in study area were provided by the school management through financial support by TETFUND intervention Grant. Also the management and maintenance is being handled by the school authority by Poly Consult and Industrial Services unit/section of the institution.

Challenges faced by the unit in charge of management and maintenance of the facilities.

During the course of survey, series of issues were highlighted by the unit as challenges faced in the course of management and maintenance of the facilities which includes among others:

i. Non-supply or shortage of water for cleaning in some cases.
ii. Non-regular supply of sanitary facilities.
Lack of proper monitoring in the usage of the facilities by the authority.
Iii. Improper uses by the users.

CONCLUSION

This study has unveiled that users' attitudes towards the usage of public toilet as an alternative has not been too good as majority of the users misuse the facilities based on their lackadaisical attitudes. Also the authority has not been doing well in the area of provision of sanitary toiletries and other cleaning materials in order to encourage more users of the facilities. While the general management and maintenance of the facilities was also observed to be below average standard. Although the users' privacy is guaranteed in the available public toilet facilities but they expressed their dissatisfaction with these facilities as a result of unclean, bad odour, nuisance from flies and poor management and maintenance.

RECOMMENDATION

Based on the research findings and conclusion, the study recommends the following:

a. Proper monitoring on the use of the facilities through a time to time checking and appropriate sanctions to any defaulter who misuse the facilities.
b. Provision of adequate sanitary toiletries for the users by the authority to improve the satisfaction of the users with the existing facilities.
c. Regular supply of water to the facilities as water stands as the major material for the cleaning of the existing facilities.
d. Orientation for the users on the benefits of using the facilities properly.
e. Encouragement of the unit in charge of maintenance and management on the improved services of adequate and regular cleaning.

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Effects of Neem Leaves (*Azadirachta Indica*) And Cassava Peels on the Performance of West African Dware Goat

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Abstract

Ruminant animals like goats are one of the major animals reared by farmers in West Africa. This paper focus on West African dwarf (WAD) sixteen female goats weighing between the range of 5.33-5.37kg were used for the experiment lasted for 56 days, which examined the effects of Neem leaves (*Azadirachta indica*) and Cassava peel supplements (*Manihot Species*) on the performance of West African Dwarf Goats. The control diets which contained 100% Neem leaves and the other three diets in which Neem leaves were replaced with Cassava peels at 25%, 50% and 75% levels respectively which constituted four treatments .Allocation of four goats each into four treatments groups , in which each group were exposed to different experimental diets. The result obtained showed that the initial bodyweight and final body weight of the experimental animals were not affected by Neem leaves inclusion. Feed intake was significantly affected by Neem leaves intake. Weight loss was recorded for the animals in all the treatment and those on 100% level of Neem inclusion could not survive on Neem alone. The treatments shows that there are no significant difference in the conversion ratio of the feed intake. The digestibility of dry matter was lower in treatment II while it was high in treatment IV and Nitrogen utilization was lower in treatment IV and treatment III has the highest Nitrogen retained value. Hence it is recommended at below 25% levels. In conclusion, WAD Goats can not survive on Neem leaves alone since the Neem leaves given to feed WAD Goats alone resulted into weight loss.

KEYWORDS- world population, ruminant animal, nutrient, Cassavas peels, Neem leaves.

INTRODUCTION

An increase in the world population today demands or calls for more protein supply by the farmers and this can be partly achieved by increasing the production of livestock to meet the challenges. Adequate diet is the principal nutritional key to achieving socio-economic advances and health improvement. An average Nigerian obtains about 9.5g of animal protein, and fat below 35g recommended by The World Health Organization as reported by .Oyenuga. (1999) Improved feeding of ruminant animal is important particularly when there is shortage of water in the dry season and the quality of pasture is always low Leng,. (1990). The viability of an animal in the long- term of production highly rely on the animals quality and environmental factors and majorly their diet because this can reduce their quality, quantity and distribution in a year. Nsahali *et al* (2004)

 The low nutrient of tropical grasses and their seasonal variability is the main limitation affecting the performance of ruminant animals. This consequently results is their low productivity. Grasses become dry, lignified and fibrous during the dry season, when the nitrogen content of feed is less than one percent, the ruminant appetite will be depress and voluntarily intake of feed is reduced Nsahali *et al* (2004) .

Ruminants dies in most of the developing countries are unbalanced and inadequate protein, protein, minerals and vitamin. Adequate supplement of mixed concentrate, grains or protein foliage demonstrated improvement of rumen ecology, dry matter intake, quality and quantity of meat of the animals. Goat serve as insurance against crop failure because they can be quickly converted to cash in time of financial need .Osakwe (2004) . According to Ologun,(2004) goats play a vital role in the county's economy which serve as a source of protein intake.

In ruminant feed, cassava peel as a source of energy play a role as basal diet or s upplement. The presence of hydrocyanic acid makes fresh cassava peel difficult to feed the animals, dry, ensiling and fermented cassava peel are used to reduce the concentration level of the acid when feeding the animals which make it save to the animals. In view of this, this paper look at feed utilization by West African Dwarf Goats fed with Neem leaves and Cassava peels, assess the digestibility of Neem leaves and Cassava peels fed to West African Dwarf Goats and make recommendation base on the result obtained.

Neem (*Azadirachta indica*) is from mahogany family Mediaceae is a species in the genus *Azadirachta* and is indigenous to Banglandesh, India, Pakistan and it grows in tropical and subtropical regions.
In Nigeria, Neem is called Dongoyaro, Aryan Vappu in Malayalam and India, like Bevy in Canada. Also called Mwarobaini in Kiswahili which means the tree of 40s. Neem can treated about 40 different diseases.

MATERIALS AND METHODS

The experiment was carried out at the Small Ruminant Experimental Unit of the Teaching and Research farm, Federal University of Agriculture, Abeokuta (FUNAAB) Ogun State, Nigeria.

The location which is 76m above sea level. Falls within latitudes 7^0 5.5-7^0 8.0N and longitudes 3^0 11.2-3^0 12.5 E. the climate is humid and is located in the derived savannah zone of South western Nigeria. It receives a mean annual precipitation of 1,037 and mean annual relatives humidity of 82%.

Experimental Animal and Management

Twelve (12) female West African Dwarf goats were used for the experiment they were allowed an adaptation period of four (4) weeks during which they were dewormed, and treated against

Ecto-parasites with the use of Kepromec which was injected and they were vaccinated against Pests Petites Ruminant (PPR). Goats were maintained on Guinea grass and peels during the adaptation period, and later Guinea grass was gradually withdrawn.

After the adaptation period, animals were randomly distributed into four (4) experimental treatments in a group of three animals each. Animals were balanced for weight during the grouping period. Each group of animals was randomly weighted during the grouping period. Each group of animals was randomly assigned to one of the different experimental diets. Animals were housed and the experiment last for a period of eight weeks (i.e.56 days)

Experimental Diets

Two experimental diets were fed to the animals. Neem leaves and Cassava peels which served as supplement. Cassava peels were bought and sun dried for 3 days and Neem leaves were harvested within and outside the University community which were wilted over night before feeding.

Table 1. Composition of Experimental Diet

Composition of Experimental Diet

Treatments	Diet
I	100 Neem
II	75% Neem leaves + 25% Cassava peels
III	50% Neem leaves + Cassava peels
IV	25% Neem leaves + Cassava peels

DATA COLLECTION

Weight Changes

Animals were weighed, before the commencement of the Experiments and subsequently on a weekly basis, to monitor the growth pattern of the animals in response to the experimental diets. Animals were weighed prior to feeding on a weekly based to determine the weight changes.Experimental diets were offered by 8:00am daily.

Feed Intake

Feed left over were weighed the following morning to estimate the feed intake .

Feed Conversion Ration

Feed conversion ration was calculated by using feed intake and weight gain daily.

Sample Analyses

Samples of Neem leaves and Cassava peels were collected for analyses of their Nutrient composition. After the feeding trial, the animals were transferred into metabolic crate for a period of 21days. The first 7 days serve as adaptation period while the last 14 days serve as data collection period. During this period estimation of feed intake, fecal and urinary outputs were made. Sample of the feed and faces collected were used for their digestibility test, by the method of A.O.A.C (1995). A.O.A.C (1995) method was used to analyze the Nitrogen content of the urine collected from the goats. Data obtained were used for digestibility and Nitrogen balance studies.

Data Analyses

All data generated were subjected to analysis of variance (ANOVA) using completely Randomized Design and level of significant was taken at 5% probability. Significant means were separated using Duncan Multiple Range Test. Duncan (1995).

RESULT AND DISCUSSION

Proximate composition of Experimental Diets Fed to the WAD Goats

The proximate composition of Neem and cassava peels were presented in Table 2 , the crude protein content of the neem leaves (22.32%) used in the present study was higher than 20.68% reported by Essonu *et al* (2006). The differences in the crude protein content may be due to age of the plant or the stage of maturity of the trees or the environmental factors. However the crude protein content of the cassava peels used in this study (5.26%)this is in line with the recommended range of (4.2-6.5%) reported by .Oyenuga.V.A (1999) and .Nwukka (1997). Other researches reported 5.29% for crude protein in cassava peels Sonaiya (1993). The crude fibre content of neem leaves 4.87% was lower than 16.6% reported by Essonu *et al* (2006) . While the Ash and ether Extract content of the cassava peels were similar to that reported by Sonaiya (1993).

Table 2: Proximate Composition of Experimental Diets (%)

Parameters	Neem leaves	Cassava peels
Dry Malter	88.53	88.90
Crude Protein	22.32	5.26
Crude Fibre	4.48	9.85
Ash	4/.45	6.15
Ether extract	2.00	0.78
Nitrogen Free Extract	66.36	77.96
Neutral Detergent Fibre	41.50	49.89
Hemi cellulose	1.46	4.34
Acid Detergent Fibre	40.04	45.55
Cellulose	29.7	21.23
Acid Detergent Lignin	10.26	24.32

Table 3. Shows the performance of WAD goats fed diets containing Neem leaves and cassava peels. The initial body weight and final weight of the experimental animals were not significant affected by the levels of Neem leaves. The trend observed was that animals fed 75%Neem leaves had the lowest weight lost, followed by 25% and 50% Neem leaves were statistically (P>0.05) similar. However, animals in 25% Neem leaves recorded significant differences in all the treatments.

The weight loss was recorded for animal in all the treatments. These on 100% Neem inclusion could not

survive on Neem alone: they died at the fourth weeks of the experiment, this is in line with Nsahali *etal* (2004) which says the production of long term viability of any animal production largely depend on the quality of the of the animal and environmental factors with the their diet because feed can limit productivity in terms of quality, , quantity and distributon within the year.

The result for the body weight gain across the treatment group resulted from higher dietary inclusion levels which lead to decrease in weight gain. This could probably due to the effect of incomplete elimination of toxic factor this is in line with Esonu *et al* (2006) and Fassae (2005), in which they reported the effect of nutrient imbalance and poor metabolism on monogastric fed high level of Neem leaf meal and unconventional feed ingredients.

Table 3: Performance of Experimental Goats Fed Diets Containing Neem leaves and Cassava peel.

Paramenters	100	75	50	25
Initial weight (kg)	5.33	5.33	5.37	5.33
Final weight (kg)		4.95	4.33	4.87
Daily weight gain/loss (kg)		-0.38	-1.04	-0.46
Feed intake		290.94[a]	322.95[a]	222.05[ab]
Feed conversion ratio		-0.77	-0.21	-0.48
% Mortality	100	66.7	66.7	0.00

Table 4, Shows the Nutrients digestibility by WAD goats fed the experimental diets.

The digestibility of the Dry Matter ranged between 73.49-78.33, the Crude protein 67.68-70.58. Crude Fibre 82.45-87.03 and Ash 88.62-90.53 while the Ether Extract is 68.81-70.58, the Nitrogen Free Extract ranged between 72.82-77.78, Neutral Detergent Fibre 78.33-82.72, Hemi Cellulose 86.33-93.38 while that of Acid Detergent Fibre is 75.86-81.95 and Cellulose 75.30-82.86, the Acid detergent lignin ranges from 63.14-80.59.

The digestibility of Dry Matter was lower in treatment II while it was high in treatment IV. The higher Dry

Matter digestibility recorded in treatment IV shows that the animal has ability to digest the diets, this may be due to lower of Neem inclusion.

The Crude Protein digestibility was lower in treatment II and higher in treatment IV, animal fed containing 25% Neem inclusion has highest Crude Fibre digestibility value compared to those fed other diets. This could probably due to lower Dry Matter intake of animal, which could result in longer exposure of time, of feed to rumen fermentation

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Table 4: Nutrient Digestibility by WAD Goats Fed the Experimental diets (g/100gdm)

NUTRIENT		Diets		
	Ti	T ii	T iii	T iv
Dry Matter	-	73.49	77.60	78.33
Crude Protein	-	67.68	70.58	69.01
Crude Fibre	-	82.45	87.03	88.40
Ash	-	88.62	89.33	90.53
Ether Extract	-	68.81	69.79	77.13
Nitrogen Free Extract	-	72.82	74.13	77.13
Neutral Detergent Fibre	-	78.33	82.62	82.72
Hemicellulose	-	86.33	92.35	93.38
Acid Detergent Fibre	-	75.86	81.95	81.90
Cellulose	-	75.30	82.86	79.23
Acid Detergent Lignin	-	77.70	80.59	63.14

Table 5: Shows the nutrient utilization by experimental animals fed diets containing neem leaves and cassava peels.

The result obtained shows that treatments II and III had highest nitrogen retained values. The nitrogen retained was lower in treatment IV.

Table 5: Nitrogen Utilization by WAD Goats Fed the Experimental diet.

Parameters	T I	T II	T III	T IV
Feed intake (DM)	-	257.90	286.75	197.15
Nitrogen in fed (%)	-	7.06	40.33	3.31
Faecal output (DM)	-	67.94	2.81	42.72
Nitrogen in faeces (%)	-	3.33	20.71	2.41
Urinary output (mls)	-	102.71	0.365	59.29
Nitrogen in urine (%)	-	0.596	13.59	0.601
Nitrogen intake	-	18.21	1.13	6.53
Faecal Nitrogen	-	2.26	0.08	1.03
Urinary Nitrogen	-	0.61	12.34	0.36
Nitrogen retained	-	15.34	19.10	5.14
Nitrogen retained (%)	-	84.24	91.10	78.71

CONCLUSION

In conclusion, WAD Goats can not survive on Neem leaves alone since the Neem leaves given to feed WAD Goats alone resulted into weight loss.

It is recommended that Neem inclusion in the West Africa Dwarf Goat feed should be below 25% level since this research work shows that any inclusion above 25% will have negative impact on the animals,

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Formulation of Natural Products Repellents for the Control of Cockroaches (*Periplaneta americana*)

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Abstract

The use of synthetic pesticides for insect pest control has been under serious attention due to the deleterious effect imposed on both human and the environment. This present study aimed at evaluating the effect of selected indigenous plants (*Azadirachta indica, Nepata cateria and Citrus sinensis*) for their repellency against cockroach (*Periplaneta americana)*. 200 adult cockroaches were used for the experiment. Cold maceration was the method of extraction of botanicals using ethanol and afterward, experimental insects were introduced to each of the plant extracts using five different doses. Inclusion dose were; 0%extract+100% biscuit (Control), 25%extract+75% biscuit, 50%extract+50% biscuit, 75%Extract+25% biscuit and 100%extract+0% biscuit. Repellency was observed and recorded at interval of 2, 4-, 8-, 12- and 24-hours duration. Results obtained were subjected to statistical analysis to determine the mean repellency, excess proportion index (PI) and percentage repellency. Neem extract showed the highest repellency (93%), followed by Catnip (86%) and Citrus oil had the least (74%) at the highest dose of 2.0g in 24hours exposure. All experimental plants used showed high repellency and maximum PI values in the highest dose (2g). It was concluded that the three botanicals used in this study could be adopted as a repellent in cockroach control.

Keywords: Doses, Insect, Plant Extracts, Proportion index, Repellency.

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INTRODUCTION

For decades, cockroaches have been a pest of economic importance throughout the globe. They create lots of menace by contaminating food and eating utensils, destroying fabrics, imparting stains and unpleasant odour to surface they have contact with. In addition to the menace created by this invertebrate, they serve as vectors transferring harmful microbes on their body surfaces to humans, particularly in environments such as homes and hospital. Cockroaches are linked with allergic actions in human. They produce tropomyosin, a type of protein that is linked with asthmatic condition in human (Rachel & David, 2014). Due to the significant menace created by this invertebrate, there is need for urgent resolution to curtail their negative effect on human and the environment.

In an effort to control cockroaches, two methods have been widely employed. Top priority was given to biological method of control and second by chemical control method. Synthetic pesticides have been playing significant role in pest control. Synthetic pesticides have significant neurotoxic effect on insects and they play major role in large scale vector control. In contrary, the organochlorines (Dichlorodiphenyltrichloroethane and Benzene

hexachloride) present in most pesticides as active ingredient has residual effect on the biosphere (Gobette, 1980). Research has shown the traceof DDT and BHC in food products, animal body and in human breast milk as a result of biomagnifications (Garwood, Ross, Sotty, Chabard, Charbonnier, Sutton & Withers, 2012). Botanical insecticides have been well recognized as potential alternatives to conventional synthetic pesticides and insecticides. This became an option because the botanicals would have lesser or no deleterious impact on the environment and human health compared to many of the conventional pesticides that have had demonstrable and significant adverse effects on non-target organisms and ecosystems.

There is limited research involving use of plants or plant extract in controlling cockroaches. Most of the research related to cockroach management has been centered on essential oils. The volatile compounds of essential oils (terpenes, benzene derivatives and so on) have been reported to be very potent as cockroach repellent and preventing their infestations (Lewis., Connick, & Fravel, 1998). In the course of evolution, plants have developed various defensive mechanisms in form of chemical molecules which protect them against insect pests (Swan, 1977). Among the most

reported plants which have high lethal effect or ability to repel insect pests are Neem, Tulsi, Catrip and Citrus. Recently, the toxicity and bio-efficacy of extract of *Cassia fistula, Datura alba* and commercial product neemarin (0.15% EC) was reported against adult *Periplaneta americana*. The essential oil of catnip (*Nepeta cataria*) showed repellency against adult male *Blatta germanica*. The study on the commercial essential oils for repellency against cockroaches revealed that Citrus hystix oil exhibited complete repellency against the American and German cockroach (*Periplaneta americana* and *Blatta germanica*) Faujan et al. (2015). With this background, this study intends to evaluate the comparative effect of the ethanolic leaf extract of *Azadirachta indica, Nepata cataria and Citrus sinensis* peel as a potential repellent for cockroaches.

MATERIALS AND METHODS

Experimental site
This study was carried out at the Environmental Biology Laboratory, Department of Science Laboratory Technology, The Federal Polytechnic Ilaro, Ogun State, Nigeria.

Experimental Insect's Collection
Two hundred adult cockroaches (*Periplaneta americana*) were collected from infested manholes of houses in Orita, Ilaro, Ogun state. For maintenance purposes, a carton covered with net was used as a maintenance cage. In the maintenance cage, collected cockroaches were sheltered, supplied with food and water to adapt to their new habitat for at least 24 hours before the commencement of the experiment.

Collection of Plant Samples
Fresh samples of *Azadirachta indica* (Neem) leaves were collected from the botanical garden of Science Laboratory Technology, Federal Polytechnic Ilaro while fresh samples of *Nepata cataria* (Catnip) leaves were collected around the residence area Ilaro town. *Citrus sinensis* (Sweet oranges) were bought from Bola market Orita, Ilaro, Ogun state.

Preparation of Plant Samples
The *Azadirachta indica and Nepata cataria* plants samples were washed thoroughly with clean distilled water in order to remove dust and soil particles, while *Citrus sinensis* were peeled. Samples were air dried under shade to prevent direct ultra-violet rays from inactivating the chemical constituents as described elsewhere (Das, Tiwan, & Shivasteva, 2010; Ncube, Afolayan & Okoh, 2008). Samples were frequently examined and when dry enough to break, each plant sample was pulverized into fine powder using electric stainless steel blade electric blender.

Preparation of Plant Extracts
The pulverized samples were extracted with ethanol using cold maceration method according to Evbuomwan, Achor and Opute (2015). The ethanolic extract was prepared by suspending 100grams of the finely blended dried powder of the three botanicals separately in 500 ml of 70% ethanol. Using a sterile rod, the mixtures were stirred for 3 minutes and then allowed to stand for 48 hours. The extract was then filtered, first through a sterile muslin cloth and again using Whatman filter paper. The extracts were concentrated to dryness under reduced pressure and controlled temperature (40–50 ºC) in a rotatory evaporator.

Experimental setup
For this study, a square-box measuring 50cmx50cmx15cm with the top covered with net was employed in the repellent tests. Four (4) boxes were used per treatment. Walls of the box were smeared with vaseline to prevent escape of cockroaches. A piece of carton was used to divide it into 2 equal parts (treated and control areas) and 10 starved cockroaches were introduced. The treatments were in four replicates.

Treatments and method of application
Control = 2.0 g of biscuit powder only
Treatment 1 = 1.5 g of biscuit powder + 0.5 g of plant extract
Treatment 2 = 1.0 g of biscuit powder + 1.0 g of plant extract
Treatment 3 = 0.5 g of biscuit powder + 1.5 g of plant extract
Treatment 4 = 0 g of biscuit powder + 2.0 g of plant extract
The repellency was recorded at 2, 4, 8, 12 and 24 hours' time interval. The PI and PR were recorded in each of the time interval

Statistical Analysis
Repellency was calculated from the data obtained using the experimental formula of Sakuman and Fukami (1985).

$$PI = \frac{TC - NC}{TC + NC}$$

$$PR = \left[1 - \frac{TC}{TC + NC}\right] \times 100\%$$

PI: Excess proportion index
TC: Number of insects trapped in the chemical-treated test box
NC: Number of insects trapped in the control test box
PR: Percentage repellency (i.e., percentage of insects trapped in control test box)

RESULTS

Presented in table 3 is the repellency of *Azadirachta indica* at different doses against *P. americana* at different hours of exposure. There is a linear progression in the values obtained as the highest repellency was observed in the highest dose (2.0g). The negative excess proportion index (PI) values across table 3 signify more of attractancy than repellency, that is, the number of insects trapped in the chemical-treated test chamber is lesser than number of insects trapped in the control test chamber. This implies that excess proportion index (PI) and percentage repellency (PR) have inverse relationship as indicated in table 3. The greater the PI values, the lower the percentage repellency of the different doses of the extracts used. In the experiment, as the dose of neem extracts increases, PI value gradually reduces from -0.30 to -0.71, -0.34 to -0.75, -0.37 to -0.77, -0.52 to -0.80 and -0.50 to -0.85 at 2 h, 4 h, 8 h, 12 h and 24 h time interval respectively which thereby gives a gradual increase in the values of percentage repellency in all the time interval as the *P. americana* is exposed to different dose of 0.5, 1.0, 1.5, 2.0g of the extract.

Table 4 reveals the repellency of *N. cateria* leaf extract against *P. americana*. Result showed increase in PR as the hours of exposure increases while there is reduction in the PI as hours of exposure progresses. Increased hours of exposure seem to have significant effect on the insect as the repellency increases as time of exposure increases. This study shows that at the maximum hours of exposure (24 h), the repellency was highest as this gives an extensive time frame for Catnip extract to act upon the experimental insect at maximum dose of 2.0 g. Repellency of *N. cateria* remained at zero level in the control experiment for all the hours of exposure. However, at 2.0 g the percentage repellency is seen to be highest (86%) even at 8h exposure which continues to show its repellency even at 24 h.

Table 5 shows the repellency of *Citrus sinensis* peel extract at 2, 4, 8, 12 and 24-hour durations under different doses. Extract shows positive PI indicating attractancy at 2, 4-, 8-, 12-, and 24-hours exposure in 0.5 g dose. Attractancy was also observed in 2 h and 4hrs exposure in 1g dose. The highest repellency was seen at the highest dose (2.0 g), PI value is -0.09%, -0.14, -0.16, -0.26 and -0.46 and percentage of repellency was 55%, 58%, 59%, 64% and 74%. Among all the doses of extract used 0.5g showed the least repellency with higher PI while the control group showed no repellency.

Table 3: Percentage repellency and PI value of *Azadirachta indica* against *Periplaneta americana* at different time interval

Plant Name	Extract Dose (g)	Time Duration									
		2 h		4 h		8 h		12 h		24 h	
		PI	PR	PI	PR	PI	PR	PI	PR	PI	PR
Neem	0.5	-0.30	60%	-0.34	64%	-0.37	70%	-0.52	75%	-0.50	74%
	1.0	-0.46	74%	-0.52	77%	-0.57	79%	-0.60	81%	-0.71	86%
	1.5	-0.60	81%	-0.71	86%	-0.73	87%	-0.71	86%	-0.80	90%
	2.g	-0.71	86%	-0.75	87%	-0.77	89%	-0.80	90%	-0.85	93%
	Control	0	0%	0	0%	0	0%	0	0%	0	0%

Table 4: Percentage repellency and PI value of *Napeta cateria* against *Periplaneta americana* at different time interval

Plant Name	Extract Dose (g)	Time Duration									
		2 h		4 h		8 h		12 h		24 h	
		PI	PR	PI	PR	PI	PR	PI	PR	PI	PR
Catnip	0.5	-0.29	58%	-0.31	61%	-0.34	64%	-0.35	68%	-0.38	70%
	1.0	-0.28	56%	-0.35	68%	-0.37	70%	-0.57	79%	-0.71	86%
	1.5	-0.31	61%	-0.33	64%	-0.49	72%	-0.73	87%	-0.58	81%
	2.0	-0.29	58%	-0.31	61%	-0.34	64%	-0.35	68%	-0.38	70%
	Control	0	0%	0	0%	0	0%	0	0%	0	0%

Table 5: Percentage repellency and PI value of *Citrus sinensis* against *Periplaneta americana* at different time interval

Plant Name	Extract Dose (g)	Time Duration									
		2 h		4 h		8 h		12 h		24 h	
		PI	PR	PI	PR	PI	PR	PI	PR	PI	PR
	0.5	+0.31	34%	+0.11	36%	+0.21	42%	+0.20	40%	+0.21	42%
Citrus	1.0	+0.28	42%	+0.20	40%	-0.06	54%	-0.03	52%	-0.14	58%
	1.5	-0.06	54%	-0.03	52%	-0.14	58%	-0.23	63%	-0.62	62%
	2.0	-0.09	55%	-0.14	58%	-0.16	59%	-0.26	64%	-0.46	74%
	Control	0	0%	0	0%	0	0%	0	0%	0	0%

DISCUSSION

Over the last two decades, researchers throughout the globe have intensify in their efforts toward the development of natural products for insect/pest control due to increased regulations on the use of synthetic chemicals in insect pest management. Even though pesticides can be remedial to several insect diseases and pest growth, its side effects on both human and the natural environment are also highly noticeable and therefore cannot be overlooked. As a result, this study becomes paramount as the use of botanicals can be a potential substitute to harmful pesticides. This present study showed the repellent potential of the three botanical extract used at different doses of 0.5, 1.0, 1.5, 2.0 g and at various time interval (2, 4, 8, 12 and 24 hours). Treatment without extract showed no repellency or attractancy in all groups. Among the three botanicals tested, the highest repellency (74%, 86%, 90%, 93%) was observed in *P. Americana* exposed to 2.0g *A. indica* extract at 2, 4, 8, 12 and 24hrs exposure, followed by Catnip (70%, 81%) and the least which is Citrus oil (42%, 58%, 62%, 74%). Rejitha, Reshma, and Anu (2014) also observed similar strong repellency effect of *A. indica* on *P. Americana* when compared with Turmeric, Lantana, vitex, *Ocimum* and *Adathoda vasica* extract. However, *C. sinensis* extract showed the highest attractancy at 0.5g in all the hours of exposure and 1g dose at 2hrs and 4hrs respectively. This implies that *C. sinensis* extract is good as repellent at 2g dose with an exposure of 12 to 24hrs and as an attractant at 0.5 g dose with exposure ranging from 2 h to 24 h. Stauffer, (2009) also observed attractancy in German cockroaches (*Blatta germanica*) when citrus pulp was used together with other plants. Since it is observed in this study that increased hours of exposure seem to have significant effect on the insect as the repellency increases as time of exposure increases, therefore higher doses of the botanicals tested are excellent properties in controlling cockroaches. The botanicals will be more effective, especially in difficult-to-reach or hidden places such as plumbing and electrical fittings which may serve as runways or hide out for cockroaches.

CONCLUSION

Few to several plants have been examined to have bioactivity (repellency and attractancy) against cockroaches and their multiple targets of actions against cockroaches assure effectiveness as alternative bio-insecticides. It should be noted that the efficacy of these botanicals against cockroaches and other insect pest vary depending on some factors such as the plant part used, the extraction method adopted, solvent used for extraction, geographical locality the plant was obtained, the dose and concentration of the extract used.

Since it has been shown in this present study the potency of *Azadirachta indica*, *Nepata cateria* and *Citrus sinensis* as a repellent or attractant for cockroaches, the adoption of this environmentally safe control measures either as alternatives or complements to chemical control in an integrated approach could be adopted. In addition, other plant-based extract should be identified and tested in future work for their repellent, attractant and lethal potential against cockroaches and other form of economic insect pest.

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Managing Air Pollution Through Sustainable Landscaping in the Emerging Lagos Megacity

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Abstract

Worldwide, air pollution is a major source of mortality, sickness, and social distress. It is similarly a troubling truth in Lagos, Nigeria's commercial centre and one of the world's fastest-growing megacities. Despite mounting worries about the lethal consequences of air pollution, Lagos lacks both a policy and a comprehensive management plan. This study examined landscaping as a strategy for combating air pollution and environmental degradation in Lagos megacity with a particular focus on Ikeja Local Government Area. The methodology adopted by this study comprised field survey and review of related literature for purpose of collecting primary and secondary data respectively. A structured questionnaire was used to collect primary data from 475 households which were sampled from 95,426 estimated household population using the Taro Yamane sampling model. These findings necessitate an immediate plan of action to enhance the air quality in the city, with a particular focus on the major pollution sources: road transportation, industrial emissions, and power generation.

Keywords: Air Pollution, Environmental Degradation, Combating, Megacity

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INTRODUCTION

Air pollution has become an increasingly international challenge due to the release of air pollution from human activities (Motesaddi *et al*., 2017; Von Schneidemesser *et al*., 2019). Urban air pollution has risen as a result of human activity and weak environmental legislation (Komolafe *et al*., 2014). Quality air is of great importance to people, plants, animals, and materials. (Garg *et al*., 2006). Turbulence or pollution of air components caused by human activities, on the other hand, can cause significant harm or risk the lives of all living creatures on land (Wang *et al*., 2014). In 2005, the World Health Organization (WHO) stated that air pollution was responsible for more fatalities than illnesses including AIDS, TB, breast cancer, and malaria. Lagos air pollution is a major problem in Nigeria, owing to overpopulation caused by heavy industrial and commercial activity (Odekanle *et al*., 2016). Previous research in Lagos has shown that local air quality had a substantial influence on individuals when compared to WTO guidelines (Efe, 2008; Odekanle *et al*., 2017). Rail transit is one of the sources of air pollution in Lagos. The significance of rail transportation as a source of certain persons at any given moment depends on the intensity of traffic and the closeness of other sources of specific things and weather conditions (Odekanle *et al*., 2016, 2017; Onat & Stakeeva, 2013). According to a study on air quality done by the Lagos Metropolitan Transport Management Authority, Lagos Metropolitan Area Transport Authority [LAMATA] (2002), vehicle service contributes about 43 per cent to Lagos' poor air

quality. Municipal solid waste combustion is another important cause of air pollution in Lagos. It is normal practice in Lagos to burn solid garbage, even in landfills. Although the burning of solid waste informs of waste disposal is beneficial in terms of its low cost in the overall waste management, it, therefore, leads to the release of harmful compounds into the environment. The aim of this study is using landscaping materials in a sustainable way to manage air pollution, from other studies it has been shown how plant can be used to reduce air pollution. One of the biggest problems in public institutions such as Lagos is increasing the amount of waste produced (Adeniran *et al*., 2017; Ayantoyinbo & Adepoju, 2018). Similarly, it is of importance to note that poor and uncontrolled management of public waste by the government is of great concern. Another method of solid waste originating in sawdust and wood workshop waste which are burning openly without proper environmental control (Igben, 2019; Owoyemi *et al*., 2016). Sawmills of all sizes may be seen along Lagos's coastline. As a result, one of the most pressing environmental issues confronting the city today is determining how to dispose of the pollutants produced daily by these operators' ever-increasing operations (Igben, 2019; Owoyemi *et al*., 2016). Without adequate disposal measures, this trash is dumped and burned along the Lagos lagoon's bank (Okedere *et al*., 2017). As demand for wood and its products grows, the waste volume produced by these sawmills in Lagos is predicted to grow, resulting in increased emissions from waste burning. There are reports on both the

environment and the health effects of these emissions on ventilation from combustion processes. Frederica believes that the products of the burning of crude and crude oil by-product are the most serious threats in the world to the health and future of children, and make the greatest contributions to both international and environmental inequality. Similarly, the burning of fossil fuels in developed countries and the burning of biomass in developing countries have been calculated to alleviate much of the global air pollution problem, which releases up to 85% of the possible particles in the air, SO_2 and NO_X, to the environment (International Energy Agency (IEA, 2016). Numerous health-related instances have been found as direct causes of these diseases as a result of emissions from various combustion systems (Agarwal & Yamamoto, 2015; World Health Organization (WHO, 2016). Despite all of these environmental and health concerns, distinct combustion processes happening from various sources, ranging from manufacturing operations to household cooking, continue to increase in Lagos, necessitating the need to compute emissions of combustion systems.

LITERATURE REVIEW

Landscaping otherwise known as landscape architecture, "is the professional skill of composing man-made structures, including buildings and paving, with the natural landscape and with designs for landform, water and planting" (Gardenvisit, 2009) The underlying notion of landscape design is problem solving via the application of horticultural science, aesthetic composition, and spatial organization to create appealing and efficient outdoor spaces for a variety of purposes. (Parsons, 2011) The benefits of a landscape. Environmental benefits: - Trees, shrubs, fences and flowers offer great environmental benefits, as plants protect the water supply, provide food (in the form of vegetable gardens) and reduce air pollution by absorbing carbon dioxide and planting oxygen dropped. Having your garden set up can also reduce noise pollution in your home by preventing ambient noise. Other reasons for landslides include reduced flood flow and therefore flooding. Also, to control the maximum temperature, it is kept cool in summer and warm in winter. Landscaping is also beneficial for erosion management, which reduces the loss of soils in waterways. Also important is the use of the garden to reduce evaporation and soil damage (Marc-Frank, 2003). b. Improving biodiversity: - Landscaping provides food and shelter for insects, birds and animals developed with them. The development has led to the dramatic depletion of indigenous communities and the division of wildlife.

In the management of our private and public landed spaces, we can provide food, shelter, water and connectivity to reduce loss, which is the result of activities such as deforestation (Novak, 2003). c. Health reasons: - Create a healthy environment by

filtering polluting agents and producing clean air. It helps to adapt to the local population by cultivating an active lifestyle. It also creates a beautiful environment that is not vulnerable to factors that promote stress and all other health challenges and provides privacy for individuals (Novak, 2003). d. Economic reasons: - Landscaping increases the economic value of assets. It also increases investment in the area in question because some aspects of land surveying contribute to physical development (Novak, 2003). e. Societal Objectives: By creating green areas, increases the quality of life of our communities. Incidentally, it is also believed that local noise reduction and heat reduction are also possible. The attraction site also serves as an agent for sports and recreation. It also increases the probability of high-density growths (Novak, 2003). Landscape Architecture in Lagos is like in any other city in the country; there is little or no deliberate landscaping within the city, both at the macro and the micro-level of the city. The general idea is that landscaping is an unnecessary component of property development and people are not aware of the function of landscaping within the built area. Roads and buildings were built with little or no plans for landscape development. The negative impact of this indifference to landscape design is often seen on the environment, especially in areas where development and urbanization are rapidly taking place. It is important to say that the use of plants to combat pollution is the main reason for this. Plants have essential ecological roles in cities by eliminating various types of organic debris (Leung *et al.*, 2011). Some research aimed at determining the material (quality and quantity) of the particles accumulated on the leaves has revealed that activating green matter to the particles may be useful because when the particles created on the turbulent path flow fall on a leaf, they are guided by a dream layer to the surface of the leaf, on which they are exposed (dry precipitation) (Beckett, 2000; McDonald *et al.*, 2007 & Rai, 2016). According to research, 1 m^2 of leaf area may absorb between 70 mg and 2.8 g of particles every year (Nowak, 2006 & Beckett, 2000). Some simulations produced in the United States for a large-scale project in Chicago revealed that 1 hectare of trees (11 per cent area) eliminated 9.7 kg of garbage each year (part for which the effect the most important is that the particles are less than 10m, e.g., 3.5 kg) (Nowak, 1994) and the removal for the entire urban area (e.g., 600 km^2) is 591 tons. The results of Yang *et al*. (Yang *et al.*, 2005) showed that trees in central Beijing removed 1241 tons of particles in 2002 (mostly PM10, 772 tons). A work by Nowak *et al*. (Nowak, 2013) linked the removal of PM 2.5 from trees in 10 U.S. cities linked to health outcomes. The average value of PM2.5 shifts from annual trees ranging from 4.7 tons in Syracuse (NY) to 64.5 tons in Atlanta (GA), with annual values generated by direct and indirect gains from $ 1.1 for

Syracuse to $ 60.1 million for New York City. Most of these values are given by the effects of human mortality. The reduction in mortality is estimated at 1 / year per person in different cities, but in New York City with a population of 7.6 per year. Similar models have also been developed in Europe (McDonald *et al.*, 2007) showing the role of trees as "destroyers" of pollutant particles for other plant species and other species. (McDonald *et al.*, 2007) showed that a conscious increase in tree cover, up to a maximum of 54%, would reduce PMx concentration by 26% in the West Midlands region in the United Kingdom.

Lagos megacity, Air Pollution and Landscape Architecture
In many cities in Nigeria, pollution is a sanitary practice during development. In the course of what is called physical development, the wind is unknown, trees are cut down, mountains are pushed, and so on. Lagos falls within the category of cities currently seeking development, which attracts urban sprawl but also does not assess its impact on the environment. Concerns arising from corporate activities to transportation activities may reflect the impact it has had on the air (which is the focus of this study). Human and environmental services go hand in hand. This is because any human activity takes place within the community and the result is either positive or negative for the people. According to Uchegbu (1998), negative effects of man arise from these economic and domestic activities. Areas, where air pollution is most prevalent, include transportation, commercial and industrial services, domestic services, coal burning and waste disposal (Uchegbu, 1998). On transportation, Lagos 'megacity is similar to the most developed megacities in the world. Urban travel in Lagos is very important, in transporting goods and people and therefore it stands as an economic backbone. So it is hoped that, if more trips are made on the roads, the city will often be plagued with traffic problems such as high cost of transportation, replacement of traffic and environmental pollution. City traffic faces many challenges, primarily caused by rapid urbanization and an increase in car ownership that affects the speed of traffic use and its impact on the environment. With changes in the economic system, transportation costs increase, increasing traffic capacity at a tremendous rate.
Newman and Jeffrey (1997) therefore emphasize the negative effects of urban traffic, as it contributes to accidents, water and air pollution such as road congestion on the roads. In areas with a lot of traffic, the pollution generated is expected to be very high. In a similar situation, carbon monoxide (CO) which is released from vehicles (e.g. cars, buses, trailers, etc.), this problem is more pronounced in that most vehicles are not very efficient, and improper maintain machines, therefore, emit a lot of toxic fumes, of which CO is

commonly found in and CO not being easily detectable upon emission, can result in degenerating climatic conditions, for example, ozone depletion and global warming. Therefore, whether it is a deliberate attempt of the urban traffic constituents to emit harmful atmospheric pollutants, it is still a means of development. Most cars must be equipped with exhaust fumes that separate harmful chemicals before being released into the air. It is also a possible way of air pollution reduction. The city of Lagos is notorious for its corporate activities. These companies are known for their heavy manufacturing activities that cause air pollution. Therefore, the increase in the smoke generation is not noticeable whereby unwanted toxins are released into the air. The reasons for industrial pollution range from lack of policy to pollution. The lack of effective policies and poor implementation has led many companies to avoid the rules laid down by the Environmental Protection Agency, leading to huge pollution affecting the lives of many people. Another reason is the unplanned industry development. This is noticeable in many industrial cities where unplanned growth occurs, in which companies do not read the rules and regulations and pollute the environment with both air and water. The use of old technologies is also a strong factor. Many companies still rely on old technologies to produce products and these processes produces large amounts of waste. To avoid high costs, many companies continue to use traditional custom technologies to produce high-end products. These large volumes of wastes are then released into the air and water polluting the environment. The presence of a large number of small-scale companies is also a contributing factor. Where many small and medium-sized enterprises do not have a capital base but rely on government grants to conduct their business daily, and environmental regulations are often avoided and they release large amounts of toxic fumes into the air. Ignorance is also a factor, people are not sure about the damage they do when they let out toxins into the air. In domestic works and the burning of fossil fuels, studies have shown that illegal burning around the world pumps more pollution into the air. Indoor services are also one of the most important sources of air pollution. Families in Lagos are known for using energy for many, most productive jobs. Waste disposal in Lagos is also a cause of air pollution. The more waste is created, the more we have to throw away. Some waste disposal systems release greenhouse gases and greenhouse gases into the atmosphere. Waste disposal in Lagos is most commonly manifested by traditional methods of waste disposal, i.e. burning of waste, this occurs at collection centres or even in households. The best-case scenario for waste recycling is to use other methods that do not emit large amounts of pollutants but are environmentally friendly, including burning fossil fuels - petroleum, coal, greenhouse gases and others, when they have repeated the updates. and combustion (use)

of these fuels. These activities are dangerous to the environment. After all, they release more people into the atmosphere because they facilitate the multiplication of two major environmental pollutants, acid rain and global warming. In terms of land architecture, the landscape in Lagos is no different from other cities. There is no big deal of pure landscape design, not macro or micro.

People consider landscape design as an unnecessary component during development. Individuals rarely know the extent of the activity of the landscaping, so Lagos cannot be different from other cities in its disposition to landscaping. Roads are being built, buildings raised and infrastructure have been developed, but little emphasis has been placed on the importance of landscaping. Development in Lagos has shown a negative impact on the environment for the lack of attention to the landscaping of the city. Note that the focus on the landscape as a remedy for the increasing impact of pollution is the primary aim of this study limiting the boundaries of vegetation (forest cover). The benefits of plants as a remedy to the contrary are enormous. For example, plants reduce greenhouse gas emissions (CO_2) caused by many factors that contribute to climate change. The trees absorb CO_2, remove it and store it while releasing oxygen into the air. Trees and plants release more oxygen into the atmosphere due to photosynthesis; they also take in a lot of greenhouse gases that contribute to air pollution. The world vegetation is responsible for the removal of two-thirds of pollution known as volatile organic compounds (VOCs) released internationally. Research has shown that one hectare of trees growing a year absorbs the amount of CO_2 produced when a car is driving 26,000 miles. Trees absorb harmful sunlight and greenhouse gases (nitrogen oxides, ammonia, sulfur dioxide and ozone) and filter particles from the air by trapping them on their leaves and bark. Trees, shrubs and grass remove smoke, dust and other debris from the air. A tree can remove 26 kilograms of carbon dioxide annually from the surface, which is equivalent to 11,000 kilometres of car exhaust. One study showed that an acre tree can remove 13 tons of particles and gases annually, while nearly 2,500 square feet of peat draws carbon dioxide from the air and releases enough oxygen for a family of four at the same time. Trees also save energy. It has been discovered that no less than three trees in a process placed around a single-family home can reduce air conditioning needs by up to 50 per cent. By reducing energy needs to cool our homes, carbon dioxide emissions and other pollution from power stations can be reduced. Trees can also protect a person from ultraviolet rays. Cancer is the most common form of cancer. The trees reduce ultraviolet exposure by about 50, thus providing people with protection during their outdoor activities.

METHODOLOGY

The data used for this study is collected from both primary and secondary sources, the use of a well-structured questionnaire and the review of related works of literature.

The Yaro Yamanne formula was applied to the population of the city to determine the sample size for the study,

The formula is given as

$$n = N/1 + N(e)^2$$

Where, n = sample size desired N = population for the study e = level of significance (5%). In the end, a sample size of *475 households* was arrived at and used for the study. Spearman's Rank Correlation analysis was employed to examine the significant relationship between Lagos megacity grade of landscaped architecture and the prevalence of air pollution-related ailments and Analysis of Variance (ANOVA) was used to examine the significant differences in the occurrence of air pollution-related ailments around the megacity.

1. Spearman's Rank Correlation Analysis is given by:

Rs= 1- 6$\sum$d^2/N(n^2 -1)

2. Analysis of Variance (ANOVA) model is given by:

SST= Σx ^{2} – (Σx) ^{2} ……………. (1)

SSB= (Σx1) ^{2} x (Σx2) ^{2} x (Σx3) ^{2} x (Σxn)^2……………. (2)

SSW = SST – SSB ……………. (3)

Where, SST = Total variation (Total sum of squares) SSB = Variation between groups (sum of squares between) SSW = Variation within groups (sum of within)

RESULT AND DISCUSSION

Summary and Findings This paper made some findings. Prominent among such are:

1. Burning of fossil fuels, improper agricultural practices, exhaust fumes of automobiles, vehicular traffic, factories and industries, mining operations, and indoor activities are the major factors that cause air pollution and environmental degradation in cities and elsewhere.

2. The major adverse consequences of air pollution include acidification, eutrophication, ozone layer depletion, skin cancer, the release of particulate matter into the ambient surroundings, diseases etc.

3. The major causes of environmental degradation include land disturbance, pollution (air, water, soil), overpopulation, landfills, deforestation, and natural disasters.

4. The prominent consequences of environmental degradation are ill-health to man, loss of biodiversity, ozone layer depletion, depletion of national income, and loss of tourist sites.

5. Landscaping comes with many environmental, biodiversity, health, economic, and social benefits, which highly recommends it as a potent strategy for curbing the adverse effects from air pollution and environmental degradation in the Lagos metropolis.

DISCUSSION

Air pollution is a product of man's yearning need for a better livelihood, ignorant of the after-effects, hence sustained development at all sectors of the society with its devastating effect on the inhabitants and the natural environment. To squarely address the consequences associated with air pollution and environmental degradation in cities in Nigeria, efforts should, first and foremost, be made to strengthen the official mechanisms for control of pollution such as emission from traffic, industries, and automobiles by the relevant authorities of government. Secondly and most crucially, there should be increased use of landscaping as a tool for curbing air pollution. Landscaping has a role to play in our urban environment, Enugu, in this period of rapid urbanization. It is not only of lesser cost because it deals with the natural environment which is almost complete and free, but without the conscious activity of man, wouldn't materialize. This is why landscaping should be encouraged, since it has been shown that areas with high vegetative belts of high quality experience the least occurrences of diseases, unlike the lowly vegetative areas.

CONCLUSION

Development is viewed as a very costly enterprise but its after-effects largely go unnoticed. One of them, being air pollution, the introduction of harmful particles into the atmosphere, is the reason for health and environmental mishaps in our society today. Generally, solutions have been forthcoming and one of them is landscaping. Landscaping, which aims at shaping the environment for the comfort of man, with careful application in the urban environment, would go a long way to securing the expected livelihood of the inhabitants of the society, particularly in Enugu urban.

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Removal of Pb²⁺ And Zn²⁺ from Aqueous Solution using Eggshell Powder as Adsorbent: Kinetics and Equilibrium Studies

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Abstract

Pollution caused by human activity is a growing concern in today's world. Several contaminants from various companies are emitted into the environment. Heavy metals are non-biodegradable, poisonous, and persistent pollutants that have negative impacts on the ecological niche of all life forms, including humans. Therefore, the objective of this study was to use locally produced chicken eggshell powder to remove metal ions (Pb²⁺ and Zn²⁺) from aqueous solutions using an adsorption technique. The sorption process is influenced by pH, contact time, initial metal ion concentration, and sorbent dose. The pH of 7.0 and contact time of 60 minutes is ideal for the uptake of metal ions. Pseudo-first order and pseudo-second order rate measures were utilized to examine the adsorption kinetics. Langmuir and Freundlich models were employed for the adsorption isotherm study. Equilibrium adsorption data of Pb²⁺ and Zn²⁺ followed the Langmuir and Freundlich isotherms with R^2 of 0.834 and 0.993 respectively. The kinetics data revealed pseudo-second order rate model to best describe the reaction while Freundlich isotherm model was a better model that best fit for Pb²⁺ and Zn²⁺ adsorption onto eggshells adsorbent. In conclusion, chicken eggshell powder may be employed as alternative, low cost and effective local adsorbent for Pb²⁺ and Zn²⁺ removal from aqueous solution.

Key words: Metal ion; Adsorption; Eggshell powder; Kinetics; Equilibrium

INTRODUCTION

Frequent discharge of heavy metal-containing wastes from agrochemicals such as herbicides and pesticides, as well as industrial activities such as mining, oil refining, pigments, and smelting, has resulted in a slew of environmental issues. The existence of heavy metals in the environment has potential health risks for humans and plants (Volesky, 2000; Garbisu & Alkorta, 2003). Lead is one of the most poisonous heavy metals that induce environmental pollution. Lead pollution comes from the coating of metals, pigments, the ceramic and glass industries, textile dyeing, refining and finishing of petroleum (Volesky, 2000; Aksu, 1998). In low concentrations, lead can cause a variety of adverse effects, including impaired behavior, damage to the nervous system, and even increased blood sugar. Lead is stored mainly in muscles, bones, the brain, and kidneys. Increased lead concentration can cause many serious illnesses, including gastrointestinal damage, anemia, liver disease, neurological disorders, and death (Lo et al., 1999). Zinc is one of the most abundant elements in the Earth's crust. In regions where zinc is naturally present or mined, it can easily contaminate the soil and water. When consumed in excess, whether willingly through supplements or involuntarily from contact with contaminated soil or water, zinc can result in serious health crises such as anemia, nausea, and stomach cramps. A high level of zinc can harm the pancreas, disrupt protein metabolism, and lead to arteriosclerosis. Chemical oxidation or reduction, electrochemical treatment, ion exchange, coagulation and precipitation, evaporation, membrane separation and electroplating adsorption are the traditional techniques of removing lead and zinc from aqueous solutions and industrial wastewater. However, these techniques have different drawbacks, such as toxic waste generation, being expensive to maintain, producing large quantities of secondary pollutants, sludge, high reagent and energy requirements, and are not always effective for low concentrations of metals (Pan, Cao, & Zhang, 2009). The most effective classical method is activated carbon adsorption, but it's production cost is extremely expensive and it cannot be regenerated (Farooq et al., 2010). Hence, it is essential to discover inexpensive and environmentally friendly methods to remove heavy metals from the environment (Juwarkar, Singh, & Mudhoo, 2010; Sahan et al., 2010). Adsorption is a process that uses agricultural materials as adsorbents to remove toxic heavy metals from aqueous solutions. Adsorption is among the most promising alternative strategies for the lessening of heavy metal ions, because it provides many benefits, such as the possibility of biosorbent regeneration and metal recovery, high metal binding capacity, low cost, environmentally friendly and more traditional efficient treatment wastewater dilution method. Hence, this study aims to determine the capacity of chicken eggshell powder as an alternative biomass for the removal of Pb²⁺ and Zn²⁺ ions in aqueous solution.

Sorbent Preparation

Chicken eggshells were obtained from Eleshin Poultry Farm in Ilaro. The eggshells were rinsed with tap water followed by distilled water two times each. Thereafter, the samples were dried under the sun for about six days and then in the oven at 80°C for three hours. The dried eggshells were sieved after being grounded through a 100 micrometre sieve and stored in desiccators before use.

Reagents and Metal ions Solutions Preparation

All of the chemicals used in this study were analytical grade. The reagents used include $Pb(NO_3)_2$, HNO_3, NaOH and $ZnSO_4$. $Pb(NO_3)_2$ and $ZnSO_4$ were used to make stock solutions of the standardized Pb^{2+} and Zn^{2+} ions of 2.5 mg L^{-1} each. HNO_3 and NaOH (1 mol/L each) were prepared by sufficient dilution of concentrated HNO_3 and sufficient weighing of NaOH pellets, respectively.

Effect of pH

The pH of 2.5 mg L^{-1} metal ions solutions was adjusted with 1 molL^{-1} HNO_3 and NaOH solution, which resulted in metal ions standards with pH ranging from 3 to 8. A considerable amount (2.0 g) of eggshell was slowly stirred for 60 minutes at 35°C in a rotary shaker with 30 ml of each of the metal ion solutions. Previous research had shown that biosorption reached equilibrium within 60 minutes (Ayodele and Godswill, 2014). Before performing Atomic Absorption Spectrophotometry (AAS) measurements, samples were instantly filtered using 0.45 µm filter paper paper.

Effect of Contact Time

At room temperature, contact time impact was conducted in a rotary shaker containing 30 ml of stock solutions with 2g of the adsorbent using 250 ml Erlenmeyer flasks at 180 rpm. The contact time effect was studied between 15 - 105 minutes. The metal ion quantity in the filtrate was determined using AAS after filtering the adsorbent with 0.45 m filter paper. The equilibrium adsorption time was determined from the plot of adsorption capacity against time. The adsorption capacity, qe (mg/g) at equilibrium, is calculated using Equation (1), while the percentage of Pb^{2+} and Zn^{2+} ions uptake is calculated using Equation (2).

$$qe = (Co - Ce)\frac{V}{W} \tag{1}$$

$$\% \, of \, metal \, ion \, uptake = \frac{Co - Ce}{Co} \times 100 \tag{2}$$

Effect of Sorbent Dosage

A rotary shaker was used to stir precisely weighed volumes of eggshell varying from 0.5 g to 3 g with 30 ml of metal ion solutions at pH 7 for 1 hour. The mixture were then filtered through a Whatman filter paper. The concentrations of metal ions in the filtrates were determined.

Effect of Metal ion Concentration

Metal ion standards in the range of 2.5 to 15 mg L^{-1} were made. On a mechanical shaker, a measured quantity (2.0 g) of eggshell was stirred for 60 minutes at pH 7 with 30 ml of each set of metal ion standards. The compositions were filtered after 60 minutes of stirring at room temperature. The concentrations of metal ions in the filtrates were determined

RESULT AND DISCUSSION

Effect of pH

According to Ofomaja and Ho (2007), pH influences heavy metal ion dissociation, hydrolysis, complexation, precipitation, and other processes in an aqueous solution. Furthermore, pH has an influence on the availability and speciation of ions, which has a direct impact on sorption of metal ions from aqueous solutions. Figure 1 depicts the influence of pH on adsorption capability of eggshell for Pb^{2+} and Zn^{2+} ions. When the pH was increase from 3 to 7, the sorption of Pb^{2+} and Zn^{2+} by eggshell increases. Sorption rates were substantially higher at pH 7 than at other pH standards. The sorption effectiveness does not improve substantially beyond pH 7.

Similar results have been reported in the literature for a variety of sorbent systems (Ajaykumar, et al 2009; Sharma 2007). This means that when analyzing adsorption kinetics and equilibrium, adsorption at pH 7 is preferred. The ion-exchange mechanism, in which carbonate groups with cation-exchange properties play an important role in the effect of pH on metal ion sorption (Chojnacka, 2005). Pb^{2+} and Zn^{2+} sorption were reduced at lower pH because of competition between hydrogen and metal ions on sorption sites. More carbonate groups are linked with hydrogen at lower pH, leaving fewer carbonate groups available to metal ions.

The surface charge of eggshell is also affected by pH. Positively charged sites occur on the surface of eggshells under acidic conditions, causing metal ions to be poorly adsorbed on or repelled by it (Wang, Chen, Huang, & Cao, 2010).When the pH of a solution approaches 7, additional carbonate groups in the eggshell appear to have access to metal ions, which should allow them to better engage with binding sites of negatively charge. As a result, the optimum pH of 7 was chosen in further sorption tests.
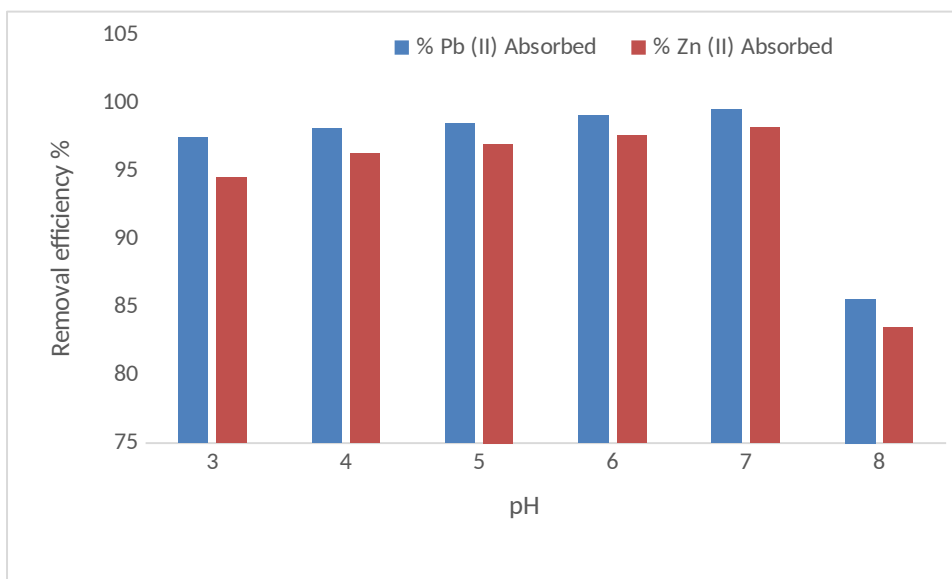
Figure 1 **Contact Time Effect**

The adsorption rate is crucial for designing batch adsorption studies. The influence of contact time was determined by adjusting the absorption of metal ions in the model solution within 105 minutes at room temperature. For these two metals, the percentage of metal absorption reached a maximum within 60 minutes (Figure 2). Thereafter, no substantial changes took place in the uptake efficiency of metal ions by the adsorbent after 1 hour. The short contact time determines the ability of the eggshell biomass as an ideal biosorbent to rapidly remove heavy metals from aqueous solution.
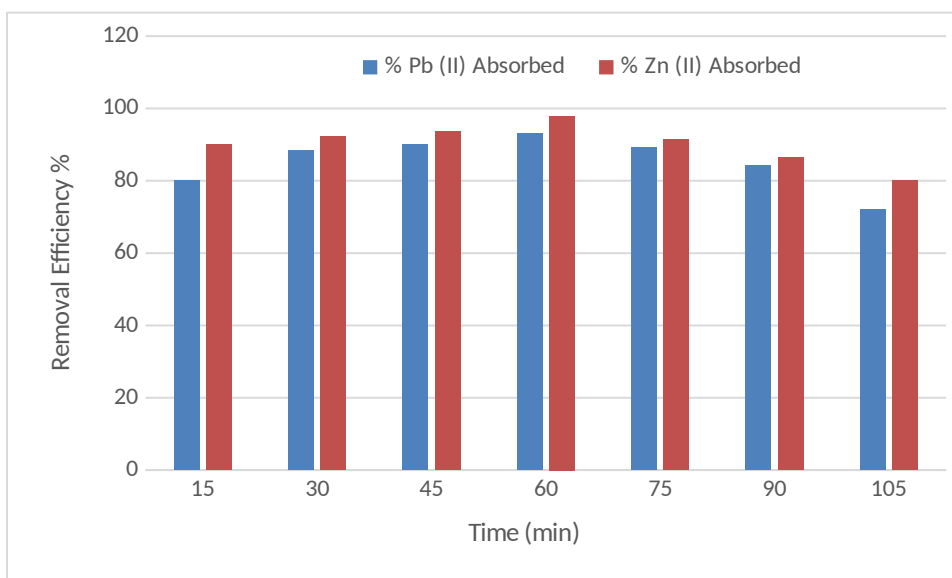

Figure 2. **Effect of Sorbent Dosage**

Figure 3 reveals a chart of the removal efficiency of metal ions against the adsorbent dosage used. At a preliminary metal ion concentration of 2.5 mg L⁻¹, the amount of metal uptake increases as the amount of eggshell increases from 0.5 g to 2.5 g. It means that the removal of Pb²⁺ increases from 93.1% to 99.2%, and the removal of Zn²⁺ increases from 81.6% to 96.8%. Because of the increased number of binding sites for the ions and sorbent surface region, these rises in the removal efficiency are noticeable. The

available metal ions appear to be adequate to enclose all the substitutable sites on the eggshell at an

enormous sorbent dosage, resulting in significant metal ion absorption (Ayodele and Godswill, 2014)
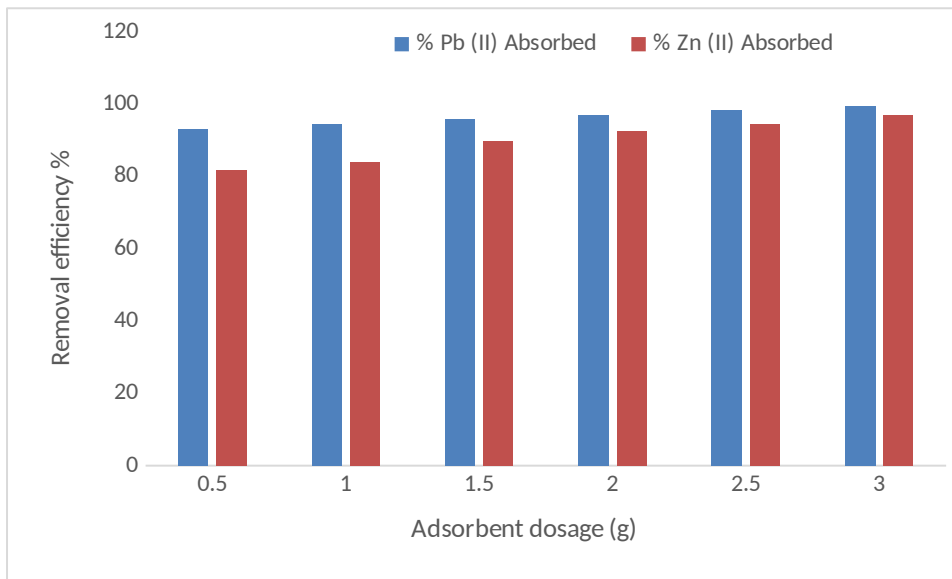

Figure 3: **Impact of Metal ion Concentration**

Metal ion concentration works as a powerful force that overcomes all barriers to metal ion mass transfer among the solid and liquid phases (Aksu & Akpinar, 2000). As the metal ion concentration increased from 2.5 to 15 mg L⁻¹, the metal uptake rate for Pb²⁺ decreased from 97.9% to 95.5% and for Zn²⁺ from 98.5% to 96.4% (Figure 4). All metal ions in solution interacted mostly with the active site at lower metal ion concentrations. Lower metal ion concentrations contributed to higher percentage adsorption as a result. Low percentage sorption at higher metal ion

concentrations is due to clustering of the surface of the adsorbent (Ayodeji and Godswill, 2014). The overall surface area of the eggshell particles available for sorption reduces as a direct consequence of clustering, but the diffusion channel length rises (Yasemin & Tez, 2007). This discovery is consistent with the findings of Rao et al. and Chojnacka. Similar findings were also reported when sugar cane bagasse pith and wild cocoyam were employed as adsorbents (AjayKumar et al., 2009).
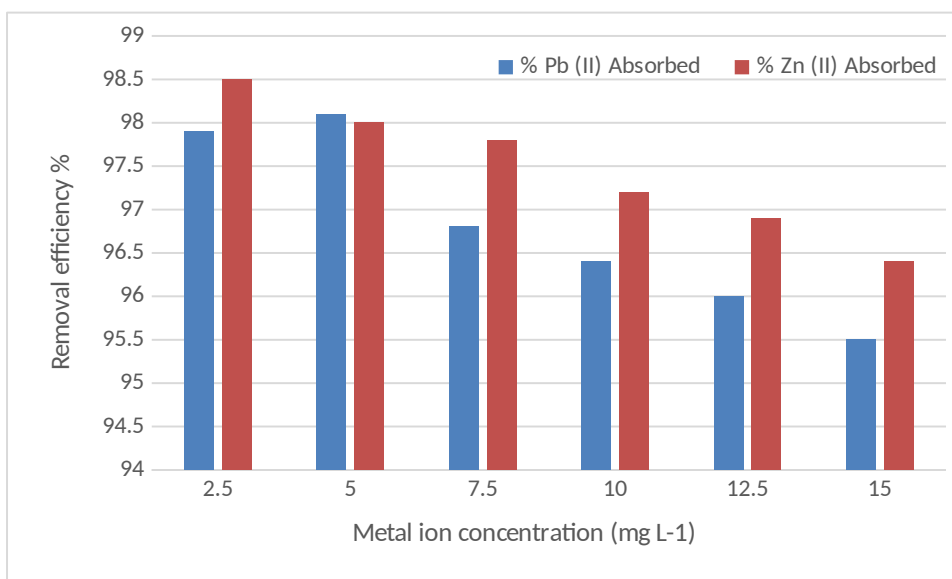

Figure 4: **Isotherm Studies**

Adsorption isotherms are essential in optimizing the usage of adsorbents for the removal of pollutants from aqueous solutions because they describe how pollutant concentrations interact with adsorbent surfaces (Emmanuel and Rao, 2008). The Langmuir and Freundlich adsorption isotherm model were used to facilitate the estimation of adsorption potentials of the eggshells. The linear form of these two models is stated as:

$$\frac{Ce}{qe} = \frac{1}{QzKb} + \frac{Ce}{Qz}, \qquad (2)$$

$$\log(qe) = \log(Kf) + \frac{1}{n}\log(Ce) \qquad (3)$$

where K_b is Langmuir constant defining affinity of binding regions and adsorption energy (mgL⁻¹), n is a constant which provides information on heterogeneity level, Q_z is adsorbent maximum monolayer capacity of adsorption (mgg⁻¹), K_F is Freundlich constant describe sorption capacity (g⁻¹) (mgL⁻¹).

Langmuir Isotherm

The regression coefficient (R^2) varying from 0.835 to 0.994 (Table 1) of Langmuir isotherm gives a satisfactory model for the adsorption system. Adsorption power (q_m) ranging from 0.9 to 1.0 (Table1) reveals an increase in adsorption affinity for metal ions in the order of Pb²⁺ > Zn²⁺. Metals with high electronegativity show a remarkable tendency to adsorption than metals with low electronegativity. (Lim, Kang, Kim and Ko, 2008). Taking into account that the electronegativity of the Pb²⁺ and Zn²⁺ are 2.33 and 1.91, respectively, the observed adsorption affinity of the Pb²⁺ and Zn²⁺ affected by the q_m value is inconsistent with the order of electronegativity. This means that other factors, such as the initial concentration of Pb²⁺ and Zn²⁺, will contribute to the adsorption affinity of Pb²⁺ and Zn²⁺ to eggshell. The acceptable adsorption energy order of metals is the Zn²⁺ greater than the Pb²⁺, as indicated by the adsorption coefficient (K_a), which is connected to the apparent adsorption energy. Due to its higher K_a value, the adsorption strength of Zn²⁺ is more favorable than that of Pb²⁺. Furthermore, K_R value can as well be utilized to predict whether adsorption is favorable or unfavorable (Venkata, Ramanaiah rajkumar, & sarma, 2007). Since K_R is greater than 0 and less than one (0.02 to 0.03), this indicated that adsorption of the two metal ions on egg shell is favourable.

Freundlich isotherm

This isotherm show a linear connection between the plotted parameters and the charts were not contained in this article. For the equilibrium unit concentration, the general capacity of the metal ions adsorbed to the eggshell is represented by K_f and $1/n$, the values of K_f and $1/n$ collected from the Freundlich isotherms varying from 1.17 -1.26 and 0.39 - 0.50, respectively. The K_f adsorption capacity obtained for the two metal ions indicates that Zn²⁺ is greater than Pb²⁺. The n value in this research is between 1.99 and 2.55. Therefore, Checken eggshell powder is a productive biomass for the absorption of metal ions. The value obtained for $1/n$ is less than 1, indicating that significant adsorption occurs at low concentrations of metal ions. It is worth noting that as the concentration increases, the increase in the amount of metal ion adsorption becomes less remarkable at higher concentrations and vice versa (Makata, sajidu, Masambal and Mwatseteza, 2010)

Table 1: Langmuir and Freundlich Isotherm Parameters for the Metal Ions by Eggshell

	Langmuir isotherm parameters					Freundlich isotherm parameter			
	K_a	Q_m	K_R	R^2		N	$1/n$	K_f	R^2
Pb	6.6	1.1	0.03	0.835		1.99	0.50	1.17	0.970
Zn	27.8	0.9	0.02	0.994		2.55	0.39	1.26	0.949

Kinetics of Metal Ions Adsorption

Table 2 and 3. shows the pseudo first and pseudo second order parameters k_1, q_e (calculated) and regression coefficient (R^2). The obtained R^2 value indicates that the first-order model is not suitable for explaining the adsorption system. The experimental rate constant k_1 of Pb²⁺ is the highest. The q_e calculated for the two metal ions is significantly varied from the Q_z in the experiment. This is what is expected, because the pseudo-level is not suitable for defining the adsorption process. This result is

invariant with the view of (Rao et al., 2010), that in most circumstances, the pseudo first-order equation of the liquid\solid system does not apply to the entire contact time range, and usually applies to the first 20-30 minutes adsorption process. On the other hand, the correlation coefficient (R^2) of pseudo-second-order kinetics is between 0.999 and 1.000, and is higher than the complementary coefficient of the first-order kinetic model. Therefore, calculated q_e value using the

pseudo-second-order kinetic model is approximate to the corresponding value of the q_e (experimental) in Table 2 and 3. Hence, the kinetics of metal ion adsorption is best described by a pseudo-second-order kinetic model instead of a pseudo-first-order. The magnitude of h and k_2 is that Zn^{2+} is greater than Pb^{2+}. This means that Zn^{2+} is better absorbed by eggshells than Pb^{2+} in solution, which is similar to the outcomes in the literature. (Ayodele & Godswill, 2014).

Table 2: Pseudo-First Parameters for the Adsorption Metal of Ions by Eggshells

Metals	q_e(exp) / (mg g⁻¹)	q_e(cal) / (mg g⁻¹)	k_1 (min⁻¹)	R^2
Pb	0.1246	3.49E*10⁻⁵	-0.07	0.260
Zn	0.1260	7.47E*10⁻⁵	-0.08	0.439

Pseudo second-order parameters for the Adsorption Metal of Ions by Eggshells

Metals	q_e(exp) / (mg g⁻¹)	h / (mg g⁻¹ min)	k_2/ (mg g⁻¹ min)	R^2
Pb	0.1249	0.61	34.00	0.999
Zn	0.1259	2.59	157.32	1.000

CONCLUSION

Chicken eggshell powder was found to be an effective, environmentally acceptable, and low-cost adsorbent for removing Pb^{2+} and Zn^{2+} from aqueous solutions in this investigation. pH had a significant impact on the adsorption efficacy of eggshell for the removal of heavy metals, with a pH of 7 being shown to be ideal. The adsorption of heavy metal ions by eggshell was extremely fast in the first 30 minutes, with an equilibrium lasting 60 minutes. The ability of eggshell to adsorb metal ions decreased as the initial metal ion concentrations increased. Kinetic studies have demonstrated that the pseudo-second-order rate model better describes the reaction, while the Freundlich isotherm model is a better model, which better fits the adsorption of Pb^{2+} and Zn^{2+} in Chicken egg shells powder. In short, Chicken egg shells powder can be utilized as an alternative and effective local biomass for the lessening of Pb^{2+} and Zn^{2+} from aqueous solutions.

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