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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.

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

FEPI-JOPAS VOLUME 3 ISSUE 2 TABLE OF CONTENTS

Serial No	Paper Tile and Author(s)	Page
01.	**Physicochemical Evaluation and Pasting Properties of Flours, Biscuit And Chinchin Prepared From Okara Fortified Plantain – Sorghum Blends.** Ilelaboye N.O. and *Jesusina T.I. Department of Science Laboratory Technology, Federal Polytechnic, Ilaro, Ogun State Nigeria. **titilayo.jesusina@federalpolyilaro.edu,ng**	1-13
02.	**Framework Model of Facial Analysis for Gender Classification Using Convolutional Neural Network** **Ojo, A. I., & Ebisin, A. F.** ***Department,of Computer Science Ogun State Institute of Technology, Igbesa, Ogun State.*** ✉***ronkujoyme@yahoo.co.uk*** **,** ebironke16@gmail.com	14-26
03.	**A Survey of Fish Hatcheries in Yewa South and Yewa North Local Government Areas of Ogun State, Nigeria** **[1]Yusuff, K. O. [1]Ibidapo-Obe, E. O. and [1]Sangosina, M. I.** [1]Department of Agricultural Technology, School of Pure and Applied Sciences, The Federal Polytechnic, P.M.B. 50 Ilaro, Ogun state, Nigeria. **Corresponding author :khadijah.yusuff@federalpolyilaro.edu.ng,**	27-33
04.	**Effect of Aqueous Blend of Three Herbs on Haematobiochemical Indices of Broiler Chicken at Starter Phase** **Akinlade, O. O.,[1]* Okusanya, P. O. and Okparavero, O. O.** [1]Department of Agricultural Technology, School of Pure and Applied Sciences, The Federal Polytechnic, P.M.B. 50 Ilaro, Ogun state, Nigeria. ***olamilekan.akinlade@federalpolyilaro.edu.ng***	34-39
05.	**Effective Communication as a Tool for Good Governance in Nigeria** **Obun-Andy, M. & Banjo, A. O.** *Department of Mass Communication, Federal Polytechnic, Ilaro, Ogun State.* ✉ *maria.obunandy@federalpolyilaro.edu.ng*	40-44
06.	**In Vivo Antiplasmodial Effect of the Ethyl Acetate**	45-48

	Fraction of Crude Extract of Phyllanthus Niruri. ***Omotayo, S. O., & Fafioye, A. O.*** *Department of Science Laboratory TechnologyFederal Polytechnic Ilaro, Ogun State.* ***✉olakunle.omotayo@federalpolyilaro.edu.ng***	
07.	**Covid-19 Crisis Management in Nigeria and Brazil** **Buoye P. A***. and **Ojuawo O. O**. Department of Computer Science , The Federal Polytechnic, Ilaro. ***adewuyi.buoye@federalpolyilaro.edu.ng***	49-65
08.	**Assessment of Public Toilets Facilities Provision and Management in Tertiary Institutions in Nigeria- An Overview of The Federal Polytechnic, Ilaro, Ogun State.** **Elesin, O.G[1] and Obafunmiso, C.K[2]** [1]Department of Urban and Regional Planning, The Federal Polytechnic, Ilaro. olanrewaju.elesin@federalpolyilaro.edu.ng; princealesh4real@gmail.com. [2]Department of Library and Information Science, The Federal Polytechnic, Ilaro. ***christianah.obafunmiso@federalpolyilaro.edu.ng; 08038559401;***	66-72
09.	**Effects Of Neem Leaves (*Azadirachta Indica*) and Cassava Peels On The Performance Of West Afr Ican Dware Goat** **Ajeigbe, O.M.. Sangosina,M.I. Ogunseitan, T. O. Lawal,R A. and Yusuff.K.O** *Department of Computer Science, Gateway (ICT) Polytechnic Saapade-Remo, Ogun State.* **✉moruf.sangosina@federalpolyilaro.edu.ng**	73-79
10.	**Formulation of Natural Products Repellents for the Control of Cockroaches (*Periplaneta americana*)**	80-83

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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.

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
Citrus	0.5	+0.31	34%	+0.11	36%	+0.21	42%	+0.20	40%	+0.21	42%
	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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