Journal of Biology, Agriculture and Healthcare
ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
Vol.8, No.4, 2018
www.iiste.org

Observations on the Availability of *Pleurotus Oestratum* Jacq. On Some Economic Plants, Associated Insects and Their Control.

[1.*]NWAUZOMA, A. B. and [2.]OGBALU, O. K.
[1.] Plant Pathology Unit, Department of Plant Science and Biotechnology, Rivers State University, Nkpolu-Oroworukwo, P. M. B. 5080, Port Harcourt, Nigeria.
[2.] Formerly of Entomology Unit, Department of Animal and Environmental Biology, Rivers State University, Nkpolu-Oroworukwo, P. M. B. 5080, Port Harcourt, Nigeria.

Abstract
The edible Niger Delta mushroom, *Pleurotus oestratum* was collected from twelve plants of economic importance namely: Mango (*Mangifera indica*), Avocado pear (*Persea Americana*), African pear (*Dacryodes edulis*), African sour sop (*Annona muricata*), *Terminalia catappa*, *T. ivorensis*, *Tectona grandis*, *Anacardium occidentale*, *Citrus sinensis*, *Elaise guineensis*, *Kola nitida* and *Cocos nucifera*. Flies associated with their different phases of growth in *Pleurotus oestratum* were also collected, enumerated and identified. Identified insects included *Megaselia halterata*, *Drosophila melanogaster*, *Fannia spp, Atherigona orientalis*, *Ceratitis capitata*. Other insects also collected were *Cryptolestis* spp, *Carpophilus dimidiatus*, *Zonocerus variegatus* and *Pseudocreobotra* species and *Cathartus quadricollis*. Three phases of growth of the Mushroom were categorized as early growth phase, mature growth phase and dry growth phase. Detailed report on the percentage occurrence of the insects on different phases of mushroom growth is presented and their control using a biocide, *Lepidagathis alopecuroides* is discussed.
Keywords: *Pleurotus oestratum*, *Lepidagathis alopecuroides*, insects, economic plants, control.

1. Introduction

Mushrooms are the earliest form of fungi known to mankind and they are widespread in nature occurring in different parts of the world. The most cultivated species worldwide is *Agaricus bisporus* followed by *Lentinula edodes*, *Pleurotus species* and *Flammulina velutipes* (Aida *et al*., 2009). Edible mushrooms are excellent foods that can be incorporated into well balanced diets due to their low fat content but high dietary fibre. The most cultivated mushroom worldwide is *Agaricus bisporus* followed by *Lentinula edodes*, *Pleurotus* species and *Flammulina velutipes* [Aida *et al*., 2009]. In Nigeria, the most popular edible mushroom is the sclerotium-forming *Pleurotus oestratus* which is exploited as foods, supplements and snacks in both urban and rural settings (Gbolagade *et al*., 2006). They are known to be used in traditional medicine, and especially women and children harvest mushrooms for commercial purposes. Concomitant varieties of mushrooms i.e. lichenized, mycorrhizal, parasitic and saprotrophic that abound in Nigeria have continued to gain recognition and elicit different interests and questions in different aspects of scientific studies. For instance, *Pleurotus species* are efficient colonizers and converters of hard wood trees and lignocellulosic agro-industrial residues into useful human materials (Singh and Kumar, 2012). Oyster mushrooms are the easiest and least expensive commercial mushrooms to grow because they are well known for the conversion of crop residues to food proteins, minerals and vitamins (Caglarirmak, 2007).

In Nigeria, different tribal groups consume mushrooms (Akpaja *et al*., 2003, 2005; Osemwegie *et al*. 2006; Gbolagade *et al*., 2006). The Yorubas however have recorded the highest number of edible and medicinal mushrooms (Okhuoya *et al*., 2010; Oso, 1975, 1977). Although mushrooms are found almost all over Nigeria, the arid nature of the northern parts, as well as the occasioned desert encroachments have been attributed to their scarcity. Generally, the availability of alternative sources of proteins in the form of animal proteins might have contributed to the lack of interest in mushroom research and its cultivations. Apart from their organoleptic properties such as aroma, taste, flavor and texture (Osemwegie *et al*., 2006), most consumers that enjoy the edible mushrooms are ignorant of both medicinal and nutritional values. They constitute health foods for the diabetics, people with arterial blood disease and those with high cholesterols in their systems. It is therefore very unfortunate that in Nigeria many people believe that edible mushrooms are meant for the lowest class and poor peasant farmers.

Singh and Sharma (2016) gave a detailed account of pests associated with the mushrooms in India. However and to the best of our knowledge, there have been no such studies on the type of insect pests associated with the different stages in the development of *P. oestratum* in this region. Therefore, the objectives of this work were to identify the insects as pests of *P. oestratum*, and also to exploit the use of natural herbs as possible control measures of these insects.

2. Materials and Methods

2.1 Study Area and Sample Collection

The sample collection site for this research work was the Rivers State University premises, including the Agricultural Research Farm, Port Harcourt. Surveys were made during the rainy season of 2016 [between April and July]. Sampling of mushrooms were done by systematic method and mushrooms were collected in the morning using a hand trowel to obtain part of the substratum (wood) on which the mushrooms were growing following the procedure of Jonathan and Adeoyo (2011b). Survey trips were made and inventory of *Pleurotus oestratum* in these areas were taken at seven days intervals (Jonathan and Adeoyo, 2011a). Collections were made on the following tree species in the sampling site: *Mangifera indica*, *Persea americana*, *Dacryodes edulis*, *Annona muricata*, *Terminalia catappa*, *T. ivorensis*, *Tectona grandis*, *Anacardium occidentale*, *Citrus sinensis*, *Elaise guineensis*, *Kola nitida* and *Cocos nucifera*. They were identified using the standard procedures of Zoberi (1973).

2.2 Collection and Identification of Insects

Insect pests were removed from the mushroom samples by the use of a pooter, while the larger ones were hand-picked. The insects were collected from mushrooms up to their basal point of attachment to the substratum and kept in specimen bottles. After collection, mushrooms were taken to the laboratory where parts of the sporophores were carefully dissected in search of insects that gained entry into the tissues of the mushrooms. All insects recovered from the mushrooms were placed in 4% formalin for preservation and were identified using the procedures of Kim and Hwang (1996). Accuracy of identification were further carried out and authenticated by Prof. O. K. Ogbalu, an Entomologist in the Department of Animal and Environmental Biology, Rivers State University, Nkpolu-Oroworukwo, Port Harcourt.

2.3 Control of Insect Pests Using *Lepidagathis alopecuroides*

Fresh leaves of *Lepidagathis alopecuroides* Vahl were harvested and air-dried until a crispy condition of the leaves was obtained which was quite appropriate for blending. The leaves were ground in a Moulinex blender into fine powder. Five grams of the ground *L. alopecuroides* leaves were spread on the sporophores up to the substratum of *P.oestratum*. Estimates of dead insects were recorded after 48h.

2.4 **Statistical Analysis:** Two-way Analysis of Variance (ANOVA) was used to test for significant differences between number of insects in the mushrooms and the growth phases. Students' Neuman Keule (SNK) test, a furtherance of DMRT was used for further mean separation at 5% level of significance. Pie Percentage evaluations were used to assess the mortalities of insects exposed to *L. alopecuroides*.

3. Results and Discussion

Many insects associated with the edible mushrooms in the Niger Delta of Nigeria cause a cosmetic damage to the fruiting bodies of the mushrooms affecting their yield, beauty and their marketability. Fig. 1 shows the attractive arrangement of *P. oestratum* on an 18-year old Avocado plant. The display of the edible mushroom on old tree stumps and on woods parked as firewood showed attractive overlapping arrangements of their fruiting bodies.

Fig. 1: Pattern of arrangement of *P. oestratum* on an old Avogado pear (P*ersea Americana*) at the Rivers State University Agricultural Research Farm, Port Harcourt, Nigeria, 2016.

Early visitors as insect pests of P. oestratum are the phorid flies notably Megaselia halterata, Drosophila melanogaster, Fannia canicularis and F. pusio as well as other dipterans; Atherigona orientalis and Ceratitis capitata. The flies attacked mushrooms at their early growth phases when their fruiting bodies are soft and tender. The mushrooms that were mature were attacked by mostly Orthopterans notably Z. variegatus,

Pseudocreobotra species found on mushrooms were predating on pests of P.oestratum e.g. on Z. variegatus, beetles and earwigs. Table 1 shows the different insect orders that were recovered from mushrooms growing on old fruit-bearing plants; apparently both their inflorescences and fruits either in their formative or maturation phases attracted the dipterans as they were mostly fluid-feeders. As most insects visited for nectar they also alight on mushrooms and their gravid females deposit their eggs on conducive and decaying mushrooms which served as alternate food sources for their larvae. During the rains, some unharvested mushrooms and other vegetative foliage and fruits decompose presenting a favourable ovipositing site for most phorid flies. A. orientalis oviposited on decomposing animal and plant matter, being a facultative feeder chooses any filthy matter for oviposition (Ogbalu et al, 2005). Megaselia spp also exhibit the same attributes as A. orientalis, the Meditarranean fly, Dacus spp larvae showed the same preference as other flies of the Niger Delta. Cocos nucifera inflorescences attracted insects and any mushrooms.

Generally, the phorid flies attacked most mushrooms at both early growth and mature growth phases during rainy seasons in the Niger Delta (Table 2a). Results in Table 2b showed that there were a significantly highest percentage of dipterans [88.2%] that attacked *P. oestratum* at both early and mature phases of mushroom growths. Also the population of Coleopterans (86.3%) was significantly higher than other groups of insects that infested mushrooms at their dry phase stage. Apparently the beetles encountered in this study are known to attack dry matters (Ogbalu *et al*., 2005). Predating ants especially *Oecophyllalongi noda* were also caught during sampling.

3.1 Control studies using *L. alopecuroides*

Results of the control of insects on the edible mushroom *P.oestratum* was successful using *L. alopecuroides.* Table 3 show the percentage of insects dead after exposure to the ground *L. alopecuroides* leaf powder. Mortality was high amongst the dipterans exposed to the biocide after 72h.

Table 1: Insect orders associated with *Pleurotus oestratum* growing on some plants of economic importance in the Rivers State University, Port Harcourt, 2016.

Plants	Lepidoptera	Diptera	Coleoptera	Orthoptera	Dermaptera
Mangifera indica	+	+	+	+	+
Persea americana	+	+	+	+	+
A. occidentale	+	+	+	+	+
K. nitida	+	+	+	+	+
D. edulis	+	+	+		+
T. catappa	+	+	+	+	+
T. ivorensis	+	+	+	+	+
Elaise guineensis	+	+	+	+	+
Tectona grandis	+	+	+	+	+
G. arborea	+	+		+	+
C. sinensis	+	+	+	+	+
C. nucifera	+	+	+	+	+
A. muricata	+	+	+	+	+

Table 2a: Insect orders associated with different growth stages of *Pleurotus oestratum* in the Rivers State University, Port Harcourt, 2016.

Growth Stage	Diptera	Orthoptera	Coleoptera	Dermaptera	Lepidoptera
Early Growth Phase	*M. halterata, Atherigona orientalis, Drosophila melanogaste, C. capitata*	Nymphs *Z.variegatus, Pseudocreobotra* sp.	Not present	Earwigs	*Acraea acerata* larvae
Mature Growth Phase	*M.halterata, A. orientalis, Dacus sp Fannia spp*	*Z.variegatus*	Not present	Not present	*A. acerata*
Dry Growth Phase	Not present	Not present	*C. quadricollis, C.dimidiatus, Cryptolestis spp. D. maculatus*	Not present	Not present

Table 2b: Assessment of number of insects from different Orders and their occurrence at the three growth phases of *Pleurotus oestratum.*

Growth Stage	**Diptera**	**Orthoptera**	**Coleoptera**	**Dermaptera**	**Lepidoptera**
Early Growth Phase	88.2a	2.3b	2.8b	2.5b	4.2a
Mature Growth Phase	78.3b	18.5a	0.0c	0.0c	3.2b
Dry Growth Phase	0.0c	0.0c	86.3a	13.7ab	0.0c

Figures in the columns with different letters were significantly different from each other [DMRT, P<0.05].

Control studies: Results of the control of insects on the edible mushroom *P.oestratum* was successful using *L. alopecuroides.* Table 3 show the percentage of insects dead after exposure to the ground *L. alopecuroides* leaf powder. Mortality was high amongst the dipterans exposed to the biocide after 72h.

Table 3 show the efficacy of *L. alopecuroides* on different insect pests of *P.oestratum* in the field. Members of the order Diptera had the highest significant mortality on *P. oestratum* [treated with the biocide] than insects of other orders. Generally all insects exposed to the biocide died after 48hours on all the plants that had P. oestratum. *L. alopecuroides* had been reported as a biocide (Obomanu *et al*, 2006; Orlu and Ogbalu, 2012). Generally, most of the insect pests of *P. oestratum* exposed to the *L. alopecuroides* had high mortalities (Table 3).

Table 3. Assessments of mortality of insect pests of *P. oestratum* exposed to *Lepidagathis alopecuroides*

Plant	**Insect Order**				
	Diptera	Orthoptera	Coleoptera	Lepidoptera	Dermaptera
Persea americana	98.8a	78.6c	98.5a	99.1a	91.6b
Mangifera indica	100a	98.4a	90.7d	100a	92.7c
Annona. muricata	100a	84.5c	98.2a	100a	97.5
Elaise guineensis	99.3a	97.5a	57.7d	98.6a	98.6a
Dacryodes edulis	100a	98.7a	99.8a	95.6b	98.7b
Gmelina arborea	96.5b	100a	90.8c	95.6c	99.7a
Cocos nucifera	97.8a	100a	98.8a	84.6c	100a

Figures with different letters across row are significantly different from each other [DMRT, SNK: P< 0.05%].

Fig. 3 shows percentage contribution of *L. alopecuroides* on the mortalities of dipterous insects on different plants. Collective percentage contribution made up to 100% with a range of 14-15% [individual contribution]. Highest mortalities were recorded on flies exposed to the biocide on *D. edulis* and *M. indica*; apparently both plants had fruits on them at the periods of sampling. The flies were available on fruits for feeding and ovipositing and had easy migration to mushrooms at their different growth phases. Individual contribution to mortality of Orthopterous insects were lowest on Avacado (12%) (Fig. 4), the availability of *Pseudocreobotra* sp, a predating Orthopteran might have caused further reduction in the population of Orthoptera apart from the toxicity of the biocide. Fig.5 shows that insects of *P. oestratum* on *D.edulis*, Avocado, *C. nucifera* had 16% mortalities when exposed to *L. alopecuroides*. Lepidopterous group showed an individual mortality rate of 12-16% (Fig.6).

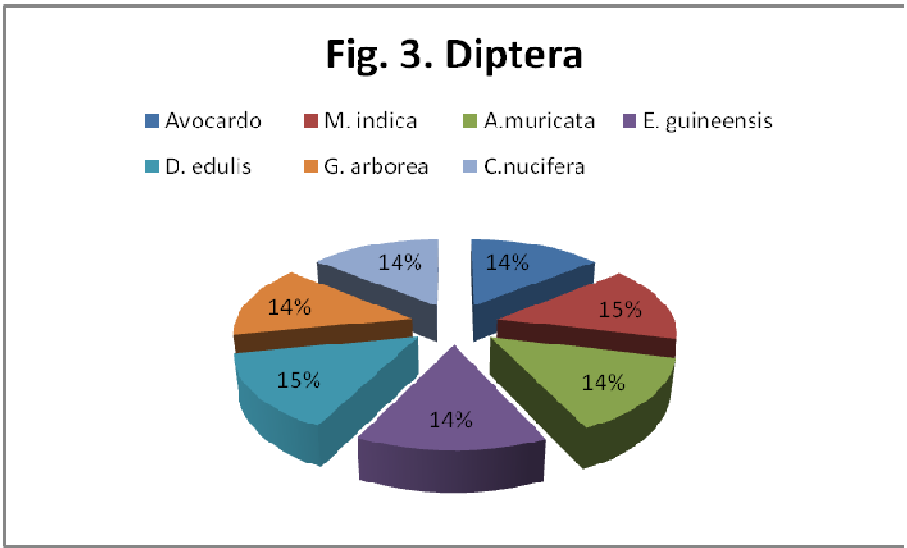


Fig. 3. Diptera
Avocardo
M. indica
A.muricata
E. guineensis
D. edulis
G. arborea
C.nucifera
14%
14%
15%
14%
14%
15%
14%

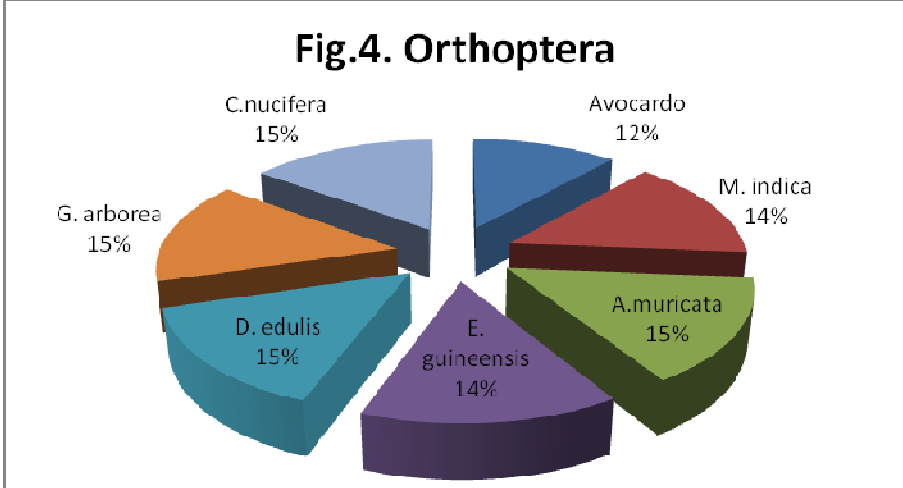


Fig.4. Orthoptera
C.nucifera
15%
Avocardo
12%
M. indica
14%
G. arborea
15%
A.muricata
15%
D. edulis
15%
E.
guineensis
14%

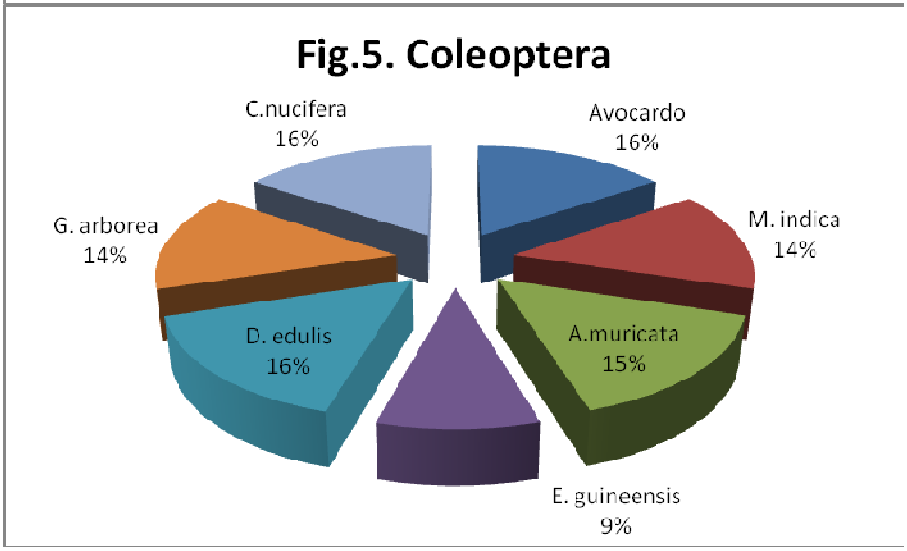
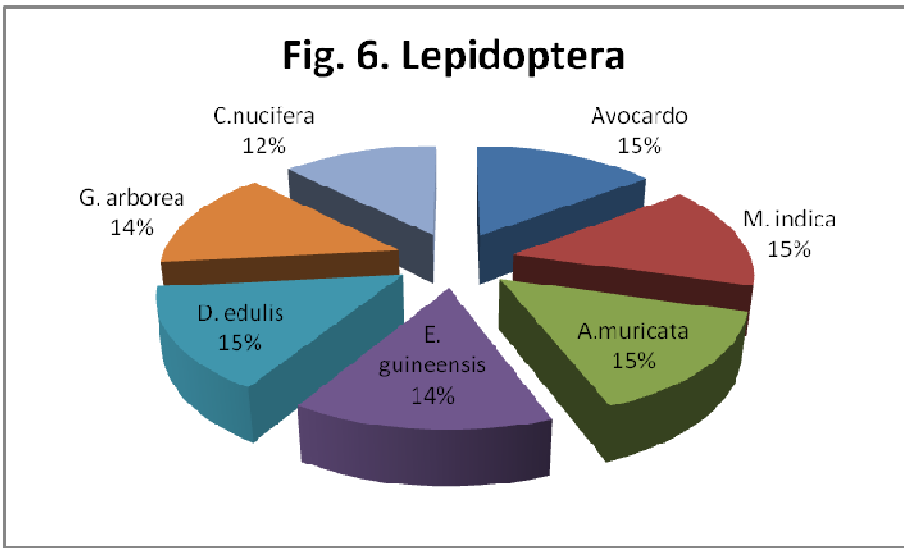


Fig.5. Coleoptera
C.nucifera
16%
Avocardo
16%
M. indica
14%
G. arborea
14%
A.muricata
15%
D. edulis
16%
E. guineensis
9%



Figs.3-6. Percentage mortality of Different Insect Orders Extracted from *Pleurotus oestratum* growing on some economic plants in Port Harcourt, Nigeria.

5. Conclusion

P.oestratum grown on plants of economic importance in Port Harcourt of the Niger Delta was infested at its different phases of growths by phorid flies [diptera], Coleoptera, Lepidoptera, Orthoptera and Dermaptera. A biocide, *Lepidagathis alopecuroides* was very effective in the control of insect pests of *P. oestratum*.

Acknowledgements: The authors are grateful to the Rivers State University Agricultural Research Farm staff for their assistance in data collection.

References

Aida, F.M.N.A, Shuliaimi, M, Yazid M, Maaruf, A.G.2009]. Mushroom as a potential source of prebiotics: a review. Trends in Food Science and Technology, 20: 567-575.

Akpaja, E.O., Isikhuemhen, O.S. and Okhuoya, J.A. 2003. Ethnomycology and usage of edible and medicinal mushrooms among the Igbo people of Nigeria. *International Journal of Medicinal Mushrooms* 5:313-319.

Akpaja**,** E.O., Okhuoya, J.A. and Eliwer-Heferere, B.A. 2005.Ethnomycology and indigenous uses of mushrooms among the Bini-speaking people of Nigeria: A case study of Aihuobabekun community near Benin City, Nigeria. *International Journal of Medicinal Mushroom* 7(3): 373-374.

Caglarirmak, N. 2007. The Nutrients of Exotic Mushrooms (*Lentinula edodes* and *Pleurotus* species) and an Estimated Approach to the Volatile Compounds. *Food Chemistry,*105: 1188–1194.

Gbolagade, J.S., Ajayi, A., Oku, I. and Wankasi, D. 2006. Nutritive value of common wild edible mushrooms from southern Nigeria. *Global Journal of Biotechnology and Biochemistry* 1(1):16-21.

Okhuoya, J.A.; Akpaja, E.O.; Osemwegie, O.O.; Oghenekaro, A.O.; Ihayere, C. A. 2010. Nigerian Mushrooms: Underutilized Non-Wood Forest Resources J. Appl. Sci. Environ. Manage. *March*, Vol. 14(1) 43 - 54

Orlu, E. E. and Ogbalu, O. K. 2012. Partial Inhibitory Effect of Ethanol Extract of *Lepidagathis alopecuroides* (Vahl) on Spermatogenesis in Sprague-Dawley Rats. International Journal of Animal and Verterinary Advances, 4(3): 214-220.

Osemwegie, O.O., E.G.Eriyaremu and J. Abdulmalik. 2006. A survey of macrofungi in Edo/Delta region of Nigeria, their morphology and uses. *Global Journal of Pure and Applied Science* 12(2):149-157.

Jonathan, S. G. and Adeoyo, O. R. 2011a. Comparative studies on enzyme activities of bacterium (*Bacillus subtilis*) and Nigerian edible fungi (*Termitomyces clypeatus*,*Termitomyces globulus*, *Pleurotus tuber-regium*, and *Agaricus sp*). *Natural products* 7(3):124-127

Jonathan, S. G. and Adeoyo, O. R. 2011b. Collection, morphological characterization and nutrient profile of some wild mushrooms from Akoko, Ondo state, Nigeria. *Natural products*: 7(3):128-136

Kim KJ, Hwang CY (1996) An investigation of insect pest on the mushroom (Lentinus edodes, *Pleurotus ostreatus*) in south region of Korea. Korean Journal of Applied Entomology 35: 45–51.

Obomanu F.G, Ogbalu O.K, Gabriel U.U, Fekarurhobo GK, Adediran B.I 2006. Larvicidal properties of *Lepidagathis alopecuroides* (Vahl) and *Azadirachta indica* on *Anopheles gambiae* and *Culex quinquefasciatus*. Afr. J. Biotech. 5:761-765.

Ogbalu, O.K, Emelike N.J.T, Amachree E.I, Uche F, Thomas C.N. 2005. Characterization and preferred oviposition sites of *Atherigona orientalis* (Schiner) on Nigerian pepper fruits. *Journal of Applied Sciences*

and Environmental Management 9:19–23.
Oso, B.A. 1975. Mushrooms and the Yoruba people of Nigeria. *Mycologia* 67(2):311-319.
Oso, B.A. 1977. *Pleurotus tuberregium* from Nigeria. *Mycologia* 69: 271-279.
Singh, M. P. and Kumar, V. 2012. Biodegradation of vegetable and agro wastes by *Pleurotus sapidus*: A noble strategy to produce mushroom with enhanced yield and nutrition. Cell Mol. Biol.58 (1): 1-7
Singh, A.U, Sharma K 2016. Pests of Mushroom. Adv Crop Sci Tech 4: 213. doi:10.4172/2329-8863.1000213
Zoberi, M.H. 1973. Some edible mushrooms from Nigeria. *Nigerian Field* 38:81-90.