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Studies on the Efficacy of Lime Peel Oil in Protecting Stored Maize against Adult Maize Weevils (*Sitophilus zeamais:* Motschulsky)

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ABSTRACT

Maize is one of the most important and oldest cultivated cereals. However a wide range of insect pests attack maize both in the field and storage. Lime was collected from Dora farm House, Kaduna State and was identified in the Herbarium of Department of Pharmacognocy, Ahmadu Bello University, Zaria. The unripe, peeled and dried lime was grounded into powder using pestle and mortar. The oil was extracted by soxhlet extraction method. *Sitophilus zeamaise* was obtained from naturally infested maize grains obtained from Rimi market, Kano State. The insect was identified based on morphological appearance. The Maize used for bioassay was disinfested in a deep freezer for 96 h and later air-dried in the laboratory under the ambient conditions (32±0.64°C and 68±3% RH) and the moisture content was determined. Twenty five gram of the sample was weighed into separate containers. Four concentrations of the oil (1.5, 2.0, 2.5 and 3.0 mL) were inoculated separately into these containers. These concentrations correspond to (6.0, 8.0, 10.0 and 12.0% v/w). Five insects (day old) were separately inoculated into these containers and covered with muslin cloth. Each treatment was replicated, arranged in a Completely Randomized Design (CRD). The result indicated that the mortality of the insect was dose dependant where the higher concentration used recorded the highest mortality (100%) after 72 h of treatment which is significantly higher ($p<0.005$) than untreated control (0%). Lime peel oil is effective in the protection of maize against weevil *Sitophilus zeamaise*.

Key words: Efficacy, *Sitophilus zeamaise*, lime peel oil, soxhlet, extraction

INTRODUCTION

Maize is an important food crop grown commercially on a large scale and as a small garden crop throughout the world (Richard *et al*., 1994). Nearly one thousand species of insects have been found associated with stored products in various parts of the world (Gc, 2006). Many pests of stored maize are Coleopterans and the most destructive tropical species for maize belongs to the genus *Sitophilus* and *Tribolium* (Bello *et al*., 2000). The maize weevil, *Sitophilus zeamais Motschulsky* is a serious and the most important pest of stored maize, causing considerable losses. Prempeh (1971) estimated that out of a total annual harvest of 250-300,000 tones of maize in Ghana, about 20% was lost to *Sitophilus zeamais*. Significant reduction in the viability of the grain is a common effect of infestation by *Sitophilus* species (Okiwelu *et al*., 1987). The weevil (*Sitophilus zeamais* Motschulsky) poses a serious threat to food security, particularly in developing countries. The economic situation in a developing country, like Nigeria, has been adversely affected

mostly by the postharvest losses of commodities which are usually encountered, especially during storage (Arannilewa *et al*., 2002). Currently fumigation and application of chemical grain protectants are measures Commonly used to control pest infestation in grain and other dried foodstuffs. Methyl Bromide (MB) is being gradually phased out (Anonymous, 1997). There is therefore an increasing need to search for edible, cheap and safe plant materials that will not contaminate food products in acting as grain protectants in small-scale storage systems. Other problems associated with the continuous use of synthetic insecticides, such as resistance and residue, will stimulate the use of any effective, easy to use, inexpensive, biodegradable and safe alternatives which are already a part of our diet (Okonkwo and Okoye, 1996).

There have been lots of search for locally available plant materials that may be of grain protectant ability (Odeyemi, 1993; Ivbijaro, 1983; Ofuya, 1986; Lale, 1992, 1995; Ivbijaro and Agbaje, 1986; Arannilewa *et al*., 2002; Arannilewa, 2002; Adedire and Lajide, 1999; Ajayi and Adedire, 2003; Adedire and Akinneye, 2004; Akinkurolere *et al*., 2006).

Plant essential oils and their components have been shown to possess potential for development as new fumigants and they may have advantages over conventional fumigants in terms of low mammalian toxicity, rapid degradation and local availability (Isman, 2000, 2008).

Lime is traditionally used in many part of northern Nigerian as an insecticide to prevent insects from their harm, by burning the peel and then its smoke prevents insects (Kabir, 2008). The present study was undertaken to evaluate the efficacy of lime peel oil against sitophilus zeamaize.

MATERIALS AND METHODS

Sample collection and identification: Lime was collected from Dora farm house Dakaci local govt area, in 2010 in Kaduna state. It was identified in the herbarium of Department of Pharmacognocy, Ahmadu Bello University, Zaria.

Oil extraction: The oil (lime peel oil) was extracted by soxhlet extraction method (Arannilewa *et al*., 2006). The unripe, peeled and dried lime was grinded into powder using pestle and mortar (Lale, 2002). The powder was mixed with petroleum ether in the apparatus. The powdered peel was tighed and placed in the thimble and the petroleum ether in a round bottom flask, the extraction occurred through vaporization and condensation through out the apparatus and then after hours of this process the petroleum ether was left to evaporate at room temperature where a greenish oily liquid was finally obtained.

Culture of *Sitophilus zeamais*: *Sitophilus zeamaise* was obtained from naturally infested maize grains from Rimi market Kano state. The insect was identified based on their morphological appearances (Southgate *et al*., 1957; Halstead, 1963). The insect was culture reared on disinfested maize grains at ambient conditions (32±0.64°C and 68±3% R.H.).

Bioassay: The food medium (maize) used for bioassay was disinfested in a deep freezer for 96 h and later air-dried and the moisture content was determined as described by Ho *et al*. (1996).

Twenty five gram of the sample was weighed separately into separate containers. Different concentrations of diluted oils in organic solvents were inoculated into separate containers 1.5, 2.0, 2.5 and 3.0 mL of the diluted oils were used after a trial experiment). These concentrations correspond to 6.0, 8.0, 10.0 and 12.0% v/w. The inoculated concentrations into these separate containers were vigorously shaken to ensure proper coating of the seed with the oils (Talukder and

Howse, 1994). The containers containing the sample were taken out to the sun for 1-2 h to evaporate the solvent. Five-one day old insects which were sieved from the culture were separately inoculated into different containers containing different concentrations of diluted oils (Talukder and Howse, 1994). These were covered with a muslin cloth to facilitate proper aeration and prevent entry of other insects. Each treatment were replicated and arranged in a Completely Randomized Design (CRD) and left on the laboratory bench for daily observation (Oparaeke, 1996).

RESULTS AND DISCUSSION

The use of plant extracts in the control of stored products insects is an ancient practice (Qi and Burkholder, 1981). Oils are commonly used in insect control because the oils are relatively efficacious against virtually all life stages of insects (Nezan, 1983; Adedire, 2002; Don-Pedro, 1989, 1990). The toxicity bioassay of the lime peel oil on adult *S. zeamais* is presented in Table 1. Adult mortality significantly increased with increase in concentration and days of exposure. The highest value of 100% mortality was observed in the treatment with lime peel oils by the third day using 3.0 v/w. This was followed by 2.5 v/w by the 4th day (100.0%), 0.5 and 1.5 v/w by the 6th day (100.0%). Lime peel oil may have been very potent because of the odors they produce and which may have exerted a toxic effect by disrupting normal respiratory activity of the weevils, thereby resulting in asphyxiation and subsequent death (Adedire and Ajayi, 1996). Essential oils of plant origin are highly lipophilic and therefore have the ability to penetrate the cuticle of insects. This may be another reason for the potency of the extracts. By this method the plant material apart from its odour, may have acted as a contact poison. The toxicity of the oil may be attributed to the presence of limonene, terpenine, sinensal, neral octanal tridecanal chemical which were reported to have some insecticidal properties (Kabir, 2008). The result of this study was similar to that reported by Asawalam and Emosairye (1990) using essential oil from *Vernonia amygdalina* and ashes of certain medicinal plants. The author have reported these substances to be toxic against adult maize weevils. Furthermore, neem (*Azadirachta indica* A. Juss), cottonseed and yellow oleander (*Thevetia peruviana*) oils were also found to be toxic against maize weevils (*S. zeamais* Motschulsky) and several plants products were also reported to be effective against insects including *Callasobruchus maculates* (Sathyaseelan *et al*., 2008). These plant oils have been reported to possess insecticidal properties. Plants produce essential oils that have been found to possess insecticidal activities to various species of insects (Ukeh, 2008). Essential oils from many herbs and spices have been reported to have fumigant and other activities (Rice and Coats, 1994; Regnault-Roger and Hamraoui, 1995). Shaaya *et al.* (1991, 1997), found that a number of essential oils from spices showed fumigant toxicity to stored-product insects. Alkofahi *et al.* (1989) reported that coconut oil when applied to rice protected it against lesser grain borer (*Rhizopertha dominica*).

Table 1: Mortality of *Sitophilus zeamais* on maize grain treated with different dosage of lime peel oil

Amount applied (%) v/w	Weight of grain	No. of insect	Mortality of insect (%) 24	48	72	96	120	144
1.5 (6.0)	25	5	0.00	26.66	73.33	86.66	93.33	100.00
2.0 (8.0)	25	5	0.00	40.00	53.33	86.66	93.33	100.00
2.5 (10.0)	25	5	33.33	60.00	86.66	100.00	100.00	100.00
3.0 (12.0)	25	5	26.66	73.33	100.00	100.00	100.00	100.00
Control	25	5	0.00	0.00	0.00	0.00	0.00	6.06

Similarly Neem oil when applied at 0.5, 1.0 and 2.0% v/w was found cause 100% mortality of the beetle (*Callasobruchus maculatus*) after 2 days of treatment (Ram and Gopal, 2000). The findings from these studies indicated that oils from plants were effective in protecting stored product from insect infestation. However little or no work has been reported in the literature on the use of lime peel oil against maize weevil *Sitophilus zeamaize,* especially in Kano State of Nigeria. Therefore the findings in this study of the effectiveness of lime peel oil against maize weevil *Sitophilus zeamaiz* in Kano State of Nigeria has been a new finding which can benefit low resource farmers in the area in protecting their stored products against insect infestation.

CONCLUSION AND RECOMMENDATIONS

The use of lime peel oil has demonstrated a potent activity against the maize weevil *Sitophilus zeamaiz* indicating that the plant oil may have some properties which can be useful in short listing the oil as an alternative source of botanical pesticide. It is recommended that further studies be conducted to evaluate the bioactive compound present in the plant oil.

REFERENCES

Adedire, C.O. and T. Ajayi, 1996. Assessment of insecticidal properties of some plants extracts as grain protectant against the maize weevil *Sitophilus zeamais* (Mots). Nigerian J. Entomol., 13: 93-101.

Adedire, C.O. and L. Lajide, 1999. Toxicity and oviposition deterency of some plant extracts on cowpea storage beetle *Callosobruhus maculatus* Fabricus. J. Plant Dis. Prot., 106: 647-653.

Adedire, C.O., 2002. Use of nutmeg *Myristica fragrans* (Houtt.) powder and oil for the control of cowpea storage bruchid, *Callosobruchus maculatus* Fabricius. J. Plant Dis. Plant Prot., 109: 193-199.

Adedire, C.O and O. Akinneye, 2004. Biological activity of tree marigold, *Tithonia diversifolia*, on cowpea seed bruchid, callosbruchus maculatus (Coleoptera: Bruchidea). Ann. Applied Biol., 144: 185-189.

Ajayi, O.E. and C.O. Adedire, 2003. Insecticidal activity of under-utilized tropical plant seed oil, *Hura crepitans* L. on cowpea seed beetle, *Callosobruchus maculates*. (F) (Coleoptera: Bruchidae). Nig. J. Entomol., 20: 74-81.

Akinkurolere, R.O., C.O. Adedire and O.O. Odeyemi, 2006. Laboratory evaluation of the oxic properties of forest acnchomanes, *Anchomanes difformis* against pulse beetle *Callosobruchus maculates* (Coleoptera: Bruchidae). Insect Sci., 13: 25-29.

Alkofahi, A., J.K. Rupprecht, J.E. Anderson, J.L. Mclaughlin, K.L. Mikolajczak and B.A. Scott, 1989. Search for New Pesticides from Higher Plants. In: Insecticides of Plant Origin, Arnason, J.T., B.J.R. Philogene and P. Morand (Eds.). American Chemical Society, Washington, DC., pp: 25-43.

Anonymous, 1997. Report of the ninth meeting of the parties. Proceedings of the Report of the 9th Meeting of the Parties to Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 15-17, Montreal, pp: 1-222.

Arannilewa, S.T., 2002. Assessment of the Insecticidal properties of four plant extracts as protectants against the cowpea bruchid *Callosobruchus maculates* (F) (Coleoptera: Bruchidae). Annals Agric. Sci., 3: 49-55.

Arannilewa, S.T., O.O. Odeyemi and C.O. Adedire, 2002. Effects of medicinal plant extract and powder on the maize weevil, *Sitophilus zeamais* Mots. (Coleoptera: Curculionidae). Ann. Agric. Sci., 3: 1-10.

Arannilewa, S.T., T. Ekrakene and J.O. Akinneye, 2006. Laboratory evaluation of four medicinal plants as protectants against the maize weevil, *Sitophilus zeamais* (Mots). Africa J. Biotechnol., 5: 2032-2036.

Asawalam, E.F. and S.O. Emosairye, 1990. Plant Health Management. The American Phytopathological Society, Abia State, Nigeria.

Bello, G.D., S. Padina, C.L. Lastrab and M. Fabrizio, 2000. Laboratory evaluation of chemical biological control of rice weevil, *Sitophilus oryzae* L. in store grain. J. Stored Prod. Res., 37: 77-84.

Don-Pedro, K.N., 1989. Mode of action of fixed oils against eggs of *Callosobruchus maculates* (F.). Pestic. Sci., 26: 107-115.

Don-Pedro, K.N., 1990. Insecticidal activity of fatty acid constituents of fixed vegetable oils against *Callosobruchus maculatus* (F.) on cowpea. Pest. Sci., 30: 295-302.

Gc, Y.D., 2006. Efficacy of indigenous plant materials and modified storage structures to insect pests of maize seed during on-farm storage. J. Inst. Agric. Anim. Sci., 27: 69-76.

Halstead, D.G.H., 1963. External sex difference in stored products coleopteran. Bull. Entomol. Res., 5: 119-134.

Ho, S.H., L. Koh, Y. Ma, Y. Huang and K.Y. Sim, 1996. The oil of garlic *Allium sativum* L. (Amaryllieae) as a potential grain protectant against *Tribolium castenum* (Herbst) and Sitophilus zeamais Motsch. Post Harvest Biol. Technol., 9: 41-41.

Isman, M.B., 2000. Plant essential oils for pest and disease management. Crop Prot., 19: 603-608.

Isman, M.B., 2008. Perspective botanical insecticides: For richer, for poorer. Pest Manag. Sci., 64: 8-11.

Ivbijaro, M.F., 1983. Toxicity of neem seed *Azadirachta indica* A juss. to *Sitophilus oryzae* (L.) in stored maize. Prot. Ecol., 5: 353-357.

Ivbijaro, M.F. and M. Agbaje, 1986. Insecticidal activities of *Pipper guineense* schum and thorn and *Capsicum* species on the cowpea bruchids, *Callosobruchus maculatus* (F.). Insect Sci. Appl., 7: 521-524.

Kabir, A.A., 2008. Nutritional and medicinal values of essential oils. An Essay Review, the Department of Science and Technology, School of Technology, Kano State Polytechnic.

Lale, N.E.S., 1992. A Laboratory study of the comparative toxicity of products from three spices to the maize weevil. Postharvest Biol. Technol., 2: 61-64.

Lale, N.E.S., 1995. An overview of the use of plant products in the management of stored product coleoptera in the products. Post Harvest News Inform., 6: 69N-75N.

Lale, N.E.S., 2002. Stored Products Entomology and Acarology in Tropical Africa. 1st Edn., Mole Publications Ltd. Maiduguri, Nigeria, pp: 204.

Nezan, J.T., 1983. The use of local materials (pepper, ash and oil) to control storage pests on sorghum, millet, cowpea, groundnut and maize. HND Thesis, College of Agriculture, Ahamadu Bello University, Zaria.

Odeyemi, O.O., 1993. Insecticidal properties of certain indigenous plant oils against *Sitophilus zeamais* Mots. Applied Eng. Phytopathol., 60: 19-27.

Ofuya, T.I., 1986. Use of wood ash, dry chilli pepper fruits and onion scale leaves for reducing *Callosobruchus maculatus* (Fabricus) damage in cowpea seeds during storage. J. Agric. Sci. (Cambridge), 107: 467-468.

Okiwelu, S.N., O.O. Adu and V.N. Okankwo, 1987. The effect of sitophilus zeamais (Motsch) (Coleoptera:curculinionidae) on the quality and viability of stored maize in Nigeria. Insect Sci. Appl., 8: 374-384.

Okonkwo, E.O. and W.I. Okoye, 1996. The efficacy of four seed powders and the essential oils as protectants of cowpea and maize grains against infestation by *Callosobruchus maculatus* (Fabricius) (Coleoptera: Bruchidae) and *Sitophilus zeamais* (Motschulsky) (Coleoptera: Curculionidae) in Nigeria. Int. J. Pest Manage., 42: 143-146.

Oparaeke, A.M., 1996. Comparative evaluation of some local plant materials for the control of *C. maculates* (L) (Coleoptera:Bruchidae) on stored cowpea. M.Sc. Thesis, Department of crop protection, Faculty of Agriculture, Ahmadu Bello University, Zaria.

Prempeh, H.R.B.A., 1971. Maize crop: harvesting processing and storage in Ghana. Proceedings of the Maize the Wonder Crop Symposium UST, (MWCSUST'71), Kumasi, pp: 18-27.

Qi, I.T. and W.E. Burkholder, 1981. Protection of stored wheat from the granary weevil by vegetable oils. Econ. Entomol., 74: 502-505.

Ram, B.P. and P.S. Gopal, 2000. Use of botanicals for the management of pulse beetle(*Callasobruchus maculates*) in lentils. Nepal Agric. Res. J., 4-5: 27-30.

Regnault-Roger, C. and A. Hamraoui, 1995. Fumigant toxic activity and reproductive inhibition induced by monoterpenes on *Acanthoscelides obtectus* (Say) (Coleoptera) a bruchid of kidney bean (*Phaseolus vulgaris* L.). J. Stored Prod. Res., 31: 291-299.

Rice, P.J. and J.R. Coats, 1994. Insecticidal properties of several monoterpenoids to the housefly (Diptera: Muscidae), red flour beetle (Coleoptera: Tenebrionidae) and Southern corn rootworm (Coleoptera: Chrysomelidae). J. Econ. Entomol., 87: 1172-1179.

Richard, J.O., J.G. Loius and L.A. Henry, 1994. Crop Production. 4th Edn., Prence Hall Inc., New Jersey, USA., pp: 744.

Sathyaseelan, V., V. Baskaran and S. Mohan, 2008. Efficacy of some indigenous pesticidal plants against pulse beetle, *Callosobruchus chinensis* (L.) on green gram. J. Entomol., 5: 128-132.

Shaaya, E., U. Ravid, N. Paster, B. Juven, U. Zisman and V. Pissarev, 1991. Fumigant toxicity of essential oils against four major stored-product insects. J. Chem. Ecol., 17: 499-504.

Shaaya, E., M. Kostjukovski, J. Eilberg and C. Sukprakaru, 1997. Plant oils as Fumigants and contact Insecticides for the control of stored product insects. J. Stored Prod. Res., 33: 7-15.

Southgate, B.J., R.W Howe and B.A. Brett, 1957. The specific status of C. Maculatus (F). Bull. Entomol. Res., 48: 79-89.

Talukder, F.A. and P.E. Howse, 1994. Repellent, toxic and food protectant effects of pithraj, *Aphanamixis polystachya* extracts against the pulse beetle, *Callosobruchus chinensis* in storage. J. Chem. Ecol., 20: 899-908.

Ukeh, D.A., 2008. Bioactivities of essential oils of *Aframomum melegueta* and *Zingiber officinale* both (Zingiberaceae) against *Rhyzopertha dominica* (Fabricius). J. Entomol., 5: 193-199.