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Chemical Composition and Bioactivity of *Lippia adoensis* Hochst ex. Walp (Verneneaceae) Leaf Essential Oil Against *Callosobruchus maculatus* Fabricius (Coleoptera: Chrysomelidae)

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Abstract: Essential oil (EO) of Nigeria-grown *Lippia adoensis* leaf was analyzed using gas chromatography mass spectrometry (GCMS) and its fumigant and repellent properties against *Callosobruchus maculatu*s were evaluated. Sixteen compounds predominated by monoterpenes were identified. The major compounds were Eucalyptol (28.36%), *α*-Terpineol (25.99%), *γ*-Terpinene (15.24%), *α*-Pinene (5.08%), 1H-Cyclopropa[a]naphthalene (4.25%) and 1, 3, 6, 10-Dodecatetraene (3.74%). Percentage mortality due to fumigant toxicity was dose- and exposure period-dependent. One hour after treatment (HAT), application of *L. adoensis* leaf EO at 107 $\mu L \cdot L^{-1}$ air caused significantly ($p<0.05$) higher mortality (50.00%) than 0.00% mortality observed at 0-53 $\mu L \cdot L^{-1}$ air, but not significantly ($p>0.05$) different from 22.50% observed in 80 $\mu L \cdot L^{-1}$ air. At 3 HAT, application of *L. adoensis* EO at 80 $\mu L \cdot L^{-1}$ air caused significantly higher mortality (90.00 %) than mortality observed at 0 $\mu L \cdot L^{-1}$ air. At 6 HAT, application of *L. adoensis* EO at 53-107 $\mu L \cdot L^{-1}$ air caused significantly higher mortality (100.00 %) than that was observed in the control. The same trend was observed at 12 HAT where 100 % mortality observed in 27-107 $\mu L \cdot L^{-1}$ air was significantly greater than 13.33 % observed in the control. At 3 HAT, percentage repellence was significantly ($p<0.05$) affected by doses. Application of EO at 10-30 $\mu L \cdot cm^{-2}$ caused class V repellence (86.67%-100%) compared with the control which caused class I repellence (0-20%).

Key words: *Lippia adoensis*, *Callosobruchus maculatus*, GCMS, bioactivity, repellence, fumigant

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Introduction

Cowpea (*Vigna unguiculata* (L.) Walp) is an important grain legume in drier region and marginal areas of the tropics and subtropics. It is particularly important in West Africa with over 9.3 million tones annual production (Kareem and Taiwo, 2007). It is high in protein contents (20%-25%) and often depended upon by resource-poor people as the major protein source. In some African countries, apart from the lot reserved for immediate consumption by the farming family and sale, cowpea is often stored for 2-8 months to allow for its availability after the production period. Farmers are often forced to sell some lots to be able to raise money to offset the cost of production or attend to other immediate financial obligations. The cowpea seed beetle, *Callosobruchus maculatus*, is the main post harvest pest of cowpea, which causes damage to the seeds also reduces the aesthetic value and nutritional

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contents of the crop; it also reduces the germination ability of the seeds (Babarinde *et al*., 2015). The need to control the pest is therefore, a paramount necessity in order to ensure protein food security among the resource-poor population who largely depends on cowpea for protein source.

Although, the use of chemical protectants against *C. maculatus* infestation of seeds has been reported, its diverse negative impacts have necessitated the search for better alternatives (Isman, 2006). For instance, synthetic insecticides are noxious to men and livestocks and can be pollutants to the environment. Their availabilities to and affordability by the resource-poor farmers are often not certain. Furthermore, their applications may require a degree of skills that the rural farmers who are the producers of the bulk of the nations' food supply do not have. Persistent use of some synthetic chemicals can induce the emergence of strains that are resistant against the same chemical once a generation of the insect becomes more immune to the constituent compounds. In addition, non-selective insecticides kill beneficial insects thereby causing an imbalance in the ecosystem. In the present circumstance an approach that will rely on ecofriendly and bio-rational strategies like the use of plant products appears to hold a great hope for increasing cowpea production in the traditional cereal dominated cropping system throughout the tropics and sub-tropics, including Nigeria.

In search for eco-friendly alternatives to overdependence on synthetic products, many botanicals have been considered, with many formulations evaluated. For instance, in previous studies, on botanical pest control, members of Annonaceae (Babarinde *et al*., 2008, 2015; Babarinde and Adeyemo, 2010), Meleaceae (Babarinde and Ewete, 2008), Piperaceae (Babarinde *et al*., 2011b), Lamiaceae (Babarinde *et al*., 2014), Zingeberaceae (Babarinde and Daramola, 2006), Euphorbiaceae (Babarinde *et al*., 2011a, 2016) in different formulations have been reported to be insecticidal against various stored product insect pests. *Lippia* species are plants in the verbena family, Verbenaceae. About 200 *Lippia* species have been identified (Terblanché and Kornelius, 1996) and are located around the globe; some of which have been reported to be insecticidal against insects of stored products and mosquito larvae (Carvalho *et al*., 2003; Cavalcanti *et al*., 2004; Ngamo *et al*., 2007; Silva *et al*., 2008; Mahmoudvand *et al*., 2011). *L. adoensis* is a tropical shrub that is found around the world. Culturally, leaves of *L. adoensis* can be cooked as herbs and food additive. The pharmaceutical and anti-oxidant potentials of the species have been reported (Demissew, 1989; Asres and Bukar, 2002). It has been reported that chemical composition of the essential oils from the same botanical species differ, due to geographical locations and soil nutrients available to the flora (Basta *et al*., 2007; Jemaa, 2012). Therefore, this work was designed to determine the chemical compounds in Nigeria-grown *Lippia adoensis* essential oil (EO) using gas chromatography mass spectrometry (GCMS) method and to evaluate the fumigant toxicity and repellence of EO against cowpea seed bruchid, *Callosobruchus maculatus*.

Materials and Methods

Experimental location

The experiment was carried out in the Laboratory of Crop and Environmental Protection Department, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.

Callosobruchus maculatus culture

Bruchid-infested seeds of Oloyin local cowpea variety were purchased from Sabo Market, Ogbomoso. The cowpea bruchid were cultured by transferring the infested cowpea of desirable quantity into a plastic jar that was covered with a muslin cloth and held tight with a rubber band to avoid escape of the emerging insects, ensure adequate aeration and prevent entering of other insects. The insect culture was maintained under ambient environmental conditions, according to the method of Babarinde and Ewete (2008).