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An Assessment of The Indigenous Knowledge of the Insecticidal Potency of Locally Available Plant Botanicals: *Ageratum Conyzoides* (Goatweed) and *Hyptis Suaveolens* (Bushmint) Against Stored Cowpea Infested Weevils *(Callosobruchus maculatus)* among Gbagi Farmers and Traders in Abuja, FCT, and Nigeria

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Abstract: *The study aimed to assess the indigenous knowledge of the insecticidal potency of locally available plant botanicals, Ageratum conyzoides (goatweed) and Hyptis suaveolens (bushmint), against stored cowpea infested weevils (Callosobruchus maculatus) among Gbagi farmers and traders in Abuja, FCT, Nigeria. The research was conducted using a combination of ethnobotanical and experimental approaches. Ethnobotanical surveys were conducted to gather information on the local use of the plant botanicals as insecticides, and their methods of preparation and application. The experimental approach involved testing the insecticidal potency of the plant extracts against stored cowpea infested weevils using a completely randomized design. The results of the study showed that Ageratum conyzoides and Hyptis suaveolens were commonly used by Gbagi farmers and traders as insecticides for stored cowpea. The extracts of these plant botanicals showed significant insecticidal activity against the stored cowpea weevils, with Ageratum conyzoides showing a higher level of potency than Hyptis suaveolens. The study concludes that the Gbagi farmers and traders possess a rich indigenous knowledge of the insecticidal potency of locally available plant botanicals, and that Ageratum conyzoides and Hyptis suaveolens can be used as an alternative source of insecticides for stored cowpea.*

Keywords: Indigenous knowledge, insecticidal potency, locally available plant botanicals, Ageratum Conyzoides, Goatweed, Hyptis Suaveolens, Bushmint, stored cowpea infested weevils, Callosobruchus maculatus, Gbagi farmers, traders, Abuja, FCT, Nigeria.

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INTRODUCTION

The use of naturally occurring plant materials to protect agricultural crops and products against a variety of insect pests, is an old age practice in most developing countries of the world (Peter, 1985; Oparaeke *et al.*, 2006), who reported that extracts and powdered substance from different plants have been shun to posses*insecticidal* properties against a wide range of insect pest population (Imam, 1997; & Yahaya & Magaji, 1997). Cowpea plant from which the cowpea seed (Common beans) are produced, has a protein rich food component, which is used as a stable food for Human consumption and also, as a fodder for livestock feeds, in many societies/communities of the dry savanna regions of the sub-Saharan Africa; including Nigeria. Cowpea (common beans) is also rich in minerals, fats, oils, vitamins, and is also recommended as a food supplement for loss of blood (anaemia) and diabetic patients. Similarly, the young leaves and immature pods are eaten as vegetables in most of our rural settlements (IITA, 2006).

Cowpea yields are generally low, with sometimes total yield loss, and even crop failure occurring due to the devastating activities of a wide range of insect pests, which ravage the crop in the field at different stages of growth and even in the store (Olatunji *et al.*, 2009; IITA, 2006; & NCRI, 2011).

Though, several losses of cowpea seeds have been reported from insect pests damage in the field, one of the major constraints yet confronting the cultivation and harvesting of cowpea is in its *stored pests infestations*, the most common of which is the common beans weevil: *Callosobruchusmaculatus*. The larvae and adults of this insect pests constitute the destructive stages attacking cowpea seeds in storage, such that severely damage seeds are turned into powdery substances (of mass) which is unfit for human consumption (Lale & Ofuya, 2011), thereby constituting a major constraint on the food availability and security.

Thus, in view of the economic importance of cowpea to us and consequent upon the severity of damage caused by insects pests, various traditional control practices, both in the field and in the store have been adopted by subsistence/commercial farmers and traders in sub-Saharan Africa, including Nigeria (Lale & Vidal 2013).

Currently, alternative control strategies requiring the use of potent botanical extracts from a

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variety of plants are being adopted to replace the traditional and synthetic insecticides due to insect resistance and harmful effects of fumigants to field and storage workers. These botanical extracts have been found to affect the biology of target insects in different modes, either as ovicides repellents, antifeedants, fumigants, contact toxicants or insecticide (Jalal *et al.*, 2011).

Despite all these efforts of control, most field and storage insect pest infestations of cowpea, have largely remained uncontrolled in the tropical Africa, including Nigeria, in the last five decades. It is therefore in the light of these challenges that current attempt is carried out to assess the efficacy of locally available plant botanicals against insect pest infestations and the attendant economic losses suffered in the field and in the store, by our rural farmers, is imperative.

MATERIALS AND METHODS

The research is conducted in six area councils of Abuja, FCT and involved two assessment procedures/methods; the administration of structured questionnaires to the Gbagi farmers and the laboratory investigations of the insecticidal use of the locally available plant botanicals in Abuja, FCT, Nigeria.

Sampling Procedure

Fifteen (15) randomly selected Gbagi farmers and traders from Abuja Municipal Area Council, AMAC, and seventeen (17) each from the remaining five (5) area councils of Abaji, Bwari, Gwagwalada, Kuje, and Kwali; totaling one hundred (100) farmers/traders, altogether, were administered structured questionnaires, under the guidance of recruited research assistants from the native population, who are educated up to SSCE level.

Collection and Rearing of Insect Pests (Cowpea weevils *C Maculatus)*

Adult cowpea weavils (*C Maculatus)* were isolated from already infested cowpea *Vignaungucuilata)* obtained from the markets and house hold stores, among farmers and traders in the six area councils; and placed in a plastic container covered with a muslin net material tightly fastened with rubber band and taken to the laboratory for rearing/culturing. The rearing was done to adopt the weevils to the prevailing laboratory condition, thereby ensuring the emergence of new adults, for the purpose of the experiment.

Harvesting and Preparation of Test Plants (extracts/powdered substances or samples)

Fresh and matured leaves/stems of the test.*A conyzoides* and *H suaveolens* were harvested from the cultivated farmlands and then air dried in a shade with diffused light, and grounded into a fine powder, using an electric blender. Each portions of the dried powder samples weighing 100gm, was dissolved in 500ml of 95% of ethanol and extracted using the extractor after shaking, stirring and filtering through a funnel plunged with white cotton and whatmann filter paper No. 1. The resultant filtrate was then concentrated to a powdered form through complete evaporation, using an extractor solvent by a rotator evaporator, to give a 35% solid residue of greenish colour and then stored in a refrigerator until further use or the next experimental test (Pavia et al, 1996). The solvent/liquid extracts is use to assess its effects on larval/immature stages of weevils/insects, and also for determining their phytochemical constituents.

Phytochemical Screening of the Test Plant extracts

This was carried out using procedures suggested and adopted by, Harbone, (1998); Harbone 2010); & Aboubakry *et al.* (2008). The chemical constituents tested were reducing sugars, glycosides, saponins, Sterol/steroids, flavonoids, tannins, anthraquinones, Terpenes and alkaloids, using their characteristic colour changes on application of standard procedure and Reagents (Harbone, 1998).

Test for reducing sugars

This is also called Fehlings test. Here 2mls of water/ethanol extract was added to a mixture of equal volume of Fehling re-agents A and B and then boiled on water bath. A brick red colour at the bottom of the test tubes indicated the presence of free reducing sugar.

Test for Glycosides

Ten (10) mls each of H_2SO4 and Fehlings solutions were added to one ml (1) of extracts and the mixture was heated in a boiling water for 15 minutes. A brick red precipitate was confirmatory of the presence of glycosides.

Test for Alkaloids

A ml (1) of HCL was added to 3mls of the ethanolic test extracts in a test tube and about 2-3 drops of Meyer's reagent added. A creamy and turbid precipitate indicated the presence of Alkaloids.

Test for saponins

It is also called the Frothing test. About 2 mls of the extracts (ethanolic) was poured into a test tube and vigorously shaken for about 6 minutes. The presence of the frothing in the test tube indicated the presence of saponins in the extract.

Flavonoids Tests

To a ml (1) of the ethanolic extracts, was added or dropped *magnesium Ribbon* followed by the addition of HCL in a drop wise fashion/manner. A *magenta coloration* indicated the presence of flavonoids.

Sterols/Steroids and Terpenes Test

For these tests, powdered samples was used, not the ethanolic extracts of the plant material/leaves, stems etc.

Preparation

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Powdered samples of about 5grm was extracted by maceration with 50mls of 95% ethylacetate and filtered. The filtrate was then evaporated to dryness (i.e residues). The residues was dissolved in 10mls of anhydrous chloroform and then filtered again.

To Test for Steroids/sterols

One of the portions of the filtrate was mixed with 2mls of conc. H_2S0_4. A reddish brown – like colour, indicated the presence of a sterol, in the form of steroidal ring. This is called salkworkis test for sterols.

To Test for Terpenes

The other portion of the filtrate was mixed with 1ml of acetic anhydride, followed by the addition of 1ml of conc. H_2S0_4, carefully down the wall of the test-tube, to form a layer underneath. The resultant formation of a redish-violet colour indicated the presence of terpenes. This is called Liebermann-Burchards test for Terpenes.

Test for Anthraquinones

About 5gm of the powder was taken into a test tube and 10mls of chloroform was added and shaken for 5 minutes. The extract was then filtered and another 5mls of Ammonia (NH3) was added to the mixture and shaken. A *bright pink colour* in the upper aqueous layer indicated the presence of anthraquinones.

Test for Tannins

To 1ml of aqueous extract, was added about 7ml of feric chloride ($feCl_3$). The presence of *blue-black* and or *blue-green* precipitate indicated the presence of Tannins.

Determination of the mortality of cowpea weevils: *C. maculatus*

15gms each of the leaves powder of the two experimental plants: *H. suaveolens* and *Ageratum conyzoides* separately, and another 15gms each of the test plants, totaling 30gms were mixed with 100gms of cowpea seeds and each introduced into three (3) containers containing the admixture. Also, another 100gms of cowpea seeds was taken into another container of similar size and type, without the plants powder as control. These preparations were labeled A-D, and labeled with their contents (treatment regimens) containing the cowpea seeds; and gently shaken to ensure a thorough mixture. To each of these containers A-D, was introduced about 50 to 100 number of *Callosobruchus maculatus* weevils, and covered with a net fastened material tightly with rubber band. The four containers, A – D, were weighed with metlers weighing balance daily for 14 days noting both the weight loss of the seeds and mortality rate of the *C. maculatus* weevils, during the period of investigation.

RESULTS

DATA PRESENTATION

Results of Administration of structured Questionnaire to Respondents

A total of one hundred (100) structured questionnaires were administered to indigenous Abuja farmers and traders, in the six area councils of Abuja, FCT, and their responses to a wide range of questions on the subject matter, are presented in table 1 as follows:

Table 1. Condensed/summary of responses to administered questionnaires, on the efficacy/insecticidal effects of traditional application of *A. conyzoides* and *H. suaveolen* against stored cowpea weevils *(C. maculatus)*.

S/N	Parameter for Assessment	Responses by Respondents		
		Yes %	No %	Specific Respondents to Questions
1.	What are the likely pests that destroy cowpea seeds generally?			Insect pests
1a.	If insects, common class of insects responsible?			Coleoptera, *C. maculatus*
2.	Whether *C. maculatus* is a storage/field pest.			Storage pest
3.	Have you encountered any damage to stored cowpea seeds by *C. maculatus?*	90(90%)	10(10)	
4.	Any enlightenment campaign undertaken in the village/community about this damage to C. *maculatus* by Govt/NGOs?	42(42)	58(58)	
5.	Any control measures suggested/assisted by Govt/NGOs?	40(40)	60(60)	
6.	Possible control measures suggested by Govt/NGos in the village/community (Yes in 5)			Use of synthetic pesticides
7.	Traditionally adopted control measures in the village (No. in 5)			Use of traditional plant herbs, powdered/natural herbs/spices
8.	Whether *A. conyzoides and H. suaveolen*are used by farmers/traders	71(71)	29(29)	
9.	Alternative plant bolanicals adopted	28(28)	72(72)	Neem, *Parkia* leaves/powdered substances

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10.	How successful was the application/adoption of synthetic insecticides/pesticides?	Successful +++ Unsuccessful +
11.	How successful was the application/adoption of traditional method of stored cowpea seeds against insects	Successful ++ Unsuccessful +
12.	Estimated losses arising from lack of control of stored cowpea weevils by synthetic insecticides/pesticides	10 metric tonnes (#1 million) per 50 metric tonnes.
13.	Estimated losses arising from lack of control of stored cowpea weevils in seeds/cobs using traditional herbs	6 metric tonnes (#800,000) per 50 tonnes

Results of Phytochemical Screening/analysis of plant extracts of *A. conyzoides* **and** *H. suaveolen*

The results/analysis of the phytochemical determination of the constituents/active ingredients of the extracts/powdered substances of the test plants:*A. conyzoides* and *H. suaveolen*, showed the presence of the following active ingredients/chemical constituents as presented in table 11 as follows:

Table 2. Phytochemical Constituents of *A. conyzoides* and *H. suaveolen harvested, Abuja FCT*

Chemical constituents (active ingredients)	**Results/Analysis (+ve-ve) *A. conyzoides***	**H. Suaveolens**
Reducing sugars	++	++
Alkaloids	+	+
Glycosides	+	+
Flavonoids	+	+
Anthraquinones	+	+
Tannins	+	+
Terpenes	+	+
Saponins	+	++
Sterol/steroids	-	-

Results of Insecticidal activity (efficacy) of extracts/powdered samples of *A. conyzoides* and *H. suaveolens* against *C. maculatus*

The results of the assessment of the insecticidal efficacy of the leaf and stem extracts/powdered samples of A. *conyzoides* and *H. suaveoelens* botanicals against the storage insects weevils (*C. maculatus)* of cowpea (*Vignaunquiculata)* seeds/cops, using different treatments or test regimes, indicated various rates of mortality (death rates) of these weevils as well as observable economic loss manifested in weight loss and depreciation value of cowpea seeds/cops, as presented in tables III, IV and V below:

Table 3. The mortality rates of *Callosobruchus maculatus (cowpea weevils) in relation to the various treatment regimens*

Days	**Treatment regimens**			
	D_1	**D_2**	**D_3**	**D_4**
1	04	08	12	-
2	02	06	10	-
3	-	-	09	2
4	04	02	04	-
5	-	04	05	01
6	05	-	05	-
7	-	05	05	02

Table 4. Daily weight losses of various test treatment regimens of cowpea seeds for successive days of assessment

Days	**Treatment regimens/weights**			
	D_1 (grams)	**D_2 (grams)**	**D_3 (grams)**	**D_4 (grams)**
1.	125.70	125.70	140.71	110.69
2.	125.58	12.51	140.47	110.64
3.	125.39	125.20	140.17	110.55
4.	125.18	124.89	139.84	110.40
5.	124.94	124.56	139.50	110.19
6.	124.69	124.23	139.16	109.94
7.	124.40	123.89	138.81	109.66

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Table 5. Daily weight losses of cowpea seeds as per successive days of treatment regimens

Days	Treatment regimens/weights			
	D_1 (grams)	**D_2 (grams)**	**D_3 (grams)**	**D_4 (grams)**
1.	0.00	0.00	0.00	0.00
2.	0.12	0.11	0.24	0.06
3.	0.19	0.31	0.30	0.09
4.	0.21	0.31	0.33	0.15
5.	0.24	0.33	0.34	0.21
6.	0.25	0.33	0.34	0.25
7.	0.29	0.34	0.35	0.26
Total	**1.30**	**1.13**	**1.90**	**1.02**

Key: D_1 – *C. maculatus* + cowpea seeds + *A. conyzoides* powder
D_2 – *C. maculatus* + cowpea seeds + *H. suaveolens*powder
D_3 – *C. maculatus* + cowpea seeds + *Aconyzoides and H. suaveolens powdered mixed*
D_4 – Cowpea seeds + *C maculatus – test plants (control)*

DISCUSSION

It is reported that over 90% of the insect damage to cowpea seeds/cops in storage is caused by the cowpea weevils, *CallosobruchusmaculatusF (coleotera: Bruchiidae)*, also a pest of various leguminous plants (pulses) such as soya beans *(Glyceine max)*, common beans *(Phaseolus vulgaris)*. Thus, over the years, interest in botanical insecticides (herbs) has increased partly, as a result of environmental concerns arising from unfavourable traditional practices, as well as a result of insect population becoming resistant to chemical insecticides, both in the field and in the store; thereby necessitating the evaluation of essential oils (ingredients) in natural plant extracts/powdered samples, against more importantly, stored product insect pests (Kim *et al.*, 2013; Ashamo, 2011; & Ayvaz *et al.*, 2009).

Traditionally, it was reported that most of our rural farmers have adopted locally available plants extracts, parts or even powdered grinded substances of the leaves or stem or both to control various insect infestations against stored crop produce as cowpea (common House beans) and Grains (Lale, 2005; & Lale *et al.*, 2011).

In the present study, the responses of the Gbagi farmers and traders to the research questionnaires indicated that substantial progress and success have been achieved with the application of the locally available herbs of *A. Conyzoides & H. suaveolens* powdered samples and natural herbs (Leaves and stem parts) to control cowpea weevils infestation and damage in the store (Table I). Similarly, the scientific evaluation of the various extracts and powdered preparations of the leaves and stems of these two locally available botanicals to ascertain their insecticidal efficacy, against the cowpea weevils (*C. maculatus*) in the store was undertaken and the results obtained confirmed the insecticidal efficacy/property of these plants extracts/powdered scores, with respect to the mortality of the cowpea weevils; though the rate of mortality was generally low during the 1st few days of assessment until at the end of the 7th day observation. However, with combined treatment regimens (D4), the potency and hence efficacy was higher, meaning that the death of the insects tests *C. maculatus* was observed to be higher and faster as compared to the single DI & DII treatment regimens (table III). Also, the economic value of the stored seeds was observed to be lower at the end of the seven day treatment regimes than at the early stage (1st – 3rd day). This is reflected in the quality and quantity (depreciated value and weight loss of cowpea seeds) of the seeds before, during and after the successive days of the seventh day test treatment. This is confirmed in the 1.3% decrease in the test treatments regimens DI – DIII and a 0.93% decrease in the control treatment (DIV) respectively (Tables IV and V).

CONCLUSION

Callosobruchus maculatus (cowpea weevils) has been reported to parasitise a wide range of legumes in store, preferably infesting members of the *vignaunguiculata*commonly referred to as the common house beans. A single larvae of *C. maculatus* is reported to diminish the weight of a cowpea bean by 3% and multiple larvae will infest one cowpea in most storage infestations. Additionally, Mahfuv and Khalaquzzaman (2007) reported that a slight damage by the larvae of *C. maculatus* can be destructive towards the viability of a cowpea seed for the next planting season. Following the destructive prevalence of agricultural products in the field and in the store by these insect pests, several researchers of Entomologist and Crop protection discovered through ascertaining the insecticidal efficacy of both the synthetic and natural control of the pest population in the field and in the store. This research is one of the attempts in the present study; which has proved beyond doubt that a great breakthrough in the population reduction of Callosobruchus maculatus is established in the store, considering their generation time and continuity of life.

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REFERENCES

1. Abduljalal, D.S., Ahmad, B.L., Yusuf, B.R., & Abdullahi, U. (2011) Laboratory evaluation of insecticidal potentials of *Anogeissusleiocarpus* (Kane plant: Guil andPerr) for the control of callosobruchussubinnotatus pic (Bambara Gnut weevil) on stored Bambara Gnut *(Vignasubterranean* Verdcont). *Nig. Journal of EnT, 28*, 75-84.
2. Aboukakry, K., Olo, H.O., & Eriata, D.O. (2008). Alkaloid, Tannins andSaponins contents of some Nigerian medicinal plants. *Journal of Medical Aromatic plant science, 23*(8), 344 – 349.
3. Ashamo, M. O., Morawo, T. O., & Oke, B. I. (2011). Effects of oils of eight different plants against the Angoumois grain moth Sitotroga cerealella(Olivier).(Lepidoptera: Gelechiidae). *Nigerian Journal of Entomology*, *28*, 35-41.
4. Ayvaz, A. B. D. U. R. R. A. H. M. A. N., Karaborklu, S. A. L. I. H., & Sagdic, O. (2009). Fumigant toxicity of five essential oils against the eggs of Ephestia kuehniella Zeller and Plodia interpunctella (Hübner)(Lepidoptera: Pyralidae). *Asian Journal of Chemistry*, *21*(1), 596-604.
5. Credland, P. F. (1992). The structure of bruchid eggs may explain the ovicidal effect of oils. *Journal of Stored Products Research*, *28*(1), 1-9.
6. Harbone, J.B. (2010). *Phytochemical methods: A guide to modern techniques of plant analysis* 111. Springer (India) put.ltd. New Delhi 40-96.
7. IITA, (2006): Control of the cowpea weevil; *Callosobruchus maculatus* at the savanna level in Nig. *Global conference on tropical Agric*, *IITA report*, *Nig.*
8. Imam, M.M. (1997). Neemand other botanical insecticides commercialization.*Phytoparasitica*, *25*(12), 339-344.
9. Kim, S. I., Park, C., Ohh, M. H., Cho, H. C., & Ahn, Y. J. (2003). Contact and fumigant activities of aromatic plant extracts and essential oils against Lasioderma serricorne (Coleoptera: Anobiidae). *Journal of Stored Products Research*, *39*(1), 11-19.
10. Lale, N.E.S., & Maina, Y.T. (2005). Influence and duration of storage of insecticidal plant oils after extraction and oil – treated seeds prior infestation on the efficacy of neem seed oils against *C. maculatus*infesting cowpeas. *Nig. Journal of Ent. 22*, 54 -63
11. Ofuya, T. I., & Lale, N. E. S. (2001). Overview of pest problem and control in the tropical storage environment. *Pests of Stored Cereals and Pulses in Nigeria. Biology, Ecology and Control. Dave Collins Publications, Nigeria. ISBN*, *978*(5447), 13.
12. Lale, N. E. S., & Vidal, S. (2003). Simulation studies on the effects of solar heat on egg-laying, development and survival of Callosobruchus maculatus (F.) and Callosobruchus subinnotatus (Pic) in stored bambara groundnut Vigna subterranea (L.) Verdcourt. *Journal of Stored Products Research*, *39*(5), 447-458.
13. Mahfuz, I., & Khalequzzaman, M. (2007). Contact and fumigant toxicity of essential oils against Callosobruchus maculatus. *University Journal of Zoology, Rajshahi University*, *26*, 63-66.
14. National Cereals Research Institute, NCRI, (2011). Phytochemical constituents of five Nigerian Med. Plants: Responses of stored weevils, *C. maculatus*against selected cowpea seeds. *Journal of stored products research*, *39*(4), 16 – 24.
15. Oparaeke, A. M., Dike, M. C., & Amatobi, C. I. (2006). Field activity of three mixture levels of plant extract formulations for the management of post-flowering insect pests of cowpea, Vigna unguiculata (L.) walp–the flower thrips, Megalurothrips sjostedti (Trybom). *Journal of Sustainable Agriculture*, *28*(4), 45-54.
16. Olatunji, K., Jumoke, R., & Tunde, S. (2009). Effects of three common seed oils on the survival, eggs laying and development of the cowpea weevils *C. maculatus* Fab. *Journal of biolSci, 15, 390-398.*
17. Yahaya, M.A., & Magaji, M.D. (1997). Insecticidal efficiency of some plant materials/extracts as protectants of cowpea.*Vignaunguiculata* against cowpea weevil,*C. maculatus* during storage.*Paper presented at the 20th Annual int. Conf. of chem..Society of Nig.* 2nd – September, Arewa House Kd.

***Corresponding Author:** Ahmad-Alizaga, S.L.