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CONTROL OF MAIZE AND BEAN WEEVILS IN STORAGE WITH COMMONLY-CONSUMED SPICES.

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ABSTRACT
The following plants commonly used for their values as spices namely, *Zingiber officinale* Rosc. (Ginger), *Myristica fragrans* Warb. (Nutmeg) and *Allium sativum* Linn. (garlic), were screened for their efficacy in the control of *Zea mays* Linn. (maize) and *Vigna unguiculata* Walp. (beans) weevils in storage. One hundred and fifty (150) freshly dried healthy seeds of each of the plants were selected and used for the experiment. The protectant effect was worked out using the "Weevil Perforation Index" (WPI) (where WPI ≥ 50% shows a negative protectant effect). Phytochemical screening results showed that all the spices except *M. fragrans* contained high concentrations of cardiac glycosides and polyphenols. Using mean values from 5 replicates, statistical analysis of results showed that *A. sativum* (WPI=30.2%) and *Z. officinale* (WPI=33.8%) possessed more protectant effect on *V.unguiculata* than *M. fragrans* (WPI=70.8%). For *Z. mays*, all the spices had a positive protectant effect. However, *A. sativum* had a higher positive effect (26.9%).

Keywords : Weevil Perforation Index, *Zingiber officinale,* protectant effect.

1. INTRODUCTION

Cereals belong to the family *Poaceae* and are widely cultivated and consumed the world over. When compared to root crops, they provide a better source of protein. In Nigeria, especially in the northern part of the country, cereals provide a greater part of energy in diets (Okoh, 1998).
Maize is the third most important crop in the world next to rice and in Nigeria, it occupies the second place with an estimated annual production of about 5.6 million tonnes (Central Bank of Nigeria, 1992).

Vigna unguiculata (beans) belongs to the family *Fabaceae* and sub-family *Papillionaceae*. It is the second most important source of food and fodder next to the family *Poaceae*. They constitute a good source of dietary protein (Abroh, 1977; Sinha, 1977). There are rich in lysine and tryptophan (Kelly, 1995). They are used as food, for soil improvement, as forage and as ornamentals (Elegbede, 1998).

The main causes of damage to grains in storage are insects and rodents (MacDonald and Low, 1984). Chemicals in form of dust have been employed in the control of these pests in storage. Damage to grains by insects generally reduce the the palatability of the grains, their market value and germination potentials (Javaid and Poseal, 1995).
Several methods have been employed in the protection of grains against these pests in storage. They include covering the grains with sand to block spaces that would have served as ingress route for the pests, drying over high temperature and use of chemicals synthesized to serve as repellent or insecticide. However, the use of chemicals is limited because they are beyond the reach of the poor farmers who are the main producers of these crops and because of their negative effects on the crops, soil organisms and the consumers (Fatope, *et al.*, 1995).
Many insecticidal plants are useful for pest control in the field as well as in storage (Stoll, 2000). They are known to contain active substances that are either toxic to the adult insect, reduce their egg-laying ability, toxic to eggs or toxic to the larvae before or after entering grains (Fatope, *et al.*, 1995).

This work therefore looks at how weevils of maize and beans can be controlled while grains are in store using commonly consumed and indigenous spices.

2. MATERIALS AND METHODS:

2.1 Sources of plant materials.

Freshly harvested beans and maize grains were used. They were bought from Apiapum market in Obubra Local Government Area of Cross River State, Nigeria. The spices were bought from the same market.

These spices were oven-dried at 60°C for 2hrs after pounding in a mortar. After this, grinding was carried out to reduce the shredded materials into powder.

2.2 Collection of insects.

Two (2) species of insect pests were used for the study. They were *Callosobruchus maculatus (Coleoptera:Bruchidae)* and *Sitophilus zeamais (Coleptera:Curculionidae*). The two pest species were obtained from stored beans and maize grains respectively. They were maintained in screened containers. The identification of the insect specimens was done in the Department of Zoology, University of Calabar.

2.3 Phytochemical screening of spices.

This was done in the Biochemistry laboratory of the University of Calabar using the method of (Ekpendu *et al*., 1984).

2.4 Insect activity test.

To 500ml measuring cylinder, 150 freshly dried and healthy seeds of the grains were put and to each, 50 heavily infested grains were added. To these, 10g of the spice powder was added. This was done for each of the spices. No treatment was given to the control. Replication was 5 times. The cylinders were covered with a 0.1mm mesh to prevent insects from escaping or entering the set-up. The experiment was allowed to stand for ten (10) days at room temperature to allow for insect infestation.

2.5 Results analysis.

The weevil perforation index (WPI) was worked out with means from (5) replicates according to (Stoll, 2000). The formula used was as below:-

% of treated seeds perforated X 100 + % of treated seeds perforated
% of control seeds perforated

3. RESULTS AND DISCUSSION.

Table 1 shows results of phytochemical screening of the spices. Alkaloids were found in all the spices while; hydroxymethyl anthraquinone was not obtained in any. All the spices except *M. fragrans* contained cardiac glycosides and polyphenols. However, *A. sativum*, contained more cardiac glycosides than *Z. officinale.* The same trend was observed in polyphenols and alkaloids.

Tables 2-4 show the effects of the spices on *V. unguiculata*. With *M. fragrans,* there was more perforation of the beans seed than with *A. sativum* and *Z. officinale. Allium sativum* had a more protectant effect of 30.2% WPI. This was followed by *Z. officinale* with 33.8%. *M. fragrans* had no protectant effect because its WPI of 70.8% is greater than 50% that is used as the standard (figure 1).

Tables 5-7 give the results of weevils' response to the three spices for *Zea mays. Allium sativum* still had a more positive protectant effect of 26.9% WPI followed by *Z. officinale* with 30.6% WPI. The least was *M. fragrans* with 44.2% though, there was still a positive protectant effect (Fig 2).

Results have confirmed the use of medicinal plants parts in the control of some animals and plant diseases and pests. According to Mishra *et al*., (1984), extract from *Allium sativum* can be used in the control of growth and sporulation of some fungal pathogens on potato and yam in store. This potency is also seen in its control of beans and maize weevils in this work. Ekpendu, (1975), also confirmed the use of *Tephrosia sp* leaves extracts in protecting cowpea, maize and bambara nuts against weevils and farm animals against tick.

FAO (2000) observed that chickpeas were better protected in store against weevils when spearmint oil was applied to them as emulsion.

In recent times, only the use of popular plant species as repellents or insecticide has been researched into. In Nigeria, only very few studies have been carried out to test spices potency on control of storage pests. This work has revealed that extract potency is a function of its phytochemicals and agrees with the work of Udo *et al*., (2001). *M. fragrans* had the lowest protectant effect of 70.8% for beans probably due to its high saponin content because according to FAO (2000), *Imperalis sp*. possesses no insecticidal or anti-feedant activity because of its very powerful saponins.

According to Oka *et al.*, (2000), most plant materials used as insecticides contain essential oils produced in various external and internal glands of these plants. These oils are a very complex mixture of terpenes, sesquiterpenes, their oxygenated derivatives and other aromatic compounds. The actual chemical composition is a function of species, chemotype, climate, soil conditions and geographical location. (Shaaya and Kostyukovsky. 2006).

The high WPI possessed by *A. sativum* may be due to its high cardiac glycosides and polyphenols content compared to their availability in other spices.

It was strongly observed that the spices served as repellents rather than insecticides. In Nigeria, because of problems faced by farmers in the aspects of evacuating the produce from farms and storage, the excesses are often wasted. The main thrust of this work therefore, was to look at ways in which these spices can be used to protect grains in storage rather than being wasted. In summary, *Allium sativum* can be used to protect maize and beans, against weevils while in store.

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Table 1; Phytochemical components of spices.

Phytochemical	**species**					
	Zingiber officinale		*Myristica fragrans*		*Allium sativum*	
	Al	Aq	Al	Aq	Al	Aq
Alkaloids	+	+	+	+	++	+
Saponins	+	+	++	+	-	-
Tannins	-	-	-	-	+	+
Cardiac glycosides	++	+	-	+	+++	++
anthroquinones	+	+	+	+	-	-
Polyphenols	+	+	-	-	++	++
Reducing compounds	+	-	+	+	+	+
Hydroxymethyl-anthroquinones	-	-	-	-	-	-
Flavonoids	+	-	++	+	+	+
Phlobatannins	-	-	++	-	-	-

Note: +++ Strongly present; ++ Moderately present; + Present; - Absent; Al =Alcohol; Aq=Aqueous

Table 2; Insects activity test for *A. sativum* on *V. unguiculata*.

	No. of maize seeds perforated	
	Treated	Control
	108	683
	21.6±0.02	136.6 ± 0.31
	WPI = 30.2%	

Table 3: Insect activity test for *M. fragrans* on *V. unguiculata*.

	No. of maize seeds perforated	
	Treated	Control
	525	683
	105±0.05	136.6 ± 0.31
	WPI = 70.8%	

Table 4: Insect activity test for *Z. officinale* on *V. unguiculata*.

	No. of maize seeds perforated	
	Treated	Treated
	121	683
	24.2±0.04	136.6 ± 0.31
	WPI = 33.8%	

Table 5: Insect activity test for *A. sativum* on *Z. mays*.

	No. of maize seeds perforated	
	Treated	Treated
	93	643
	18.6±0.04	128.6 ± 0.03
	WPI = 26.9%	

Table 6: Insect activity test for *M. fragrans* on *Z. mays*.

	No. of maize seeds perforated	
	Treated	Control
	153	643
	30.6±0.04	128.6 ± 0.03
	WPI = 44.2%	

Table 7: Insect activity test for *Z. officinale* on *Z. mays*.

	No. of maize seeds perforated	
	Treated	Treated
	106	643
	21.2±0.14	128.6 ± 0.03
	WPI = 30.6%	

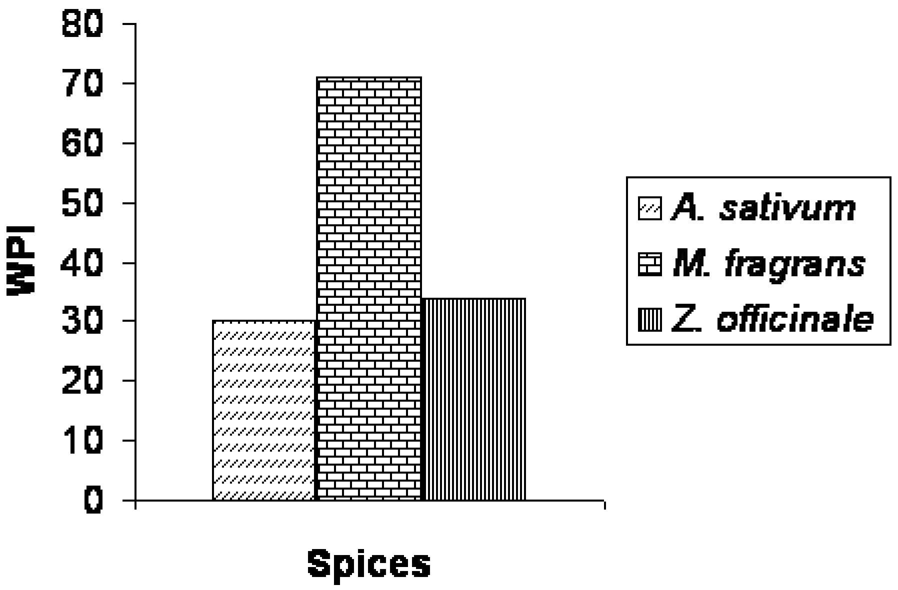

Fig.1. Weevil perforation index for *V. unguiculata*

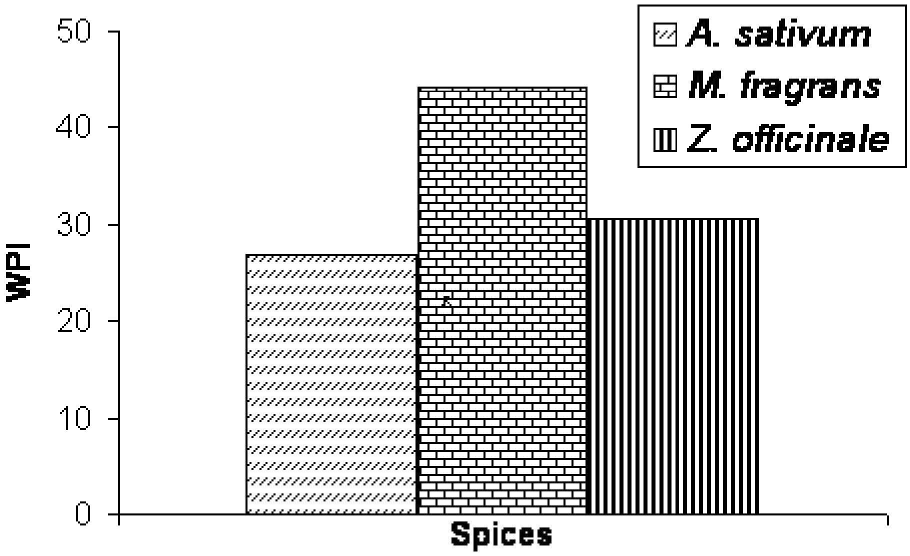

Fig. 2. Weevil perforation index for *Z. mays.*

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