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POST HARVEST TREATMENT OF PEST AFFECTING WHEAT GRAIN USING SOME SPICES (*Pipernigrum, Zingiber Officinale* AND *Ellectaria cardamom).*

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ABSTRACT
The study was conducted in the Laboratory of Plant Science and Biotechnology Department, Federal University of Lafia, Nasarawa State to investigate the insecticidal potency of three spices powder namely black pepper *(Piper nigrum L.)*, ginger *(Zingiber officinale L.)*, and true green *(Ellectaria cardamom L.*), against wheat weevil *(Tribolium castaneum)* on stored wheat grain. Spices powder was added separately to 20g of wheat grain in plastic containers at four dosages 0.15, 0.27, 0.37, and 0.5% (w/w) while control had no spices powder. Twenty insect pests (*Tribolium castaneum*) were introduced into each container. Mortality counted in each treatment was recorded after 7, 14, 21, 28 and 35 days. All treatments were replicated three times. Variations were significantly observed in the overall effect of different plant powders on the mortality of weevils extracted from wheat kernel. Weevils treated with *Piper nigrum* powder exhibited the highest mean mortality (16.37), followed by *Ellectaria cardamom* (16.05) and lastly *Zingiber officinale* (13.82). from the result obtained, it is evident that the spice powders possessed insecticidal properties which if fully extracted could be used in post harvest treatment of wheat grain on storage.

Keywords: Post-harvest, Spice Powders, Wheat weevil.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most extensively grown cereal crop in the worldl with a production of 750 million tons (MT) on about 220 million hectares (Mha) in 2017 (FAO, 2017).Wheat provide about 19 percent o f the calories and 21 percent of protein needs of daily human requirements at the global level (*Braun et al., 2010*).It is an important industrial and food grain. It ranks second among the most important cereal crops in the world, after rice (Najafi, 2014). It is the most important cereals trade on international markets (Falola *et al.*, 2017).In Nigeria, wheat is consumed in one form or the other in almost every home, and throughout the country. Besides, the crop is the main raw material in the Nigeria flour mills. Its flour is used for making bread confectionaries, biscuits, other snacks, macaroni and spaghetti. The offal (residue) is used in the feed mills in compounding livestock feeds (Ahmed, 2014). While grains can be stored for a long period of time under certain conditions, preservation of quality during long term storage is a problem in many parts of the world (Ameerah and Babatunde, 2015). An estimate of 8-10% of total grains stored in silos is lost as a result of inappropriate storage conditions yearly (Boxall 2001).Most of this damage in wheat is caused by rust red flour beetle, *Tribolium castaneum* (Herbst) causing up to 40% reduction in grain weight (Ajayi and Rahman, 2006). It consumes endosperm of seeds leaving them with coagulating consistency and moldy smell (Keskin and Ozkaya, 2013). The commonly used method of controlling pests in stored products is the application of synthetic insecticides and fumigant (Chube, 2008). Not only does these chemicals have severe effects on environment but also cause serious health issues to the consumers (Salem *et al.*, 2007).

The use of botanical products is more promising in the control of insect pests in storage system by protecting the grains while keeping their original quality: farmers can grow them and they can also be chipper and easier to use than synthetic insecticides (Govinda *et al.*, 2010).

Spices are one of the important plant powders tested and found efficacious against insect pests of stored products (Danjuma *et al*., 2009). This study aim to evaluate the efficacy of three local spice powders as protectant of wheat grain against weevils in Nigeria.

MATERIALS AND METHODS

Study area

Lafia is the capital of Nasarawa State and lies between latitude 80 250 400N to 80 300 150N and longitude 80240 250E to 80 380 190E in the guinea savannah region of Nigeria. Lafia is said to be the largest town in Nasarawa State with a population of 330,712 (NPC, 2006). The major occupation of the in habitants in Lafia is farming.

Experimental site

The experiment was carried out in the laboratory of Plant Science and Biotechnology Department, Federal University of Lafia.

Sources of plant materials

Black pepper (*Piper nigrum* L.) seed ginger (*Zingiber officinale* L.) and Green or True cardamom (*Ellecteria cardamom et al.*) were purchased in Lafia Modern Market. The local variety of wheat grains was obtained from Lafia Modern Market, Nasarawa State, Nigeria.

Sources of Insect Pest

Wheat weevils were obtained from wheat store in Lafia.

Preparation of Plant Materials

The plant materials (spices) were prepared using the method of Insikaye and Oke,(2018)

The spices were separately pounded using pestle and mortar.

The powders were sieved with a 40-mesh sieve to obtain a fine dust before application to the wheat grains. The spices were stored in airtight plastic containers at room temperature 37^0C before use.

Rearing of Experimental Insects

Local strains of the important stored-product insects were reared on uninfected whole kernels of wheat. Insects were released at the rate of 50 adults in container containing 10 kg of wheat grains. The containers were covered with muslin cloth and tied with a rubber band and kept in the laboratory maintained at room temperature of 37°C.After two weeks of ovi position, the parent insects were separated and egg laid grains was maintained and cultured to produce newly emerged adults of same generation. For this purpose, the insects emerged after four weeks was removed. One-fourteen day old adults of the insects were used in the experiment.

Mortality and Progeny Assessment Assays

The mortality and progeny assessment test was carried out using the method of Ashouri and Shayesteh,(2010). Spice Powders were added separately to 20g of wheat in plastic containers (9cmhigh, 7cm diameter)at five dosages 0.15, 0.27, 0.37 and 0.5% (w/w), while the control treatment had no spice powders. All treatments were replicated three times i.e. (32 x 3). The test materials were mixed thoroughly and gently in the containers by manual agitation until the materials were evenly distributed among the grains and ensure a homogeneous mixture. Twenty adult *Tribolium castaneum* were introduced into each container. The plastic containers were securely covered with white muslin cloth held in place with rubber bands to ensure adequate ventilation. The content of each of the containers was poured in a dish and dead insects were counted. Mortality counts in each treatment was recorded after 7, 14, 21, 28 and 35 days (Data were recorded on days to100% mortality).

Experimental design

The experimental design for mortality tests was laid out in randomized completely design (RCD) comprising four (4) treatments, one (1) test organism and four(4) concentration (4x1x4) administered in three replicates.

Statistical analysis

The data obtained was subjected to analysis of variance (ANOVA) at 5%level of probability using SPSS software version 22.

RESULTS

Effect of Different Concentrations of *Piper nigrum* Powder on *Tribolium castaneum* mortality in WheatKernel.

Results of effect of different concentrations of *Piper nigrum* powder on *Tribolium castaneum* mortality (Table1) revealed that the highest weevil mortality (20.00) was observed 3 to 4 days after application of 0.15g and 4to 5 days after application of 0.27g of *Piper nigrum* powder. No weevil deaths were observed in the control experiments. Differences in weevil mortality after application of different concentrations of *Piper nigrum* powder were significant($P \leq 0.05$).

Table 1: Effect of different concentrations of *Piper nigrum* Powder on *Tribolium castaneum* mortality in wheat kernel.

	Weevil Mortality at Different Concentrations of Plant Powder				
Days of Post-Application	0.15g	0.27g	0.37g	0.50g	Control
1	9.33^{ab}	8.33^{a}	8.33^{a}	9.00^{a}	0.00^{a}
2	17.33^{c}	17.33^{c}	13.67^{abc}	16.00^{bc}	0.00^{a}
3	20.00^{c}	19.00^{c}	17.00^{c}	17.33^{c}	0.00^{a}
4	20.00^{c}	20.00^{c}	18.00^{c}	18.33^{c}	0.00^{a}
5	20.00^{c}	20.00^{c}	19.00^{c}	19.33^{c}	0.00^{a}

Means followed by same super scripts within same rows and columns are not significantly different ($P \leq 0.05$).

Effect of Different Concentrations of *Ellectaria cardamom* Powder on *Tribolium castaneum* Mortality in Wheat Kernel.

The highest mortality of wheat weevil 20.00 (100%) was observed 5 days after the application of 0.15g, 3 to 5days after application of 0.27g, and 5 days after application of 0.50g of *Ellectaria cardamom* powder (Table 2).The least weevil mortality (6.00) was observed in weevils treated with 0.50g of *Ellectaria cardamom* powder.Weevil mortality was not observed in the control experiments. Differences in weevil mortality after application of different concentrations of *Ellectaria cardamom* powder were significant ($P \leq 0.05$)

Days of Post-Application of Plant Materials	Mean No. of Dead Weevils
1	8.08[a]
2	14.56[b]
3	16.72[c]
4	18.28[cd]
5	19.42[d]

Table2: Effect of different concentrations of *Ellectaria cardamom* powder on *Tribolium castaneum* Mortality in wheat Kernel.

Days of Post-Application	Weevil Mortality at Different Concentrations of Plant Powder				
	0.15g	0.27g	0.37g	0.50g	Control
1	10.00[abc]	13.00[bcd]	6.33[ab]	6.00[a]	0.00[a]
2	16.00[cdef]	19.00[def]	12.33[bcd]	14.00cd[ef]	0.00[a]
3	17.00[def]	20.00[f]	14.33[cdef]	18.33[def]	0.00[a]
4	18.67[def]	20.00[f]	16.67[ef]	19.67[ef]	0.00[a]
5	20.00[f]	20.00[f]	19.67[ef]	20.00[f]	0.00[a]

Means followed by same super scripts within same rows and columns are not significantly different (P≤0.05).

Effect of Different Concentrations of *Zingiber officinale* Powder on *Tribolium castaneum* Mortality in Wheat Kernel.
Results of the effect of *Zingiber officinale* powder on the mortality of weevils from wheat (Table 3) revealed that the highest weevil mortality (20.00) was observed after 5 days of post application of 0.15g, and 3 to 5days' post-application of 0.27g of *Zingiber officinale* powder. The least weevil mortality (2.33) was observed after 1-day post-application of 0.37g of the test plant. Weevil deaths were not observed in the control experiments. Differences in weevil mortality after application of different concentrations of *Zingiber officinale* powder were significant (P≤0.05).

Table 3: Effect of Different Concentrations of *Zingiber officinale* Powder on *Tribolium castaneum* Mortality in Wheat Kernel.

Days of Post-Application	Weevil Mortality at Different Concentrations of Plant Powder				
	0.15g	0.27g	0.37g	0.50g	Control
1	8.00[abcd]	11.67[a]	2.33[a]	4.67[ab]	0.00[a]
2	14.00[cdefg]	18.33[fg]	7.00[abc]	9.67[bcde]	0.00[a]
3	15.00d[efg]	20.00[g]	9.67[bcde]	13.00cd[efg]	0.00[a]
4	18.33[fg]	20.00[g]	13.67[cdefg]	16.00[efg]	0.00[a]
5	20.00[g]	20.00[g]	1567[efg]	19.33[g]	0.00[a]

Means followed by same super scripts within same rows and columns are not significantly different (P≤0.05).
Overall Effect of Post-Application Duration on Weevil Mortality in Wheat Kernel.
Mean total death of weevils extracted from wheat increased significantly (P≤0.05) with increase in the post-inoculation duration (Table 4). The highest mean death of weevils (19.42) was observed after 5 days of treatment with plant powders, followed by 4days (18.28), 3days (16.72), 2days (14.56) and lastly 1day
(8.08).

Table4: Overall Effect of Post-Application Duration on Weevil Mortality in Wheat Kernel.

Means followed by same super scripts within same rows and columns are not significantly different P≤0.05).

Overall Effect of Different Plant Powders on Weevil Mortality in Wheat

Variations were observed in the overall effect of different plant powders on the mortality of weevils extracted from wheat (Table 5).Weevils treated with *Piper nigrum* powder exhibited the highest mean mortality (16.37), followed by *Ellectaria cardamom* (16.05) and lastly *Zingiber officinale* (13.82). The overall effect of *P. nigrum* and E. cardamom powders on weevil mortality differed significantly from the effect of *Zingiber officinale* (P≤0.05).

Table5:Overall Effect of Different Plant Powder son Weevil Mortality in Wheat

Plant Powder	Mean Weevil Mortality
Zingiber officinale	13.82^{a}
Ellectaria cardamom	16.05^{b}
Piper nigrum	16.37^{b}

Means followed by same super scripts within same rows and columns are not significantly different (P≤0.05).

Overall Effect of Different Concentrations of Plant Powder son Weevil mortality in Wheat Kernel.

Variations in mean total mortality of wheat weevils were observed at different concentrations of plant powder treatments (Table6).The highest mean total weevil mortality (17.78)was produced by the application of 0.27g of plant powders, followed by the application of 0.15g (16.24), 0.50g (14.71) and lastly0.37g(12.91).Differences in mean total effect of different concentrations of plant powders on weevil mortality were significant (P≤0.05).

Table 6:Overall Effect of Different Concentrations of Plant Powders on Weevil mortality in Wheat Kernel.

Plant Powder Concentration (g)	Mean Total Weevil Mortality
0.15	16.24^{bc}
0.27	17.78^{c}
0.37	12.91^{a}
0.50	14.71^{ab}

Means followed by same super scripts within same rows and columns are not significantly different (P≤0.05).

DISCUSSION

The results of this study has shown that Black pepper (*Piper nigrum*), True – green (*Ellectaria cardamom*) andGinger (*Zingiber officinale*) has insecticidal effect on *Tribolium castaneum* at all levels of treatment but variedwith the exposure period and powder concentration. In a similar study by Boff *et al*., (2006), it was alsoreported that insecticidal potential of certain plant extract such as *P. nigrum* has been established againststorage pest. Also insecticidal, repellent and development inhibition activity of *P. nigrum* oil have been reported against wheat grain pest *Tribolium castaneum* (Herbst) (*Coleoptera Tenebrionidae*) to control its infestation. An observation was also noted by Updhyay and Ahmad, (2011) who explained that *P. nigrum* show enormous toxicity against several stored product pests (*T.castaneum*) and provide prolonged protection to the grains. However,it was also revealed by Huang *et al*.,(2000) that volatile oil from cardamom acts as a potential grain protectant by killing various life stages of the stored product insects attacking wheat, suchas *Tribolium castaneum* and Sitophilus zeamais, via contact and fumigant action. Furthermore, *Zingiber officinale* have additionally been discovered to have insecticidal botanicals against *Tribolium castaneum* (Ahmed *et al*.,2018).

From the results of table 5 Weevils treated with Piper nigrum powder exhibited the highest mean mortality(16.37), followed by Ellectaria cardamom (16.05) and lastly Zingiber officinale (13.82). *Ellectaria cardamom* has been found to contain Monoterpenes while *Z. officinale* contain allicin and these can be some of the bestand safest alternatives to synthetic insecticides Popovic et al., (2013). The monoterpenes can penetrate through breathing and quickly intervene in physiological functions of insect. *Piper nigrum* contain piperine which is also insecticidal. Similar work carried out by: Vijay-Kumar *et al*.,(2015) determined biological activities of spices namely turmeric, chilli, coriander, fennel seeds, black pepper, ginger, fenugreek garlic and cumin against *Tribolium castaneum.* All spices showed significant effect on adult mortality. Toxic effect followed- black pepper>cumins> garlic> fennel seed> ginger> fenugreek> untreated control. This study (Table6) showed that the overall effect of different concentrations of plant powders on *T. castaneum* mortality in wheat powder was observed at 0.5g (10.33) followed by 0.27g (9.78), 0.15g (9.71) and lastly 0.37g (9.31).Recent research shows that Pepper and Ginger extracts on *Tribolium castaneum* has been tested by five concentrations of 0.5,1.0,1.5,2.0 and 2.5ml for 7days by Mary and Durga, (2017) and it was found that the *T. castaneum* mortality mean rate was recorded highest in 2.5 ml concentration. This was in line with the findings of Tripathi *et al*., (2009) and Vijay-Kumar *et al*., (2015) having used various powdered spices found it to have fumigant and toxic effect respectively.

CONCLUSION

This experiment aim at investigating the effect of three spices powder namely *Piper nigrum* L., *Zingiber officinale* L., *and Ellectaria cardamom* L., against wheat weevil (*Tribolium castaneum*) on stored wheat grains.

From the experiment, result shows that weevils treated with *Piper nigrum* powder exhibited the highest mean mortality (16.37%), followed by *Ellectaria cardamom* (16.05%) and lastly *Zingiber officinale* (13.82%). Result of the overall effect of post-application duration on weevil mortality in wheat kernel showed that the highest mean death of weevils (19.42%), was observed after 5 days of treatment with plant powders, followed by 4days(18.28%), 3 days (16.72%), 2 days (14.51%) and lastly 1 day (8.08%), while effect of different concentration ofplant powders on weevil mortality in wheat kernel revealed that the highest mean total of weevil mortality (17.78%) was produced by the application of 0.27g of plant powders while the lowest mean was observed at 0.37g(12.91%).

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