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ORIGINAL RESEARCH ARTICLE

Insecticidal Potentials of *Capsicum chinense* (Jacq) and *Garcinia kola* (Heckel) Extracts on *Callosobruchus maculatus* (Cowpea Weevil) Infestation.

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ABSTRACT

The use of synthetic organic pesticides has resulted in significant environmental pollution that threatens human health and kills unintended organisms, leading to their eventual restriction and a demand for better alternatives. In this study, the insecticidal potentials of ethanolic extracts of *Capsicum chinense* and *Garcinia kola* against *Callosobruchus maculatus* infestation on cowpea were assessed. From the results, it can be concluded that exposure time and extract concentration increased mortality. The data obtained demonstrated a significant change ($p<0.05$) in 2 g at 24 hours and 48 hours following exposure. The concentration and time-dependent mortality of *C. maculatus* in *C. chinense* extract increased. Mortality was observed 100 % at 4 hours in 2-8 g of the extract when compared to the control. Values ranged from 3.600.55 to 10.000.00 for the effect of the *C. chinense* extract at 2 g, and there was no discernible difference ($p>0.05$). The results were considerably different ($p<0.05$) at 4 g and 6 g compared to the control. The toxicity rate of the plant extracts on the test organism was also seen to increase from day 1 to day 3. The insects moved jerkily and quickly and tended to try to get out of the Petri dishes. The plants' strong insecticidal and repellent properties suggest that they are useful for managing and controlling the cowpea weevil and can be used as an alternative to commercially available harmful insecticides.

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INTRODUCTION

It is clear that agriculture is essential to human survival because over ninety percent of the population of the globe consumes and utilizes one or more kinds of produce from agriculture or goods on a daily basis. The state of any country's farm sector has a direct impact on that country's development (Ashamo and Ogungbite, 2014). Increasing the gross domestic product through the agricultural sector and providing enough sustenance for the planet's increasing population are now the two main objectives of agriculture globally (Ileke and Dare, 2018).

According to Ashamo *et al.* (2021a), the damage caused by pests and diseases is one of the major restraints on food production in impoverished countries. In countries where there are no contemporary storage sites, a loss of roughly 40 % is reported (Ofuya, 2001). When accessible, insecticides are the principal method used to control these pests. Weevils in particular pose a known threat to humans and have historically presented difficulties in produces storage (Patrick *et al.*, 2019; Oyedeji *et al.*, 2020). These synthetic herbicides have adverse effects that result from their uncontrolled use, eradication of natural foes, disruption of the natural ecosystem, and environmental pollution. These undesirable environmental health risks call for the creation of an innovative strategy for controlling insect pests that will be inexpensive and efficient in keeping pest numbers below economic limits while also safeguarding the environment (Ashamo *et al.*, 2022).

Presently, applying synthetic insecticides is the primary strategy used to control beetle populations in dried cowpea seeds (Onekutu *et al.*, 2015). Ileke *et al.* (2012) also highlighted other problems with the use of traditional synthetic pesticides, including high animal toxic exposure, enormous ecological tenacity, lack of expertise, high costs, insects' resurgence, resistance to genes by the insect pest, and negative effects on organisms that are not targets. The use of naturally occurring plant insecticidal substances in place of synthetic pesticides is one strategy to address the drawbacks of synthetic insecticides (Ileke *et al.*, 2012; Khater, 2012).

Cowpea (*Vigna unguiculata* (L.) Walp.) is a major pulse that is primarily grown across Nigeria, as well as infested by the weevil (*Callosobruchus maculatus*). Preservation and

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mass production of cowpeas has been severely impacted by the cowpea pest (Ileke *et al.*, 2020a; Obembe *et al.*, 2020). Cowpea is grown and eaten by subsistence farmers in arid or semi and sub-humid regions throughout Africa, and it is an essential source of livelihood for disadvantaged resource farmers (Ileke, *et al.,* 2012). Within three to five months of storage, cowpea seed quality and quantity have reportedly suffered significantly due to cowpea pest infestations (Ileke *et al.*, 2012). Furthermore, Ashamo (2007) posited that post-harvest losses brought on by insect pest infestation pose the biggest problem for Nigerian farmers. This is so that the farmer can preserve the cowpea seeds for the following farming season. Hence, this study investigates the possibility of controlling the cowpea weevil using extracts of *C. chinense* and *G. kola*.

MATERIALS AND METHODS

Collection of plant materials and preparation of extracts

Garcinia kola and *C. chinense* seeds were collected from spice vendors at Tombia market, Yenagoa, Bayelsa State, Nigeria. The plant samples were air-dried for 15 days, and each of them were ground into powder using an electric blender. Samples were weighed (2 g, 4 g, 6 g, and 8 g) into beakers containing 100 ml of ethanol. After 72 hours, the solvent layer was filtered with Whatman filter paper No 1. The extract was kept at 4 °C until it was needed again after the filtrate had been condensed using a rotary evaporator at 35 °C.

Rearing of *Callosobruchus maculatus*

Adult *C. maculatus* was obtained from the department's stock culture at Niger Delta University, Wilberforce Island, Amassoma, Bayelsa State, Nigeria. In 1.5-liter glass vessels kept at room temperature, the insects were raised on cowpea that was seeds. The experiment was then conducted using newly emerged bruchid adults that were 1–2 days old.

Test for toxicity

The method of Tavares *et al.* (2021) was employed to evaluate the extracts' toxicity on the cowpea weevil. The experiment was set up in a complete randomized design (CRD) with four replications. Cowpea test samples that had been sterilized were individually treated with plant extracts prior to being air-dried for 30 minutes. Ten recently emerged weevils were placed in each petri dish, which was then covered with muslin fabrics to keep the weevils from escaping the experimental setting. The mortality was counted and recorded one at 24, 48, and 72 hours after contact. Percentage mortality was calculated using the formula below;

Percentage mortality =

$$\frac{Number\ of\ dead\ C.macultaus}{Total\ number\ of\ C.maculatus\ adults} \times 100$$

Statistical analysis

Data obtained were subjected to analysis of variance (ANOVA). The treatment means were separated using using New Duncan's Multiple Range Test. The Analysis of Variance was done using the Statistical Package for the Social Sciences (SPSS) version 20.

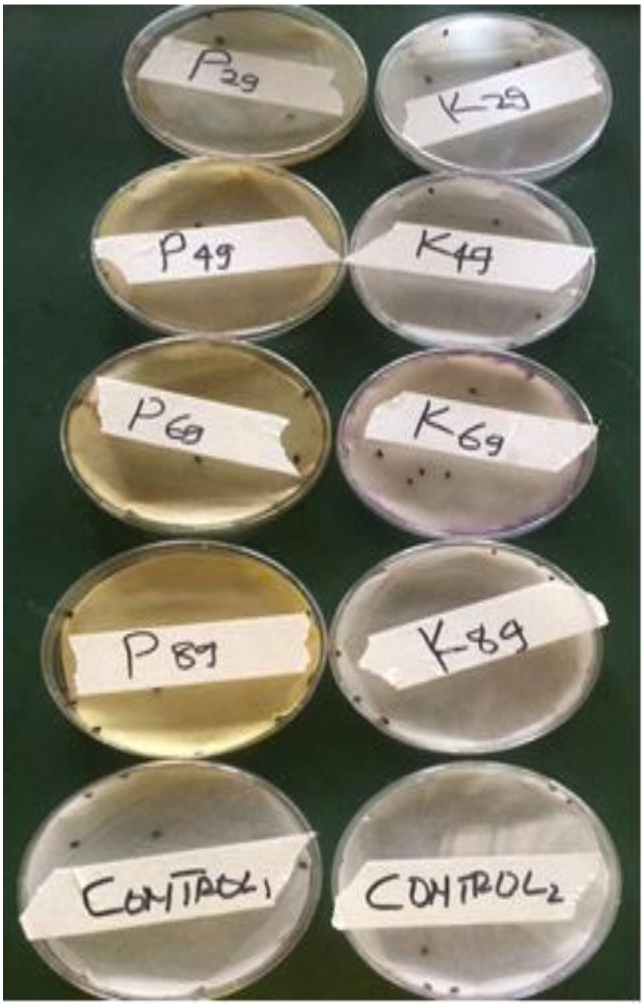

Plate 1: Petri dishes containing weevils and plant extracts

RESULTS

Effect of *G. kola* seed extract on *C. maculatus* mortality

Table1 shows the result of the effect of ethanolic seed extracts of G. *kola* on the cowpea weevil. The results obtained indicated varying degrees of mortality on the test organism. From the results, mortality increased with an increase in the concentration of the extracts and time of exposure. Within 72 hours of applications of the extracts, there was 100 % mortality. At 24 hours and 48 hours after exposure, the results obtained showed a significant difference ($p< 0.05$) in 2 g. The values ranged from 2.20±0.45 - 6.20±0.45 respectively (Table 1). Statistical comparison of the means of the effect of the ethanolic seeds extract of *G. kola* at 4 g showed that there was a significant different ($p<0.05$) within the time of exposure.

The values ranged from 3.80±0.45 - 10.00±0.00 respectively. Within 24 and 48 hours of application, the extracts at 6 g had no significant effect on the weevil (Table 1). At 8 g of the extract within 24 hours to 72 hours, the effect of the extract on the test organisms was significantly difference ($p < 0.05$). The values ranged from 7.80±0.84 - 10.00±0.00 respectively when compared to the untreated. The result also showed 0 % mortality on the control within 24-48 hours; however, at 72 hours, there was 20 % mortality (Table 1).

Table 1: Effect of G. kola seed extract on the mortality of C. maculatus

TIME	2 g	4 g	6 g	8 g	Control	Mean
24	2.20±0.45^{a}	3.80±0.45^{a}	7.40±0.55^{a}	7.80±0.84^{a}	0.00±0.00^{a}	4.240^{a}
48	6.20±0.45^{b}	7.600±0.55^{b}	7.80±0.88^{a}	9.40±0.55^{b}	0.00±0.00^{a}	6.200^{b}
72	10.00±0.00^{b}	10.00±0.00^{c}	10.00±0.00^{b}	10.00±0.00^{c}	2.00±0.00^{b}	8.400^{c}
Total	**6.13^{b}**	**7.133^{e}**	**8.400^{c}**	**9.067^{d}**	**0.667^{a}**	**6.280**

Means in the same column having the same superscripts are not significantly different ($p>0.05$).

Effect of *C. chinense* seed extract on *C. muculatus*

Mortality of *C. maculatus* in *C. chinense* extract increased as the concentration and time increased (Table 2). At 2– 8 g of the extract, 100 % mortality was observed at 72 hours when compared with the control. The effect of the extract of *C. chinense* at 2 g were not significantly different ($p>0.05$), the values ranged from 3.60±0.55 - 10.00±0.00. At 4 g and 6 g, the effect of the extracts on the weevil was significantly different ($p<0.05$) when compared to the control. Mean value of 9.20±0.45 - 10.00±0.00 was recorded at 8 g of the extract when compared to the control, 10 % mortality was observed in the control. However, the result was not significantly different.

Table 2: Effect of *C. chinense* seed extract on the mortality of *C. maculatus*

TIME	2 g	4 g	6 g	8 g	Control	Mean
24	3.60±0.55^{a}	5.20±0.45^{a}	7.20±0.45^{a}	9.20±0.45^{a}	0.00±0.00a	5.040^{a}
48	5.40±0.55^{c}	7.40±0.55^{b}	8.60±0.55^{b}	10.00±0.00^{b}	0.00±0.00^{a}	6.280^{b}
72	10.00±0.00^{c}	10.00±0.00^{c}	10.00±0.00^{c}	10.00±0.00^{b}	1.00±0.00^{b}	8.200^{c}
Total	**6.333^{b}**	**7.533^{c}**	**8.600^{d}**	**9.733^{e}**	**0.333^{a}**	**6.507**

Means in the same column having the same superscripts are not significantly different ($p>0.05$).

DISCUSSION

This study evaluated the pesticide potency of ethanolic extracts of *G. kola* and *C. chinense* against *C. maculata.* According to the research's finding, *G. kola* and *C. chinense* seed extracts appeared to have positive effects on *C. maculatus*. On the control experiment, there was 1 % mortality seen within 72 hours of exposure. The toxicity rate increased from day 1 to day 3 according to analysis of the data and the test organism's response to the seed extracts.

The bug moved jerkily and quickly, and had a propensity to break out from the Petri plates.

This finding may have been made because of the presence of bioactive compounds that disrupted the test organism's regular respiration patterns, causing asphyxiation and mortality. The results of this investigation are consistent with previous studies. (Onunkun, 2013).

Researches have thoroughly proved the effectiveness of *G. kola* preparations in traditional African medicine, particularly when used to create treatments for laryngitis, cough, liver illnesses, and other related diseases (Farombi and Owoeye, 2011). The plant demonstrates extremely powerful pharmacological actions, including anti-inflammatory, antiviral, antifungal, and antioxidant effects (Adegboye *et al.,* 2008). Its effects on bacteria and fungi have also been documented. Despite the absence of caffeine, the alkaloid and bi-flavonoid portions of bitter kola are thought to relax smooth muscles.

The extract from *G. kola* contains a plentiful supply of phenolic acids, which prevent fungus from developing toxins, making it an excellent biological fungicide (Joseph *et al*., 2005).

It should be mentioned, nonetheless, that scientific studies on the insecticidal properties *of G. kola* are comparatively few. However, this investigation has confirmed that these extracts are efficient against bean weevils. The test organism demonstrated various degrees of death when exposed to the plant extracts. The death rate noted in this study is, however, concentration- and time-dependent. The insecticidal properties of *G. kola* seeds against *C. maculatus* found in the current study point to the presence of poisonous phytochemicals (secondary metabolites) in the plant, including saponins, alkaloids, phenolics, flavonoids, and tannin (Omokhua *et al.,* 2016).

CONCLUSSION

This investigation showed that the *C. maculatus* is considerably harmful to *C. chinense* and *G. kola* seed extracts at the various exposure times studied. Although proper processing is still required to confirm its suitability as a replacement, the plants' high repellent and insecticidal activities suggest their efficiency in the management and control of the cowpea beetle and can be used as a substitute for commercial insecticides. Food security in Nigeria and the tropics may be supported by the use of these extracts to stored or grown cowpea.

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