



Insecticidal Effect Of *Adansonia digitata* Stem Bark And Leaf Powders On *Dinoderus porcellus*

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ABSTRACT: This study evaluated insecticidal activity of different doses of *Adansonia digitata* stem bark and leaf powders on yam beetles *dinoderus porcellus*. Obtained plant parts from Federal college of Forestry, Jos were pulverized into powders. Phytochemical constituents of the plant were extracted by Soxhlet extraction and identified using standard procedure. Mortality testing was done by exposing *dinoderus porcellus* to yam chips mixed with various doses of *Adansonia digitata* stem bark and leaf powders. Yam chips without treatment served as the control. The experiments were laid out in randomized complete design with three replications. Data obtained were analysed using analysis of variance ($P \leq 0.05$). The result of the phytochemical examination of ethanolic extract of *A. digitata* revealed the presence of saponins, phenols, tannins and alkaloids flavonoids. The finding revealed the superiority of yam chips mixed stem bark and leaf powders over the untreated. The effect of plant extracts on percentage mortality showed significant difference ($p < 0.05$) among the treated and control. The sample treated with 15g of *A. digitata* stem-bark powder gave the highest mortality. The research hence recommends the use of 15 g of *A. digitata* stem-bark powder in elimination of *Dinoderus porcellus* infecting yam chips.

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Yam cultivated in Nigeria belong to genus *Dioscorea* and species farmed in Nigeria include the *D. rotundata* (white yam), *D. cayenensis*, (yellow or guinea yam) and *D. alata* (water yam) (Amusa *et al.*, 2003). The organoleptic qualities of yam makes it the most consumed staple food and provide estimated 350 dietary calories per person daily. Globally, over 30 million tonne per annum of yam is cultivated, out of which Nigeria alone account for 22 million tonne (FAO, 1998). In spite of this huge cultivation in Nigeria, demand exceed supply always. To mitigate this, yam tubers are processed into chips to reduce post-harvest losses and to provide raw materials for industries in agro businesses. However, the yam chips are heavily infested by insect pests leading to great losses. The insect *D. porcellus* is a major pest of stored farm produce of many roots and tubers such as yam in West Africa (Loko *et al.*, 2019). *D. porcellus* destroys yam chips by making holes, thereby transforming the internal parts of the yam into powder, which adversely affects their quality and market value. The effect of *D. porcellus* on newly dried yams under laboratory investigation led to weight loss of 29.5% in 4-5 months (Adesuyi, 1979). Furthermore, infestation of

stored yam chips by *D. porcellus* makes yam floors like amala undesirable for consumer (Babarinde *et al.*, 2013). Synthetic pesticide application is the most common means of control employed by farmers against *D. porcellus* associated with stored yam chips (Vernier *et al.*, 2005). Interestingly, several of these pesticide are not produced specifically to protect yam chips in storage and food poisoning cases has grown immensely due to their misused (Adeleke, 2009). Faced with this challenge, search for novel botanical with insecticidal potential is urgently needed to save the environment and human health. A typical important plant is *Adansonia digitata* also called African Baobab, *Adansonia digitata* occurs naturally in Africa and therapeutically, its pulverized powders are used to treat all forms of diseases in Africa (Zagga *et al.*, 2018). Therefore, the aim of this work is to investigate the insecticidal activities of *Adansonia digitata* leaf and stem bark powders against *D. porcellus*.

MATERIALS AND METHODS

Sample Collection and Preparation of *Adansonia digitata* Plant Parts: The leaves and stem bark of *Adansonia digitata* were collected in Federal College

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of Forestry Jos, Plateau state Nigeria. The plant parts of *Adansonia digitata* were collected in clean polythene bag and were taken to the Herbarium of Federal College of Forestry Jos for identification and authentication. After identification, the collected materials were washed and dried under shade to avoid active compounds degradation by sunlight. Fine powder of plant materials were obtained after drying by grinding using mortar and pestle and followed by sieving, (Loko et al., 2017).

Extracts Preparation: Soxhlet extraction with ethanol was done using fifty gram of dried and pulverized leaf and stem bark *Adansonia digitata* samples. Distillation was carried out and plant extracts collected through rotary evaporation and kept at 4°C in a refrigerator.

Phytochemical Screening of *Adansonia digitata* Leaf and Stem Bark Extract: The *Adansonia digitata* leaf and stem Bark extracts were examined for the presence phytochemicals using standardized procedures described by Harborne (1984).

Processing Of Yam Chips: This was carried out using the method of Babajide *et al.* (2006). The yam tubers were washed with water to remove sand and other unwanted elements, and then peeled using sterile knife. The tubers were cut into slices of 2cm x 4cm. The yam slices obtained were pre-cooked in water at a temperature of 50°C for 2 hours. They were also allowed to be macerated in the pre-cooking water for 24 hours in order to soften them. The slices were strained and dried in the oven at 60°C for 3 days in order to have 12 to 14% of final moisture content. The chips samples were sterilized at 105°C for 2 hours in order to kill the hidden insects and their eggs. The samples were exposed to an ambient temperature for 1hour. The dried chips obtained were put in a dry and clean polythene bags and stored in the laboratory at ambient temperature.

Collection and Breeding of *Dinoderus porcellus*: The procedure described by Onzo et al. (2015) was adopted. Infested yam chips were purchase from Yandoya market in Jos North L.G.A. and identified at the Entology Laboration Federal College of Forestry Jos, Plateau state Nigeria under microscope with the aid of insect atlas. The collected insect adultes and eggs were transferred into a plastic bowl and maintained on healthy yam at room temperature to enhance their development. The plastic container was covered with a muslin cloth, allowing an adequate aeration and preventing insects from running out and kept on a stable table in the laboratory. Newly emerged adult beetles were used for the experiments.

Mortality Test: Mortality test was conducted according to the methodology used by Chebet et al. (2013). Leaf and stem bark powders of *Adansonia digitata* (5g, 10g and 15g) were mixed with 100g of disinfected yam chips in plastic containers while the control had 100g of untreated sterile yam chips. The treated and untreated yam chips in the plastic containers were inoculated with twenty adults of *Dinoderus porcellus*. Each box was covered with a transparent muslin cloth to prevent the insects from escaping. Treatments were set up in a completely randomized design with three replicates. The set up was observed after 24, 48, 72, 96 and 120 hours of infestation and dead adults counted. The adult mortality rate was calculated according to the formula of Asawalam et al. (2006).

$$\% \text{ Motality} = \frac{\text{ND dead}}{\text{ND introduced}} \times 100$$

Where ND dead is number of *D. porcellus* dea, ND introduced is number of *D. porcellus* introduced

Data Analysis: Data collected was analyzed using analysis of variance (ANOVA) to check for significant difference between the different treatments at 5% significant difference. The means was separated using Duncan test.

RESULTS AND DISCUSSION

The result of the phyto-chemical examination of ethanolic extract of *A. digitata* plant leaf and stem bark in Table 1 revealed the presence of saponins, phenols, tannins and alkaloids flavonoids. This finding concord with work of Musau et al. (2016) who showed the presence of Steroids, saponins, glycosides, alkaloids and flavonoid in *A. digitata* seed leaf. Similar results were reported by Shukla et al. (2001), the indicated the presence of flavonoids, terpenoids, sterols in different parts of *A. digitata* including the seed oil.

Table 1:Phytochemical Constituents of Ethanolic Extract of *Adansonai Digitata*

S/N	Phytochemical	Presence
1	Saponin	+
2.	Flavonoid	+
3.	Phenol	+
4.	Alkaloid	+
5.	Gelatin	-
6.	Tannin	+
7	Glycoside	+
8.	Terpenoids	-

The results on percentage mortality as presented in Table 2 showed that the insecticidal effect from *A. digitata* leaf powder were significantly ($p < 0.05$) different at days 1 to 5. Results of the study thus

revealed that mean values recorded for each treatment increased as the days increased from day one to five. The highest mean value for day one, two, four and five was obtained from 15g, this was followed by 10g > 5g > 0g (control). Subsequently, a change in mortality rate was later obtained from day 3 and the order of increase were 10g > 15g > 5g > 0g (control). This revealed that the phytochemicals shown in *adansonia digitata* plants

powder has insecticidal activities against adult *D. porcellus*. Kumar et al. (2015) reported similar phytochemicals in celery seed oil exhibiting larvicidal action against *Aedes aegypti* L. The current finding is in agreement with work of Loko et al. (2017) which reported leaves of *Blighia sapida*, *Khaya senegalensis* and *Bridelia ferruginea* were active against *D. porcellus*.

Table 2: Percent insecticidal effects of *A. digitata* leaf powder on percentage mortality of *D. porcellus* at different day's interval

Treatment	MORTALITY AND TIME				
	Day 1	Day 2	Day 3	Day 4	Day 5
5g	6.67 ^b	18.33 ^b	26.67 ^b	50.00 ^b	85.00 ^c
10g	13.33 ^a	21.67 ^{ab}	36.67 ^a	78.33 ^a	91.67 ^b
15g	15.00 ^a	26.67 ^a	35.00 ^a	80.00 ^a	100.00 ^a
Control (0g)	0.00 ^c	0.00 ^c	1.33 ^c	1.33 ^c	1.67 ^d
SE	1.86	2.04	2.77	3.91	1.68

Means on the same column with the same superscript do not differ significantly from each other ($P = 0.05$). Where: SE = Standard error

Table 3: Percent insecticidal effects of *A. digitata* stem bark powder on percentage mortality of *D. porcellus* at different day's interval

Treatment	MORTALITY AND TIME				
	Day 1	Day 2	Day 3	Day 4	Day 5
5g	33.33 ^b	46.67 ^b	70.00 ^b	91.67 ^b	98.33 ^a
10g	40.00 ^b	58.33 ^a	93.33 ^a	100.00 ^a	100.00 ^a
15g	53.33 ^a	65.00 ^a	98.33 ^a	100.00 ^a	100.00 ^a
Control (0g)	0.00 ^c	0.00 ^c	2.00 ^c	2.33 ^c	2.00 ^b
SE	2.76	3.44	3.13	0.94	0.88

Means on the same column with the same superscript do not differ significantly from each other ($P = 0.05$). Where: SE = Standard error

Table 4: Mean synergetic effects of *A. digitata* leaves and stem bark powder on percentage mortality of *D. porcellus* at different day's interval

Treatment	MORTALITY AND TIME				
	Day 1	Day 2	Day 3	Day 4	Day 5
5g	15.00 ^b	38.33 ^b	65.00 ^b	90.00 ^a	93.33 ^a
10g	28.33 ^a	56.67 ^a	81.67 ^a	93.33 ^a	95.00 ^a
15g	33.33 ^a	58.33 ^a	86.67 ^a	93.33 ^a	100.00 ^a
Control (0g)	0.00 ^c	0.67 ^c	1.33 ^c	2.33 ^b	2.33 ^b
SE	3.44	4.34	4.00	2.80	2.25

Means on the same column with the same superscript do not differ significantly from each other ($P = 0.05$). Where: SE = Standard error

Table 5: Mean insecticidal effects of *A. digitata* leaves powder; stem-bark powder and leaves powder + stem-bark powder on percentage mortality of *D. porcellus* at different day's interval

Treatment	MORTALITY AND TIME				
	Day 1	Day 2	Day 3	Day 4	Day 5
Leaf powder	8.75 ^b	16.67 ^b	24.92 ^b	52.42 ^a	69.58 ^a
Stem-bark powder	31.67 ^a	42.50 ^a	65.92 ^b	73.50 ^a	75.08 ^a
Leaf powder + Stem-bark powder	19.17 ^{ab}	38.50 ^a	58.67 ^b	69.75 ^a	72.67 ^a
SE	4.39	6.41	9.38	11.38	12.33

Means on the same column with the same superscript do not differ significantly from each other ($P = 0.05$). Where: SE = Standard error

The effect of *A. digitata* stem-bark powder on percentage mortality of *D. porcellus* were significantly ($p < 0.05$) different from day one to five (Table 3). Results of the study revealed that total mean values recorded for each treatment increased as the days increased from day one to five. The sample treated with 15g of *A. digitata* stem-bark powder gave the highest value from day one to five and the order of increase were 15g > 10g > 5g > 0g (control). The stem bark powder showed its effect on the studied insect in different ways. According to Loko et al. (2017), this could be attributed to the physiological features of the insect species as well as the kind of the botanical. The

synergetic effect of *A. digitata* leaves and stem-bark powder on percentage mortality of *D. porcellus* were significantly ($p < 0.05$) different from day one to five (Table 4). Results of the study revealed that total mean values recorded for each treatment also increase as the days increased from day one to five. The sample treated with 15g of the combination of *A. digitata* leaves and stem-bark powder gave the highest total value and the order of performance from day one to five were 15g > 10g > 5g > 0g (control). Combining the various plant parts did not enhance insect mortality and the effect is dose dependent. This is similar with the study of Oladejo et al. (2020) who

indicated insecticidal effects of stem bark and leaf powders combination in controlling *S. zeamais* were not very effective. The effect of plant extracts on percentage mortality shows significant difference ($p < 0.05$) on the 1st, 2nd and 3rd day but non-significantly different at the 4th and 5th day. The result showed that mortality of *D. porcellus* caused by the various doses of stem-bark, leaf and stem-bark + leaf powders used was higher when compared with those observed in the negative control. From the results on Table 5, stem-bark powder show highest effect on mortality of *D. porcellus* and the order of increase were stem-bark powder > Leaf powder + Stem-bark powder > leaf powder. The biocidal activity of *A. digitata* is majorly as a result of flavonoids, alkaloids, tannins and saponins (Ubulom *et al.*, 2012) and this might have led to insect mortality in this study. Flavonoids exhibit antifeedant effect against insects and herbivores that attack plants (Acheuk and Doumandji-Mitiche, 2013). According to Padin *et al.* (2013) botanicals like *A. digitata* contain phytochemicals which are toxic and lead to death of insect pests found in storage. Alkaloids content of *Arachis hypogaea* extract exhibited larvicidal activity against malarial vectors (Velu *et al.*, 2015). Death of insects arises due to insect spiracles blockage by dust particles of pulverized powder of botanical (Fernando and Karunaratne, 2012). In another report, botanicals also gain entrance into insect body through the respiratory system and cause death (Kedia *et al.*, 2015).

Conclusion: This study revealed the insecticidal potentials of powder of leaf and stem bark of *Adansonia digitata* against *D. porcellus*. Significant difference ($p < 0.05$) was observed on the mortality between the treated yam chips and the controls. Thus, powder of *Adansonia digitata* leaf and stem bark can serve as alternative means of preventing and controlling yam chips infestation caused by *D. porcellus*. Further research is required to ascertain the efficacy of seed, fruit and root bark of *Adansonia digitata* on *D. porcellus*.

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