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Effects of short term laboratory infestation of dried cassava variety TME–7 by *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae)

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Abstract

Researches have shown that dried cassava varieties are relatively susceptible to *Prostephanus truncatus* (Horn) infestation. Laboratory studies were conducted to determine weight loss and nutritional status of dried cassava chips (TME-7) and *P. truncatus* emergence rate over an infestation period of 8 weeks. TME-7 mean weight loss (±SD) rose to 11.30% ± 4.01 (22.67%) with *P. truncatus* mean emergence rate (± SD) of 18.50 ± 8.25; 16.33 ± 6.85 and 9.93 ± 3.30 for larvae, pupae and adults respectively. Nutrition proximate analysis conducted on infested TME-7 revealed the dried cassava nutritional status as follows: protein content was 1.30%; fat content recorded was 0.99%, while moisture content was put at 5.50%. Other parameters analyzed were ash content which was 1.81%, and lastly, crude fiber and carbohydrate was 29.03%. The dried cassava variety supports *P. truncatus* breeding, with appreciable damage to the crop. Breeding and damage have been implicated in the reduction of nutritional and market values of the dried cassava.

Key words: *Prostephanus truncatus* (Horn), Cassava, Weight loss, Emergence and Nutritional contents.

Introduction

Africans depend more on roots and tubers as food. Nigeria the most populous black nation in the world needs to meet her citizen food requirement. Therefore, in the 1960s – 70s, the nation economy was agriculturally driven. In the 80s, agriculture was relegated to the background due to oil exploration activities and since then the mono product economy has been sustained on oil. However, past Nigerian government attempted to revolutionize agriculture without positive result.

Currently, the government of the day (1999 – 2007) in its reform programme resolved to make the economy multi products driven to include agriculture. Consequently, under the agricultural reform programme, cassava was chosen as one of the crop to be propagated. The impact of this programme earns the nation the largest producer of cassava in the world; a third more than production in Brazil and almost double the production of Indonesia and Thailand. Furthermore, cassava production in other African countries, the Democratic Republic of Congo, Ghana, Madagascar, Mozambique Tanzania and Uganda appear small in comparison to Nigeria with sustained output which has been estimated in 2002 to approximately 34 million tones (1).

Cassava is believed to have originated from Brazil and was first introduced to West Africa by the Portuguese explorers in the 16th century (2). A confirmed report stated that the crop spread from trading post along the Western and Central Africa (3).

Cassava, *Manihot esculenta* (Crantz) is one of the most important root crop in the tropics. It is the major source of carbohydrate for Nigerians. Besides being used for food it is a major industrial raw material for production of starch, alcohol, pharmaceutics gums, confectionaries and livestock feeds. It has been reported that cassava is generally free from arthropod pests, however, presently; cassava products have been faced with pests' infestation right on the field and after harvest in the store. Among these pests are mites and insects

Prostephanus truncatus (Horn) a stored pest of cassava originated from Central America, Tropical South America and the extreme south of the U.S.A as a localized pest of farm stored maize. In the late 1970s it was introduced to East and West Africa and became serious pest of stored maize and dried cassava. They are equally present in parts of Asia, Europe and North America. *P. truncatus* (Horn) belong to the Bostrichidae family, order

Coleoptera superficially, they resemble both Dinoderus and Rhyzopertha. It has a short and cylindrical body with the bottom part in square form hence the name *truncates* (trunks). Life cycle takes about 26 days under optimum conditions of temperature (30°C) and air humidity (75%) (4)

Insects infestations are the major causes of losses during cassava storage. Impact of feeding activity of *Prostephanus truncatus* have resulted to weight loss in the stored products. Some assessment studies and estimations on dried cassava chips have been conducted in different parts of the world. The most recent are researches which estimated a 15-20% loss of dried chips stored for eight months (5). Wright *et al*. (6) assessed post-harvest losses of chips up to 30% when *P. truncatus* attacked the dried chips. A weight loss of 65% after 3 months of storage of cassava chips have been reported (7).

Calculation of storage losses have been faced with controversy. However, these losses may be based on terms of quality and quantity. It is difficult to incorporate different types of losses such as nutritive deterioration or reduced processing quality into a single index of food loss. Consequently, this research work was centered on weight loss or damage, nutritional status of infested dried cassava chips and emergence of *P. truncatus* with period of 8 weeks of infestation in storage.

Materials and Methods

A total of 150 *Prostephanus truncatus* (Horn) were collected from a culture stock raised in the laboratory. Cassava variety TME-7 commonly called "Okoiyawo" an IITA breed was processed by peeling and soaked to reduce the cyanide content in clean water which was changed every 24 hours for a period of 72 hours in the laboratory. After soaking the cassava were removed from water and sun dried for 12 hours after which the partially dried cassava chips were transferred to the laboratory in the oven at a temperature of 60°C until they were completely dried and sterilized. Subsequently, the dried cassava chips were stored away until needed in the laboratory.

A total of 20 sterilized jars of 200ml size were used. In each jar, 50g of dried cassava chip was introduced and in 15 jars, 10 *P. truncatus* were added while the set up was covered with muslin cloth and fastened with rubber band to prevent the insect pest escape and to screen the set up from any pest around. The remaining 5 jars with cassava were not infested and were used as control. The set-up were stored in a wooden cage box of 3ft × 1ft size and left in the laboratory for a period of 8 weeks with the cage stands soaked in tin containers oil to further screen the set-up from contamination.

At 8 weeks of infestation with *P. truncatus*, the number of adults and instars that emerged were counted under the binocular microscope and recorded. The mean values were used to determine losses of dry weight, damage attributable to insect attack were estimated for the dried cassava chip after infestation with adult *P. truncatus*. This was done by sieving the frass generated by the insect pest from the fragment, using 120 unit mesh size, London standard. The weight of the frass was used as the weight loss/damage by *P. truncatus*. Mean weight loss and percentage weight were calculated to express the loss. Nutritional analysis of the infested and uninfested dried chips (frass) was conducted in the analytical laboratory of International Institute of Tropical Agriculture (IITA). Proximate analyses were done on carbohydrate, protein, ash, moisture content and fat.

Plant nitrogen analysis combined already known methods (8, 9, 10) to determine the ammonia and phosphate contents in estimating protein status of the dried cassava chips. Protein was calculated using the formula;

$\%$ Total $N_2 \times 6.25$ (6.25 is the conversion factors from total N_2 to protein).

Fat content was analyzed using the Soxhlet method. Subsequently, the percentage oil content was calculated as follows:

$$\% \text{ oils} = \frac{W_3 - W_2}{W_1}$$

Where W_1 = weight of samples (chips)
W_2 = weight of cup and chips
W_3 = weight of cup and extracted oil

Ash content was analyzed by preheating the cassava dried chips; this was transferred into

Muffle furnace at 600°C for 30 minutes and covered. Percentage ash content was finally calculated by using the formula;

$$\text{Ash}\,\% = \frac{\text{Weight of Ash} \times 100}{\text{Weight of sample}}$$

Crude fiber and carbohydrate was estimated by calculation as follows:

100 – (Fat + protein + ash + moisture content + water content)

Statistical analysis used includes mean and standard deviation of breeding values and weight loss, while the analyzed nutritional contents were done in percentage.

Results

Table 1: Values of *Prostephanus truncatus* emergence and weight loss/damage of cassava dried chips (TME-7), using an initial parent density of 10 for infestation for a period of 8 weeks in the laboratory

	P. truncatus emergence			*P. truncatus* emergence range			Cassava chips	Cassava
	Larval	Pupal	Adult	Larval	Pupal	Adult	Mean wt (g) loss	chips % wt loss
Infested dried cassava chips (TME-7)	9.93±7.34	16.33±6.75	18.53±8.12	2 – 34	7 – 35	5.35	11.33±4.01	22.66
Control set-up uninfested TME-7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

The number of adult insects used for infestation was increased. However, some were still at the developmental stage of larval and pupal at the end of 8 weeks of infestation. The control set-up had a sharp contrast in outcome where zero emergence was recorded.

The nutritional content analysis conducted on the dried cassava chips shows the effect of the infestation activity of *P. truncatus* on infested chips. The percentage protein, fat, moisture content and ash values for infested dried cassava chip were more than that of the uninfested (control). Only the carbohydrate and crude fiber estimated from the results was less in infested compared to the uninfested dried cassava chips (Table 2).

Table 2. Percentage values of nutritional contents of *P. truncatus* infested and uninfested dried cassava chip after storage period of 8 weeks in the laboratory

Treatment	Protein (%)	Fat (%)	Moisture content (%)	Ash (%)	Carbohydrate and crude fiber (%)
Infested cassava chips (TME-7)	1.30	0.99	5.50	1.18	91.03
Uninfested cassava dried chip (TME-7)	1.08	0.48	4.12	1.05	93.27

Discussion

This investigation reveals that TME-7 is susceptible to *P. truncatus* infestation and breeding. After 8 weeks of infestation, all the developmental stages were found in the experimental set-up which was a reverse in the control set-up. Although fecundity study was beyond the scope of this research .However this was assumed to have occurred, consequently, the emergences of the developmental stages that were encountered. Edible root and tubers may constitute the natural breeding site for *P. truncates* (11). Boring and feeding activities are responsible for the production of frass and frass generated determines the numbers of eggs laid. Emergence rate is a function of eggs laid (12) since eggs were recorded laid and hatched through instars to adults, it confirmed that the TME-7 supports breeding thereby making emergence possible. Emergence depends on length of storage and some other factors. The highest adult emergence was recorded in the 8th week of the experiment. These findings agree to what had been reported earlier (13, 14).

Direct feeding by *P. truncatus* on dried cassava chip (TME-7) have been implicated as the cause of weight loss in stored produce. Both larvae and adults stages of *P. truncatus* were responsible for the weight loss. These were possible due to the possession of powerful mandible which made boring easy thereby causing great damages (15).Weight loss increase with adult emergence; this is due to length of infestation along with food availability and qualities. Boring is necessary for offspring emergence (12). Considering the conducive nature of the storage, the emerged adults and the parent adult engaged themselves in continuous boring activity to provide nest for their offspring thereby causing weight loss in the TME-7.

As earlier reported (6), the nutritional quality of dried cassava chips is less likely to decrease; instead some nutritional variables might by enhance due to pest infestation. This research work results conform to the submission since the percentage protein, ash and moisture content for the infested dried cassava chips when compared with the uninfested were more. The percentage increase recorded for protein may be as a result of cast, skins and dead insects' debris which remains in the chips during the proximate analysis. Insect activities also create a moist microclimate within the infested chips; this may be responsible for increase in moisture content level. Waste generated by pest may cause increase in the ash and fat contents as observed in the infested dried cassava chip. It has been known that insects in stored chips generated uric acid inoculate fungi and bacteria, leave faecal matter and cast-off skins thereby increasing fat and ash content and also creating a foul odour (16). Crude fiber and carbohydrate level were observed to have decreased. It may be due to infestation where some of the cassava has been degraded to frass. It was found out that P. *truncatus* in Togo reduced fiber and carbohydrate level by about 4% (6). Similar finding had earlier on been reported.

It may be concluded that cassava dried chips variety TME-7 is a susceptible variety to *P. truncatus* infestation. Short term storage may cause a measurable physical damage and allowed for exponential breeding rate of the pest. This physical damage on the dried cassava chips may result in a drop in demand for the product in market and consequently bring about a high economic loss. Therefore, possible environmentally friendly control measures should be considered for reduction of the pest population.

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