Annals of West University of Timişoara, ser. Biology, 2020, vol. 23 (1), pp.47-54

SUITABILITY AND SUSCEPTIBILITY OF SELECTED CARBOHYDRATE-BASED FOODS TO CIGARETTE BEETLE *LASIODERMA SERRICORNE* (FABRICIUS) (COLEOPTERA: ANOBIIDAE)

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Received 7 April 2020; accepted 20 May 2020

ABSTRACT

The cigarette beetle, Lasioderma serricorne (F.) (Coleoptera: Anobiidae), is a major insect pest that can cause total damage to durable stored commodities of plant and animal origin. It is a major pest of stored tobacco, flours, dry mixes, dried fruits and other products kept in kitchen cabinets, hurricane food supply storage containers, and other areas in the home. This study was carried out to evaluate the food preference of the cigarette beetle on five Nigerian carbohydrate-based foods: plantain chips, yam chips, yam flour, cassava flour and baked cassava flakes (garri) under laboratory conditions of 27.7 ± 3.9°C temperature and 78.7 ± 8.5% relative humidity. Ten 1-3 days old cigarette beetles were introduced into vials containing different food media and left to stand for 7 days. At the end of the 7 days period, the introduced adults was removed and data were collected on adult mortality, developmental period, the number of F1 emerged adults, weight loss of the kept food. The mean mortality recorded for cassava flakes (garri) (10.00) was significantly ($p<0.05$) higher than the values observed in other food produce. Also, there was neither adult emergence nor weight loss from cassava flakes (garri). Plantain chip had significantly ($p<0.05$) higher number of emerged adults (265.75) than the respective values in other studied food. Also, median development period (37.00) was lowest in plantain chips and the weight loss (2.55) from plantain chips was significantly ($p<0.05$) higher than that from other food produce. It was concluded that plantain chip was suitable for the growth and development of cigarette beetles; implying that it was susceptible to the infestation of the beetle. Hence, appropriate preservative measures need to be put in place in order to avoid the infestation and economic damage of plantain chips by L. serricorne.

KEY WORDS*: Lasioderma serricorne, plantain chip, yam chip, yam flour, cassava flour and baked fermented cassava flakes*

INTRODUCTION

The cigarette beetle, *Lasioderma serricorne* (F.) (Coleoptera: Anobiidae), is a major pest of stored products. It is a commonly encountered stored-product pest in the

home and has long been associated with humans (Lu *et al.*, 2012). *L. serricorne* (F.) causes significant damage to durable stored commodities of plant and animal origin. Besides it being the most damaging pest of stored tobacco, the cigarette beetle is also a major pest of many stored food products including flours, dry mixes, dried fruits such as dates and raisins, cereals, cocoa, coffee beans, herbs, spices, nuts, rice, dry dog food and other products kept in kitchen cabinets, hurricane food supply storage containers, and other areas in the home (Dimetry *et al.*, 2004; Babarinde *et al*., 2008a; Mahroof and Phillips 2008; Edde *et al.*, 2012). Since carbohydrate is a major staple food in many developing countries, where storage facilities are used to store diversed agricultural produce (Babarinde *et al.*, 2008b), there is the need to evaluate the susceptibility of some major carbohydrate-based food to *L. serricorne.*This is because the anobiid beetle is a polyphagous early colonizer (Babarinde *et al.*,2008a).

Non-food products that it infests include dried plants and herbarium specimens, dried floral arrangements, potpourri, decorative grapevine wreaths, prescription drugs and pills, medicinal herbs, pinned insects, furniture stuffing and bookbinding paste (Yu *et al.*, 2011). Although adults have been reported as an occasional feeder, most of the damage to stored products is caused by larvae (Yu, 2008). This study is aimed at assessing the suitability of some selected carbohydrate-based Nigerian food (yam chips, yam flour (elubo), cassava flour (lafun), cassava flakes (garri) and plantain chips) for development and reproduction of *L. serricorne.*

MATERIALS AND METHODS

Collection and preparation of food materials. The experiment was carried out on different food products which included plantain chips, yam chips, yam flour (elubo), cassava flour (lafun) and cassava flakes (garri). The food products were obtained from the Abule-Oja Local Market, Yaba, Lagos, Nigeria (6.517^{o}N, 3.384^{o}E). Prior to the experiment, the foodstuff was stored in the deep freezer for a period of 2 weeks to ensure that they were free from infestation by any postharvest insects or pathogens. The food products were later conditioned to room temperature before they were used for the experiment.

Collection and culture of *Lasioderma serricorne.* Adult experimental beetles were obtained from the cultures in Cocoa pops cereal in a laboratory stock at the Nigerian Stored Products Research Institute (NSPRI) Lagos, Nigeria. Adult beetles were initially reared in the laboratory under a diet of cocoa pops at a temperature of 28± 5°C and 70 ± 5% RH. Fifty (50) pairs of newly emerged (1 – 3 day old) adults were placed in jars containing the various food produce. The jars were covered with perforated lids to allow for aeration and left to stand for 7 days to allow for oviposition. The parent insects were removed afterward and the jars were covered with pieces of cloth fastened with rubber bands to prevent contaminations of the foodstuff

and escape of the beetles. The subsequent emerging progenies were then used for the experiment.

Adult mortality assessment.Ten (10) g of each food was measured into different vials. This was replicated four times for each food produce. To each vial, ten 1 -3 day old *L. serricorne* adults were introduced. After introducing the insects, the mortality of the insects in each vial was recorded daily for 7 days. At the end of the 7 day period, both the dead and living adult insects were removed and the vials were kept to obtain data on adult emergence.

Adult emergence. Adult emergence was assessed at the 20 days after adult removal. During this period, the jars were inspected daily and the number of F1 adults that emerged were counted and recorded.

Weight Loss Assessment. Percentage weight loss (PWL) was calculated using the formula:

$$PWL = \frac{P_1 - P_2}{P_1} \times 100$$

Where;

P_1 = Initial weight of food produce.

P_2 = Final weight of food produce.

Assessment of median development time. The median development period was estimated as the time (days) from the middle of the oviposition period to the emergence of 50% of the F1 progeny.

Experimental design and statistical analysis. The experiment was laid out in completely randomized design and data obtained were graphically presented as mean values of four replicates and 95% confidence interval (CI) using Microsoft Excel 2013 (Microsoft Corporation, USA).

RESULTS AND DISCUSSION

There was no significant ($p>0.05$) difference between the mean mortality observed in yam chips (1.75), yam flour (2.00), plantain chips (1.75) and cassava flour (2.50) as shown in (Figure 1). However, the mean mortality (10.00±0.00) recorded for cassava flakes (garri) was significantly higher ($P<0.05$) than those for other food produce.

The number of emerged adults from plantain chips (265.75) was significantly higher ($P<0.05$) than those from other food produce; while there was no adult emergence in cassava flakes (garri). Significant ($p<0.05$) difference was recorded among the number of emerged adults from yam chips (164.75), yam flour (185.75) and cassava flour (74.50) (Figure 2).

In Figure 3, cassava flour had the highest median development period (MDP) (71.25) and differ significantly ($p<0.05$) from other produce. No reproductive development in cassava flakes (garri) (0.00). The median development period in yam

chips (38.50) and plantain chips (37.00) differ significantly ($p<0.05$) from that of yam flour (43.00).

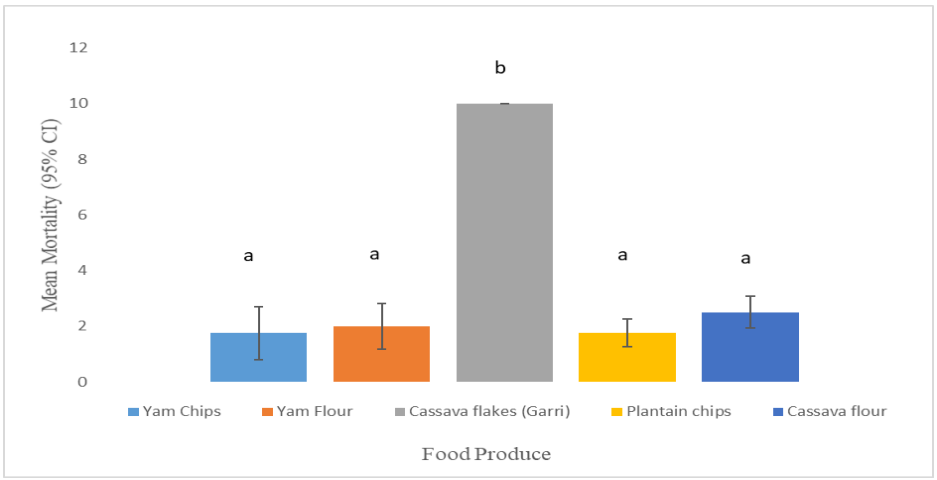

FIGURE 1. Mortality of *L. serricorne* after exposure to five Nigerian carbohydrate-based foods (CI= Confidence interval)

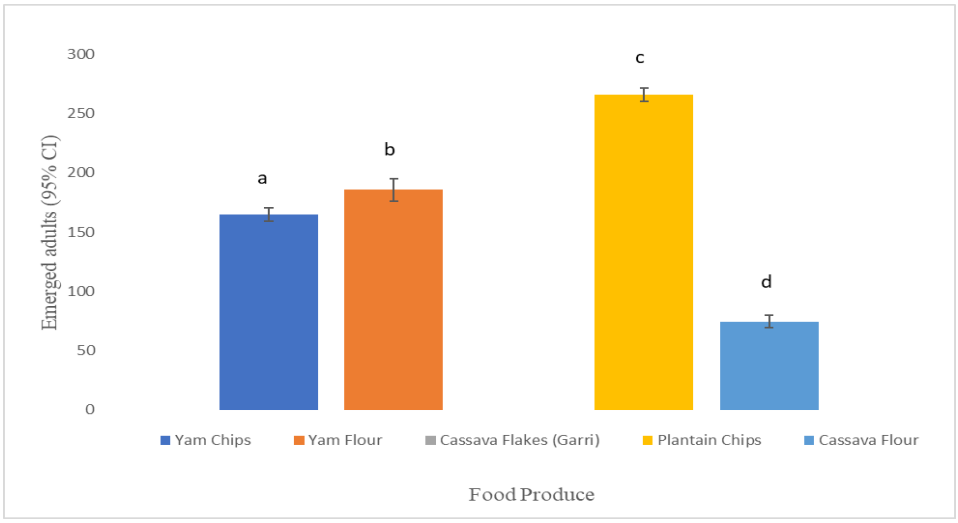

FIGURE 2. Adult emergence of *L. serricorne* after exposure to five Nigerian carbohydrate-based foods

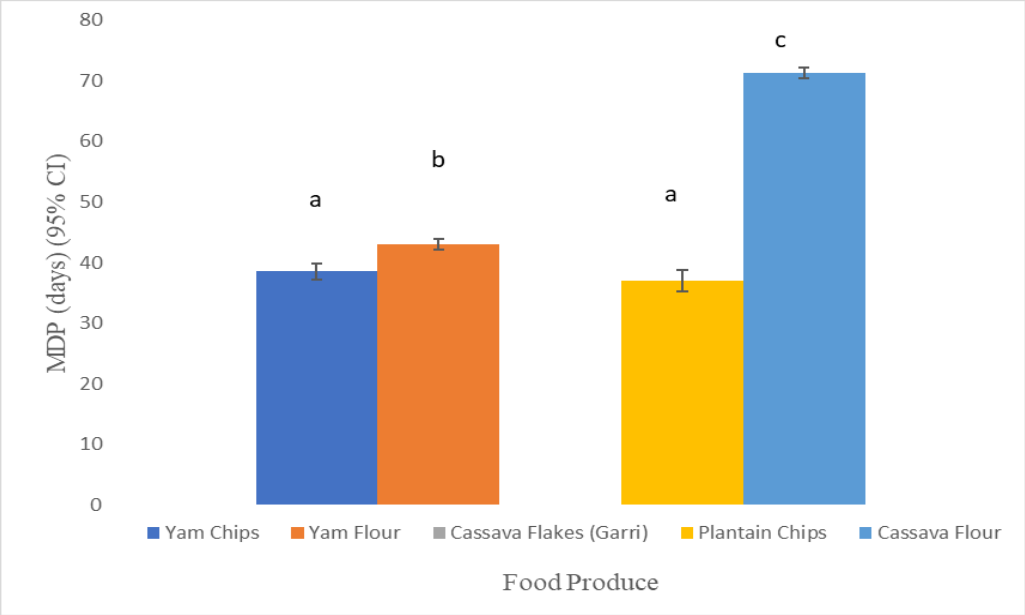

FIGURE 3. Developmental period of *L. serricorne* on five Nigerian carbohydrate-based foods

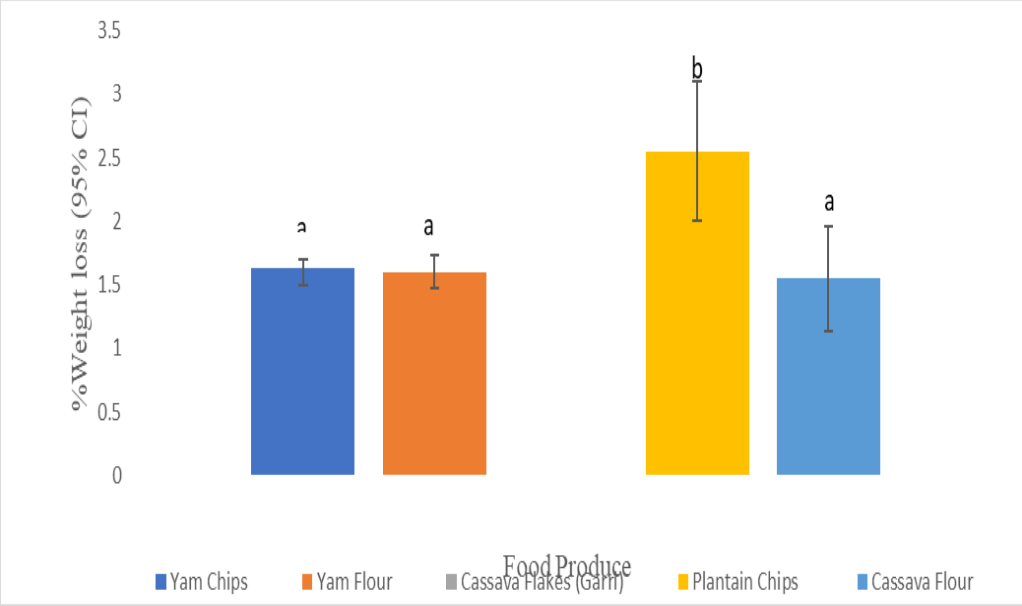

FIGURE 4. Weight loss (%) from the food produce after infestation by *L serricorne*

The percentage weight loss from the food produce was highest in plantain chips (2.55) and differed significantly ($P<0.05$) from the weight loss in yam chips (1.63), yam flour (1.60) and cassava flour (1.55). No weight loss was recorded in garri (0.00) (Figure 4).

This study assessed the effect of different carbohydrate-based produce on the mortality, adult emergence and median development time of *L. serricorne* as well as the effect of the insect on the weight loss from the food produce. The highest mortality of cigarette beetle was observed in cassava flakes. Also, there was neither adult emergence nor weight loss from cassava flakes. These results suggest that the produce was not suitable for the survival of cigarette beetle. Unlike cassava flakes, cassava flour supported the growth of cigarette beetles.

The emergence of adults also resulted in significant weight loss from cassava flour although it was observed that, the number of emerged adults and the median development time for cigarette beetle in cassava flour were significantly lower and higher respectively, than those recorded for other foods. The result of the present study does not agree with Babarinde *et al*. (2008a), who studied the damage potentials of *L. serricorne* on six crop materials and reported that *L. serricorne* evoked the highest damage on cassava chips. There are two types of cassava chips-the sweet and the sour chips. The chips used in this study were the sour type with much higher cyanide content. It is very likely the cassava chips used by Babarinde *et al* (2008a) were the sweet type. This could have resulted in the result found in their study.

Yam chips and yam flour supported the growth and development of cigarette beetle. This is similar to findings by Allotey & Unanaowo (1993) who reported that dried yam supported cigarette beetles biology. Plantain chips appeared to support the development of cigarette beetles more than any other food produce used in this study. Although adult mortality was similar in all food produce, plantain chips produced a significantly higher number of emerged adults as compared with other food produce. Also, median development time was lowest in plantain chips and the weight loss from plantain chips was significantly higher than that from other food produce. This is in conformity with findings by Babarinde *et al*. (2010) who reported that plantain chips are prone to *Trogoderma granarium* attack.

The susceptibility of plantain chips and other food produce to cigarette beetle may be due to factors such as the texture (crispy or bristle nature) and the nutritional (biochemical) composition, which have been reported to predispose chips and flours to storage insect attack (Campbell & Runnion, 2003; Wong & Lee, 2011; Ajayi & Rahman, 2006; Ogedegbe & Edoreh, 2014). The possible cyanide and lactic acidic content (sour taste) of the cassava feedstock (especially the cassava fakes (garri)) when compared with the other studied food type may be responsible for the low or no growth and development of cigarette beetle. As the amount of lactic acid and cyanide content produced during fermentation has been reported to affect its quality (Amoa-

Awua *et al*., 1996; Achinewhu *et al.,* 1998; Uzomah *et al*., 2001). Also, some plants have numerous chemical compounds with insecticidal and repellent properties which can retard the growth and development of storage insects (Hatil, 2009).

CONCLUSIONS

In conclusion, this study reveals that plantain chips are suitable for the growth and development of cigarette beetles, while cassava flakes (garri) was less suitable. Hence, appropriate preservative measures need to be put in place in order to avoid the infestation and economic damage of plantain chips by *L. serricorne*.

Acknowledgement: The authors hereby appreciate Nigerian Stored Products Research Institute, Lagos Nigeria for providing the culture of *L. serricorne* that was used for the research.

REFERENCES

- Achinewhu S.C., Barber L.I., Ijeoma I.O. 1998. Physicochemical properties an garification (gari yield) of selected cassava cultivars in Rivers State, Nigeria. *Plant Foods* for *Human Nutrition* 52: 133–140.
- Ajayi F.A., Rahman S.A. 2006. Susceptibility of some staple processed meals to red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). *Pakistan Journal of Biological Sciences*, 9(9): 1744-1748.
- Allotey J., Unanaowo I.E. 1993. Aspects of the biology of *Lasioderma serricorne* on selected food media under tropical conditions. *Insect Science and its Application*, 14(5-6): 595-601.
- Amoa-Awua W.K., Appoh F.E., Jakobsen M. 1996. Lactic acid fermentation of cassava dough into agbelima. *Int. J. Food Microbiol*. 31:87-98
- Babarinde S.A., Adebayo T.A., Pitan O.O.R., Folorunso J.T. 2008a. Host influence on population growth and damage by cigarette beetle (*Lasioderma serricorne* Fabricius) in Ogbomoso, Nigeria. *Crop Research*, 35(3): 268-272.
- Babarinde S. A., Sosina A. Oyeyiola E. I. 2008b. Susceptibility of the selected crops in storage to *Sitophilus zeamais* Motschulsky in southwestern Nigeria. *Journal of Plant Protection Research* 48(4): 541-550.
- Babarinde S.A., Babarinde G.O., Olasesan O.A. 2010. First report of infestation of stored plantain chips by *Trogoderma granarium* Everts (Coleoptera: Dermestidae) in southwestern Nigeria. *Tree and Forestry Science and Biotechnology*, 4(2): 35-38.
- Campbell J.F., Runnion C. 2003. Patch exploitation by female red flour beetles, *Tribolium castaneum*. *Journal of Insect Science*, 3: 20–27.
- Dimetry N.Z., Barakat A.A., El-Metwally H.E., Risha E.M.E., Abd El Salam A.M.E. 2004. Assessment of damage and losses in some medicinal plants by the cigarette beetle (*Lasioderma sericorne* (F.)). *Bulletin of National Research Center Egypt*, 29: 325-333.
- Edde P., Eaton M., Kells S., Philips T. 2012. Biology, behavior and ecology of pests in other durable commodities. In: Stored product protection. Kansas State University Press, 45-61.
- Hatil H. E. 2009. Effect of certain medicinal plants extracts against storage pest, *Tribolium castaneum* (Herbst). *American-Eurasian Journal of Sustainable Agriculture*, 3: 139–142.
- Lü J.H., Su X.H., Zhong J.J. 2012. Fumigant activity of *Elsholtzia stauntonii* extract against *Lasioderma serricorne*. *South African Journal of Science* 108 (7):556 – 560.
- Mahroof R.M., Phillips T.W. 2008. Life history parameters of *Lasioderma serricorne* (F.) as influenced by food sources. *Journal of Stored Products Research*. 44 219–226.
- Ogedegbe A., Edoreh J.A. 2014. An evaluation of infestation of insect pests of flours in Benin City, Edo State, Nigeria. *Journal of Applied Sciences and Environmental Management*, 18(3): 487-494.
- Uzomah A., Ubaonu C.N., Anichie K. 2001. Assessment of the characteristic qualities of gari produced in the compliance with the gari regulation. *Nigerian Food Journal* 19: 70-75.
- Wong L., Lee C. 2011. Relationship between population growth of the red flour beetle *Tribolium castaneum* and protein and carbohydrate content in flour and starch. *Journal of Economic Entomology*, 104: 2087–2094.

- Yu C. 2008. Susceptibility of *Lasioderma serricorne* (F.) Life stages exposed to elevated temperatures. A thesis submitted in partial fulfillment of the requirements for the degree Master of Science, Department of Grain Science and Industry, College of Agriculture, Kansas State University. 176pp.
- Yu C., Subramanyam B., Flinn P.W., Gwirtz J.A. 2011. Susceptibility of *Lasioderma serricorne* (Coleoptera: Anobiidae) life stages to elevated temperatures used during structural heat treatments. *Journal of Economic Entomology* 104 (1): 317 – 324.