African Journal of Biotechnology Vol. 8 (10), pp. 2346-2348, 18 May, 2009
Available online at http://www.academicjournals.org/AJB
ISSN 1684–5315 © 2009 Academic Journals

Short Communication

Proximate composition and cholesterol concentrations of *Rhynchophorus phoenicis* and *Oryctes monoceros* larvae subjected to different heat treatments

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Accepted 20 March, 2009

The proximate composition and cholesterol concentrations of *Rhynchophorus phoenicis* and *Oryctes monoceros* larvae subjected to different heat treatments were determined. For both *R. phoenicis* and *O. monoceros,* lipid and cholesterol contents were significantly lower in the smoke-dried samples (P < 0.05) compared to the raw samples. The cholesterol levels in *R. phoenicis* were as high as 500.90 and 514.63 mg/100g dry weight basis (DWB) for raw and fried samples, respectively, but decreased to 295.20 mg/100 g DWB in the smoke-dried samples. Similarly, the cholesterol levels in *O. monoceros* were 223.50, 245.46 and 45.05 mg/100 g DWB for raw, fried and smoke-dried samples, respectively. On the other hand, there was no significant difference (P > 0.05) in the ash, protein and carbohydrate contents in the heat-treated samples of both larvae except for moisture which decreased significantly (P < 0.05) in the fried samples. The high protein, oil and ash levels of the larvae indicate that they are good sources of these nutrients.

Key words: *Rhynchophorus phoenicis*, *Oryctes monoceros*, proximate composition, cholesterol, heat treatment.

INTRODUCTION

Insects have played an important role in the history of human nutrition in Africa, Asia and Latin America. They are an important resource for the natives of Southern Nigeria, who like other indigenous groups, expend much organization and effort in their harvest and utilization as food. Hundreds of species have been used as human food. Some of the more important groups include grasshoppers, caterpillars, beetle grubs (larvae) and sometimes adults variety of winged termites, bees, wasp and ant brood (larvae and pupae) as well as winged ants, cicadas and a variety of aquatic insects.

Ordinarily, insects are not used as emergency food to ward off starvation, but are included as a planned part of the diet and as delicacies throughout the year or when seasonally available. The importance with which the people of Southern Nigeria, particularly in the Niger Delta, regard their edible insects and larvae is indicated by the high regard from both the rich and poor. Insect fatty acids are similar to those of poultry and fish in their degree of unsaturation (DeFoliart, 1991). Some families make a fairly good living from selling edible insects and their larvae. They are sold widely in the markets, restaurants and highways. Thus, the edible larvae are both a by-product of the raffia palm and oil palm trees from which palm wine is obtained and the trees die there-after. Some insect larvae are also believed to possess medicinal properties (Ekpo and Onigbinde, 2005)

During the past few years, there has been a new upsurge of interest in insects as food. One factor that may be responsible is an increasing awareness in the Western world that insects are traditionally and nutritionally important food for many non-European cultures. In harmony with this, the “flavour” of palm larvae (fat, legless larvae of the beetle genera, ryncophorus and oryctes) has been well appreciated throughout the tropical world. The larvae are harvested from dead raffia palm and oil palm trees. In this study, the proximate analysis including cholesterol contents of *Rhynchophorus phoenicis* and *Oryctes monoceros* larvae subjected to different heat treatments were determined.

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Table 1. Proximate composition and cholesterol levels (mean ± SEM) of *Rhychophorus phoenicis* larva samples (dry weight basis; n=2).

Larva samples	Moisture (%)	Ash (%)	Protein (%)	Carbohydrate (%)	Lipid (%)	Cholesterol (mg/100 g)
Raw	64.70 ± 3.00	6.20 ± 1.00	28.10 ± 0.85	3.56 ± 2.30	62.15 ± 0.45	500.50 ± 1.50
Fried	24.30 ± 1.20*	7.70 ± 0.30	27.57 ± 0.13	1.14 ± 0.28	65.60 ± 0.10	514.63 ± 0.28
Smoke-dried	28.35 ± 3.15	5.25 ± 1.45	27.05 ± 0.04	10.16 ± 1.67	56.70 ± 0.30*	295.20 ± 6.30*

SEM: Standard error of mean. *Significant (P < 0.05).

Table 2. Proximate composition and cholesterol levels (mean ± SEM) of *Oryctes monoceros* larva samples (dry weight basis; n=2).

Larva samples	Moisture (%)	Ash (%)	Protein (%)	Carbohydrate (%)	Lipid (%)	Cholesterol (mg/100 g)
Raw	64.70 ± 3.00	7.80 ± 0.80	26.41 ± 0.35	51.62 ± 0.35	14.18 ± 0.03	223.50 ± 2.60
Fried	32.25 ± 3.35*	8.82 ± 0.16	26.13 ± 0.19	49.54 ± 0.23	15.54 ± 0.10	245.46 ± 1.44
Smoke-dried	44.40 ± 4.50	5.90 ± 0.00	25.97 ± 0.59	55.17 ± 2.00	11.47 ± 0.10*	43.05 ± 1.55*

SEM: Standard error of mean. *Significant (P < 0.05).

MATERIALS AND METHODS

Collection and preservation of samples

The three duplicate samples (raw, fried and smoke-dried) of *R. phoenicis* and *O. monoceros* as eaten by consumers were bought from Melkaver Market in Warri South, Delta State. The samples were dried in an oven, ground to homogenous mixture and stored for analysis.

Biochemical analyses

The method of Association of Official Analytical Chemist (A.O.A.C., 1980) was used to measure the ash and moisture contents. The soxhlet extraction method as described by Ranganna (1979) was used in the determination of the ash fat content. A modification of the Kjeldahl's method was used in the determination of protein content spectrophotometrically (Egan et al., 1988). Cholesterol present was determined using the enzymatic endpoint method. The amount of carbohydrate content was calculated by difference ((A.O.A.C., 1980)).

RESULTS AND DISCUSSION

The adequacy of a diet is determined by the amount of nutrients it contains and provides to meet the needs dictated by an individual's physiological state and genetic makeup. During the past few years, the upsurge of interest in the use of insects as food to meet the quest for optimal nutrition has promoted the exploitation of the insect world in order to determine the proximate composition and investigate the nutrition quality of certain edible insects. The results of the proximate composition and cholesterol concentration of the raw, fried and smoke-dried samples of *R. phoenicis* and *O. monoceros* are presented in Tables 1 and 2, respectively. In an earlier study on *R. phoenicis*, Ekpo and Onigbinde (2005) obtained 66.61, 22.06, 5.53 and 5.79% (dry weight) for lipid, protein, carbohydrate and ash, respectively. These are very comparable to the values obtained for the control in this study. There is a significant decrease ($P < 0.05$) in the moisture content of fried samples compared to raw samples, while the decrease in the moisture content of smoke-dried samples was not significant ($P > 0.05$). This observation may be attributed to loss of moisture due to heating, which in turn is dependent on the type of heat treatment. Bragagnolo (2001) reported that frying could cause more loss of water than roasting.

For both *R. phoenicis* and *O. monoceros*, there was no significance increase ($P > 0.05$) in the ash content of the fried samples relative to raw samples as well as the ash content of the smoke-dried samples compare to raw samples. However, the ash content of the fried samples appears to be higher than the raw samples for both *R. phoenicis* and *O monoceros.* On the other hand, the ash contents of the smoke-dried samples appeared to be lower than those of raw samples of *R. phoenicis* and *O. monoceros*. The ash content of *O. monoceros* is higher than that of *R. phoenicis.* This may be attributed to taxonomic difference and may thus suggest that the larva of *O. monoceros* is richer in mineral content than that of *R. phoenicis.*

For both *R. phoenicis* and *O. monoceros,* there was no significant decrease ($P > 0.05$) in the protein content of fried samples compared to that of raw samples as well as the protein content of the smoke-dried samples compared to that of raw samples. Nevertheless, there appeared to be a slight decrease in the protein content in this order: raw > fried > smoke-dried samples. This trend suggests that protein may have been lost due to heat treatment, which is also dependent on the method of heat

treatment.

The results also indicate that for both *R. phoenicis* and *O. monoceros,* there was no significant difference ($P > 0.05$) in the carbohydrate content of fried samples compared to that of raw samples as well as the carbohydrate content of the smoke dried samples compared to that of raw samples. However, the carbohydrate contents of the larva of *O. monoceros* are generally higher than that of *R. phoenicis*.

There was a significant increase ($P < 0.05$) in the lipid content of fried samples compared to that of raw samples for both *R. phoenicis* and *O. monoceros* as well as a significant decrease ($P < 0.05$) in the lipid content of the smoke-dried samples compared to that of raw samples. The lipid content of the three samples decreases in this order: fried > raw > smoke-dried samples. The highest value associated with the fried samples may be attributed to influence of cooking oil while the lowest value in smoke dried samples may be due to loss during smoke-drying. However, the lipid content of *R. phoenicis* is generally higher than that of *O.monoceros.* Ekpo and Onigbinde (2005) reported the presence of essential fatty acids such as linoleic, linolenic and arachidonic acids in substantial amounts in *R. phoenicis* indicating the nutritional value of the larval oil. However, the high fat content in the insect larva may increase susceptibility of the undefatted larva to storage deterioration through lipid oxidation (Greene and Cumuze, 1982). For both *R. phoenicis* and *O. monoceros,* there was a significant increase ($P < 0.05$) in the cholesterol concentration of fried samples compared to raw samples as well as that of smoke-dried samples compared to that of raw samples. The order of decrease is fried > raw > smoke-dried samples. This could be attributed to the influence of cooking oil and loss due to heat treatment on the part of fried samples and smoke-dried samples respectively.

This study demonstrates that the larva of *R. phoenicis* is a richer source of lipid and cholesterol than the larva of *O. monoceros*, and that the method of heat treatment exerts remarkable influence on their lipid and cholesterol concentrations. Also, *R. phoenicis* appears to be a richer source of protein than *O. monoceros* while the later seems to be a richer source of carbohydrate and minerals. Additionally, the study demonstrates that the type of heat treatment is the major factors affecting the proximate composition and cholesterol concentration of the larvae of *R. phoenicis* and *O. monoceros.*

Since decrease intake of protein and increase intake of cholesterol are strongly related to the incidence of protein malnutrition and cholesterol related diseases respectively, it will be prudent to recommend that the consumption of smoke dried samples of *O. monoceros* should be encouraged for its low cholesterol content. Specifically, the smoke dried samples of *R. phoenicis* may be recommended for its high protein content and reduced cholesterol level.

The kind of heat treatment that retains the chemical composition and cholesterol contents is that in which the larvae are spread above the fire with a support in a slanting position to prevent the fat or lipids released during the smoking from entering the fire. This helps to prevent contaminants and mutagens from being absorbed by the larvae.

ACKNOWLEDGEMENT

We wish to thank Dr. Nyerhovwo Tonukari for his helpful criticism and assistance in preparing the manuscript.

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