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Oils of *Oryctes owariensis* and *Homorocoryphus nitidulus* Consumed in Cameroon: Sources of Linoleic Acid

[1]Hilaire Macaire Womeni, [2]Michel Linder, [1]Bernard Tiencheu, [1]Felicite Tchouanguep Mbiapo, [3]Pierre Villeneuve, [2]Jacques Fanni and [2]Michel Parmentier
[1]Departement of Biochimie, Faculty of Sciences, University of Dschang, B.P. 67 Dschang, Cameroun
[2]Laboratoire of Science and Genie Alimentaires, ENSAIA-INPL, 2, Avenue de La Foret de Haye, 54500, Vandoeuvre-les-Nancy Cedex, France
[3]Laboratoire of Lipotechnie, UMR IATE, CIRAD, TA 40/16, 73 Rue JF Breton, 34398 Montpellier Cedex 5, France

Abstract: Two unusual oils, obtained from *Oryctes owariensis* (raphia weevil) and *Homorocoryphus nitidulus* (crickets) collected in Cameroon were investigated. In addition to the oil content extracted with hexane in Soxhlet, the fatty acid composition as well as differents class of lipids was determined, respectively by CPG and TLC-FID-Iastroscan. The oil content of insects *Oryctes owariensis* amounted to 53.75% whereas, *Homorocoryphus nitidulus* came to 67.25%. The oils contained 45.46 and 45.63% of linoleic acid, 37.60 and 27.59% of palmitoleic acid, 4.19 and 16.19% of linolenic, respectively for raphia weevil and crickets oils. The total PUFA and UFA ranged, respectively from 50.86 and 94.49% in *Oryctes owariensis* and 62.39 and 97.14% in *Homorocoryphus nitidulus*. Results also showed that the ratios of PUFA/SFA ranged to 16.70 and 105.75. The neutral lipids (TAG 91-93%) were the predominant class of fat amount fatty acids. These 2 insects may be an alternative potential source of essential fatty acids: linoleic acid.

Key words: Insect larva, *Homorocoryphus nitidulus*, *Oryctes owariensis*, essential fatty acids, linoleic acid

INTRODUCTION

Edible insects are important dietary components in many developing countries. Insects commonly consumed include locusts, termites, grasshoppers, weevils and various caterpillars (Ene, 1963). Many studies have shown that edible insects contain appreciable amounts of proteins of good quality and high digestibility (Ashiru, 1988; De Foliart, 1989; Ramos-Elorduy *et al*., 1997). They have also been found to be rich sources of fat, vitamins and minerals, especially iron and zinc (Oliveira *et al*., 1976; Malaisse and Parent, 1980; Kodouki *et al*., 1987). The larva and edible crickets are known by various names by the different ethnic groups in Cameroon, who strongly believe it to have high nutritive as well as certain pharmaceutical potentials. The mode of preparing and for eating differs from one geographical locality to another. In some places, its are boiled while, others smoke, fry or simply eat its raw. Its may be consumed as part of a meal or as a complete meal or traditionally, many claim that the larva has medicinal properties. Phytophagous insects such as lepidopterous larvae have been reported to contain appreciable amounts of the polyunsaturated fatty acids (Fasts, 1970). *Oryctes owariensis* and *Homorocoryphus nitidulus* are insects pest of plantes. The larvaes of the 1st one are processed into the fresh and fried form which is widely marketed and consummed as an essential ingredient in vegetable soups (Fasoranti and Ajiboye, 1993). *Homorocoryphus nitidulus* (crickets) are also eaten though rather infrequently and largely by young children. These insects are fried and eaten in several countries, where active marketing of the fried or fresh forms takes place mainly in Mvog-mbi, Mvog-ada, Mvog-atangana mballa, Melen and Mfoundi markets of the capital of Cameroon. Members of the class insecta are important sources of food to many animal species including man (De Foliart, 1992; Adedire and Aiyesanmi, 1999). Edible insects are important sources of high protein to rural dwellers and many city dwellers in Cameroon and Nigeria (Balinga, 2003; Fasoranti and Ajiboye, 1993). Among the most important orders of insects consumed

Corresponding Author: Hilaire Macaire Womeni, Departement of Biochimie, Faculty of Sciences, University of Dschang, B.P. 67 Dschang, Cameroun

in Cameroon are Coleoptera, Hymenoptera, Isoptera, Lepidoptera, Odonata, Orthoptera and they are highly priced (Balinga, 2003; N'Gasse, 2003; Moussa, 2002). Notable examples of these are the palm weevil, *Rhynchophorus phoenicis*, *Oryctes owariensis*, termites, *Macrotermes nigeriense* (queen, king and reproductives), *Cirina forda*, crickets and variegated grasshopper, *Zonocerus variegatus* (Ashiru, 1988; Mercer, 1997; Adedire and Aiyesanmi, 1999). *Oryctes owariensis* (raphia weevil) and *Homorocoryphus nitidulus* (crickets) are major pests of raphia palm, date palms, coconut palms, oil palms and sugarcane (Vidyasagar *et al*., 2000; Aldryhim and Al-Bukiri, 2003). Though, they are very destructive, their nutritional potentials have endeared them to man. *Oryctes owariensis*, which inhabits raphia palms and coconut is highly cherished. It is a large insect, which usually measures over 25 mm in length and is found in wide geographical areas spanning many different climates such as Africa, Southern Asia and Southern America (Kalshoven and Laan, 1981). The weevil is attracted to dying or damaged parts of palms, cut or split palm trunks and can also attack undamaged palms as well as decaying sugarcane. There is little information on the lipids composition, especially on the fatty acid profile of these 2 insects. Such composition data would be very useful for food and consumption studies, in updating food composition tables and in diet therapy. The purpose of this study, was to determine the fatty acid profile of the larva of *Oryctes owariensis* and *Homorocoryphus nitidulus* (crickets).

MATERIALS AND METHODS

Sample collection: Live larvae of palm raphia weevil (*Oryctes owariencis*) were purchased from Mvog-mbi market of Yaounde, Cameroon. Adults of crickets (*Homorocoryphus nitidulus*) were collected in the Dschang University campus, Cameroon. The live samples were transported to the laboratory for confirmation of identity at the Department of Biology University of Dschang, Menoua.

Analysis: The insect larvae were killed by freezing (Finke *et al*., 1989; Adedire and Aiyesanmi, 1999). The frozen samples were then allowed to othaw at room temperature and dried in an oven at 50°C for 72 h. The dried samples were ground into powder with the laboratory pestle and mortar and kept or stored in air tight containers until required for subsequent analysis. The oil in the sample was extracted in Soxhlet using hexane as solvent and the lipid value (crude fat) was evaluated. The oil extracted after drying was put in a bottle and kept in the refrigerator until required for analysis.

The extracted fat was hydrolysed and the fatty acids converted to their methyl ester derivatives (FAME) using the method of test tubes (Gunstone, 1969) while, the GLC used was equipped with one FAME ionization detector (F.I.D 260°C) and connected to a Hewlette Packard, model 5890A Hitachi Ltd, Tokyo, Japan was used to determine fatty acids constituent and their concentrations. The stationary phase comprised of 10% SP 2300 silanized chromosorb (Supelco inc Belle fonte, pa/USA) packed in a omega Wax 320.30 mm ID, 0.25 μm film glass column of length 5 feet. The carrier gas (Helium) flowed at 2.5 cm sec^{-1} set at 200°C, while injection, oven and column temperature was 250°C 1 mL automatically in Split mode. The fatty acid peaks were identified to reference co chromatographed authentic fame standards.

Quantification of different class of lipids: Triacylglycerols, diacylglycerols, monoacylglycerols and free fatty acids was quantified with Iastrocan TLC/FID analyzer (Laboratory Iatro, Inc., Tokyo, Japan). This method combines thin layer chromatography and flamme ionisation detection. Oils samples are dissolved in chloroform methanol 2:1 (8 mg mL^{-1} of solvent). Micropipette of 1 μL was used for the deposition on 2 chromarods, 1 and 2 μL of the same dilution of sample. The chromarods was developed at room temperature in the mixture of solvents constituted of hexane/diethyl ether (80:20 v v^{-1}); then dried in 100°C for 1 min. Revelation was done with Iatroscam FID with constant flux rate of hydrogen (160 mL min^{-1}). All determinations were done in duplicate.

RESULTS AND DISCUSSION

Table 1 shows the lipid value of *Oryctes owariencis* larva and *Homorocorphus nitidulus*. The result shows that these insects are good sources of fat because these values are quite high (53.75 and 67.25%, respectively). These crude fats content >50% are greater than the lipid range of 1.5-31.40% previously reported for various forms of lepidopterous coleopterous and orthopterous edible insects from the southwestern Nigeria (Banjol *et al*., 2005) and similar or falls within the lipid range of 4.2-77.2% previously reported for 78 various forms of edible insects from the State of Oaxaca, Mexico (Ekpo and Onigbinde, 2005; Ramos-Elorduy *et al*., 1997).

The difference in lipids values between these 2 insects and those cited in literature could be attributed to theirs differences in composition, especially, the fat content and other calorigenic components of the larvae. These lipids content are higher than the amount found in most conventional foods like beef, chicken, egg, Herring,

Table 1: Proximate lipids content composition of *Oryctes owariensis* and *Homorocorphus nitidulus*

Insects	Lipids content (dry weight%)
Oryctes owariensis	53.75±0.01
Homorocorphus nitidulus	67.25±0.02

Results represent the mean±SEM of 2 estimations

Mackerel and milk (Pyke, 1979) and are seen to contribute to its highly acceptable flavour, when roasted or fried. Malnutrition in developing countries is as much or more, a problem of caloric deficiency (De Foliart, 1992). The fat level implies that a 100 g sample of the larva will meet the caloric needs in most developing countries (Davidson *et al*., 1973).

Table 2 shows the fatty acid composition of oils extracted to *Oryctes owariencis* larva and adults of *Homorocorphus nitidulus*. Palmitoleic, oleic, linolenic and linoleic acids are the major fatty acids in the different oils. The total unsaturated fatty acids are 94.49 and 97.14%, respectively. This value when compared to oils from most conventional sources is quite high. Saturated fatty acids account for 3.05 and 0.59% of the fat. These figures are not comparable to 35.5 and 29.6% reported for poultry and fish, respectively but more greater than 52.0 and 44.1% reported for beef and pork, respectively (De Foliart, 1992). Saturated fatty acids found in the larva included lauric acid (0.12-0.00%); palmitic acid (0.20-0.00%); myristic acid (2.50-0.59%) and stearic acid (0.23-0.00). Palmitic acid as well as myristic acid have been demonstrated to raise Low Density Lipoprotein (LDL) cholesterol and are therefore, considered atherogenic (Willett and Sacks, 1991). Unsaturated fatty acids constitute 94.49-97.17% of the total fatty acid and 43.63-34.75% of this are monounsaturated. Oleic acid accounts for 95% of the monounsaturates and has been shown to be hypocholesterolemic (Mensiuk and Katau, 1989). However, stearic acid, which constitutes nearly 2.35% of the saturated fatty acid in the larva has been shown not to raise plasma LDL cholesterol (Bonamone and Grundy, 1987).

They contain a high amount of polyunsaturated fatty acids, linolenic acid (4.19-16.19%) and linoleic acid (45.46-45.63%). Ratio of Polyunsaturated to Saturated fatty acids (P/S) has been used widely to indicate the cholesterol lowering potential of a food. A P/S ratio of 0.2 has been associated with high cholesterol level with high risk of coronary heart disorders while, a ratio as high as 0.8 is associated with desirable levels of cholesterol and reduced coronary heart diseases (Mann, 1993). The P/S ratios of 16.70-105.75 tend to suggest that the insects have the potential of being used in the dietetic management of certain coronary heart diseases. The results of this study show that the larvae have the potential to provide substantial amounts essentials polyunsaturated fatty acids to the diet of low income people, whose diets are usually deficient in animal and vegetal fats. The level of unsaturation observed in *Oryctes owariensis* and *Homorocorphus nitidulus* oil (Table 2) are higher than what is obtainable in most animal lipids, as well as for palm oil and coconut oil, which are common household oils. Insect fatty acids are similar to those of poultry and fish in their degree of unsaturation (De Foliart, 1992). Nutritionally, a high level of saturated fatty acids in foods might be undesirable because of the linkage between saturated fatty acids and atherosclerotic disorders (Rahman *et al*., 1995). The presence of the essential fatty acids such as linoleic and linolenic acids in substantial amounts further points to the nutritional value of the insects oils. One implication of the high fat content in the insect larva is that it may increase susceptibility of the undefatted larva to storage deterioration via lipid oxidation (Greene and Cumuze, 1982). Another implication of the high fat content is that defatting the larva will markedly increase the relative proportions of the other nutrients encompassed in the proximate composition.

Table 2: Fatty acid composition and degree of saturation of *Oryctes owariensis* and *Homorocoryphus nitidulus* oils

Fatty acids	*Oryctes owariensis* fatty acid (%)	*Homorocorphus nitidulus* fatty acid (%)
C12:0	0.12±0.01	-
C14:0	2.50±0.21	0.59±0.06
C16:0	0.20±0.00	-
C16:1	37.60±1.12	27.59±0.99
C18:0	0.23±0.00	-
C18:1 n-9	5.24±0.13	6.89±0.16
C18:2 n-6	45.46±1.03	45.63±0.72
C18:3 n-3	4.19±0.08	16.19±0.19
C18:3 n-6	1.22±0.02	0.58±0.01
C20:1	0.79±0.03	0.28±0.04
NI	2.48±0.06	2.27±0.07
SFA	3.05±0.22	0.59±0.06
UFA	94.49±0.16	97.14±0.13
MUFA	43.63±0.97	34.75±0.79
PUFA	50.86±1.13	62.39±0.92

Results represent the mean±SEM of 2 estimations; NI: Not Identified

Contents in oils of locust: Figure 1 and 2 show the different lipid class of: Triacylglycerols, diacylglycerols, monoacylglycerols and free fatty acids contained in raphia weevil and crickets oils. These results show that neutral lipids are the major lipid in these 2 insects oils, present essentially as triacylglycerols (91-93%); follow by diacylglycerols (1-2%). Free fatty acids are completely absent. These oils contain <3% of free acidity, maximum value recommended by the Codex (1992) for the edible oils. The nil level of free fatty acid indicated that these oils can be stable for spontaneous oxydation (Dosunmu and Ochu, 1995), but there are quite unsaturated and not need thermic process.

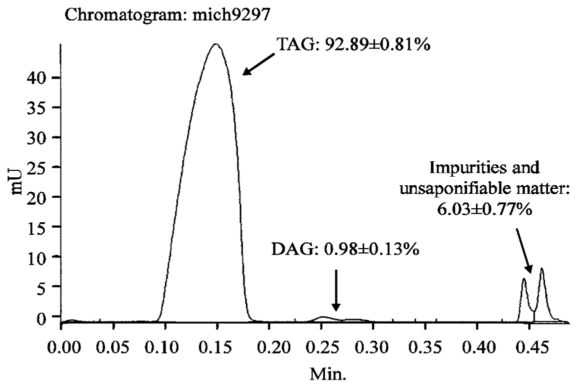

Fig. 1: Iatroscan chromatogramm for the analysis of raphia weevil: migration solvent (Hexane diethyl ether 80/20)

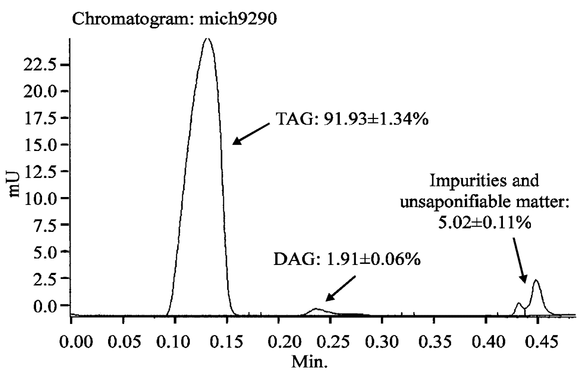

Fig. 2: Iatroscan chromatogramm for the analysis of cricket: migration solvent (Hexane diethyl ether 80/20)

CONCLUSION

The insect larva could form a base for new feed products of considerable lipid value, especially if some level of defatting is done to further increase the relative proportion of the protein component. The results obtained in this study indicated that both crickets and raphia weevil samples are rich sources of fat. Therefore, they can be consumed as food or as supplementary ingredients especially in Africa and Asia to alleviate the problem of nutrient/lipid malnutrition. The results of this study show that these insects have the potential to provide substantial amounts of polyunsaturated fatty acids to the diet of low income people, whose diets are usually deficient in animal fats. Also, the insects have a high polyunsaturated to saturated fatty acid ratio (P/S>0.8). Further, studies are needed to establish the nutritional and health benefits of these nutrient ratios found in them.

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