Article

Physicochemical Properties of Oil Extracted from Winged Termite *Macrotermis bellicosus*

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Abstract: The present investigation was aimed to extract oil from edible insect *Macrotermis bellicosus* and carry out studies on its physicochemical properties. The result obtained shows that the oil extracted from the *Macrotermis bellicosus* is a clear, odourless liquid, with a light yellow colour. The physicochemical properties of the oil revealed 122.30 mg KOH/g for saponification value, 0.52 mg/100 g for iodine value, 7.59 meq/kg for peroxide value, 4.07 mg KOH/g for acid value, 117.73 mg KOH/g for ester value and that it contained 31.43% for crude lipids. These findings show that the termite *Microtermis bellicosus* contains high percentage of quality crude oil, which could be stable in storage, less susceptible to oxidation and rancidity. This suggests that the oil could be exploited for domestic, pharmaceutical and industrial purposes. Also the oil extracted contains unsaturated fatty acids which could be nutritionally essential and therefore justify their consumption in various communities in Nigeria and Africa.

Keywords: termite; *Macrotermis bellicosus*; extraction; oil; physicochemical properties.

1. Introduction

Insects have been used as traditional foods among various communities in Nigeria and have played an important role in the history of human nutrition in Africa, Asia and Latin America (Bodenheimer, 1951). There are more than 400 known species of edible insects (Allotey and Mpuchane, 2003). Insects, including termites are essential to human beings and they are good sources of protein with high fat content and many important minerals and vitamins (Banjo et al., 2006). For
instance, various researches conducted on edible insects reported the presence of high amounts of protein, vitamins and minerals (Allotey and Mpuchane 2003; Motschegwe et al., 1998). Also, they are known to have the same amino acid requirement as humans (Gilmour, 1961). They accumulate these amino acids thus being a readily available source of these useful nutrients. Apart from proteins and carbohydrates, fat is the chief form in which energy is stored in insect larvae (Chapman, 1980; Gilmour, 1961; Wigglesworth, 1976). Apart from humans, insects are attractive and important natural source of food for many kinds of vertebrate animals including birds, lizards, snakes, amphibians, fish and other mammals (Frost, 1942; McHargue, 1917). The winged termites, *Macrotermes bellicosus* simply called “Termite” are exopterygotous insects which belong to the order Isoptera of the class Insecta. Due to their eating habits, termites act as scavengers because of their ability to clear wastes from surroundings (Malaka, 1996). In Africa, winged termites emerge in dense numbers, and they appear with the first rains at the ends of the dry season. At the onset of a rainy season, male and female long-winged reproductives fly off from their nest in large numbers. This is called ‘Swarming’ (Collins, 1981). Some species of insects are eaten as a delicacy in Nigeria, while some are used for traditional medical practice, yet there is very little information on their oil and its physicochemical properties. Therefore the present investigation was undertaken to extract oil from *Macrotermes bellicosus* and also conduct physicochemical analysis on the extracted oil, in order to accurately evaluate its quality and nutritional value. This could unravel some unknown potentials of the oil and hence, know whether it could be applicable for industrial, medical and/or cosmetic use.

2. Materials and Methods

2.1. Chemicals

All solvents and chemicals used in this study were mostly of the analytical reagent grade and purchased from Sigma Chemicals Co. (St. Louis, USA). The chloroform and methanol were redistilled before being used in this study.

2.2. Sample Collection and Identification

*Macrotermes bellicosus* (termites) were collected at the beginning of the rainy season on the May, 2011 in Samaru Area, Zaria, Nigeria. They were taken to herbarium of the Department of Biological Sciences, Ahmadu Bello University Zaria, Nigeria for identification where a voucher specimen was deposited.

2.3. Processing of Sample

The winged termites (*Macrotermes bellicosus*) were dewinged, air dried at room temperature
and then ground into fine paste. The fine paste was then used immediately for oil extraction.

2.4. Extraction of Oil from the Macrotermis bellicosus

The oil sample was extracted from the dried Macrotermis bellicosus sample according to the method of AOAC (2005) using petroleum ether (40 - 60 °C) in Soxhlet extraction apparatus for 6 h and the solvent was distilled off at 80 °C.

2.5. Chemical Analyses of the Oil Extracted from the Macrotermis bellicosus

The lipid content, acid value, saponification value, peroxide value, iodine value and ester value were determined according to the methods described by AOAC (1980).

3. Results and Discussion

The results obtained show that the oil extracted from the Macrotermis bellicosus is a clear, odourless liquid, with a light yellow colour. Other physicochemical properties of the oil are shown in Table 1, which revealed 31.43% for crude lipids, 122.30 mg KOH/g for saponification value, 52.34 mg/100 g for iodine value, 7.59 meq/kg for peroxide value, 4.07 mg KOH/g for acid value and 117.73 mg KOH/g for ester value. Considering the results, the crude lipid value of this edible insect is higher when compared with the values reported for a number of insects (Fast, 1970). However, the value obtained was in agreement and falls within the range of those reported for termites’ species by Ukhun and Osasona (1985), Ekpo and Onigbinde (2007). The fat content of this insect could have contributed to its highly pleasant and acceptable flavour when fried or roasted.

Table 1. The physicochemical properties of the oil extracted from Macrotermis bellicosus

<table>
<thead>
<tr>
<th>Physicochemical properties</th>
<th>Values obtained</th>
</tr>
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<tbody>
<tr>
<td>Crude lipids (%)</td>
<td>31.43 ± 0.04</td>
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<tr>
<td>Saponification value (mg KOH/g)</td>
<td>122.30 ± 0.99</td>
</tr>
<tr>
<td>Iodine value (mg/100 g)</td>
<td>0.53 ± 0.05</td>
</tr>
<tr>
<td>Peroxide value (meq/kg)</td>
<td>7.59 ± 0.05</td>
</tr>
<tr>
<td>Acid value (mg KOH/g)</td>
<td>4.07 ± 0.99</td>
</tr>
<tr>
<td>Ester value (mg KOH/g)</td>
<td>117.73 ± 0.71</td>
</tr>
</tbody>
</table>

Note: The results are mean ± standard deviation of triplicate determination.

The lipid value of the insect when compared to lipids derived from conventional foods of animal origin was found to be higher (Pyke, 1979). The saponification value of Microtermis bellicosus oil obtained was lower than that obtained from rape seed oil (Pearson, 1976) and for coconut oil (Peters, 1956). Since saponification value is inversely proportional to the weight of the fatty acid present in the oil, it can be deduced that the oil extracted from Microtermis bellicoideus contained...
glycerides with lower molecular weight fatty acids than those of palm oil and groundnut oil (Abalaka, 1986; Eka; 1989; Oyenuga, 1986). The iodine value of 0.52 g/100 g obtained indicates that the oil extracted from Macrotermis bellicosus is unsaturated which suggests that it might be more fluid at room temperature and less viscous at low temperatures. The iodine value (an index for the degree of unsaturation) is quite high a common feature of most insect lipids as reported by (Ekpo, 2003; Wigglesworth, 1976). The lower peroxide value obtained from the oil extracted from this edible insect is an indication of high stability of the oil to oxidation because oil with high peroxide values are known to be unstable (Ojeh, 1981). More so, the acid value of the oil extracted from the winged termites is lower than that of olive oil and therefore makes it suitable for use in soap making (Davine and Williams, 1961). Low acid value is an indication of the oils lower susceptibility to rancidity. The ester value of the oil is very high compared with the acid value which is a very essential characteristic of edible oil (Gregory, 2005).

4. Conclusions

The findings from this investigations show that the termite Microtermis bellicosus contains high percentage of crude oil that will be of high quality, which suggest that the oil could be exploited for domestic, pharmaceutical and industrial purposes. In addition, the oil extracted contains unsaturated fatty acids which could be nutritionally essential and therefore justify their consumption in various communities in Nigeria and Africa. Similarly, the oil will be stable in storage, less susceptible to oxidation and rancidity, a quality that will make it acceptable for use in cosmetic and pharmaceutical industries.

References


