Fatty Acid and Amino Acid Profiles of the Larva of Raffia Palm Weevil: *Rhynchophorus phoenicis*.

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ABSTRACT

The edible larva of the raffia palm weevil is a true delicacy to the inhabitants of some parts of Nigeria. It is believed to be rich in nutrients. The fatty acid and amino acid compositions of the larva of the raffia palm weevil have been determined in this study. The result of the fatty acid composition shows the presence of only two fatty acids; stearic acid (69.72%) and palmitoleic acid (30.28%). The saponification number, 192.74 mgKOH/g, and iodine value, 77.41, are fairly high. These values indicate that the oil will be fairly stable to oxidation. The peroxide value, 11.50mEq/g, compares favorably with oils from plant Sources. The free fatty acid, 3.65, is high when compared to reported standard maximum values for lard and edible tallow. The amino acid composition reveals a total of 17 amino acids (excluding tryptophan) with glutamic acid (15.20g/100g) and aspartic acid (11.19g/100g) as the predominant amino acids. The amino acids have a total value of 92.02g/100g. The essential amino acids make up 44.59g/100g of the total amino acids (excluding tryptophan). This value represents 48.45% of the total amino acid composition of the raffia palm weevil sample. The larva of the raffia palm weevil has high values of lysine (8.32g/100g), leucine (8.04g/100g), phenylalanine (5.24g/100g), and arginine (6.47g/100g). The essential amino acids: lysine, leucine, isoleucine, threonine, valine, phenylalanine and tyrosine have higher values than the FAO/WHO/UNU (1991) reference values for the respective amino acids, thus, the larva of raffia palm weevil can serve as a good source of essential amino acids to consumers.

(Keywords: Raffia palm weevil, oil, fatty acid, amino acid, nutritional value)

INTRODUCTION

In Nigeria, the major sources of meat for the populace come mainly from livestock in the form of beef, mutton, pork, and poultry. These major sources of meat are consumed as a result of their protein contents. The scarcity of the existing source of animal protein is at a high rate as a result of the increasing growth of human populations [1]. This fact is also buttressed by the rising standard of living in Nigeria.

There are however, several other unconventional sources of meat which have not been fully exploited. The larva of raffia palm weevil is one of the unexploited unconventional sources of meat.

The edible larvae of the raffia palm weevil are found throughout the tropical areas with a flavor resembling hazel nuts. They are a true delicacy for forest inhabitants of Central and West Africa. In some parts of Nigeria, the larvae of the raffia palm weevil are known as the raffia palm tree worms. The larva of raffia palm weevil is believed to be rich in nutrients.

In Nigeria, the larvae of raffia palm weevil (or raffia palm tree worms) are roasted or fried and garnished with spices and consumed with palm wine. They can also be taken with rice in place of meat or fish. The larvae of the raffia palm weevil are also taken fresh after removing the alimentary tissues of the worms. In spite of the fact that the larvae are highly relished by the inhabitants of some rural communities, they still remain relatively unknown and in fact, strange to many.

The proximate, mineral and vitamin compositions of the larva of the raffia palm weevil had earlier been reported [2].

The report revealed appreciable values of crude protein (44.68±0.20%), crude fat (31.46±0.02%), ash (11.47±0.01%), iron (36.53±0.01mg/kg), zinc (3.30±0.10mg/kg), vitamin A (479.7±0.2514iu/100g), riboflavin (5.9+ 0.09mg/kg), niacin (1.9±0.01mg/kg), and thiamine (5.1±0.11mg/kg) in the larvae. The larvae of raffia palm weevil are rich sources of essential nutrients.

Our paper presents the fatty acid and the amino acid profiles of the larvae of raffia palm weevil. The result obtained from this study will further reveal the potentials of the larvae of raffia palm weevil as sources of essential nutrients as well as substitutes to meats, fish in the supply of essential nutrients for human health and nutrition.

MATERIALS AND METHODS

Live larvae of the raffia palm weevil were purchased directly from dealers in the Umuariaga Community in the Ikwuano Local Government Area of Abia State where the University is located. They were properly washed with water. The heads were cut off and the internal (alimentary) tissues (organs) were squeezed out. They were subsequently cut open longitudinally and dried in the oven for 72 hours. The dried larvae were then milled to obtain the powdery sample used for the study.

Determination of Fatty Acid Profile

Five grams (5g) of the milled sample was weighed into the extraction thimble and the fat was extracted with a 50:50 mixture of analytical grade ethanol and N-Hexane using soxhlet extraction apparatus. The extraction lasted for 4 hours. The extracted oil was subsequently methylated to obtain the methyl esters of the fatty acids using the method of A.O.A.C (2006) [3].

One half micro liter (0.5 μl) of the sample was then injected into the Hewlett Packard 6890 Gas Chromatograph and the chromatogram of the separated fatty acid methyl esters was obtained as described by the Standard Analytical Methods (1999) [4].

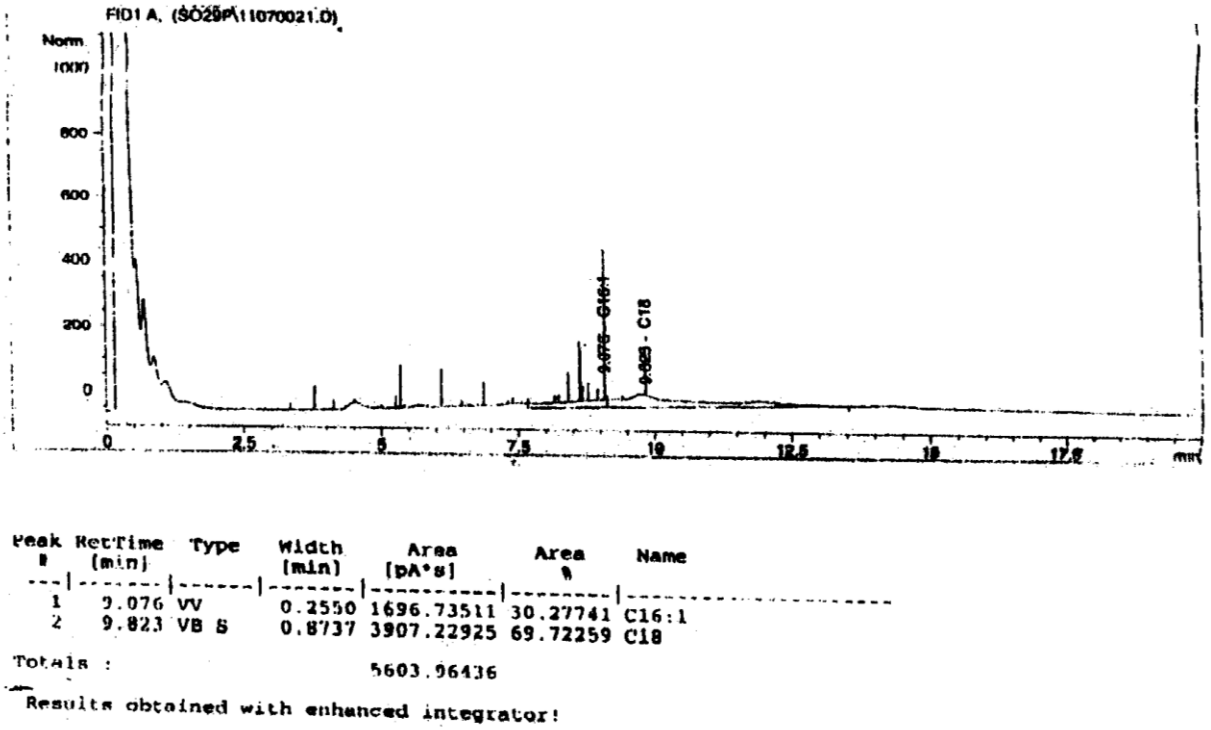
The saponification number (S.N), iodine value (1.V), and peroxide value (PV) were determined according to the various methods described by James (1995) [5]. The free fatty acid (FFA) was determined by the method described by Pearson (1976) [6].

RESULTS AND DISCUSSION

The fatty acid composition of the larva of raffia palm weevil oil is presented in Table 1. The chromatogram of the fatty acid separation of the larva of raffia palm weevil oil is also presented in Figure 1. The result shows the presence of only two fatty acids; stearic acid (69.72%) and palmitoleic acid (30.28%).

Table 1: Fatty Acid Profile of Larva of Raffia Palm Weevil Oil.

Fatty Acid	Carbon Skeleton	Composition (%)
Palmitoleic acid	C 16:1	30.28
Stearic acid	C 18:0	69.72
Total		100.00



Peak #	RetTime [min]	Type	Width [min]	Area [pA*s]	Area %	Name
1	9.076	VV	0.2550	1696.73511	30.27741	C16:1
2	9.823	VB S	0.8737	3907.22925	69.72259	C18
Totals :				5603.96436		

Results obtained with enhanced integrator!

Figure 1: Chromatogram of the Fatty Acid Separation of the Larva of Raffia Palm Weevil Oil Using Hewlett Packard 6890 Gas Chromatograph, C:\HP CHEM|1|METHODS\SO29P.M

These values show that the oil is fairly saturated (or fairly unsaturated). The stearic acid (69.72%) and palmitoleic acid (30.28%) compositions are high. Lower values of 15.3±4.2% stearic acid and 3.2 ± 0.8% palmitoleic acid for goat meat [8] and 10.54% stearic acid and 10.95% palmitoleic acid for oily fish [9] had been reported in the literature. The stearic acid composition of legumes range from 2% to 8% [10]. A value of 0.1% palmitoleic acid had been reported for soybean oil [11].

Stearic acid (18:0) is a saturated fatty acid. Several studies have shown that the stearic acid effect on total cholesterol is minimal and not detrimental to human health [12-15]. For practical purposes, stearic acid is essentially neutral in its effects on serum total cholesterol, similar to oleic acid [16]. It has been reported that the fraction of dietary stearic acid oxidatively de-saturated to oleic acid is 2.4 times higher than the fraction of palmitic acid analogously converted to palmitoleic acid. It has also been reported that stearic acid is less likely to be incorporated into cholesterol esters [17]. These findings indicate that stearic acid is less unhealthy than other saturated fatty acids. Thus, the presence of stearic acid as the only saturated fatty acid in the larva of the raffia palm weevil implies that the consumption of the raffia palm weevil will not be detrimental to human health. Stearic acid finds use in food, cosmetics and other industrial products [18].

Palmitoleic acid (C16:1) is a mono-unsaturated fatty acid also found in rich amounts in macadamia nuts, olive, canola, and peanut oils. This monounsaturated fatty acid is beneficial in reducing bad cholesterol (LDL) and it behaves like a saturated and not as an unsaturated fatty acid in its effect on LDL cholesterol [19]. It also reduces the fat deposition in blood vessels and reduces blood clot formation [16]. Palmitoleic acid is a key enzyme that controls fat oxidation, at extraordinarily high rates [20] and has therefore, been suggested as a molecule that can help to fight weight gain. Therefore, in terms of the fatty acid composition, the consumption of the larva of the raffia palm weevil will have no adverse health implications. The level of saturation (or unsaturated) is also reflected in the saponification number (192. 74) and iodine value (77.41) (Table 2).

Table 2: Physico-Chemcial Properties of the Larva of Raffia Palm Weevil Oil.

Physicochemical Properties	Composition
S.G	0.798
S.N	192.74 mgKOH/g
I.V (wijs)	77.41
Acid Value	7.29mgKOH/g
FFA	3.65%
PV	11.50mEq/kg

The saponification number (192.74) is fairly high. The value is comparable to reported range of values of 195±3.54 to 197±4.47 for tallow [21]. These values are however, higher than the reported values for some plant oils such as pumpkin seed (91.16mgKOH/g) and cashew nut (92.57mgKOH/g) [22] but lower than reported values of 278.26 and 243.41 for palm kernel oil and palm oil, respectively [23], as well as coconut oil (248-265mg KOH/g) [24]. The saponification values indicate that the larva of raffia palm weevil oil has comparable molecular weight and level of saturation as tallow However, it is more saturated than pumpkin seed and cashew nut oils but less saturated than palm, palm kernel and coconut oils.

The iodine value (77.41) is higher than a reported range of values of 48.66±2.66 to 49.15 for tallow [21] and palm oil with the reported value of 56.10 [25]. These values indicate that larva of raffia palm weevil oil is composed of more of unsaturated fatty acids than tallow and palm oil.

The fairly high iodine value and saponification number indicate that the oil will be fairly stable to oxidation.

The peroxide value; 11.50meq/kg compares favorably with oils from plant sources such as fluted pumpkin seed (11.75), cashew nut (15.23) [22]. However, a POV of 10meq/kg fat has been reported as the maximum level for edible animal (lard, tallow, rendered pork fat) fat or oil [26].The peroxide value of 11.50meq/kg for the raffia palm weevil larva oil implies that the oil is considerably pure when compared to the standard requirement.

The FFA; 3.65 is also high when compared to reported values of 0.65% for lard or 1.25% for edible tallow [26].The specific gravity of the oil; 0.798 is likely as a result of the high FFA value. Thus, the oil may be purified and used for edible purposes.

The amino acid composition of the larvae of raffia palm weevil is presented in Table 3.The chromatograms of the standard amino acid mixture and the amino acid composition of the larva of raffia palm weevil are also presented in Figures 2 and 3, respectively.

The result shows a total of 17 amino acids (excluding tryptophan) with glutamic acid (15.20g/100g) and aspartic acid (11.19g/100g) as the predominant amino acids. The amino acids have a total value of 92.02g/100g. The essential amino acids (excluding tryptophan), (Table 4), make up 49.41g/100g of the protein. This value represents 53.69% of the total amino acid. This value may be considered reasonable.

The larva of the raffia palm weevil has high values of lysine (8.32g/100g), leucine (8.04g/100g), phenylalanine (5.24g/100g) and arginine (6.47g/100g). Lower values of lysine have been reported for some legumes such as soybean (6.40g/100g) [27], cowpea (2.8g/100g) [28], groundnut (6.83g/100g) [29].

The reported leucine values of these legumes range from 5.9/100g in cowpea [28] to 7.80g/100g in soybean [27].

Table 3: Amino Acid Composition of the Larva of Raffia Palm Weevil (g/100g).

Amino Acid	Concentration
Lysine	8.32
Histidine	3.51
Arginine	6.47
Aspartic Acid	11.19
Threonine	3.47
Serine	4.59
Glutamic Acid	15.20
Proline	3.61
Glycine	4.08
Alanine	3.94
Cysteine	1.46
Valine	4.50
Methionine	1.30
Isoleucine	3.72
Leucine	8.04
Tyrosine	3.38
Phenylalanine	5.24
Tryptophan	Not Determined
Total	**92.02**

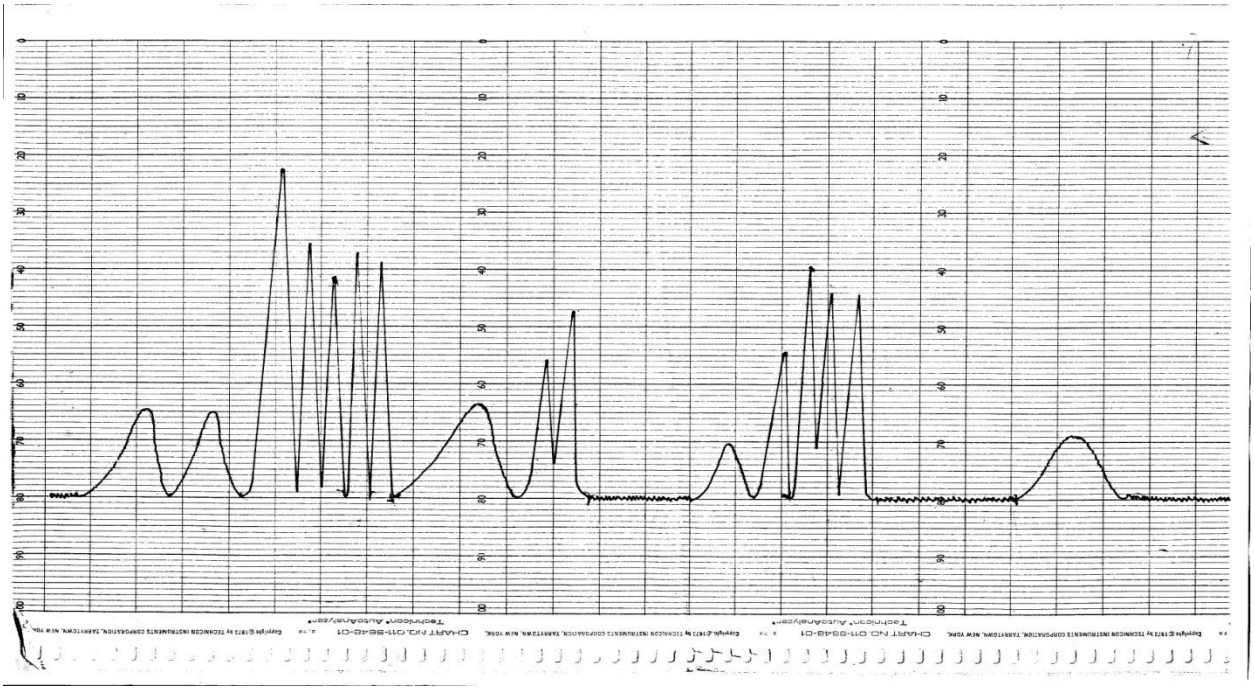


Figure 2: Chromatogram of Standard Amino Acid Mixture Using Technicon Sequential Multi-Sample (TSM) Amino Acid Analyzer.

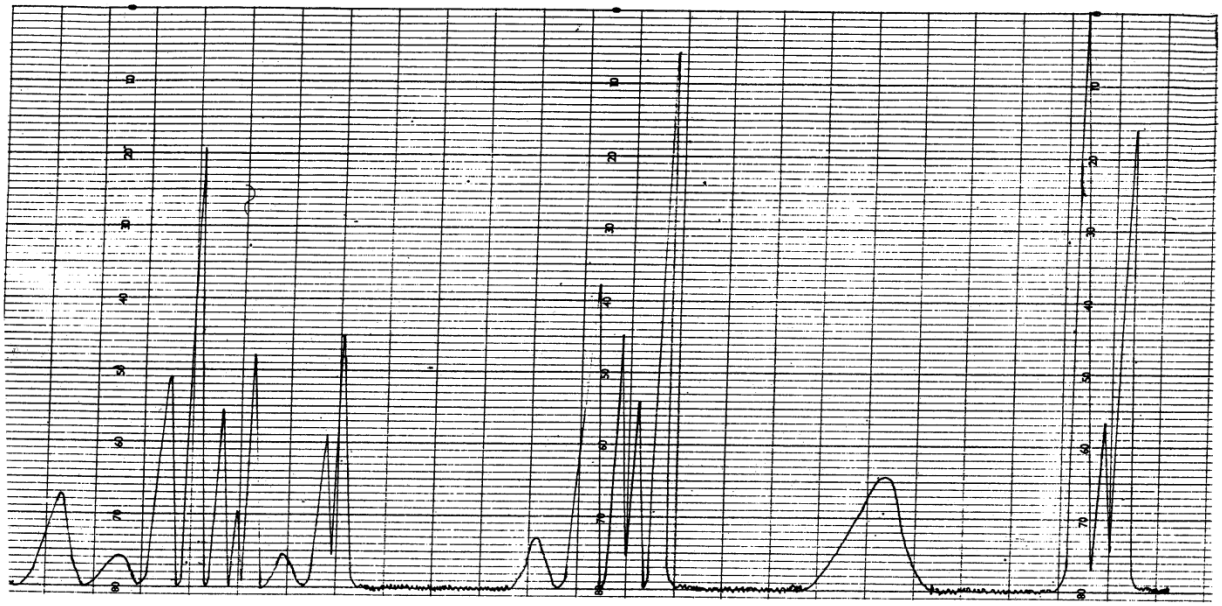


Figure 3: Chromatogram of Amino Acid Composition of the Larva of Raffia Palm Weevil using Technicon Sequential Multi-Sample (TSM) Amino Acid Analyzer.

Table 4: Essential Amino Acid Composition of the Protein of Raffia Palm Weevil Larva (g/100g).

Essential Amino Acids	Concentration
Lysine	8.32
Methionine + Cysteine	2.76
Threonine	3.47
Tryptophan	N.D.
Valine	4.50
Leucine	8.04
Isoleucine	3.72
Phenylalanine + Tyrosine	8.62
Arginine	6.47
Histidine	3.51
Total	**49.41**
% Total of A. As	**53.69**

The larvae of the raffia palm weevil also has appreciable values of lysine (8.32g/100g), threonine (3.47 g/100g), valine (4.50 g/100g), leucine (8.04 g/100g), phenylalanine (5,24 g/100g), arginine (6.47 g/100g) and histidine (3.51 g/100g) when compared to reported values of lysine (8.40 g/100g), threonine (4.00 g/100g), valine (5.70 g/100g), leucine (8.40 g/100g), phenylalanine (4.00 g/100g), arginine (6.61 g/100g) and histidine (2.90 g/100g) for beef meat [30] as well as the values of lysine (7.40 g/100g), threonine (4.80 g/100g), valine (5.40 g/100g), leucine (8.40 g/100g), phenylalanine (3.50 g/100g) arginine (7,50 g/100g) and histidine (2.10 g/100g) for goat meat [30].The values imply that the larva of raffia palm weevil is as good as the legumes, goat and beef meats in the supply of essential amino acids.

The branched chain amino acids; valine, leucine and isoleucine make up 16.26g/100g 0f the protein. These three essential amino acids make up about one third of the skeletal muscles in human body. Branched chain amino acids are basically required for protein synthesis, and repair and maintenance of the muscle tissues. Apart from this, each of the branched chain amino acids is concerned with some specific functions. For example, leucine plays a crucial part in insulin secretion, healing of skin, muscle tissues and bones, while isoleucine is known to regulate the level of blood sugar, and is required for hemoglobin production. Valine on the other hand, facilitates muscle metabolism and repair of tissues. It also helps to maintain the balance of nitrogen in the body. In general, branched amino acids are believed to increase endurance and enhance energy, for which their supplementations are so widely used by the athletes to increase exercise performance.
(http://www.buzzle.com/articles/branched-chain-amino-acids.html)

The sulphur-containing amino acids; methionine and cysteine make up 2.76g/100g protein of the Raffia Palm Weevil Larva. Methionine assists in the breakdown of fats and thus prevents the build-up of fat in the arteries. It also assists with the digestive system and removes heavy metals from the body since this sulphur containing amino acid can be converted to cysteine which is very important nutrient in detoxifying the liver. Methionine is also a great antioxidant because the sulphur it supplies to the body inactivates free radicals. It is also one of the three amino acids that are needed by the body to manufacture a compound called monohydrate, which is very essential for energy production and muscle building.
(http://www.ourgoodhealth.org/aminoacids/Sulphur_Containing_Amino_Acids.html)

Protein quality is usually assessed by comparing its essential amino acids content with reference standard ideal protein set by the World Health Organization [31],which is based on the amino acids need for the children aged 2- 5 years. The amino acid score of the larvae of raffia palm weevil in comparison with FAO/WHO/UNU reference standard is presented in Table 5.

From the table, lysine (8.32%), leucine (8.04%), threonine (3.47%), valine (4.50%), isoleucine (3.72%), phenylalanine + tyrosine (8.62%) score higher than their respective reference standards. However, the value for methionine + cysteine, and isoleucine contents of the larva of raffia palm weevil are below the recommended amino acids requirements (4.6g/100g protein) for infants, but are adequate for both pre-school children between the age of 2 –5 years, school children between the age of 10 – 12 years and the adults [32]. Likewise, the leucine content is adequate for both infants, preschool children between the age of 2–5 years, school children between the age of 10 - 12 years and the adults [32].These amino acids are found to be higher than 1.9g/100g protein set as reference standard [31]. This implies that the amino acids composition in the larva of raffia palm weevil has a high biological value and could contribute in meeting the human requirements for these essential amino acids.

Table 3: Comparison of Essential Amino Acid Composition of the Larva of Raffia Palm Weevil with FAO/WHO/UNU Reference Values.

Amino Acid	Composition	FAO/WHO/UNU (1991) Ref. Value
Lysine	8.32	5.8
Methionine + Cysteine	2.30	2.5
Threonine	3.47	3.4
Tryptophan	ND	1.0
Valine	4.50	3.5
Leucine	8.04	6.6
Isoleucine	3.73	2.8
Phenylalanine +Tyrosine	8.62	6.3
Arginine	6.47	-
Histidine	3.51	-

Histidine and arginine are also essential for children and infants. Histidine is essential for infants and small children (decreasingly with age), while arginine is made by the body at all ages, only at a slower rate in the early years

CONCLUSION

The fatty acids of the larva of raffia palm weevil are health friendly. It can also supply appreciable amounts of amino acids comparable to goat and beef meats. Therefore, it can serve as substitute to goat and beef meats. The essential amino acids: lysine, leucine, isoleucine, threonine, valine, and phenylalanine+tyrosine have higher values than the FAO/WHO/UNU (1991) reference values for the respective amino acids. Thus, the larva of raffia palm weevil can serve as a good source of essential amino acids to consumers and even better than the legumes.

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