Nutritional Assessment of Some Nigerian Land and Water Snail Species

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Abstract

Proximate and mineral analyses were carried out on Nigeria's three land (Archachatina marginata ovum, Archachatina marginata saturalis and Limicolaria spp) and two fresh water (Lanistes varicus and Nucella lapillus) snail species for nutritional assessment using their muscular foot tissues. The mean of crude protein ranged from 70.00 ± 0.03 in Lanistes varicus to 84.43 ± 0.01% in Archachatina marginata ovum and moisture content of 73.69 ± 0.01 in Nucella lapillus to 80.78 ± 0.06% in Archachatina marginata ovum were obtained. The water snails had significantly (P < 0.05) higher crude fibre than the land snails. Values as low as 0.50 ± 0.02 crude fibre were obtained in Archachatina marginata ovum while Nucella lapillus had the highest value of 1.50 ± 0.01. Mineral analysis of the snail species revealed relatively high amount of minerals in the water snails compared to the land snails. Calcium values of 172.79 ± 0.01 in Limicolaria spp to 182.70 ± 0.02mg /100g in Nucella lapillus were obtained. Phosphorus ranged from 51.49 ± 0.01 in Archachatina marginata saturalis to 62.52± 0.01 mg/100g in Lanistes varicus and Iron content ranged from 6.79 ± 0.06 in Archachatina marginata ovum to 11.09 ± 0.01mg/ 100g in Nucella lapillus with low zinc content of 1.14 ± 0.01 in Limicolaria spp. to 1.32 ± 0.01mg/100g in Nucella lapillus. This research therefore, encourages increase in production and consumption of snail species especially Archachatina marginata ovum based on its high crude protein content and size.

Key words: *Land and water snails, minerals, chemical composition, and nutritive qualities.*

Introduction

A major task facing the world today is that of providing sufficient food of adequate quality for the rapidly increasing human population. The food deficit situation is more intense with protein deficiency when compared to the availability of carbohydrate and the micro elements (Pond and Maner, 1974; Adesehinwa and Ogunmodede, 1995). A survey of a typical village in Nigeria will immediately show malnutrition as manifested by the number of children and the aged with clear symptoms of kwashiorkor (Idufueke, 1984). Kwashiorkor is a protein – energy malnutrition that occurs in children under 5 years. The symptoms include growth retardation, underweight, anorexia, diarrhea, oedema and a generalised apathy, (Davidson *et al*., 1975). This calls for emergency measures to ensure additional animal protein in order to raise the protein intake of the average Nigerian from its present level of 5.5g/head/day (FAO, 1988) to 35g/head/day (Idufueke, 1984). This can be achieved by widening the scope of livestock research to commercial snail resource farming which could additionally
generate revenue to augment the family income (Adegbola, 1998).

The widely consumed and available snail families are the Helicidae and Achatinidae found mainly in Western Europe and West Africa, respectively (Hodasi, 1982). In spite of the considerable external and local demands, commercial snail farming as could be found in Europe, South East Asia and the United States of America do not exist in West Africa (Awa, 1997). In Nigeria and Ghana where snail meat called "*Congo meat*" is a delicacy, snails are still gathered mainly from the forest, the wild snail and other species are on the decline due to frequent exploitation, deforestation, and other human activities (Adegbola, 1998).

Humans have used snails for food for many generations and despite this, most of the scientific work done on snail in West Africa have been from the point of view of animal parasitology where snails act as intermediate host of pathogenic nematodes (Wosu, 2003). However, in recent years researchers have studied snails as human and livestock food (Imevbore and Ademosun, 1988; Simpson, 1990; Thompson, 1996; www.weightlossforgood.co.uk, 2003).

The economic and medicinal benefits from snails are immense, these runs from their foot tissue to shells (Wosu, 2003). Snails are cheap to rear at subsistent and commercial levels with high returns on low input. They serve as valuable sources of nutrition to human and animals with high levels of protein, iron,

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lysine, leucine, arginine, calcium and phosphorus, relatively low amount of sodium, fat and cholesterol compared to poultry and other livestock (Imevbore and Ademosun, 1988; Simpson, 1990; Thompson, 1996; Wosu, 2003). Traditionally, snail is used in the preparation of concoctions for various cases as reduction of labour pains, blood loss during delivery and in the cure of small pox (Akinnusi, 1998). It is also implicated in the treatment of anaemia, hypertension, high blood pressure and other fat-related ailments (Wosu, 2003; Imevbore and Ademosun, 1988 and Adegbola 1998).

This present research was aimed at analyzing and comparing the nutritional values of three land snail and two water snail species commonly found in Cross River State of Nigeria.

Materials and Methods

Five samples each of five different snail species; *Archachatina marginata ovum, Archachatina marginata saturalis, Limicolaria* species of land origin, *Lanistes varicus* and *Nucella lapillus* of fresh water, were collected from the wild in three towns (Calabar, Odukpani and Ugep) of Cross River State Nigeria, between the months of September and October 2004 when snails are in their dormancy phase. They were adult snails whose ages could not be ascertained.

The samples were immediately processed and the soft (foot tissue) part separated from its shell through the use of a drilling pin. The pedal mass with the head, mantle edge with minimum part of mucus and haemolymph collected during separation from visceral mass were lyophilised. For each set of snail specimens 10-40g of fresh matter was dehydrated in a laboratory oven (ELE) at 60^{o}C for 24 hours (Imevbore and Ademosun, 1988; Ebenso, 2003). The dried samples (30 specimens per species) were then reduced to impalpable powders in an electric food blender (National) and stored for two weeks within which all the analyses were carried out. The samples were stored at room temperature in an air tight container for proximate composition and mineral analyses using official methods (AOAC, 1990). These samples were stored in order to have enough samples for the different analyses from the same pool of snails.

Each sample was replicated five times in a quasi completely randomized design (CRD). Analysis of variance (ANOVA) and Duncan multiple range test were used in determining significant levels and in the separating means, respectively, according to Steel and Torrie, (1980) techniques.

Results and Discussion

Proximate composition of the snail species

The chemical components of the foot tissue were significantly ($P < 0.001$) different between the various snail species (Table 1). *Archachatina marginata ovum* had the highest moisture content value of 80.78±0.006 percent and showed high significant difference ($P<0.001$) from the other species. *Nucella lapillus* however had the least percentage moisture content (73.50 ± 0.01). These values are within the range of 73.67-79.20 percent earlier reported on snails (Simpson, 1990 and Wosu, 2003).

Percentage crude protein ranged from 70.00 ± 0.03 to 84.43 ± 0.01percent with *Archachatina marginata ovum* having the highest value while the least value was obtained from *Lanistes varicus*. These results agree with that of Imevbore and Ademosun, (1988) of 88.37 percent crude protein. On percentage wet basis, Wosu, (2003) reported snail meat of 20.70 percent crude protein. These values imply that snail meat is a good protein source.

Nucella lapillus showed significantly ($P < 0.001$) higher percentage ether extract (8.50±0.02%) than other species. *Limicolaria* species had the least value (3.75 ± 0.02%). These values are higher than those reported by Imevbore and Ademosun, (1988) and Wosu, (2003) which were 1.64% and 1.21% respectively. Variations in fat contents between snail species could be due to the location and origin of snails (Aboua, 1995 and Lee *et al*., 1994).

In the same vein, *Nucella lapillus* showed the highest percentage crude fibre (1.50 ± 0.01%) while the least value (0.50 ± 0.02%) was recorded in the *Archachatina marginata ovum*. The water snails had significantly ($P < 0.05$) higher crude fibre content than the land snails. This is perhaps due to the fact that swimming in water is a more strenuous activity than crawling on land.

Thus, the water snails need to be tougher than the land snails, hence their higher crude fibre.

The fresh water snails, *Lanistes varicus* and *Nucella lapillus* had similar percentage ash (8.00 ± 0.02%), which differed significantly ($P < 0.001$) from those of the land snails. This is similar to the observations of Akinnusi, (1998) and Aboua, (1995). Therefore, it is expected that, the fresh water snails will have higher mineral contents than the land snails.

The percentage nitrogen free extract value ranged from 0.75 ± 0.01 to 19.00 ± 0.03percent. *Lanistes varicus* had the highest value while *Nucella lapillus* had the least. From these results (Table 1), it is apparent that the land snails (especially *Archachatina marginata ovum*) are more nutritive than the fresh water snails. However, it should be noted that the actual nutritive value would depend on the cooking time and methods (Imevbore and Ademosun, 1998; Lee *et al*., 1994).

Mineral composition of the snail species

Mineral compositions of the five snail species are presented in Table 2. These results were also significantly ($P < 0.001$) different between the snail species. Generally, the water snails had significantly ($p < 0.05$) higher mineral content than the land snails. The discrepancies could be attributed to the different types of equipment used for the analysis, the ages and locations of the snails and the feed supplied. Some of the phosphorus might have been used for normal development and cell activity (Ihekoronye and Ngoddy, 1985 and Wosu, 2003).

Lanistes varicus had significantly ($P < 0.001$) the highest phosphorus content (62.52±0.01 mg /100g with *Archachatina marginata saturalis* having the least value (51.49± 0.01mg/100g). These results are similar to the phosphorus content of 61.24mg/100g reported by Imevbore and Ademosun, (1988) on snail meat. However, a higher value of 272 mg/100g was reported by www.weightlossforgood.co.uk (2003).

Potassium is highly soluble hence the ions are readily available and could be easily taken in by the water snail (Nucella lapillus). Phosphorus and potassium are important in human and animal nutrition. Phosphorus is used for normal development and maintenance of bones and teeth, cell activity, normal acid-base balance of blood, muscle activity, metabolism of carbohydrates and fats while potassium helps in fluid balance, regular heart rhythm, regulation of nerve impulse conduction and cell metabolism (Ihekoronye and Ngoddy, 1985).

Contrary to the phosphorus content result, *Nucella lapillus* had the highest potassium value (72.40±0.01mg/100g) while *Archachatina marginata ovum* recorded the least value (60.74±0.06mg/100g) of potassium content.

Iron content of between 6.79±0.01 and 11.09±0.01mg/100g were obtained. *Nucella lapillus* and *Archachatina marginata ovum* maintained the highest and least values, respectively. These values are higher than the 1.4 to 3.5 mg/100g values earlier reported by Imevbore and Ademosun, (1988); Simpson, (1990) and www.Weightlossforgood.co.uk, (2003) but similar to that of Wosu, (2003) of 12.2mg/100g. The iron content varies from one locality to another depending on the mineral content of the soils in which these snails are raised (Wosu, 2003). Due to the soluble nature of some iron compounds in water coupled with the fact that elements in solution are readily absorbed than those in solid form *Nucella lapillus* had the highest concentration of iron. Water snail could be recommended for pregnant women and children for bone and teeth formation as well as for haemoglobin of the red blood cells.

A mean range of 1.14±0.01 to 1.32±0.01mg/100g of zinc was obtained in this study. The fresh water snails had higher values than the land snails. Zinc content of 1.00mg/100g in snails was reported by www.Weightlossforgood.co.uk, (2003) which was slightly lower than those of this study. Low zinc content in snails implies that snail especially the land snail meat, is non-toxic to health.

Nucella lapillus had the highest calcium value of 181.5±0.01mg/100g while the *Lanistes varicus* recorded the least value (152.7±0.01mg/100g). This calcium values are within the reported range of 170.00 to 185.70mg /100g observed by Simpson, (1990) and Imevbore and Ademosun, (1988) but higher than the value (10mg/100g) reported by Weightlossforgood (2003). The discrepancy in calcium content of the land and fresh water snails could be attributed to the fact that the

land snails could have existed in soils with low exchangeable calcium (Ebenso, 2003). Calcium plays important roles in human and animal nutrition as it contributes to the normal development and maintenance of bones and teeth, clothing of blood, nerve irritability, normal heart action, muscle activity, activates enzymes (Ihekoronye and Ngoddy, 1985).

Nucella lapillus had magnesium content of 31.73 ±0.02mg/100g which was significantly ($P < 0.001$) higher than those of other species especially the *Limicolaria* species with 27.33±0.01mg/100g magnesium. A higher value of 250mg/100g was reported by Simpson, (1990) and Weightlossforgood.co.uk, (2003). Magnesium plays important roles in human and animal nutrition as a constituent of bones, necessary for healthy muscles and nerves, and metabolism (Ihekoronye and Ngoddy, 1985).

Table 2 also indicated that the fresh water snails had higher mineral contents than the land snails thus agreeing with the percentage ash result presented in Table 1.

Conclusions and Recommendations

Results of this study reconfirm the nutritional status of snail, which could be used as food for humans. Snail production and consumption would go a long way in enhancing nutritional balance of diet. The land snails contain more crude protein and moisture than the fresh water snails, which are more fibrous with relatively high amount of fat. However, the fresh water snails have higher mineral contents than the land snails. It was recommended that awareness should be created to encourage land snails farming commercial level so as to increase their availability as protein source for the Nigerian populace.

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Table 1 Proximate composition of snail foot tissue (%, Mean ±SEM)

		Land snails		Fresh water snails	
Composition	***Archachatina marginata ovum***	***Archachatina marginata saturalis***	***Limicolaria species***	***Lanistes varicus***	***Nucella lapillus***
Moisture	80.78±0.06*	80.30±0.03*	78.64±0.02*	75.80±001*	73.69±0.01*
Crude protein	84.43±0.01*	80.95±0.01*	71.75±0.06*	70±0.03*	82.25±0.01*
Ether extract	4.50±0.03*	4.00±0.01*	3.75±0.02*	1.75±0.02*	8.50±0.02*
Crude fibre	0.50±0.02*	1.00±0.01*	1.0±0.10*	1.25±0.03*	1.50±0.01*
Ash	4.00±0.02*	4.50±0.01*	7.00±0.02*	8.00±0.02*	8.00±0.01*
Nitrogen free Extract	6.57±0.05*	9.57±0.02*	15.50±0.01*	19.00±0.03*	0.75±0.01*

Note: *within a row indicate significant differences at (P < 0.001)

Table 2. Mineral elements of snail foot tissue (mg/100g, means ± SEM)

		Land snails		Fresh water snails	
Elements	***Archachatina marginata ovum***	***Archachatina marginata saturalis***	***Limicolaria species***	***Lanistes varicus***	***Nucella lapillus***
Phosphorus	59.16±0.02*	51.49±0.01*	59.79±0.06*	62.52±0.01*	60.19±0.02*
Potassium	60.79±0.06*	70.00±0.01*	64.52±0.01*	69.39±0.02*	72.40±0.01*
Iron	6.79±0.06*	8.25±0.01*	9.00±0.01*	10.10±0.01*	11.09±0.01*
Zinc	1.19±0.01b	1.18±0.01*	1.14±0.01*	1.30±0.01*	1.32±0.01*
Calcium	180.71±0.01*	179.09±0.01*	172.79±0.01*	152.70±0.01*	181.49±0.02*
Magnesium	29.20±0.01*	28.52±0.01*	27.33±0.01*	30.56±0.02*	31.73±0.02*

Note: *within a row indicate significant differences at (P < 0.001)