Proximate and Mineral Composition of Different Species of Snail Shell.

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ABSTRACT

Proximate and mineral composition of four different species of snail shells were determined. *Achatina achatina* has: protein 0.12%, fiber 4.06%, fat 0.78%, ash content 2.00%, Nitrogen Free Extract (NFE) 93.04%, zinc 9.83mg/l, manganese 4.31mg/l, copper 6.47mg/l, and iron 251.23mg/l; *Achatina maginata* has: protein 0.42%, fiber 3.37%, fat 0.75%, ash content 10.00%, NFE, 85.46%, zinc 2.50mg/l, manganese 6.71mg/l, copper 5.33mg/l, and iron 57.45mg/l; *Achatina fulica* has: protein 0.30%, fiber 3.93%, fat 0.38%, ash content 10.00mg/l, NFE 82.36%, zinc 8.02mg/l, manganese,16.98mg/l, copper 5.51mg/l, and iron 37.04mg/l; *Limicoleria species* has: protein 0.23%, fiber 4.14%, fat 0.48%, ash content 13.00%, NFE 82.15%, zinc 6.30mg/l, manganese 1.99mg/l, copper 4.46mg/l, and iron 208.58mg/l.

The study shows the relevance of snail shell in water and waste water treatment among many other uses.

(Keywords: *Achatina achatina*, *Achatina maginata*, *Achatina fulica*, *Limicoleria sp.*, mineral composition, feed protein, heavy metals)

INTRODUCTION

The snail belongs to the phylum Mollusk and class Gastropods. The gastropods are the largest class of the phylum Mollusk (Brunt *et al.,* 1999). Snails live among wet vegetation in damp and shady places, they are more abundant in rainy seasons and most active at night. The snail's soft body consists of a head, a foot, and a visceral mass or lump, which remains permanently inside a hard protective shell.

They are found predominately in West Africa. All gastropods at some time in their phylogeny and at some stage in their development have undergone torsion. The process does not occur in any other mollusk. It implies that the visceral mass and the mantle shell covering it have become twisted through 180^0 in relation to the head and foot. As a result of torsion, all internal organs are twisted into a loop (Aboua, 1995).

More than half of all mollusk species are gastropods and encompass a range from marine, zygobranch, which can be numbered among the most primitive of all living mollusks, to the highly evolved terrestrial air breathing slugs and snails.

The shell of the large land snail is brownish yellow in color with dark markings and is up to 10cm or more in length, it is very hard. Snail shell has several important uses, which results from the hard nature of the shell. The shell protects the snail from physical damage, predators and dehydration. They are use also in the manufacture of buttons, jewels, and art collections.

Recent development involves its application in the treatment of water and waste water resulting from its chemical composition; this composition includes proteins, carbohydrates, fats, and minerals such as iron, zinc, copper, etc. (Botkin and Edward 1988).

The scope of this research is to use scientific methods to analyze the mineral and chemical composition of snail shells, to ascertain some of its constituents that may be useful in the treatment of water and waste water (among many other uses).

MATERIALS AND METHODS

Four different species of snail shell were collected which were homogenized separately into fine powder using a mortar and pestle after washing them with water. The fine powder of the snail shell was sieved using a sieve of 0.5μm pore size to obtain a fine powder.

The moisture content, ash content, protein, crude fat, total nitrogen, etc., were analyzed using standard methods (Ademoroti, 1996).

The protein content was estimated by determining the total nitrogen using the micro-Keljdal method (Usman, 2006), the amount of protein was obtained by multiplying the nitrogen content by 6.25 (a constant factor). This factor is based on the assumption that all feed proteins contain 16% nitrogen and that all the nitrogen in the tissue is present as protein, this assumption is not generally valid. Protein may vary in nitrogen content from 13% to 18%. The following factors are known to apply to different feeds (Egbon, Jatto, Asia, and Ize-Iyamu, 2006).

Table 1: Feed Protein Factors.

Feed Protein	Factors
Seed	5.4
Cereal	5.9
Leaf	6.6
Milk	6.38
Animal	6.25
Wheat	6.70

Nitrogen was determine by micro-Kjeldahl method (Usman, 2006), crude fiber was analyzed by weighing 2g of ground snail shell into one liter conical flask labeled, W_0. 20ml of 1.25% H_2SO_4 was added and the mixture was boiled gently for 30 minutes. It was cooled and then filtered using poplin material stretched over a 9cm Bunchner funnel. The residue was scrapped back into the conical flask, which was further boiled for 30 minutes using 20ml of 1.25% NaOH. The mixture was filtered and the residue washed with hot distilled water and rinsed once with 10% HCl and later with ethanol. The residue was allowed to drain dry and later dried overnight at 105^0C in an oven and was cooled in a desiccator. The sample was weighed after drying and labeled W_1. The dried sample was heated at 550^0C. The ash obtained was cooled in a dessicator, weighed, and labeled W_2. The crude fiber was determined based on the formula below:

$$\text{Percentage (\%) crude fiber} = \frac{W_1 - W_2}{W_0} \times 100$$

Soluble carbohydrate (Nitrogen Free Extract, NFE) was obtained as a difference between the sum of % ash of crude fiber, % crude fat and % crude protein, and 100. That is NFE = 100 – (% ash + % crude fiber + % crude fat + % crude protein).

Crude fat was determined by extracting the fat from the sample using solvent extraction method, petroleum ether was used as the extracting solvent, the crude fat was determined using the formula below:

$$\text{percentage \% crude fat} = \frac{W_3 - W_2}{W_1 - W_0} \times 100.$$

W_0 =Weight of empty porous thimble
W_1 =Weight of thimble + ground sample
$W_1 - W_0$ = Weight of ground sample
W_2 = Weight of empty extraction flask
W_3 = Weight of extraction flask + ether
$W_3 - W_2$ = Weight of ether.

Heavy metals were determined using an Atomic Absorption Spectrophotometer.

RESULTS AND DISCUSSIONS

The analysis of the various food compositions of different species of snail is shown in Table 2. NFE is also referred to as the soluble carbohydrate. Analysis showed that *Archatina archatina* (Africa giant snail) had the highest carbohydrate value hence it can be added to some food materials to enhance their carbohydrate content (Gaman and Sherington, 1977). Since carbohydrate has oxygen and hydrogen elements as some of its chemical composition, there is the tendency of the formation of charges such as hydrogen and oxygen ions. The oxygen ion is negatively charge and can attract metallic ions and possibly remove them from solution (Harold V 1963).

The ash content is an indication of the presence of carbon compounds and inorganic components in the form of salts and oxides (Usman, 2006) in the snail shell. Carbon plays a vital role in the absorption of substances due to its porous nature. This is an indication that snail shell in its granular form or ash form can play a vital role in the removal of metals and other particles from a solution. It can remove color and some other precursors of gaseous substances that generate odour and smell in waste water, and as such can remove smell or odor from water and other solution.

The fiber content of each species enhanced the strength of the snail shell; hence gave the shell its toughness and hardness (Ihekoronye and Ngoddy, 1985).

Apart from its hardness and toughness, it was observed that the fibrous content of the snail shell contributed immensely to its ability of removing insoluble particles from solution, hence serving as a semi permeable medium; it can also remove some heavy particle from solution.

The analysis of the composition of metals or minerals of snail shell shows that all the species consist of manganese, zinc, copper, and iron in different amounts. However the amount of iron is the highest in all the species. Sample A, *Archatina archatina* has the highest amount of iron; the value is 251.23 mg/l as unveiled in (Table 2).

A similar study was carried out by Ogbonde Chukwu (cited by Ademoroti, 1996), shows a similar trend. Iron is one of the most abundant metals on earth. It ranked as the 9th most abundant metal (Ademoroti, 1996) and is used in a variety of ways. For example, Iron(III) chloride is use as a coagulant in the treatment of water and waste water especially in the removal of heavy metals and particles. The mechanism of this reaction is that when in solution that is in water, it forms hydroxide, for example $Fe(OH)_3$. This is one possibility for the relevance of snail shell as a coagulant in treatment of water and waste water (Ademoroti, 1996).

From the result of the analysis, it is possible for snail shell to liberate or release Iron in the form of Iron(III) ions, to form Iron(III) hydroxide which is effective as a coagulant in water and waste water treatment (Ademoroti, 1983).

A study of the treatment of municipal sewage containing some heavy metals, when treated with Iron (III) chloride at pH 4.1 and optimum dosage of 300mg/l shows effective treatment. Hence, there is a correlation between this and the above report.

Other metals present in snail shell from this analysis are also useful in various ways, though they could be toxic in large amounts or at high concentration.

Table 1: Various Food Compositions of Different Species of Snail Shell.

Sample	% Protein	% Fiber	% Fat	% Ash	% NFE
A. Archatina archatina	0.12	4.06	0.79	2.00	93.04
B. Archatina maginata	0.42	3.37	0.75	10.00	85.46
C. Archatina fulica	0.30	3.96	0.38	10.00	82.36
D. Limucalaria sp.	0.23	4.14	0.48	13.00	82.15

Table 2: Heavy Metal Composition of four Different Species of Snail Shell.

Sample	Zinc mg/l	Manganese mg/l	Copper mg/l	Iron mg/l
A. Archatina archatina	9.85	4.31	6.47	251.23
B. Archatina maginata	2.50	6.71	5.33	57.45
C. Archatina fulica	8.02	16.98	5.51	37.04
D. Limucolaria sp.	6.30	1.99	4.46	208.58

CONCLUSION

From the study it shows that sample A, (*Archatina archatina*) has the highest percentage of carbohydrate, followed by sample B, (*Archatina maginata*). *Limicularia* species (sample D) has the highest amount of fiber. Metals (iron, copper, zinc, and manganese) are also present at some level. The study shows the relevance of snail shell in water and waste water treatment among many other uses.

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SUGGESTED CITATION

Jatto, O.E., I.O. Asia, and W.E. Medjor. 2010. "Proximate and Mineral Composition of Different Species of Snail Shell". *Pacific Journal of Science and Technology*. 11(1):416-419.

Pacific Journal of Science and Technology