Comparative Studies on the Composition and Purchase Costs of some Edible Land Snails in Nigeria

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Summary

Four species of edible land snails of the moist forest belt of Nigeria, Archachatina marginata *(Swainson),* Archachatina papyracae *(Pfeiffer),* Limicolaria flammea *(Muller) and* Limicolaria aurora *(Jay) were used in the study of their body composition and purchase cost analysis. Data on* Limicolaria flammea *and* Limicolaria aurora *were pooled together to simulate their occurrence in nature and presentation in the markets. They were designated as* Limicolaria flammea / aurora *throughout this study. The results showed that there was no significant (P> 0.05) difference between the dressing out percentages of the three study group of snails. However, all body component parts studied were significantly (P< 0.01) greater for* A. marginata *than for* A. papyracae *or* L. flammea/aurora*. When the mean weights of shell, visceral mass, edible flesh and the sum of the mean weights of drainable fluid, mucus and other wettings were in each case expressed as percentages of the liveweight, the results were consistently similar (P> 0.05), indicating some regular pattern of weight distribution for these mollusk species studied. When the cost implications were carefully analyzed, the results showed possible savings of $ 1.95 and $ 2.06 US dollars in favour of consumption of fresh edible snail meat from one kilogram liveweight each of* A. papyracae *and* L. flammea/aurora *respectively, as compared to the consumption of fresh edible snail meat from one kilogram liveweight of* A. marginata. *On dried snail meat basis,* A. papyracae *was cheapest ($ 0.28 US dollars / 100 g), followed closely by* L. flammea/aurora *($0.40 US dollars / 100 g), while* A. marginata *was the costliest ($ 2.30 US dollars / 100 g.*

Résumé

Etudes comparées sur la composition et le coût d'achat de quelques espèces d'escargots terrestres comestibles au Nigeria

Quatre espèces d'escargots de terre comestibles de la région forestière humide du Nigeria, Archachatina marginata *(Swainson),* Archachatina papyracae *(Pfeiffer),* Limicolaria Flammea *(Muller) et* Limicolaria aurora *(Jay) ont été utilisées pour déterminer la composition corporelle et la rentabilité de chacune de ces espèces. Vu l'absence de différenciation de ces espèces sur les marchés tant elles se ressemblent, les données portant sur* Limicolaria flammea *et* Limicolaria aurora *ont été regroupées sous l'appellation* Limicolaria flammea/aurora*. Les résultats ont montré que le poids moyen des coquilles, de la masse viscérale, de la chair comestible et des mucosités a été (p< 0,01) plus élevé pour* A. marginata *que pour les autres espèces. Lorsque le poids moyen a été exprimé en des pourcentages de poids vifs des trois groupes d'escargots étudiés, les résultats ont été semblables (P> 0,05), indiquant ainsi un modèle régulier de la distribution des poids pour ces espèces de mollusques. Concernant la rentabilité, les résultats ont montré des économies éventuelles de 1,95 à 2,06 dollars américains par kg de* A. papyracae *et de* L. flammea/aurora *respectivement et de 2,34 dollars américains pour* A. marginata*. La viande sèche d'escargot, revient à 0,28 dollars américains / 100 g de* A. papyracae*, à 0,40 dollars américains / 100 g* de L. flammea/aurora*, tandis que* A. marginata *s'achète 2,30 dollars américains / 100 g.*

Introduction

The four main species of edible land snails of the moist forest belt of Nigeria are *Archachatina marginata* (Swainson), *Archachatina papyracae* (Pfeiffer), *Limicolaria flammea* (Muller) and *Limicolaria aurora* (Jay). They are widely distributed in the moist forest belts of West Africa (Nigeria, the Republic of Benin, Togo, Ivory Coast, Liberia, and Sierra Leone). The moist forest belt of Nigeria comprises the area lying between latitude 4° 15¹ and 7° north, with mean daily temperature of about 27 °C throughout the year. The mean maximum and minimum temperatures range from 30-33 °C and 21-23 °C respectively, and they increase from the coast inland. The rainfall could be as high as 2500 mm per year (4).

The four species of snails vary widely in their respective live weights to very mature live weights of about 120 g to over 500 g for *A. marginata,* 18 g to over 30 g for *A. papyracae*, while *L. flammea* and *L. aurora,* are similar and are about 7 g to over 13 g. *L. flammea* and *L. aurora* are usually found together in company in nature during foraging time in relatively large numbers. They are therefore usually gathered together by snail gatherers and sold together in mixture in the markets.

Snail meat is highly relished in Nigeria, but the supply of snails relies mainly on the wild. Consequently, demand for snail meat outstrips supply, resulting in constant soar in price of snails in the market. For example, the sale of full grown *A. marginata* was at about $ 0.03 US dollar in 1991 and $ 0.07-0.10 US dollar in 1994 (1, 2) and at the time of this study, at about $ 0.83-0.90 US dollar. Because of the small sizes of *A. papyracae* and *L. flammea / aurora,* they are not usually demanded in the market by the affluent in the society, who rather prefers the more imposing *A. marginata* to the former.

Snails are mostly sold live in Nigerian markets. Whereas, the price at which *A. marginata* is sold in the market is based on its size, both *A. papyracae* and *L. flammea / aurora* are commonly sold using either of two local measures in Benin City named "Rubber" (about four litres- volume capacity) or "Uzokpo" (about 2½ times the volume capacity of the former). A four litre volume capacity measure of *A. papyracae* at the time of this study sold at $ 2.43 US dollars while that of mixture of *L. flammea / aurora* at $ 1.74 US dollars.

The snail body consists mainly of the shell and the visceral mass, which in-turn is made up of the edible portion (the

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head/foot complex and the digestive system) and the inedible portion (the digestive gland, the alimentary canal and the crop). During dressing of the live snail for food, the inedible portion is usually removed and discarded. Consequently, partitioning of the body of the snail to highlight the proportion of the edible component is useful in ascertaining its quantitative contribution of animal protein in human nutrition.

Very little attention had hitherto been given to the study on the comparative biomass composition of *A. marginata, A. papyracae* and *L. flammea/aurora*. Consequently, consumers have little idea on the quantity of edible meat they derive from the live snails they bought.

This study was undertaken to investigate the purchase cost for *A. marginata, A. papyracae* and the combined species *L. flammea* and *L. aurora* to estimate their quantitative contribution of edible snail meat to the consumer.

Materials and methods

Four species of edible land snails of the moist forest belt of Nigeria, namely *Archachatina marginata, Archachatina papyracae* and a mixture of *Limicolaria flammea* and *Limicolaria aurora* were used in the study of their purchase costs and quantitative contribution of edible snail meat at market weight.

They were purchased from the market in Benin City, weighed; counted and random samples of 80 snails each from the snail species were weighed to estimate the mean live weight at the time of purchase. They were managed outdoors under mature rubber (3) until required for slaughter. A day prior to slaughter, all foods except water were withdrawn from the snails overnight. Fifty random samples each were taken from *A. marginata* and *A. papyracae*, weighed and slaughtered. Twenty-five random samples each were taken from *L. flammea* and *L. aurora*, weighed and slaughtered. The data arising from the two later species were bulked together in subsequent calculations to simulate their occurence in nature and presentation in the market. Slaughtering was done by gentle crushing of the shell. The drainable fluid was quickly collected in a weighed receptacle and then weighed again with the fluid. The volume of the fluid was then measured. The weight and volume of drainable fluid of the smaller species i.e. *L. flammea* and *L. aurora* were taken up in a weighed one milliliter (1 ml) capacity hypodermal syringe, and then weighed again with the fluid and the volume read off directly on the instrument. All mucus including non descript wettings during the dressing of the snails were absorbed on to known weight of absorbent tissue papers, then weighed to estimate their weight.

The cracked shells were carefully detached from the visceral mass, and weighed. The edible portion of the snail's meat (the head / foot complex and the digestive system) was carefully detached to separate the inedible portion (the digestive gland, the alimentary canal and the crop) and each was weighed. Thereafter the shell, the edible portion of the snail's meat and the inedible portion were dried to constant weight in forced drought oven at 70 °C for 36 hours, cooled in a desiccator and then weighed. Data obtained in this study were used to estimate fresh and dried weights of shell, visceral mass, edible and inedible portions of the snail's meat, the weights of the drainable fluid, mucus and other wettings.

Statistical analysis

Differences observed between species or study groups were subjected to statistical analysis to determine the degrees of significance by the use of Duncan multiple range test (5).

Results

The market weights and prices of the snail species are presented in table 1. The mean weight of the snails sampled (sample number= 80) at the time of purchase were 384.0 ± 21.0; 21.2 ± 1.4 and 7.8 ± 0.0 g for *A. marginata, A. papyracae* and the combined species *L. flammea /aurora* respectively. Their corresponding unit market prices were $ 0.90 US dollars per single *A. marginata*; $ 2.43 US dollars and $ 1.74 US dollars per local measure (4 liters volume capacity) of *A. papyracae* and *L. flammea/aurora* respectively. Each local measure of 4 liters volume capacity contained 304 live *A. papyracae* snails and 875 live mixed *L. flammea/aurora* snails respectively.

Using the above data the single snail prices were estimated as $ 0.90, $ 0.01 and $ 0.002 US dollars for *A. marginata, A. papyracae* and *L. flammea/aurora* respectively.

The slaughter data of the snails are presented in table 2. The mean weights at time of slaughter were 387.7 ± 19.4, 20.4 ± 0.1 and 7.2 ± 0.2 g for *A. marginata, A. papyracae* and *L. flammea/aurora* respectively. The dressing out percentages, defined as the ratio of the edible snail meat to the live weight multiplied by a factor 100, were 42.2 ± 1.7%, 44.8 ± 0.5% and 43.0 ± 0.7% for *A. marginata, A. papyracae* and *L. flammea / aurora* respectively. The dressings out percentages were similar (P> 0.05). The weight distribution of the component parts of the snail's body showed that the mean weights of shell of the snails expressed as the percentage of the live weight were 22.5 ± 1.1%, 19.1 ± 0.4% and 20.8 ± 0.6% for *A. marginata, A. papyracae* and *L. flammea/aurora* respectively. The mean weights of the edible portion of the snails meat expressed as the percentage of the visceral mass (total flesh), were 68.7 ± 5.2%, 66.4 ± 5.0% and 64.6 ± 4.7% for *A. marginata, A. papyracae* and *L. flammea/ aurora* respectively. The weights of drainable fluid, mucus

Table 1
Market weight and prices of some edible species of land snails of Nigeria

	A. marginata	*A. papyracae*	*L. flammea/aurora*
Mean*liveweight of snails at time of purchase (g)	384.0 ± 21.0	21.2 ± 1.4	7.8 ± 0.0
Total number of snails / 'rubber' measure (4 litres volume capacity)	NA	304	87
Number of snails in one kilogram live-weight	2.6	49	138.9
Estimated price of snail per kilogram live weight (US dollar)	$ 2.34	$ 0.39	$ 0.28
Cost of snails / 'rubber' measure (4 litres vol. capacity)(US dollar)	NA	$ 2.43	$ 1.74
Estimated price for one single snail (US dollar)	$ 0.90	$ 0.01	$ 0.002

Key

*= mean for 80 random samples taken at time of purchase

NA= not applicable

US dollar, $= ₦144.00

Table 2
Slaughter data for some edible species of land snails of Nigeria

	A. marginata	*A. papyracae*	*L. flammea / aurora*
Mean liveweight at slaughter time (g)	378.7 ± 19.4	20.4 ± 0.3	7.2 ± 0.2
Mean shell length (mm)	158.3 ± 2.1	56.1 ± 0.4	53.4 ± 0.5
Mean shell width (mm)	82.6 ± 1.7	27.5 ± 0.3	24.2 ± 0.2
Mean weight of fresh visceral mass (total flesh) (g)	235.2 ± 3.9	13.7 ± 0.2	4.8 ± 0.1
Mean weight of shell (not dried) (g)	85.2 ± 5.8	3.9 ± 0.1	1.5 ± 0.1
Means weight of fresh edible flesh[1] (g)	161.5 ± 3.4	9.1 ± 0.3	3.1 ± 01
Mean weight of fresh inedible flesh[2] (g)	66.7 ± 1.7	4.6 ± 0.1	1.5 ± 0.1
Mean weight of drainable fluid (g)	32.5 ± 2.4	1.4 ± 0.1	0.5 ± 0.0
Mean volume of drainable fluid (ml)	34.2 ± 1.8	1.9 ±	0.7 ± 0.2
Mean weight of mucus plus wettings (g)	20.9 ± 1.3	1.0 ± 0.1	0.5 ± 0.1
Dressing out percentage (%)	42.2 ± 1.7	44.8 ± 0.5	43.0 ± 0.7
Mean weight of dried visceral mass (total flesh) (g)	48.9 ± 5.5	3.3 ± 0.5	0.7 ± 0.1
Mean weight of dried shell (g)	82.1 ± 2.3	3.6 ± 0.5	1.3 ± 0.2
Mean weight of dried edible flesh (g)	39.2 ± 4.9	2.8 ± 0.4	0.5 ± 0.0
Mean weight of dried inedible flesh (g)	9.7 ± 1.0	0.6 ± 0.1	0.1 ± 0.0

Key:
1: Edible Flesh; Comprises the head/foot complex plus the digestive system.
2: Inedible Flesh; Comprises the digestive gland, the alimentary canal and the crop.

and other wettings detected in this study were summed up, and expressed as the percentages of the liveweights; the data obtained from this practice were 14.1 ± 0.5%, 11.9 ± 0.4% and 13.9 ± 0.4% for *A. marginata, A. papyracae* and *L. flammea / aurora* respectively.

The number of live snail species that would weigh one kilogram was estimated for subsequent calculations in this study. The results were 2.6, 49.0 and 138.9, *A. marginata, A. papyracae* and *L. flammea/aurora* snails to one kilogram liveweight respectively. Thus one kilogram by weight of live *A. marginata* snails yielded about 419.9 g (161.5 x 2.6) of fresh edible snail meat, while those of *A. papyracae* and *L. flammea/aurora* were 445.9 and 430.6 g respectively. The weight of live snail species contained in a local measure (about 4 litre volume capacity) were estimated and *A. papyracae* weighed 6.2 kg (304 ÷ 49.0), while *L. flammea/ aurora* weighed 6.3 kg.
The mean weights of dried edible snail meat in this study were 39.2 ± 4.9, 2.8 ± 0.4 and 0.5 ± 0.1 g for *A. marginata, A. papyracae* and *L. flammea/aurora* respectively. Thus, one kilogram weight of live *A. marginata* snails yielded 101.9 g (39.2 x 2.6) of dried edible snail meat, while those of *A. papyracae* and *L. flammea/aurora* were 137.2 g and 69.5 g respectively.

Discussion

Although the body weight of *A. marginata* was significantly (P< 0.01) greater than for *A. papyracae* and *L. flammea/ aurora*, yet the dressing out percentages were similar (P> 0.05). Except the mean lengths and breadths of *A. papyracae* and *L. flammea/aurora* which were in each case similar (P> 0.05), other component parts of the body studied were higher for *A. papyracae* than for *L. flammea/aurora.* When the mean weights of shell, visceral mass, edible flesh and the sum of the mean weights of drainable fluid, mucus and other wettings were in each case expressed as percentages of the liveweights, the results were consistently similar (P> 0.05) for *A. marginata, A. papyracae* and *L. flammea/aurora*, thus suggesting some regular pattern of weight distribution for these mollusk species studied.

The respective live weights of the snail species at time of slaughter (Table 2) indicated that about 2.6 *A. marginata* snails (i.e. 1000 ÷ 378.7), or about 49 *A. papyracae* snails (1000 ÷ 20.4), or 138.9 *L. flammea/aurora* snails (1000 ÷ 7.2) were required in each case to weigh one kilogram. The mean fresh edible meat yield by the snail species were 161.5 ± 3.4 g per snail (equivalent to 419.9 g/kg liveweight), 9.1 ± 3.4 g per snail (or 445.9 g/kg liveweight) and 3.1 ± 0.1 per snail (or 430.6 g/kg liveweight) for *A. marginata, A. papyracae* and *L. flammea/aurora* respectively. Their corresponding market prices were $ 2.34, $ 0.39 and $ 0.28 US dollars per kilogram liveweight respectively.

Although the amount of edible fresh snail meat yield per kilogram liveweight by *A. papyracae* was slightly higher than for *L. flammea/aurora* and *A. marginata*, yet the differences were not significant (P> 0.05). When we discuss the cost implications of the fresh edible meat yield per kilogram live weight of the snail species, we discover that a consumer pays significantly (P< 0.05) more (about $ 2.06 US dollars) for preferring the consumption of *A. marginata* to the consumption of *L. flammea/aurora*, or again pays significantly (P< 0.05) more (about $ 1.95 US dollars) for preferring *A. marginata* to *A. papyracae*. A consumer preferring the consumption of *A. papyracae* to *L. flammea/ aurora* pays extra sum of $ 0.11 US dollars only. This difference was not significant (P> 0.05).

It is well known fact that food stuff is better rendered in terms of dry weight than fresh weight basis for better nutritional appreciation. This procedure eliminates much of the water content and increases the nutrients concentration and storability of the food stuff. The mean dry weight of edible snail meat in this study were further estimated as 39.2 ± 4.9 g per snail (or 101.9 g dried snail meat/kg liveweight), 2.8 ± 0.4 g per snail (or 137.2 g dried snail meat/kg liveweight) and 0.5 ± 0.1 g per snail (or 69.5 g dried snail meat/kg liveweight) for *A. marginata, A papyracae* and *L. flammea/aurora*, respectively. In consideration of nutrients concentration of the snail meat per kilogram liveweight of the snail species, *A. papyracae* appeared higher (137.2 g dried snail meat) than *A. marginata* (101.9 g dried snail meat), which in turn was higher in nutrients concentration than *L. flammea/aurora* (69.5 g dried snail meat). In order to interpret the above data regarding nutrients concentration in a commercially meaningful way, a proportionate approach was mathematically adopted. Thus, given that 101.9 g dried edible snail meat (obtained from 1 kg liveweight) by *A. marginata* cost $ 2.34 US dollars therefore 100 g dried edible snail meat by *A. marginata* will cost $ 2.30 US dollars. Employing the same mathematical calculations, 100 g each

of edible snail meat by *A. papyracae* and *L. flammea/aurora* will cost $ 0.28 and $ 0.40 US dollars respectively. These later calculations appeared to indicate that on dried edible snail meat basis, *A. papyracae* was the cheapest ($ 0.28 US dollars/100 g), followed closely by *L. flammea/aurora* ($ 0.40 US dollars/100 g), while *A. marginata* was the costliest ($ 2.30 US dollars/100 g). This again showed there were possible savings of $ 2.02 and $ 1.90 US dollars in favour of *A. papyracae* and *L. flammea/aurora* respectively as compared to the cost of dried edible snail meat from *A. marginata*.

Conclusion

In conclusion, since the comparison of the snail species was based on their full-grown market weight, the superiority of *A. marginata* over the lesser species, *A. papyracae* and *L. flammea/aurora* in terms of body weight and edible meat content were obvious in this study. However, when fresh edible meat yield per kilogram liveweight of the snail species were carefully analyzed, the result showed that there were possible savings of $ 1.95 and $ 2.06 US dollars in favour of the consumption of fresh edible snail meat from one kilogram liveweight each of *A. papyracae* and *L. flammea/aurora* respectively as compared to the consumption of fresh edible snail meat from one kilogram liveweight of *A. marginata.* The cost of dried edible snail meat proportionately estimated per 100 g dried meat, again showed possible savings of $ 2.02 and $ 1.90 US dollars in favour of *A. papyracae* and *L. flammea/aurora* respectively, as compared to the cost of 100 g dried edible snail meat from *A. marginata*. Both *A. papyracae* and *L. flammea/aurora* are within easy affordability of the poor masses.

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