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Inventory and characteristics of the small African land snail (SALS) spp in Benin metropolis, Edo State

Odafe-Shalome, G. I. O. and Omoyakhi, J. M.
Bioresource Technology Lab, Dept of Animal Science, Fac. of Agric,
Univ. of Benin, Benin-City, Nigeria.
Corresponding author: ofafebcn@gmail.com; shalomoedafe@gmail.com;
gideon.odafe-shalome@uniben.edu; +234(0)8181303319

Abstract

Six (6) species of small African land snails (SALS) were picked from bushes and home gardens in seven (7) locations in Benin metropolis. The SALS were identified by means of a picture chart and examined for their physical characteristics, shell properties, population pattern and relative abundance during season in the locations. Chemical analysis was performed to determine the proximate and mineral compositions of the SALS and to compare these with those of the common GALS, Achatina marginata. Along with the GALS, the SALS found in the metropolis belong mainly to the genus – Lumicolaria. They are rainy season gastropods; their presence became visible in April; population became significant in May; and then increased significantly to reach their peaks in July; and thereafter reduced significantly in August. There were no differentials respecting relative abundance of various species based on location in Benin metropolis. Instead the different locations sampled, fittingly represented replications of measurements and figures rather than differential biodiversity of snail species. The six species of SALS identified were L. flamnae (black and white), L.numidica, (yellow brown), L.martesiana (brown), L.aethiops (brown), L. feline (white), L.aurora (white and black). Morphologically the SALS measured 5.0 – 7.5cm in length, and 2.0 – 2.1cm in diameter. The number of whorls on shell varied from 6 – 9 between the species. There were variabilities in shell colors, sizes and relative standard live weight of the snails. The SALS and GALS showed similarity in physical characteristics and chemical composition, except in size. This means that SALS, like the GALS, also have high potential food value. Studies on the production and utilization of SALS were thus recommended.

Keywords: Small land snails, identity, characteristics, relative abundance, chemical

Une Inventaire et caractéristiques des petits escargots terrestres africains (le 'SALS') spp dans la métropole du Benin, dans l'État d'Edo

Odafe-Shalome, G. I. O. et Omoyakhi, J. M.
Bioresource Technology Lab, Dept of Animal Science, Fac. of Agric,
Univ. of Benin, Benin-City, Nigeria.
Corresponding author: ofafebcn@gmail.com; shalomoedafe@gmail.com;
gideon.odafe-shalome@uniben.edu; +234(0)8181303319

Résumé

Six (6) espèces de petits escargots terrestres africains (le 'SALS') ont été cueillies dans des buissons et des jardins potagers dans sept (7) localités de la métropole du Benin. Les 'SALS' ont été identifiés au moyen d'une carte illustrée et examinés pour leurs caractéristiques physiques, les propriétés de la coquille, la structure de la population et l'abondance relative pendant la saison dans les emplacements. Une analyse chimique a été réalisée pour déterminer les compositions proximales et minérales du 'SALS' et pour les comparer avec

celles du 'GALS' commun, Achatinamarginata. Avec les 'GALS', les 'SALS' trouvés dans la métropole appartiennent principalement au genre - Lumicolaria. Ce sont des gastéropodes de saison des pluies; leur présence est devenue visible en avril; la population est devenue importante en mai; puis a augmenté de manière significative pour atteindre leurs sommets en juillet; et par la suite considérablement réduit en août. Il n'y avait pas de différentiels concernant l'abondance relative des diverses espèces en fonction de l'emplacement dans la métropole béninoise. Au lieu de cela, les différents emplacements échantillonnés représentaient de manière appropriée des réplications de mesures et de chiffres plutôt que la biodiversité différentielle des espèces d'escargots. Les six espèces de SALS identifiées étaient L. flamnae (noir et blanc), L.numidica, (jaune brun), L.martesiana (brun), L.aethiops (brun), L. feline (blanc), L.aurora (blanc et noir). Morphologiquement, le SALS mesurait 5,0 à 7,5 cm de longueur et 2,0 à 2,1 cm de diamètre. Le nombre de verticilles sur coquille variait de 6 à 9 entre les espèces. Il y avait des variations dans la couleur de la coquille, la taille et le poids vif standard relatif des escargots. Les 'SALS' et 'GALS' ont montré des similitudes dans les caractéristiques physiques et la composition chimique, sauf en taille. Cela signifie que les 'SALS', comme les 'GALS', ont également une valeur alimentaire potentielle élevée. Des études sur la production et l'utilisation des 'SALS' ont donc été recommandées.

Mots clés: *Petits escargots terrestres, identité, caractéristiques, abondance relative, produit chimique*

Introduction

Snail is a common name for shelled gastropods, a class of land snails, the terrestrial pulmonate gastropod, belonging to the phylum - mollusks. They are many and varied; but most of the members of this class have coiled shell and hence they are generally referred to as snail. The shell serves as casing or armor into which the fleshy body of the animal retracts for safety and protection. Besides the terrestrial (land) snails, there are also aquatic (water) snails, which include numerous sea and freshwater species. Snails can be found in a very wide range of environments, including ditches, deserts, and the abyssal depths of the sea. Taxonomically, there the group, the pulmonata, that respire using a lung; and there are the polyphyletic group that respire with gills. Both groups are reportedly diverse in taxonomy and are made up of species that are distributed between land, freshwater and marine ecosystems. Humans seem to be more familiar with land snails but freshwater snails are numerous in their kinds, whereas marine snails constitute the majority of snail species, having much greater diversity and greater biomass.

Snails have considerable human relevance: on one hand, this includes their effects on environmental health, as pests or as vectors of disease; and on the other, their food value as animal protein sources, and the usefulness of their shells in jewelry or as decorative objects and artifacts. There is also the usefulness of snail slime and haemolymph in cosmetics and health care (Awah, 2000; COA, 2007; Welter, 2015). Around the world, the use of snails as food is steadily increasing. In Nigeria, giant African land snail (GALS) is popularly known as congo meat. It is considered a delicacy, highly relished as low fat, high mineral and rich protein source; and this places a higher nutritional quality on it, in comparison with beef and poultry meat. Hence during the past few decades much attention has been paid to GALS by way of snail conferences, publicity and sponsored research, including studies on the structure and function, reproduction, husbandry, processing and utilization (Awah, 2000; Oji, 2000; Ebenebe, 2000; Estoy *et al.*, 2002;

Maltz, 2003; Sringer *et al.*, 2003; Ben-Ami and Heller, 2005; Mumladze *et al.*, 2008; Nordsieck, 2007; Odafe and Olomu, 2011; Welter, 2015). These efforts proved to underscore the emerging high economic importance of GALS, and the potentials to emerge as one of the high profile species in the Nigerian livestock industry (NRC, 1991; Imevbore, 1999; Olomu, 2011; Odafe and Olomu, 2011). However, there are also small species of snails and mollusks that are used as food in Nigeria. One of such is the water mollusk periwinkle which is highly relished and used as thickener and protein enhancer in vegetable soup in some parts of the country. Also there are different kinds of small size African land snails (SALS) sold in baskets in many markets across the region. The SALS are found mostly during the rainy season, when they are abundantly many and are easily handpicked from the bushes in both rural and urban localities. This study was conducted to examine the SALS and to have relevant information on the profile of various species of this class of gastropod that are available to the Nigerian consumer. The objectives were to determine the incidence of small land snails (SALS) in Benin metropolis, in Niger-delta region of Nigeria; identify and examine the physical characteristics of each snail species; determine the abundance of each species in relation to others, during the season and incident period; and determine by chemical analysis, the proximate and mineral composition of SALS in comparison with the common GALS and *Achatina marginata* as reference.

Materials and methods

Site of study

This study was conducted in Benin-City, a metropolis encompassing seven out of the eighteen local government areas in Edo State, in the equatorial rain forest belt, Niger-delta region of Nigeria, lying and situate between longitude 6°E and 6°40`E, and latitude 6°N and 7°30`N, and bearing a variety of flora and fauna in abundance. The soils are lateritic, and climatic records indicate average daily temperature range 24 - 32°C, annual rainfall 2000 – 2620mm, and relative humidity 78 - 95%. Seven locations in the four axes of the metropolis, including city center, towns and suburbs representing the seven LGAs were selected for the study. The locations were Amagba along Sapele road; Ogbe quarters in city center/oredo, Ikhuen along Agbor road in Orhiomwan; Aduwawa/Eyaen in Uhuomwode; Oluku/Ekiadolor in Ovia NE; Uwelu in Egor; and Idogbo/Upper-sapkonba in Ikpoba-okha LGA. Four study sites were sampled in each location. The common features in those sites included bushes, uncompleted buildings, home gardens and semi-urban forests. Observations were recorded on the identity of each snail species, physical characteristics, feeding habit, growth and population pattern and prevalence during the period of study, commencing March (the onset of rainy season) and closing in July (the peak of the rainy season period) in that region.

Identification and Measurement

At site, the number of each kind of the small land snail, determined by shell color, found within defined blocks of 50ft x 50ft in each of the sites was counted, summed and averaged. Then enough quantities of each kind were collected into plastic baskets having perforations which enabled free air circulation and prevented suffocation of the live animals. The snails were transferred to a temporal holding compartment in the Mini-livestock unit, in the Faculty Experimental Farm. Identification and separation of species was performed by means of picture chart, provided by the Zoology Museum in the University. Thereafter snail population was summed and relative abundance of each species was computed and recorded. Further snails were sub-divided into two sets. The snails in Set 1

were kept captive and used for studies on growth and population pattern. Set 2 snails were used for studies on morphology, physical measurements and chemical analyses.

Set 1: Study on feeding, breeding and population pattern

This set of the snails were identified and returned to the Mini-livestock experimental unit where they were caged separately according to species in baskets designed for the management of the SALS. Separate caging was necessary in order to effectively monitor its growth of each species, feeding and population pattern during the study period. Observations were recorded; and hence it was possible to compare/simulate these with observations on sites and locations in the field.

Set 2: Physical characterization

Snail shape, size and live weight, shell color, and number of whorls on shell were measured. The number and identity of snail species collected from all locations was recorded and used to compute relative population of each species. Thereafter, snails were euthanized by breaking the shell and separating the flesh. The weights of flesh and shell were measured accordingly; and then snail flesh was prepared for chemical analyses.

Chemical analyses

Chemical analysis was performed in the Central Analytical Laboratory, in the faculty 6f Agriculture, University of Benin, Benin-City. The AOAC (2011) standard analytical methods were used for determining crude protein (kjedhal), lipids (ether extraction), ASH (minerals) and total soluble carbohydrates (NFE). The mineral content of snail samples was measured using the Unico Spectro-photometry LHW490.395.283, for sodium, potassium, magnesium, calcium and iron, following the methods described Odafe and Olomu (2007). The Giant African land snail (GALS) *Achatina marginata* was also analyzed for comparative evaluation.

Results

Identity and morphology of SALS in Benin-City

Six (6) species of small land snails (SALS) were identified by means of a picture chart. The 6 species all belong to genus: *Lumicolaria* (Table1); and were found to be distributed in the same proportion or relative abundance (Table2) in all the locations, including the city center and peripheral towns in the metropolis. In order to differentiate these *Lumicolaria spp,* a careful study of the picture chart and the morphological features of shape, color and shell pattern of species, described by Mumladze *et al*, (2008) was undertaken; and the six species of SALS identified were *L. flamnae* (black and white), *L.numidica,* (yellow brown), *L.martesiana* (brown), *L.aethiops* (brown), *L. feline* (white), *L.aurora* (white and black). Generally, the SALS exhibited similar shapes but differences in shell color and number of whorls on shell (Table1). The *Lumicolaria spp* showed different patterns of stripes on their shells; this implies that no two different species presented the same pattern. The shapes of snail shell were generally conical, but two of the SALS *L.numidica* and *L.aurora* tended to present slender/narrow cones while others showed broader/ ventricose cones. Shell color among the SALS was variable; *L.flamnae* showed black and white bands on the shell; *L.aurora* white and brown bands; *L.feline* all white; *L. martesiana* all brown; and *L.numidica* yellow brown. The GALS, *A.marginata* showed characteristic round conical shell bearing brown and black stripes (Table1).

Table 1: Identity and morphology of some Small African Land Snails (SALS) in Benin metropolis in Edo State

SALS	SHAPE	SHELL COLOR	NO OF WHORL
L. numidica	Slender conical	Yellow Brown	7
L.martesiana	Conical ventricose	All Brown	7
L. aethiops	Conical ventricose	All Brown	6
L. flamnae	Conical ventricose	Black and white Bands	9
L. feline	Conical ventricose	All white	6
L. aurora	Slender Conical	White & Black bands	9
A. marginata	Rounded cone	Brown & Black	9

Body size measurement and physical characteristics of SALS

The average body size measurements of the different SALS identified and collected from different locations across Benin metropolis are shown in Table2. *Limicolaria flamnae* measured the highest mean value (40.6g) in live weight of the SALS. It also showed the highest mean value for shell length (7.5cm), widest shell circumference (7.0cm) and shell mouth diameter (2.1cm). All the SALS had same mean value for narrowest shell circumference (0.5mm). The differences between them were non-significant for most measurements; but were also non-comparable to the weight and body size of the GALS, *Achatina marginata* which weighed 180g and recorded significantly higher body size indices than the SALS.

Table 2: Average body size measurement of SALS species in Benin metropolis

	L.flammae	*L.numidica*	*L.aurora*	*L.martensiana*	*A.marginata*
Live weight (g)	48.6	42.8	40.9	46.3	180.0
Shell length (cm)	7.5	5.5	5.0	5.0	16.5
Shell circumference wide (cm)	7.0	6.6	6.2	6.0	22.5
Shell circumference narrow (mm)	0.5	0.5	0.5	0.5	2.5
Shell mouth diameter (cm)	2.1	2.0	2.0	2.0	6.5

Growth and population pattern of SALS

The pattern of population distribution of the SALS species in the different locations within the entire metropolis was similar. Four of the species recorded stable relative colony counts / percentage of population, during the rainy season. One specie increased in population percentage as the rains increased, while one reduced with increasing rainfall (Table3). Relative colony count represents the number of each SAL species counted during the rainy season, between the months of March (low rainfall) and July (peak rainfall) in relation of the total count for all snail species expressed as percentage. The number of *L.aurora* was averagely higher than every other snail species, in the month of March, recording a relative population of 26%; and remained stable till July relative count fell significantly to 20%. On the other hand, *L.flamnae* recorded the next highest value of relative count in March (25%) and significantly the highest in the month of July (38%). This indicated steady and significant increases in population of *L flamnae* as the rainy season progressed; whereas bioclimatic or agro-ecological conditions were not favorable for other Lumicolaria species to thrive. Invariably those other species of SALS recorded no significant differences in their prevalence or relative colony counts as demonstrated by *L. flammea* (Table3).

Table 3: Average relative colony count (% of Population) of SALS species found between March (early rain) and July (peak rain) in Benin metropolis

	March (early rainfall)	July (peak rainfall)
L. numidica	17 [a]	17 [a]
L. martesiana	18 [a]	16 [a]
L. aethiops	09 [a]	08 [a]
L.felina	05 [a]	03 [a]
L.flammae	25 [a]	38 [b]
L.aurora	26 [a]	20 [a]

a b - means with same superscript are non -significantly different[p>0.01]

Chemical composition of SALS and GALS

In Table 4 comparison of the chemical composition of GAL *Achatina marginata* and the most common SAL, *Lumicolaria flammae,* is shown. The values of Crude protein, fat (ether extract), ASH and minerals Na, K, P, Ca and Mg were similar between the GALS and SALS.

Table 4: Proximate and Mineral composition of GALS and SALS found in Benin metropolis, Edo State (g/100gdm)

COMPONENT	GALS (*A.maginata*)	SALS (*L.flammae*)
Crude protein	64.70±2.21	65.37±2.35
Ether Extract	2.95±1.28	4.24±1.52
ASH	14.60±2.22	14.14±2.34
Na	2.90±0.65	1.13±0.82
K	3.54±0.19	3.47±**0.**12
P	2.66±1.44	2.31±1,70
Ca	5.72±1.34	4.99±1.33
Mg	1.14±0.78	2.72±0.55
Fe	0.35±0.20	0.28±0.14

Feeding habit of SALS

We observed that most of the snails found in the localities, were clung on the unpainted walls of fences and uncompleted buildings, particularly during morning hours, likely due to moisture on the wall; but also due, likely, to a yet to be ascertained property of cement block. There were SALS habiting bushes and home gardens, found on ground surfaces and at base of stems while some, irrespective of species, clung on the broad leaves of plants such as cocoyam. By noon they crawled back into the ground or under leaves to get shade from sun. All the species found are herbivores, as they fed on the stems, leaves and roofs of garden plants, including potato, yam, cocoyam, papaya, cucumber, and water melon.

Discussion

Characteristics and availability of SALS in Benin-city

Snail species are many and are widely distributed throughout the world (Maltz, 2003). There are indications that the largest living species are sea snails; typically, *Syrinx aruanus,* which was reported to grow up to 90cm in length, and attained live weight up to 18kg (Mumladze *et al.,* 2008). Also there were reports that several species of land snails have giant sizes; for example, some *Achatina spp,* measured 38cm in length from snout to tail, and weighed 1kg (Brunt *et al.,* 1999). There was record of a specimen of the largest known land gastropod, the African giant snail *Achachatina achatina*, which measured 39.3 cm from snout to tail when fully

extended, with a shell length of 27.3 cm, and weighed of 900g (Brunt *et al.,* 1999; Mumladze *et al.,* 2008).

On the other hand, there are the small size land snails; the smallest ever reported was *Acmella nana* (Borneo shells) which measured between 0.50 and 0.60 mm in width and 0.60 - 0.79 mm in height, while the weight was very insignificant. The snail was described as microscopic, very tiny such that it could fit into the eye of a needle (Brunt *et al.,* 1999). Notwithstanding whether a snail is identified as a small or giant size, there are common morphological features between them. However, there are also standard and relevant features / indices which form the basis of identifying and differentiating the genera and species. Some authors (Maltz, 2003; Stringer *et al.,* 2003; Mumladze *et al.,* 2008) enumerated and described those indices of interest which include the color of shell and parietal wall, the snail apex which is the very tip of the shell, and the spire being the last few whorls of the shell. The apex, for example was the significant feature used in telling the difference between an *Achatina* species, having pointed apex, and an *Achachatina,* one with blunt apex. There are also the sutures which are the ridges or depressions along the spiral groove of the shell. The extent of twist of the columella such as evident in *Achatina fulica* is also a significant feature. In addition, the structure and color of aperture and lip i.e. the shell-mouth or edge of the shell, helps in determining the group to which a snail belongs; while the profile of the whorls, the number of whorls and their comparative sizes are helpful in differentiating between species. Hence it was recommended (Mumladze *et al.,* 2008) that at all times, it is necessary and worthy to get clear pictures of these features when identifying the mollusks. Thus based on these features, we observed that two of the SALS, identified and examined in this study, *L.numidica* and *L.aurora,* had very slender bodies; the other four species were ventricose i.e. their bodies were swollen at the bottom side. Some of the SALS had huge body whorls; others had more evenly increasing whorls as was found with the GALS, *A.marginata* (Table 1). Moreover, in agreement with general concept (Stringer *et al.*, 2003) the findings of this study also indicate that both small land snails (SALS) and the Giant African land snail (GALS) have a common morphology; their bodies are divided into two main parts; and they also have similar shell characteristics. The number of grooves (lines) demarcating their shell is in the range 6 – 9 in all the snails (SALS and GALS) examined. This evidently corroborates reports of previous studies in which the structure of the giant snail was described as being made up of two component parts; the first being the anterior and lower part which is muscular and firm and normally lies outside the shell. The second part is the dorsal and posterior and is enclosed within an ecliptal cloaca in an organic matrix of a protein substance conchiocin (Selander and Ochman, 1983; Brunt *et al.*, 1999; Stringer *et al.*, 2003). In this work, the SALS species that we found to abound in Benin-city agro-ecological zone correspond with some which have been identified and reported elsewhere in Australia (Adelaide Research). This suggests that the SALS species are ubiquitous around the world. For example, the species, *Lumicolaria flammae* has been reported to have the potential to reproduce in much drier conditions than other species (Nordsieck, 2007; Mumladze *et al.*, 2008; Welter, 2015). This study also confirmed that this species had many thin lines near suture on the body whorl and obviously on the spire. The shell was less conical, and relatively narrow / slender giving it a bullet-like shape in general profile. Adult shells grew be up to about 7.5 cm in length. Shell

color was light brown with many reddish-brown to dark brown solidly colored axial bands and streaks. The anterior end of columella merged smoothly with the anterior end of the outer lip and was not truncated. The columella was also straight, while the columella pillar was pale purple in the live snail and then faded to white when the snail died. Thus most of the observations, in this study, on the *L. flammnae* occurring in Benin-City, corresponded with the feature descriptions reported by other authors (COA, 2007; Nordsieck, 2007; Mumladze *et al.,* 2008; Welter, 2015). What factors accounted for the prevalence and dominance of *L. flammnae* over and above other *Lumicolaria* species in the Benin-city agro-ecological zone would be worthy of investigation in subsequent research. *L. aurora* was described as a snail that generally attains a height of 60 mm and a width of 28 mm, with 9-9.5 whorls at maturity. The shell is smooth, dull, oblong-ovate and displays a wide range of colors. The umbilicus (navel) is narrow. The eggs are often laid in the soil and have an incubation period of approximately 30 days (COA, 2007; Nordsieck, 2007; Mumladze *et al.,* 2008; Welter, 2015). The *L. aurora* found in Benin weighed 40g; it was slender - conical shaped, 5cm (50mm) in height/ length, 2cm (20mm) width and had 9 whorls; and the colors were black and white bands. *L. martensiana* measured 5cm (50mm) in length, 2cm (20mm) in width/ daimeter and weighed 46.3g. The features were similar to those described previously. The shell was solid, oblong and turreted. The apex was reddish, dark purple-red or black in color. The shell was variegated with oblique, more or less zigzag, opaque creamed-colored stripes, some of which extended from suture to suture, while others were only a short distance from the top of the whorls. The whorls were 7 or 7½ in number, scarcely convex or almost flat, and very feebly constricted beneath the suture. The aperture was about 14mm long and 8mm wide. Aperture color was bluish within, displaying more or less of the external striping, vertical, and equalled about two - fifth of the shell length. Also confirming previous reports, there were variants of these species which had no stripes but were creamy- white in color (COA, 2007; Nordsieck, 2007; Mumladze *et al.,* 2008; Welter, 2015). *L. numidica* was reported to have adult shells that grow up to about 5 cm in length; the shell is smooth, dull yellow - brown, slender/ oblong and ovate/ conical. Those were the features we observed in *L numidica* found in Beni-City The columella was straight; it`s anterior end merged smoothly with the anterior end of the outer lip of the shell, and was not truncated. Reports indicated that there are two variants of this species, the one with dark stripes and the other with light stripes and very light colors (COA, 2007; Nordsieck, 2007; Mumladze *et al.*, 2008; Welter, 2015). In Benin metropolis we found one with a yellow – brown/ beige tone. This species had a narrow umbilicus /navel which corroborated the previous reports.

Food and economic potential of SALS

Snail rearing is not an expensive enterprise. Hence snail species are gradually receiving attention both from researchers and farmers who are concerned about increasing protein sources in human diets. **A**part from being good sources of minerals these mollusks can make a unique contribution to nutrition in many parts of the world by virtue of being a cheap source of protein just as their production cost is relatively low (NRC,1991; Imevbore,1999; Awah, 2000; Ebenebe, 2000; Oji, 2000; Olomu, 2011; Odafe and Olomu, 2011). The most common SALS, *Lumicolaria flamnae,* can thus be exploited along with the GALS, *Achachatina spp*. Snails eat many kinds of plants; both SALS and GALS have been

reported to feed on the leaves of plants such as oil palm, papaya, yam, *Dioscorea spp*, black pepper, cucumber, okra, sweet potato and legumes (NRC, 1991; Hanzat, 2000; Hardovin, 2000; Ebenebe, 2000; Olomu, 2011; Welter, 2015). The nails feed by night, taking cover by day and are most active in warm moist weather generally preferring a heavy moist soil (Hanzat, 2000). Corroborating previous reports, this study observed that the snails were apt to be pest of young growing pawpaw, potato and cucumber stems. In fact, the presence of these plants in some home gardens was the bases of their colony; the snails were especially a danger to newly planted seedling in the garden. Notwithstanding anything, advanced husbandry in which incorporates or combines pomology and snailery should prove to be a worthwhile venture yielding high dividends to the farmer. We observed no carnivorous behavior in the species of SALS during this study; and this places high credence on the SALS as edible food items for humans.

The results of chemical analysis indicated that SALS and GALS have similar nutrient profile as shown by their approximate and mineral composition values (Table 4). The Nigerian population has crossed 200 million; which implies that Nigeria is among the nations experiencing protein crisis (Odafe and Olomu, 2011). There is an increasing patronage of GALS as an alternative source of high quality protein to complement protein intakes of rural communities in Nigeria. Of interest is the fact that a few baskets of SALS for retail can be found along with GALS in the open market in Benin-City during the rainy season when they are readily available (Odafe and Olomu, 2011). Thus research on harnessing the SALS among unconventional food animals is also highly recommended, as it has the potential for comparative nutritional and economic advantage based on its availability and chemical composition. Correspondingly with GALS, studies on the reproduction pattern, genetics and biodiversity of the different SALS, particularly *L. flamnae,* would thus be worthwhile in order to encourage its enrolment in mini-livestock enterprises in Nigeria. Also of interest would be the need for research on the economic value of snail components such as the shell and the slime, especially because there are indications that the slime is potentially useful in cosmetic industry (COA, 2007; Encyclopaedia Britanica, 2009).

Conclusion and recommendation

The findings of this study indicate that the most common SALS in Benin metropolis are *Lumicolaria spp,* of which *L. flamnae* is the most abundant and biggest in size. In comparison both small African land snail SALS and giant African land snail GALS, *Achachatina marginata,* have a common morphology and similar proximate and mineral compositions. Therefore, SALS is a valuable food item like the GALS; it is available particularly during the raining reason period and can be produced as alternative or complementary source of animal protein. This only requires attention by way of research and commercialization. Hence this study recommends the inclusion of SALS in current efforts aimed at developing snail farming in Nigeria.

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