Nigerian J. Anim. Sci. 2018, 20 (4): 485-489

Mineral composition of giant African land snail's (*archachatina marginata*) shells from six south West States, Nigeria

Akinnusi, F.A.O[1]., Oni, O.O[1]. and Ademolu, K.O[2*]

1 Department of Agricultural Science Education, Federal College of Education, Abeokuta
2 Department of Pure and Applied Zoology, Federal University of Agriculture, Abeokuta

Corresponding Author: kennyademolu@yahoo.com

Target Audience: Snail farmers/breeders, animal physiologist, malacologists, and manufacturers

Abstract

The giant African land snails (GALS) have protective shell, which supports and prevents dehydration of the animal. These functions are affected by the chemical composition of the shell. This study examined the chemical composition of shells of giant African land snail, Archachatina marginata, collected from six south western states of Nigeria. Snails were collected from three locations in each state, making a total of eighteen locations across the states. Magnesium, calcium, iron sodium, potassium, chloride and phosphorus concentrations were determined in the shells by standard analytical methods and data were analyzed by one-way analysis of variance (ANOVA). Calcium was the most abundant mineral element in snail shell (1618.89 mg/100g) while chloride was the least (6.37 mg/100g). Ondo state recorded the highest total mineral concentration in the shell (780.0 mg/100g) (though not significantly different from Ekiti state) and Lagos state had the least concentration (745.6 mg/100g). The relationship between these results and environmental factors are discussed.

Keywords: Shell, snails, mineral elements, *Archachatina marginata*, southwest, Nigeria

Description of Problem

Shell plays significant protective and supportive roles in molluscs and land snails in particular. The snail shell is in form of an elongated hollow cone, which is spirally coiled round a central axis called columella (1). The thickness and degree of mineralization of snail shell increase with the age of the snail (2) as well as age of the shell whorls. Ademolu *et al* (3) reported that there was species variation in the size and mineral composition of the shell of three Giant African Land Snails in Abeokuta, Nigeria.

Snail shell has been used extensively in traditional medicine to treat measles, cough and gonorrhea (4). Its applications in wound healing process are not unconnected to high content of calcium and magnesium, which are prerequisite for blood clotting process. In animal husbandry, the shell is used in feed formulations for poultry and other livestock (5). Amubode and Fafunwa (6) likewise reported on the uses of snail shells for aesthetic purposes in cars, homes and offices.

Studies have shown that the composition of snail shell is determined by many factors. Ademolu *et al* (7) observed that location played vital role in the chemical composition of mollusk shell as aquatic molluscs had higher mineral composition than those from terrestrial habitat. In a follow up study, it was observed that older whorls of snail shell had

younger whorls closer to the snail aperture (3). Similarly the diet consumed by snail had been reported to influence the composition of the shell (8).

The south west of Nigeria is composed of six states that vary in vegetation type and rainfall pattern. There was a significant difference in the organic and inorganic substances concentration in the haemolymph of snails across the six southwest states (9) and this can be linked to the different habitats of the snails. However, the influence of these habitats on snail shell is yet to be examined. The goal of this study is to examine the mineral composition of the shell of giant African land snail (*Archachatina marginata*) from the six south western states, Nigeria.

Materials and Methods

Experimental snails

Experimental snails were collected from the six south west states of Nigeria, namely: Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti. Each state was divided into 3 senatorial districts and ten snails were purchased from snail hunters/ gatherers at each of these eighteen locations. The snails were immediately transported to the laboratory of Pure and Applied Zoology Department, Federal University of Agriculture, Abeokuta for further processing and analysis.

Snail processing

Each snail was cleaned and dried with hand towel after which it was de-shelled following methods used by Ademolu *et al* (3). 50 C for 48 hours, ground into powder and kept in clean and dry plastic bottles for further chemical analysis.

Chemical analysis

The powdered forms of the shells from each state were analyzed for various mineral elements. Na^+ and K^+ were analyzed using flame photometry, while Mg^{2+}, Ca^{2+}, Fe^{2+} and P were determined using Atomic Absorption Spectrophotometry (AAS) (Model AA403). Cl^- was determined by methods of Henry *et al* (10).

Statistical analysis

The data collected from the analyses were analyzed using one-way analysis of variance (ANOVA) and means of separation was done by Duncan Multiple Range Test (11).

Results

The chemical composition of the snail shells from the six south west states of Nigeria is shown in Table 1. The entire mineral elements tested for were present in the shells, though in varying concentrations. The mineral element with highest concentration was calcium (260.75 – 279.68 mg/100g). Phosphorus was also high in the shells varying between 196.27 mg/100g and 206.08mg/100g.

Ekiti state had highest concentrations in Mg^{2+}, Fe^{2+} and K^+ (though not significantly different from Ondo state), while Ondo state had highest concentration in Ca^{2+}. Snail shells got from Lagos state recorded least concentrations in Mg^{2+}, Fe^{2+} and K^+.

Table 1: Mineral (Mg/100g) Composition of land snails from southwest states, Nigeria

States/Mineral Elements	Mg^{2+}	Ca^{2+}	Fe^{2+}	Na^{+}	K^{+}	Cl^{-}	P
Osun	139.78^{a}	260.75^{d}	2.15	27.56^{a}	125.75^{a}	0.98	196.27^{c}
Lagos	134.72^{b}	264.56^{cd}	2.06	22.04^{c}	120.66^{b}	1.30	197.24^{c}
Oyo	139.78^{b}	267.43^{c}	2.32	27.90^{a}	127.74^{a}	0.96	206.08^{a}
Ondo	140.70^{a}	279.68^{a}	2.38	25.56^{b}	126.42^{a}	1.09	204.30^{a}
Ekiti	141.52^{a}	273.40^{b}	2.40	27.06^{a}	127.52^{a}	1.02	201.63^{b}
Ogun	138.30^{ab}	273.03^{b}	2.33	23.92^{c}	124.09^{ab}	1.03	198.75^{c}
Total	834.79	1618.89	13.64	154.04	752.18	6.37	1204.26

Means in the same column having similar superscripts are not significantly different at $p < 0.05$

Figure 1 shows the summation of all the minerals found in the shells of snails collected from the six south west states. Ondo state had the highest total mineral concentration followed by Ekiti state while Lagos state recorded the least.

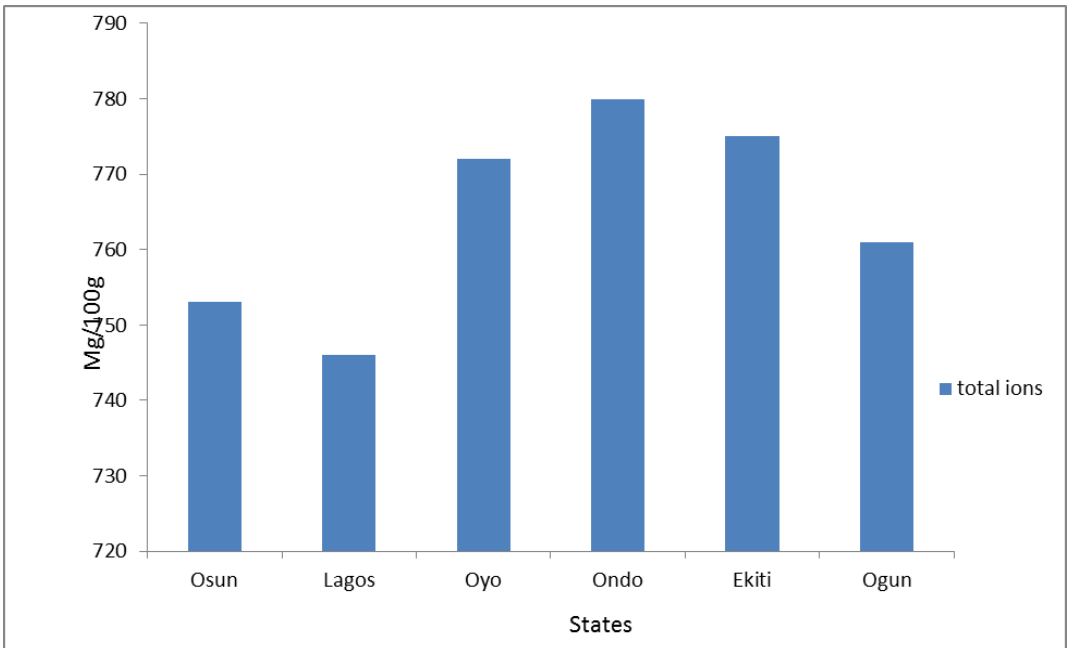

Figure 1: Total mineral composition of snail shell from south west states

Discussion

The major function of snail shell is to protect and support the soft body of the animal. The higher the concentrations of calcium and phosphorus in the shell, the stronger the shell and its ability to perform these functions. Higher concentrations of calcium in this experiment confirmed that $CaCO_3$ is the main component or element in shell of molluscs (7, 12).

Phosphorus is a very vital component of the biosphere as it is involved in basic metabolic process of energy transfer (13). The high amount of phosphorus in the shells of snails from the southwest states of Nigeria supports this fact. The high phosphorus concentration in the shell might be due to its inclusion in conchiolin, a major component of mollusk shells as well as the presence of CaPO4 in the snail shell (13).

Ondo State recorded the highest total mineral element in the shell, which is not statistically different from Ekiti state. These two states are very close to each other and share boundaries. They are both characterized by many high trees (canopy), which form a typical tropical rain forest. This type of environment has high relative humidity and low temperature, which contribute positively to the growth of land snails. Humidity plays an essential role in habitat presence and geographical distribution in terrestrial snails (15).

Earlier study by Abdel-Rehin, (16) showed that relative humidity and temperature had significant effect on the nocturnal activities of different shell color morphs of land snail, *Arianta arbustorum*. Similarly, more nutrients are available in the soil of tropical rain forest derivable from fallen leaves and high soil tilling and aeration activities of micro arthropods abundant in the habitat (17).

Lagos state is characterized by heavy rainfall due to its nearness to the oceans (18). This heavy rainfall probably exposes the soil to flooding that washes away soil nutrients, making them less available to soil ingesters like snails and this might be responsible for less mineral content in the snails' shell. Also high level of pollution in Lagos state might cause low shell mineral concentration. Discharges and exhaust from vehicles and industries find their ways to both cultivated and uncultivated farm lands inhabited by snails and thereby disrupting the soil composition that is ingested by the snails. Dagmar *et al* (19) observed that habitats contributed significantly to land snail shell decomposition rates.

Conclusion and Application

In conclusion,

1. Habitats and environmental factors can influence snail shell mineral composition
2. Snail shells from Ondo and Ekiti states have more mineral elements than other states in southwest, Nigeria.

References

1. Yoloye, V.L. (1994). Basic invertebrate Zoology. University Press, Ilorin, Nigeria. 3rd Edition pp 131-135
2. Barker G. M. (2001). The biology of terrestrial molluscs. CAB International, Hamilton, New Zealand.pp125-130
3. Ademolu,K.O.,Olaniyi,P., Ebenso,I. and Idowu,A.B.(2016). Morphometrics and mineral composition of shell whorls in three species of giant African snails from Abeokuta, Nigeria. *Folia Malacologica*. 24 (2):81-84.
4. Akinnusi,F.A.O. (2002). Introduction to snail and snail farming. Triola Publishing Company, Abeokuta,70pp
5. Houndonougbo M. F., Chrysotome C. A., Odoulami R. C., CodjiaJ. T. (2012). Snail shell as efficient mineral feedstuff

for layer hens: effects and optimum rate. *Livestock Research for Rural Development*. 24: 1–7.

6. Amubode A. A. and Fafunwa, F. (2014). Snail farming and hospitality industries. In: AbionaJ. A., OsunsinaI. O. (eds). Proceedings of the 3rd International Conference on Giant African Land Snails (NeTGALS). Federal College of Education, Abeokuta, Nigeria, pp. 31–36.
7. Ademolu K. O., AkintolaM. Y., Olanloye A. O. and Adelabu B. A. (2015). Traditional utilization and biochemical composition of six mollusc shells in Nigeria. *Revista de Biologia Tropical* 63: 459–464.
8. ZongXiu,L.,ZhaoYan,G.,Naiqin,W. and Bing,X. (2007). Diet control on carbon isotopic composition of land snail shell carbonate. *Chinese Science Bulletin* 52(3):388-394
9. Akinnusi, F.A.O., Oni, O.O. and Ademolu,K.O. (2018). Haemolymph biochemical properties of giant African land Snail (*Archachatina marginata*) from southwest, Nigeria. *Journal of Molluscan Research* 4: 40-44
10. Henry, R.J., Canon, D.C. and Winkalman, J.W. (1974). Clinical chemistry: Principle and technique 2nd ed. Harper and Row Publishers. New York. pp. 54-56.
11. Duncan,D.B.(1955). Multiple Range and F-test. *Biometric* 11:1-24.
12. Egonmwan, R. I. (2008). Effects of dietary calcium on growth and oviposition of the African land snail *Limicolaria flammea* (Pulmonata:Achatinidae). *Revista de Biología Tropical*, *56*(1), 333-343.
13. Kuenzler, E.J (1961). Phosphorus budget of mussel population. *Limno Oceanogr* 6(4):400-415
14. Jurkiewicz-Karnkowska, E. (2002). Differentiation of Phosphorus Concentration in selected Mollusc Species from the Zegrzynski Reservoir (Central Poland):Implications for P accumulation in Mollusc communities. *Polish Journal of Environmental Studies 11*(4): 355-359
15. Richards, J.C. (2012).Moving at a snail pace: the effect of temperature and humidity cues on the behavior of *Littorina subrotundata.*M.Sc. Thesis submitted to the University of Guelph, Ontario, Canada, 92pp
16. Abdel-Rehim,A.A. (1983). The effects of temperature and humidity on the nocturnal activity of different shell color morphs of land snail *Arianta arbustorum* . *Biological Journal of Linnaean Society*. 20: 385-395.
17. Oke, O.C. and Chokor,J.U. (2009). The effect of land use on snail species richness and diversity in the tropical rainforest of South-western Nigeria. *African scientist* 10(2): 95-108
18. Salau, O.R. (2016). The changes in temperature and relative humidity in Lagos state, Nigeria. *World Scientific News* 49 (2): 295-306
19. Dagmar,R.,Janovsky,Z., Horsak,M. and Jurichova,L. (2018). Shell decomposition ratio in relation to shell size and habitat conditions in contrasting types of central European forest. *Journal of Molluscan Studies* 84: 54-61