ORIGINAL ARTICLE

Nutritional Value and Health Status of Giant African Land Snails (*Archachatina Marginata*) from Three Different Sale Points

Ademolu, K.O[1*]., Onadeko, D.E[1]., Aladesida, A.A[1]., Odedara, O.O[2]. and Adelabu, B.E[2].

[1]Department of Pure and Applied Zoology, [2]Department of Microbiology, Federal University of Agriculture, Abeokuta, Nigeria.

* Author for corresponding: kennyademolu@yahoo.com

ABSTRACT

Snails contribute to the good health status of man as they are very rich in protein and minerals. The impact of sale points on the nutritive value and health status of giant African land snail, *Archachatina marginata* were investigated in this study. Snails purchased from market, farm (snailery) and roadside were analyzed by standard methods for proximate (crude protein, carbohydrate, ash, fibre and fat), mineral (Na^+, K^+, Fe^{2+},Ca^{2+} and Cl^-) and anti-nutrient composition (tannin, saponin, alkaloids, oxalate and phytate). The total microbial load and microorganisms on the snails flesh were isolated and identified by conventional microbiological protocols. Snails sold at the farm had significantly ($p<0.05$) higher protein content than snails from other sale points. There was no significant difference in the fat, ash, carbohydrate and mineral composition of snails from the three sale points. However, snails purchased from the roadside recorded the highest anti nutrients content, while snails from the farm had the least. The total microbial load on flesh of snails sold at the market was significantly lower ($p>0.05$) than other sites. Many bacteria and moulds were isolated from the flesh of the snails from the three locations. It can be concluded that sale points significantly influenced snails' nutritive and health status.

Keywords: *Archachatina marginata*, nutrients, snail market, snailery, roadside

INTRODUCTION

The contribution of snails to the health and economic status of Nigerians cannot be over emphasized. Snails are rich in protein, minerals but are low in in fats. (Imevbore and Ademosun 1988 and Idowu *et al.,* 2008). The increase in awareness of benefits derivable from snails has led to their domestication in various housing units like: pen , baskets cages and others. However, supply of snails is yet to meet up with the demand for its products locally and internationally.

Economically, snails contribute to the sustainability and maintenance of rural families as 34 -76% of rural income was derived from its sales (Adedoyin *et al.*, 2016). Ademolu *et al* (2012) compared the nutrition values of snails from two rearing systems. Snails from the wild (extensive system) had more flesh protein, minerals and vitamins than those raised in the snailery because of easy access to different types of food and large space.

Snail body is composed of three parts: head, foot and the visceral mass. The shell is made up of whorls of varying sizes and mineral composition (Ademolu *et al.,* 2016). Although all snail parts (shell, haemolymph, flesh and visceral mass) are useful industrially and domestically, only the flesh is consumed by families in Nigeria. However, best practices of hygiene are required while handling and processing snail flesh as its intestinal content and fluid contain zoonotic pathogenic bacteria like *Yersinia pestis (* Ebenso *et al*., 2016).

Snails for human consumption are derived from farms, the wild, market and road side (Adedoyin *et al.,* 2016). These locations exposed snails to situations or factors that can affect their behavior and physiology. The thrust of this study is to evaluate the nutritive composition and microbial status of snails sold at three different points in Nigeria.

MATERIALS AND METHODS

Snail Samples Adult snails (*Archachatina marginata*) samples ($\pm$ 165.20g) used in this study were gotten from three snails sales points, namely : a market (Lafenwa market, Abeokuta, Nigeria), a snailery (Forestry and Wildlife Department, Federal University of Agriculture, Abeokuta(FUNAAB), Nigeria, snail pen) and at a road side snail point (Ibadan-Ife express Road, Osun state, Nigeria). Twenty-five snails were purchased from each site (making a total of 75 snails).

The purchased snails were immediately transported in ice cooler to the laboratory of Pure and Applied Zoology Department, FUNAAB, where they were dissected by methods described by Ademolu *et al* (2013). The flesh samples were kept in the refrigerator (-10^{0}C) until further analysis.

CHEMICAL ANALYSIS

The proximate composition (crude protein, fibre, ash, fats and carbohydrate) of the snail flesh samples from three sales points were determined using A.O.A.C (1990) methods.

Anti nutrients (Tannins, saponin,alkaloids, oxalate and phytate) and mineral (Na^+, K^+,Fe^{2+}, Ca^{2+} and Cl^-) compositions were determined by methods described by Udoh *et al* (1995).

MICROBIAL ANALYSIS

Total microbial load and identification of snail flesh samples from three sales points were carried out following the methods described by Gadi *et al* (2014).

STATISTICAL ANALYSIS

Data collected from experiments were analyzed using One-way analysis of variance (ANOVA) and separation of significant means was done by Duncan Multiple Range Test.

RESULTS

The proximate composition of snail flesh samples from three sale points is presented in Table 1. The crude protein content of the snails varied from 15.68 to 21.44 %. The snails bought at roadside had the least value while those from farm (snailery) had the highest value. Point of sales did not significantly (p>0.05) affect the crude fat, ash and carbohydrate contents of snail flesh.

Table 1: Proximate composition of snails from different sale points*(%)

Sample	Moisture Content	Fat Content	Ash Content	Crude Fibre Content	Crude Protein Content	Carbohydrate Content
Road side snails	79.65[a]	1.39	1.28	0	15.68[c]	2.02
Market snails	77.84[a]	1.53	1.41	0	17.21[b]	2.02
Farm snails	72.32[b]	1.89	1.75	0	21.44[a]	2.61

*Mean values in the same column having different superscript are significantly ($p<0.05$)different

Table 2 presents the mineral composition of the snails from three sale points. Na^{2+}, K^{+}, Fe^{2+}, Ca^{2+} and Cl^{-} were found in the flesh of the snails , but there was no significant different ($p>0.05$) in their concentrations across the three locations. It is noteworthy that Cl^{-} had a very low concentration compared to other minerals (0.011-0.016 mg/ 100g).

Table 2: Mineral composition of snails from different sale points (mg/100g)

Sample	Na^{2+}	K^{+}	Fe^{2+}	Ca^{2+}	Cl^{-}
Road side snails	0.706	3.93	0.03	0.117	0.014
Market snails	0.719	3.77	0.027	0.119	0.011
Farm snails	0.726	3.86	0.034	0.125	0.016

Anti-nutrients were detected in the flesh of the snails and their concentrations varied significantly ($p<0.05$) across the three locations (Table 3). Road side snails recorded significantly higher levels than snails from other locations. Similarly, oxalate levels ranked highest in the snails, followed by tannin, while phytate was the least.

Table 3: Anti-nutrients composition of snail from different sale points (mg/100g)

Sample	Tannin	Saponin	Alkaloid	Oxalate	Phytate
Road side snails	16.85[a]	11.92[a]	27.69[a]	109.82[a]	6.54[a]
Market snails	14.97[b]	10.75[b]	22.82[b]	95.03[c]	4.84[b]
Farm snails	10.56[c]	4.57[c]	18.44[c]	67.61[b]	2.29[c]

*Mean values in the same column having different superscript are significantly ($p<0.05$) different.

The total microbial load and identified organisms from the snails purchased at the three sale locations are shown in Table 4. Snails from the farm and road side had significantly ($p>0.05$) higher microbial load than snails from the market. Different bacteria and mould organisms were isolated from the snail flesh. While some organisms were common to snails from the three locations, penicillin spp was peculiar to snails from the farm.

Table 4: Microbial load and microorganisms Identified from snails bought at different sale points

Sample site	Total microbial load	Microrganisms
Farm	2.19 x10^{7b}	*Staphylococcus aureus, Escherchia coli, Baccillus subtilis, Aspergillus niger, Rhizopus stolonifer, Mucor mucede, Penicillum sp, Enterobacter sp, salmonella sp*
Roadside	2.82 x10^{7a}	*Staphyloccus aureus, Streptobaccillus* sp, *Enterobacterium* sp, *Rhizopus stolonifer, Mucor mucedo, Enterobacter sp, Salmonella sp, Shigella sp*
Market	8.64 x10^{6c}	*Athrobacter* sp, *Staphylococcus aureus, Baccillus subtilis, Streptobaccillus sp, Streptococcus sp, Baccilis subtilis, Escherchia coli, Rhizopus stolonifer, mucor mucede, Aspergillus niger, Enterobacter sp, Salmonella sp*

DISCUSSION

The crude protein of the experimental snails from three sales points ranged from 15.68% to 21.44% which is very close to the values earlier recorded by other snail scientists (Ademolu *et al*., 2012 and Idowu *et al*., 2008). Snails are good source of protein and compete favourably with other conventional sources of animal protein like beef, pork and mutton (Imevbore and Ademosun , 1988). Similarly, the fat content recorded for snails in this study agrees with earlier values recorded for snails (Idowu *et al*., 2008). The low fat content of snails makes it ideal for everybody as it cannot cause nor complicate cardiovascular diseases. Snails from farm (snailery) had significantly higher protein content than snails from other locations. Type of management procedure might be accountable for this as snails raised at the farms had access to good diets and space which were not true for snails at the roadside and market. Road side snails were hung in ropes and starved until they are purchased. Similarly, snails sold at the markets are usually kept in baskets without food for days which make them undergo aestivation. Ademolu *et al* (2007) observed that type of diets not only affected growth but nutrient composition of the snails. Furthermore, exposure to continuous sun heat at the road side might have denatured the body protein of the snails as protein are destroyed at high temperature (Odiete, 1999)

Snails like other ectotherms cannot tolerate excess salts in their diet which can result in death (Akinnusi, 2002). Snails from the three locations recorded very low concentration of Cl^- in their flesh which possibly is a reflection of their low salt diet.

The road side snails had significantly more anti nutrients than sites in the study. The inhalation of vehicular fumes at the high traffic express road might be responsible for these elevated values of anti-nutrients in the snail flesh. Eeva *et al* (2010) reported that pollution had significant influence on the shell mass and quality of land snails.

The microbial load on the flesh of snails from the road side was higher than those from the market. Often times, snails sold at the market are kept in baskets (Akinnusi, 2002) and starved which makes them less exposed to microorganisms' infection which majorly comes from diets consumed by them.

Numerous microorganisms (bacteria and moulds) were isolated from the flesh of the experimental snails and most are inimical to the health of its consumers. Similar microorganisms were reported to be present in the gut of giant African land snails (Adedire e*t al* .1998 ; Idowu *et al*., 2008 and Yoloye, 1994). This suggests that there is microbial connection or linkage between the snail flesh and its gut. This might not be unconnected to the use of its ventral foot for creeping the soil already polluted with microorganisms' ladened excreta of the snail itself.

CONCLUSION

The point of sale of snails had significant effect on the nutrients derived from the snails as well as the health status of the snails. Hence, purchase of snails for consumption from reputable farms and thorough cooking of snails' flesh before eating are recommended.

REFERENCES

Adedire, CO,Imevbore, EA, Eyide,EO and Ayodele, W.I. 1999. Aspects of digestive physiology and the complimentary roles of the microbial enzymes in the intestinal tract of the giant land snail. *The Journal of Technoscience* 3:6-13

Adedoyin,AA, Adedoyin, OO. and Mosobalaje, M.A. 2016. Challenges to increased snails production in Ibarapa Areas of Oyo State, Nigeria. *Nigerian Journal of Animal Production* 43:260-263

Ademolu, KO, Idowu, AB, Mafiana, CF and Osinowo OA. 2007. Performance, Proximate, and Mineral Analysis of African Giant Snail (*Archachatina marginata)* Fed different Nitrogen sources. *Tropical veterinarian* 25(4):124-131.

Ademolu, KO, Idowu, AB, Jayeola, OA,Osunsina, I, Dedeke, GA, Oluwafemi, F and Ibie,E. 2012. Influence of different management systems on gut microbes and chemical constituents of Giant land snail *(Archachatina marginata*). *Nigerian Journal of Animal Production* 39 (11):179-186

Ademolu, KO,Akanmu,ET, Dedeke, GA and Jayeola, OA 2013. A preliminary chemical and structural analysis on the albumen gland of three snail species found in Abeokuta, Ogun State, Nigeria. *Pertanika Journal of Tropical Agricultural Science* 36 (1):35-42.

Ademolu, KO.Olaniyi, P, Ebenso, I. and Idowu, AB.2016. Morphometrics and mineral composition of shell whorls in three species of giant African land snails from Abeokuta, Nigeria. *Folia Malacologica* 24(2):81-84.

Akinnusi, O. (2002). Introduction to Snail and Snail farming. Triola Publishing Company, Abeokuta, 70pp.

A.O.A.C (1990). Association of Official Analytical Chemsit. Ed. W. Horwitz 13th edition Washington, D.C 1141pp.

Ebenso,IE,Abraham,EE and Idowu, OS. 2014. Antibiotic multidrug resistance of *E.coli* and *Salmonella* spp from contaminated edible land snails. *Nig.J.Anim.Sci*. 16(1):173-179

Ebenso, IE,Effiong, OE,Ndelekwute,EK, Ademolu, KO. and Ibom, LA. 2016. Prevalence of zoonotic pathogenic bacteria (*Yersinia pestis*) in the gut of Giant African land snail (*Archachatina marginata*) sold in Uyo markets. Proceedings of the 5th International Conference on Giant African Land Snails (NeTGALS) (pp. 72-77). University of Calabar, Calabar, Nigeria.

Eeva,T, Raini, OK and Suominen, O. 2010. Effect of pollution on land snail abundance, size and diversity as resources for Pied flycatcher, *Ficadula hypoleuca. Sci Total Environ* 408 (19): 4165-4169

Gandi, BR, Olusola,OO. and Bawa, GS. 2014. Quality characteristics and microbial status of beef smoked with different plant materials. *Nigerian Journal of Animal Science* 16(1): 157-165

Idowu, AB, Somide OM and Ademolu, KO. 2008. Comparative analysis of the chemical composition of the haemolymph, flesh and microflora content of the guts of some African land snails in Abeokuta, Nigeria. *Tropical veterinarian.* 26 (1&2):20-29.

Imevbore, EA. and Ademosun, AA. 1988. An evaluation of the nutritive of the African giant land snail, *Archachatina marginata* in relation to some popular protein sources. *Journal of Animal Production Research* 8(2):76-87

Odiete, WO. 1999. Basic Animal Physiology. Diversified Resources Ltd., Surulere Lagos. Pp 34-45

Udoh,AP, Akpanyung,EO. and Igiran, EI. 1995. Nutrients and antinutrients in small snails (*Limicolaria aurora*). *Food Chemistry* 53: 239-241.

Yoloye, VL. 1994. Basic Invertebrate Zoology. University Press, Ilorin, Nigeria. 3rd Edition pp. 139-145.