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EFFECT OF AGE OF *Archachatina marginata* ON MEAT BIOSAFETY AND CARCASS YIELD

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ABSTRACT

Ninety snails (*Archachatina marginata*, swainson), which comprised 30 each of adults (325.43 ± 2.03g), growers (119.05 ± 1.05g) and snailets (33.05 ± 1.00g) were used to determine the lifecycle nutritional and bio-safety benefits of consumption of snail meat. Each age group was regarded as a treatment, for the holistic determination of the proximate, macronutrient, heavy metals, lipid profile and carcass yield of the snail meat.

Snail were carefully cleaned and dressed for meat samples collection in triplicates for subsequent laboratory determination of the nutritional and bio-safety parameters. The collected samples were processed, using standard procedures. Data were collected for proximate components (Crude protein, crude fiber, Ether Extract, NFE and Ash), macronutrients (Na, K, Ca, P, Mg and Fe) heavy metals (Cu, Pb, Ni, Cd, Cr and MN), total cholesterol and lipid profile (HDL, LDL and FFA) and carcass yield. Data collected were subjected to (ANOVA), in a complete randomized design, while significant means were separated using Duncan's Multiple Range Test.

Proximate components such as Crude protein 15.88±1,39% and ether extract 1.24 ± 0.22%, increased ($P<0.05$) with the age of snail, while NFE reduced with age. Highest ($P<0.05$) carcass yield (44.23%) was obtained for snailets, with corresponding least ($P<0.05$) values for total cholesterol, LDL, HDL and FFA, cholesterol levels were significantly varied, in all groups and the contents of macronutrients and heavy metals in snail meat were tolerable in human nutrition and therefore not deleterious.

Keywords: Snail Meat, Carcass Yield, Nutrients Heavy Metals, Macronutrients,Age.Biosafety.

INTRODUCTION

Food items are produced throughout the year, due to the need to feed on a daily basis, this encompasses crops and animals. Animal been protein source is a very vital component of the human food chain (Mogbo et al.,2014) and has been discriminated to be grossly inadequate in the diets, in most developing countries, (Musa et al., 2018).

In order to salvage the gross in adequacy of conventional animal protein sources like cattle, sheep, Goat, Poultry and others, non-conventional protein sources, such as the micro-livestock like Quail, Snail and Guinea fowl are cheaper alternatives within the reach of the rural dwellers, who are regarded as poor (Ejidike and Oyekunle, 2019).

The importance of protein of animal origin in the nutrition of human is very important, because of its high level of crude protein, balanced amino acid profile and its complementary effect in the utilization of mineral and vitamins from plant sources (Akinnusi etal 2018). Proper body metabolism is sustained by the adequacy of feed intake and nutrients. The F.A.O. is concerned about the increasing trend of protein deficiency related diseases among Nigerians (Sodipe, 2018). Many factors have been implicated, such as poor quality breeds of animals, pest and diseases and inadequacy of livestock. Stakeholders in the nutrition and livestock industry are exploring non conventional sources of animal protein such as rabbits, grasscutter, snails etc as cheap and readily available alternatives (Felix etal 2013 and Ademolu 2014).

Snails consumption is common and gaining more acceptability in the rain forest of Nigeria as a source of protein. It is generally a common practice for people to gather snails immediately after rain and at night, when they are more active, due to their nocturnal nature (Sodipe, 2018). This trial is aimed at investigating the nutritional and biosafety benefits of consuming snail meat collected from the wild, in order to assess the effect of the environment on the meat of the commonest species of land snail (Archatina marginata) in Nigeria (Ukpong, 2509). The quality assurance of food is an important safety indices of consideration in the promotion of good health and safe nutrient intake. The F.A.O. is equally concerned with the amelioration of protein intake deficit in Nigeria by promoting the domestication and consumption of, micro livestock, such as snail, grasscutter and rabbits, since the conventional livestock is limited in supply and characterized by their poor genetic characteristics (Akinnusi 2018).

Snail meat is an excellent source of minerals and thus recommended for good health and treatment of certain ailments, since mineral salts are important component of metabolic reactions, serving as catalysts and part of enzymes. Its consumption has been successfully adopted for the control of malnutrition in children, rickets, osteoporosis and night blindness, thus promoting the health of rural and urban populace. In order to ascertain the quality of snails consumed, the three age categories of Archachatina marginata (adult, growers and snailets) were adopted for this trial, in order to ascertain that the quality of snail meat is not compromised, in terms of the proximate parameters, mineral elements and heavy metals, which can affect the health of consumers.(Oredein *et al* and Richard and Prabha 2002*)*

Snail farming is becoming a very popular vocation, due to its embracement as an empowerment and job creation avenue by the Federal Government of Nigeria (Oropo et al, 2019). It has been adjudged as a self sustaining business, requiring small

capital, land and other logistics, with resultant job creation potentials, along its value chain; for collectors, farmers, marketers, and research scientists (Akinnusi et al, 2018and Adeniyi et, al., 2013).

An analysis of snail market, revealed that snails of different breeds, such as Archachatina marginata, Archatina achatina, Achachatina fulica and Limicolaria species are restricted to the southern parts of Nigeria, with the predominance of Archachatina marginata (Kehinde, 2009). Snail gathering is very popular is West Africa, especially during the raining season, in the forest ecological zones (Edem, 2019), this is not sustainable, due to the decline in snail population and an ever increasing human populations combined with other factors, such as climate change human activities, like deforestation, construction, use of agrochemicals and unregulated land use system Edem ,(2019). Research activities are now focused on the promotion of organic agriculture, thus promoting snail production for good health of the populace, food security,improved income,without compromising the environment from pollution and green house gases (Brundtland,1987).This will ensure a better future for micro livestock conservation and production.

Musa et, al., 2018 inferred that environment and soil have a significant influence on the chemical and proximate composition of snail meat, shell and haemolymph, since they hibernate in the soil, feed on decaying plants and crops. In order to ensure that humans are fed with safe animal protein from Snails, effort is made to evaluate the meat of Archachatina marginata for its nutritional properties and bio-safety to humans.

Africa Giant Land Snail or Black Snail (Archachatina marginata) is very common in Nigeria and most research resources is concentrated on its breeding, multiplication and utilization, humans must however feed on rich and safe food, hence the need for this study to further investigate, the nutrients, heavy metals and bio-safety of snail consumed by Nigerians, due to increasing industrialization, use of agro-chemical mineral exploration, fumes from vehicles and improper disposal of refuse and sewage.

MATERIALS AND METHOD

Experimental Animals

Ninety Snails (Archachatina marginata), which comprised of thirty each of snailets, growers and adults were sourced from collectors from rural settlement in Oluyole local Government Area of Oyo state, Nigeria, to ascertain the nutritional and bio-safety properties of snail meat . The three categories had a corresponding weight of 328.43 ± 2.0g, 119.05± 1.5 and 33.05 ± 1g for adult, growers and snailets respectively.

Snail Processing for Carcass Analysis

Individual snail was cleaned with distilled water, after which the shell was carefully broken for the separation of the shell, visceral mass, foot, for carcass yield analysis. This was done for each adults, growers and snailets. 5g of muscle was collected from each sample, further washed with distilled water and stored at -18^0c prior to analysis (Chukwujindu et al., 2008).

Chemical Analysis of Snail Meat for Heavy Metals

Collected samples were pre-digested in 10ml concentrated $HN0_3$ at 135^0c until the liquid was clear. Then followed by the addition of 10ml $HN0_3$and 2ml $Hcl0_4$, until the liquid becomes clear and colorless. The digest was slowly evaporated till near dryness. Then, dissolved in 1M $HN0_3$, filtered through Whitman N01 filter paper and diluted to 25ml with 1m $HN0_3$, the resulting solution was analyzed for with Cd, Pb, Zn, Mn, Fc, Cu, Cr and Co, with graphite furnace atomic absorption spectrophotometer (GBC scientific equipment seas AA). Control procedure was carried out for result reliability.

PROXIMATE AND MACRONUTRIENT ANALYSIS OF SNAIL

The proximate composition of snail meat was determined by the official method of analysis as described by the Association of official Analytical Chemists (A.O.AC, 18th edition, 2005). This elicited the component crude protein, crude fiber, ether extract, Nitrogen free Extract, Ash and Moisture. All analyses were carried out in triplicate.

The level of calcium, potassium and sodium was determined by the method of A.G.Arc. (975.11), by the use of Jenway digital flame Photometer (PFP7, model). Phosphorus content of meat samples was determined by the use of spectrophotometric method (A.O.A.C 975.16) and magnesium by A.O.A.C (975.23)

DETERMINATION OF CHOLESTEROL CONTENT AND PROFILE OF SNAIL MEAT

The cholesterol content of snail meat samples was determined to elicit total cholesterol and component High Density Lipid (HDL), Low Density Lipid (LDL) and Free Fatty Acid (FFA), using the procedure highlighted by Idowu et al. (2008)

STATISTICAL ANALYSIS

Data collected were subjected to Analysis of variance (ANOVA), using complete Ramdomised Design, while significant means were separated ($P<0.05$), using Duncan's Multiple Range Test (1995) as explained by Sam et al (2008).

RESULT AND DISCUSSIONS

Proximate Composition of the Meat of Different Age Categories of *Archachatina marginata*

Table 1 shows the proximate parameters in the different age groups of Archachatina marginata, which varied significantly ($p<0.05$) in all the treatment. All proximate constituents, such as dry matter 19.61 ± 1.14% crude protein, 15.83 ± 1.39%, ether extract, 1.24 ± 0.22% and Ash, 1.18 ± 0.16%, were highest ($P<0.05$) in adult Snails; except its carbohydrate component (Nitrogen Free Extract), which reduced ($P<0.05$) from snailets to adults.

Highest dry matter, crude protein, either extract and ash is not unexpected, since they are required for growth development and formation of reproductive parts (Akinnusi et al 2018), there is however an inverse relationship between the level of crude protein and NFE, with the highest value of 62.14% in Snailets. The increased requirement for sugar for body process could be responsible for the observed variation. Adult snails are more active and has more requirement for energy substrate

(Akinnusi et al, 2018). All age categories were good sources of protein and low in either extract, which is consistent with the findings of Ogunsanmi *et al.,* 2019 and Ejidike and Oyekunle (2019).

Table 1: Proximate composition of the meat of different age categories of Snail (*Achachatina marginata).*

Parameters (%)	Ti (Adult)	T2 (Grower)	T3 (Snailet)	± SEM
Dry matter	20.75	20.07^{b}	19.61^{b}	0.50
Crude protein	17.22^{a}	16.30^{b}	15.83^{b}	0.50
Ether Extract	1.46^{a}	1.35^{ab}	1.24^{b}	0.15
Ash	1.34^{a}	1.24^{b}	1.18^{b}	0.06
Nitrogen Free Extract	59.23^{b}	60.04^{b}	62.14^{a}	1.10

abc: Means along the same row with different superscripts are significantly different (P<0.05).

Carcass Yield of Snails

The carcass yield of *Archachatina marginata* was elicited in table 2. This showed the dressing percentage, which was estimated from the weight of foot divided by total live weight, expressed as a percentage. All values for carcass analysis parameters were significantly (P<0.05) varied. Highest shell weight (17.17%) and least offal weight (36.27%) and dressing percentage (34.25%), were obtained for adult snails. Highest dressing percentage (44.23%) was obtained is snailets. Shell accounted for 29.45% in adult snails due to its size, thickness and shell calcification (Akinnusi *et al.,* 2018).

Offal weight (42.35%) was highest in growers, because of its active rate of formation of internal organs, such as reproductive, digestive excretory and others. The foot, which is the edible part of snail was least in adult snail, the low values of less than 40% is characteristic of snails from the wild, without any organized feeding programme and an indication that balanced diet is required for good carcass yield in snails (Omole, 2002). The lower the offal and shell weight, the higher the dressing percentage.

However, for the purpose of conservation and prevention of extinction, the consumption of snailets is discouraged, through advocacy (Edem), 2019), because many generations of snails are aborted, by preventing, maturity, egg laying and reproduction. The determination of carcass yield gives an indication of feed utilization, feed quality and meat yielded by snail. An average farmer planning his foundation stock of snail is guided by the fullness of the foot in the shell, low carcass yield is an indication of starvation, aestivation and unfavorable environment condition. The result revealed that snail carcass yield is lower than that of grasscutter (60%) and 55% each for rabbit and goat (Ukah *et al.,* 2006).

Table 2: Carcass Analysis of Different age categories of snail *(Archachatina marginata)*

Parameters (mg/100g)	Ti (Adult)	T2 (Grower)	T3 (Snailet)	± SEM
Live weight (g)	328.43	119.05	33.05	
Small Weight (%)	29.45^{a}	21.95^{b}	17.17^{c}	1.53
Offal Weight(%)	36.27^{c}	42.35^{a}	38.59^{b}	0.94
Dressing (%)	34.25^{c}	35.66^{b}	38.59^{b}	1.02

abc: Means along the same row with different superscripts are significantly different (P<0.05)

Minerals Analysis of Snails

Table 3 shows the level of Sodium, Potassium, Calcium, Phosphorus, Magnesium and Iron in the meat of snail due to their importance in body metabolism and human nutrition and health. The values obtained were 31.20 – 44.75 (Na), 69.24 – 92.34 (K), 26.46 – 42.19(a), 274.50 – 295.64 (P), 238.80 – 266.70 (mg) and 5.25 – 9.53 (Fe)mg/100h, all values were highest (<0.05) for adult snails, thus confirming the finding of Ogunsanmi *et al.,* (2003), when it was revealed that mineral availability increase with the age of snail. On a general note, snail meat of all age categories had more iron them goat meat, Tilapia fish, beef and mutton.

Table3: Mineral compostion of the meat of three age categories of snails. (Archachatina *marginata*)

Parameters (mg/100g)	Ti (Adult)	T2 (Grower)	T3 (Snailet)	± SEM
Sodium	44.75[a]	39.57[b]	31.26[b]	1.20
Pottasium	92.34[a]	77.55[b]	69.24[b]	2.34
Calcuim	42.19[a]	31.64[b]	26.46[b]	2.11
Phosphorus	295.64[a]	286.65[b]	274.50[b]	1.71
Nitrogen Free Extract	59.23[b]	60.04[b]	238.80[a]	1.23
Iron	9.53[a]	7.37[b]	5.25[c]	1.48

abc: Means along the same row with different superscripts are significantly different (P<0.05).

Cholestorol Profiling of Snails.

Table 4 shows the cholesterol profile of snail meat, which showed the total cholesterol, low Density Lipid (LDL) High Density Lipid (HDL) and Free Fatty acid (FFA). The content of total cholesterol, HDL, LDL and FFA increased with the age of snail; they are energy generation, as cell constituent and components of hormones and enzymes. The optimal use of cholesterol is ensured by the right combination of the component lipids. A good quality cholesterol must be richer in HDL that LDL (Neal, 2002) to prevent arteriosclerosis. The HDL is vital, as a demobolizer of fat from the wall of blood vessels, thus preventing blockage.(Onibi,2000 and Jiya *et al* 2014)

Snailets had the least value for total cholesterol, HDL, LDL and FFA, this could be the reason for the increasing consumption of snailets , and sub adult snails is some communities in Nigeria (Omole, 2002). On a general note, snail meat consumption is beneficial and recommended for people suffering from blood and fat related diseases, irrespective of the age of such snail.

Table 4: Carcass Analysis of Different Age Categories of Snail (*Archachatina marginata)*

Parameters (mg/100g)	Ti (Adult)	T2 (Grower)	T3 (Snailet)	± SEM
Total cholesterol	18.33[a]	13.50[b]	11.59[c]	2.07
HDL	2.06[a]	1.96[b]	1.97[b]	0.12
LDL	3.30[c]	3.08[a]	2.72[b]	0.25
Free Fatty Acid	12.97[c]	8.50[b]	7.10[b]	0.46

abc: Means along the same row with different superscripts are significantly different (P<0.05).

Heavy Metal Content of Snail meat

Table 5 revealed the levels of Cu, Pb, Co, Ni, Cd, Cr and Mn in snail meat. The probe into heavy metals is due to their lethal nature in high quatity, it is dangerous, because the human body does not have good mechanism for eliminating them, their bio-accumulation is dangerous and must be avoided. The outcome of the analysis showed that snail meat had 8.76 ± 1.8 (Cu) 0.04±002 (Pb), 0.021 ± 0.027 (Co), 2.0 ± 1.27 (Ni), 0.02 ± 0.002 (Cd), 1.32 ± 1.41 (Cr) and 3.68 ± 2.56 (Mn) in Mg/kg. the levels vary ($p<0.05$) and increased age of snails, however, values were within permissible limit in human nutrition by FAO (1983), Adegoke et,al,.2010 and Chukwujindu et al (2008), hence the consumption of snails of any age may not be deleterious to human health, however the consumption of snailets and sub adult is been discourage through advocacy and promotion of snail farming.

Table 5: Heavy Metal Content of the Meat of (*Archachatina marginata)*

Parameters (mg/kg)	T1 (Adult)	T2 (Grower)	T3 (Snailet)	± SEM
Cu	10.56[a]	9.58[a]	**8.76**[a]	1.0
Pb	0.008 [a]	0.006[a]	**0.004**[a]	0.002
Ni	3.27[c]	3.02[a]	2.0[a]	1.1
Cd	0.004	0.003[a]	0.002[a]	0.002
Cr	2.63[a]	1.42[a]	1.32[a]	0.5
Mn	6.24	5.79[a]	3.68[a]	

abc: Means along the same row with different superscripts are significantly different ($P<0.05$).

CONCLUSION AND RECOMMENDATION

The trial has revealed that snail meat is rich in mineral salts and low in crude fibre, fat, cholesterol and LDL. It is nutritionally beneficial in Na, K Ca, P, Mg and Fe and its levels of heavy metals were within levels tolerable in human nutrition.

Snail carcass yield of 35 – 45% is lower than that of Grass cutter (63%), Boilers (60%) and 55%, each for Rabbit and Goat. To further enhance the nutritional benefits of snail meat and enhance performance, captive breeding, improved diet and advocacy on snail conservation are important and should be adopted by all the stakeholders in snail production. Snail meat is safe and its consumption is not dangerous to human health. Snail production and conservation will assist in producing cheaper alternative animal protein, ,sustain human population ,eliminate hunger and malnutrition .There must be more advocacy on snail farming and conservation in order to ensure sustainable supply of snail meat for local consumption and export.

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