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Effect of Replacing Bone Ash with Fresh Water Snail (*Pila ampullacea*) Shell Ash on Carcass Characteristics of Weaner Rabbits

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Authors' contributions

This work was carried out in collaboration between all authors. Authors FBPA, SA and EZ designed the study. Author FBPA performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SA and EZ managed the analyses of the study. Author FBPA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The research was conducted using twenty five (25) mixed breed weaner rabbits to investigate the effect of replacing bone ash with fresh water snail (*Pila ampullacea*) shell ash on carcass parameters of weaner rabbits. Five experimental diets tagged T_1 to T_5 were formulated such that fresh water snail (*Pila ampullacea*) shell ash replaced bone ash at 0%%, 25%, 50%, 75% and 100% for treatments T_1, T_2, T_3, T_4, and T_5 respectively. The rabbits were randomly assigned to the five dietary treatments and replicated five times giving a total of one rabbit per replicate in a completely randomized design (CRD). The treatments revealed a non- significant ($P>0.05$) effect on the dietary supplementation except for colon length. This study had shown that fresh water snail (*Pila ampullacea*) shell ash can serve as a substitute for bone ash in weaner rabbits diet up to 100% without adverse effect on the parameters determined.

Keywords: Rabbit; fresh water snail (Pila ampullacea) shell ash; bone ash; carcass and organ parameters.

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1. INTRODUCTION

The increasing demand for animal protein indicates the need to intensify livestock production. In order to achieve this objective, viable options need to be explored and evaluated [1]. Among such alternatives is the use of livestock species that are yet to play a major role in animal production within the developing countries example Nigeria. Rabbit production is a veritable way of alleviating animal protein deficiency in Nigeria [2]. The rabbit has immense potentials and good attributes which include fast growth rate, high efficiency in converting forage to meat, short generation interval, high prolificacy, relatively low cost of production, and high nutritional quality of rabbit meat which includes; low fat, sodium and cholesterol levels. Rabbit meat contains about 20.8% of protein and its consumption is bereft of cultural and religious biases [3]. Rabbits are herbivorous in nature and may thrive on feed ingredients from plants sources. This is as a result of the adaptation of the digestive system. The nutrient need of rabbit consist of suitable amount of protein, carbohydrate, fat, mineral, vitamins, water and roughage. It is essential that feed containing these nutrients be provided in a palatable form and sufficient quantity. Growing rabbits need feed that contain certain amount of ten of the twenty one amino acids that made up the proteins. These are called the basic or essential amino acids. Quantities needed have been confined to Arginine, Lysine and the Sulphur amino acids (Methionine and Cysteine). Expressed as percentage of ration, the Lysine requirement for growing rabbit is 0.6% and for Sulphur amino acids, 0.75%; does, Arginine at least 0.85%, Lysine above 0.6%. Growing/fattening rabbits need a crude of 15 to 16%; breeding does, 17 to 18%. Energy requirement for growing rabbit is about 220 to 240 kcal of digestible energy per kg weight ($W^{0.75}$), lactating doe needs 300 kcal of DE/kg $W^{0.75}$ and tops 360 kcal of DE/kg $W^{0.75}$ during maximum milk production (15^{th} to 20^{th} day of lactation). It is hard to set energy requirement but intake is only correctly regulated between 2200 and 3200 kcal of DE/kg of feed. Rabbits have specific need for essential fatty acids (linoleic acid) a conventional diet containing 3 to 4% fats generally supplies this. Fiber content of 13 to 14% is recommended for growing rabbit, lactating doe, 10 to 11%. Fiber sources are better added to avoid enteritis and to aid in both microbial activities and bowl movement [3].

In an attempt to search for alternative sources of calcium feedstuffs, is an urgent need to explore the potentials of non-conventional calcium sources that do not compete with human food consumption. One such alternative feedstuff, which is not only cheap but also locally available, is the fresh water snail (*Pila ampullacea*) shells. The abundance of freshwater snails *(Pila ampullacea*) in River Benue and its tributaries has been studied by [4]. This is due to the availability of food, shelter and oviposition sites along the said river water body. Snail shell is a mineral ingredient that contains about 98% of calcium carbonate [5]. It is therefore a biological source of calcium that can be used in animal feeding. Investigations have been done on the use of many sources of calcium such as gypsum, limestone and oyster shell in layers and broilers diets [6], but there is a lack of information on the use of snail shells especially fresh water snail *(Pila ampullacea)* shells in animal feeds.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted in the rabbitry unit at the Teaching and Research Farm, College of Animal Science University of Agriculture Makurdi Benue State. Benue State lies within the lower river Benue trough in the middle belt region of Nigeria. Its geographic coordinates are longitude 7° 47' and 10° 0' East. Latitude 6° 25' and 8° 8' North; and shares boundaries with five other states namely: Nasarawa State to the north, Taraba State to the east, Cross-River State to the south, Enugu State to the south-west and Kogi State to the west. The state also shares a common boundary with the Republic of Cameroon on the south-east. Benue occupies a landmass of 34,059 square kilometers [7].

2.2 Collection and Processing of Fresh Water Snail (*Pila ampullacea*) Shells

Bone ash was bought at God 4 us Livestock consult, beside SRS junction, new bridge road, north bank Makurdi.

Freshwater snails are in abundance in River Benue and its tributaries. The test ingredient was sourced locally at Gbajimba and Iyeh in Guma Local Government Area and Makurdi metropolis, where the flesh is usually removed and the shells are thrown away by the consumers. The shells were thoroughly washed, dried and burnt for

about 1 hour until they became whitish in appearance; they were then crushed into fine powder as shell ash and used in the diet. The mineral composition of the shell was analyzed by the procedure of Association of Official Analytical Chemists [8].

2.3 Experimental Design

A Completely Randomized Design (CRD) was used for this experiment. A total of twenty five (25) weaned male rabbits of mixed breeds at five weeks of age with an initial average weight of between 664.00 – 667.00 g were obtained from Dagwom Farm, National Veterinary Research Institute (NVRI) Vom, Jos Plateau State for the research. The rabbits were allowed for a preliminary feeding period of seven days to enable them acclimatize after which they were randomly assigned to five (5) dietary treatments designated as T_1 to T_5. Each of the dietary treatment had five (5) rabbits with each rabbit serving as a replicate (R_1, R_2, R_3, R_4 and R_5).

2.4 Housing and Management of Experimental Animals

The rabbits were housed individually in the hutches and labeled according to the treatment and replicate assigned to them. The dimension of the hutches was 40 cm × 30 cm × 30 cm (this was to enable it accommodate the feeders and drinkers). The initial weight of each rabbit was taken before assigning them to one of the five dietary treatments. Prophylactic medication was given against any infection before the commencement of the experiment. Each rabbit was observed daily to ensure good health. A measured quantity of the treatment diet was served daily for each replicate and was provided *ad-libitum,* left over feed was weighed every week and the quantity consumed was determined by difference. Fresh clean water was also provided every morning. The experiment lasted for 12 weeks (from 1st December 2013 to February 22nd 2013).

2.5 Experimental Diets

Five experimental diets were formulated tagged T_1 to T_5 respectively. T_1 served as a control diet. Fresh water snail (*Pila ampullacea*) shell ash replaced bone ash at 0%, 25%, 50%, 75% and 100% respectively.T_1 containing 100% bone ash while T_5 contained 100% fresh water snail (*Pila ampullaceal)* shell ash. These were mixed with other ingredients as in the Table 1.

Table 1. Composition of experimental diets with fresh water snail (*Pila ampullacea*) Shell ash as a replacement for bone ash (%)

Feedstuff	T1 (0% Pasa)	T2 (25% Pasa)	T3 (50% Pasa)	T4 (75% Pasa)	T5 (100% Pasa)
Maize	30.00	30.00	30.00	30.00	30.00
Full fat soybean	20.00	20.00	20.00	20.00	20.00
Groundnut Cake	12.00	12.00	12.00	12.00	12.00
Maize offal	14.00	14.00	14.00	14.00	14.00
Rice offal	20.05	20.05	20.05	20.05	20.05
Bone ash	3.00	3.00	3.00	3.00	3.00
Pasa	**0.00**	**0.75**	**1.50**	**2.25**	**3.00**
Methionine	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**
Lysine	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**
Table salt	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**
Vita/Min. premix	**0.25**	**0.25**	**0.25**	**0.25**	**0.25**
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Analyzed nutrients:					
Crude Protein (%)	17.50	17.50	17.50	17.50	17.50
Crude Fiber (%)	9.87	9.72	9.63	9.46	10.77
M.E(Kcal/kg)	2897.58	2954.15	2955.16	2896.58	2963.43
Methionine	0.57	0.57	0.57	0.57	0.57
Lysine	0.58	0.58	0.58	0.58	0.58
Calcium	1.21	**1..22**	**1.26**	**1.29**	**1.34**
Phosphorus	0.44	**0.43**	**0.42**	**0.41**	**0.40**

Note: Pasa = Pila ampullacea shell ash

2.6 Carcass Evaluation

At the end of 84 days feeding trial, fifteen (15) rabbits i.e. three rabbits of approximate live weight were randomly selected from each treatment and fasted for 12 hours before slaughter so as to reduce the volume of the gut contents and therefore reduce the risk of contamination of the carcass during dressing. The jugular veins were cut using a sharp knife in the morning between 8.30 – 9.00 hours after hand stunning. Proper bleeding was done by hanging the rabbits head down. Carcass was cut into the following parts namely; loin, forelimb, hind limb, head were weighed appropriately. The visceral organs comprising the heart, gastro intestinal tract, kidneys, lungs, liver, large intestine, small intestine, gall bladder, caecum, stomach, heart and spleen were carefully separated, measured and weighed. Other parameters such as live weight, carcass length and bled weight were also measured. The dressing percentage was also calculated.

2.7 Statistical Analysis

The data collected were subjected to one way Analysis of Variance (ANOVA) using Minitab statistical software version 14 [9]. The separation of means was effected using Duncan's Multiple Range Test (DMRT) as outline by [10]. Metabolizable energy (ME/Kcal/Kg) was calculated using the method of [11]

3. RESULTS AND DISCUSSION

The result of the proximate analysis of fresh water snail *(Pila ampullacea*) shell ash is presented in Table 2. It was observed that fresh water snail (*Pila ampullacea)* shell ash contained high percentages of ash (92.45%) and calcium (41.60%) but has negligible amount of phosphorus (0.01%) unlike oyster shell ash which is void of Phosphorus but relatively lower than the amount in bone ash. The findings revealed that fresh water snail (*Pila ampullacea*) shell ash is a potential source of calcium in livestock feed. The nutrient analysis of the five experimental diets revealed that the diets met the nutritional requirements for weaner rabbits across treatments. The carcass characteristics were not influenced (P>0.05) by fresh water snail (*Pila ampullacea*) shell ash in this study for almost all the parameters measured. The fasted live weight of rabbits slaughtered for carcass evaluation ranged from 2075.30 to 2321.70(g).T1 to T5 were not significantly different (P>0.05).

Table 2. Mineral composition of fresh water snail (*Pila ampullacea*) shell ash

Parameters	Percentage composition (%)
Ash	92.45
Calcium	41.60
Phosphorus	0.01

The bled weight of rabbits did not show any significant difference (P>0.05) among the treatments. Carcass length also followed a similar pattern with no significant difference (P>0.05) among the dietary treatments. The values ranged from 31.50 to 32.73 cm. The dressing percentage values in this trial ranged from 63.43 to 66.92% with no significant differences (>0.05) among the dietary treatments. This suggested that the inclusion level of Fresh Water Snail *(Pila ampullacea)* shell ash up to 100% replacement in rabbit diet can also increase rabbit meat for human consumption. However, the result of the forelimb,

Table 3. The effect of replacing bone ash with fresh water snail (*Pila ampullacea*) shell ash on carcass characteristics of weaner rabbits

Parameters expressed as % of live weight (g)	T1 (0%)	T2 (25%)	T3 (50%)	T4 (75%)	T5 (100%)	SEM
Live weight (g)	2236.70	2262.70	2226.70	2075.30	2321.70	55.00^{NS}
Carcass length (cm)	32.73	31.80	31.80	31.53	32.00	0.40^{NS}
Bled weight (%)	96.68	98.12	97.39	97.23	97.49	0.28^{NS}
Dressing %	66.02	63.43	66.92	63.78	63.54	1.72^{NS}
Eviscerated weight (%)	77.92	78.14	79.71	79.71	75.85	0.50^{NS}
Singed weight (%)	71.30	70.64	72.15	71.36	69.52	0.66^{NS}
Forelimb weight (%)	11.69	10.64	10.83	10.80	10.81	0.23^{NS}
Hind limb weight (%)	21.54	20.79	20.35	22.81	20.13	0.52^{NS}
Loin weight (%)	18.28	18.81	18.69	17.37	17.64	0.28^{NS}
Head weight (%)	7.21	7.21	7.47	7.62	6.79	0.14^{NS}

SEM= Standard Error of Means; NS = Not Significantly Different (P>0.05); Pasa = Pila ampullacea shell ash

Table 4. The effect of replacement of bone ash with fresh water snail (*Pila ampullacea*) shell ash on internal organs of weaner rabbits

Parameters expressed as % of organs weight (g)	T1 (0% Pasa)	T1 (25% Pasa)	T1 (50% Pasa)	T1 (75% Pasa)	T1 (100% Pasa)	SEM
Small intestine weight (%)	1.89	2.14	1.95	1.95	1.74	0 08^{NS}
Large intestine weight (%)	**1.20**	**1.68**	**1.62**	**1.48**	**1.74**	0 08^{NS}
Caecum weight (%)	**3.97**	**5.47**	**4.02**	**4.59**	**3.78**	0.28^{NS}
Stomach weight (%)	**1.98**	**2.33**	**2.09**	**2.17**	**2.10**	**0.16**^{NS}
Liver weight (%)	**2.03**	**1.96**	**1.78**	**2.01**	**1.50**	**0.10**^{NS}
Gall bladder weight (%)	**0.06**	**0,06**	**0.06**	**0.06**	**0.06**	**0.01**^{NS}
Lungs weight (%)	**0.59**	**0.57**	**0.44**	**0.43**	**0.55**	**0.02**^{NS}
Kidney weight (%)	**0.55**	**0.50**	**0.53**	**0.55**	**0.47**	**0.02**^{NS}
Spleen weight (%)	**0,07**	**0.07**	**0.06**	**0.07**	**0.05**	**0.01**^{NS}
Heart weight (%)	**0.24**	**0.25**	**0.25**	**0.23**	**0.16**	**0.02**^{NS}

SEM= Standard Error of Means; NS = Not Significantly Different (P>0.05); Pasa = Pila ampullacea shell ash

Table 5. The effect of replacing of bone ash with fresh water snail (*Pila ampullacea*) shell ash on gastro intestinal characteristics of weaner rabbits

Parameters expressed as % of GIT length (cm)	T1 (0% Pasa)	T1 (25% Pasa)	T1 (50% Pasa)	T1 (75% Pasa)	T1 (100% Pasa)	SEM
GIT length (cm)	423.67	448.50	458.00	428.00	394.67	7.83^{NS}
Small intestine length (%)	70.57	72.85	75.06	70.23	81.80	1.95^{NS}
Large Intestine weight	26.95^{b}	25.16^{c}	26.07^{bc}	26.97^{b}	29.70^{a}	0.46
Caecum weight (%)	9.28	11.13	9.84	10.10	11.30	0.36^{NS}

^{a,b,c} *= means in the same row with different superscripts are significantly different (P<0.05).*

GIT= Gastro intestinal tract; SEM= Standard Error of Means; NS = Not Significantly Different (P>0.05); (P<0.05); Pasa = Pila ampullacea shell ash

hind limb, loin and head followed the same trend of non- significant differences (P>0.05) across the treatments. The incorporation of fresh water snail (*Pila ampullacea*) shell ash in the dietary treatments at different levels did not affect the visceral parameters. The small intestine values ranged from 1.74 to 2.14% with no significant differences (P>0.05) among the treatments, and this agrees with 1.40 to 2.71% reported by [12]. Large intestine also showed no significant differences (P>0.05). There were no significant differences (P>0.05) in ceacum weight with the ranged values of 3.78 to 5.47%. The liver weights ranged from 1.50 to 2.03%, lungs weights ranged from 0.43 to 0.59%, and this agrees with 1.99 – 2.38% [13]. Gall bladder weights ranged from 0.06 - 0.06%, paired kidney weights ranged from 0.47 to 0.55%, spleen weights ranged from 0.05 – 0.07% and heart weights ranged from 0.16 to 0.25% with no significant differences (P>0.05) among the treatments. These results showed that fresh water snail *(Pila ampullacea)* shell ash compete favourably with bone ash on the parameters measured. [14] reported that increased metabolic rate of the organs in an attempt to reduce toxic or anti nutritional factors in livestock feeds to non-toxic metabolites may cause abnormalities (increase) in their weights. [15] reported that the weights of some internal organs like kidney and liver of animals may be used in animal feeding experiments as evidence of toxicity. This result also proved that the inclusion of fresh water snail *(Pila ampullacea)* shell ash has no negative effect on the internal organs of the weaners' rabbits. The GIT length ranged from 394.67 to 458.00 cm. However, there were no significant differences (>0.05) across the dietary treatments. The result implies that fresh water snail (*Pila ampullacea*) shell ash at different levels has no effect on GIT length. The small intestine length values ranged between 70.23 to 81.80% with T_5 recording the highest value (81.80%). Colon showed a significant difference (P<0.05) among the treatments. The value ranged between 25.15 to 29.70%. T_5 indicated a longer length of 29.70 cm while T_2 showed a shorter length of 25.16 cm in the trial, however, the values were comparable to 23.60 to 28.98% as reported by [15]. The results of ceacum also followed the same trend

of non- significant effect (P>0.05) with the values ranging from 9.28 to 11.29%.revealing that the test ingredient competed favourably with bone ash on the organs weights.

4. CONCLUSION

The study revealed that fresh water snail *(Pila ampullacea)* shell ash could replace bone ash up to 100% without compromising carcass and organ weights.

5. RECOMMENDATIONS

Further research should be carried out to investigate cost effectiveness of feeding fresh water snail (*Pila ampullacea)* shell ash to weaner rabbit as a replacement for bone ash. Secondly, the use of fresh water snail *(Pila ampullacea)* shell ash should be done under sustainable practices in order to protect the specie from the threat of extinction.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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