Evaluation of the performance of African giant land snail (*Achatina achatina*) fed dried cassava peels meal amended with graded levels of bovine blood meal

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Abstract— The performance of African Giant Land Snail (*Achatina achatina*) fed dried cassava peel meal amended with bovine blood meal was evaluated. Forty (40) snails were randomly assigned to four (4) treatment groups with two replicates each in a completely randomized design (CRD). Treatment 1, 2, 3 and 4 were fed with: only dried cassava peel meal, cassava peel amended with 10% blood meal, cassava peel amended with 20% blood meal and poultry starter feed respectively. Mortality, weight gain, feed intake, length, width and feed growth ratio (FGR) were determined. The proximate properties of the samples were also determined. Results were analyzed using one-way analysis of variance (p≥0.05). Proximate analysis reveals that the cassava peel meal was high in fiber (13.320 ± 1.218) but low in crude protein (8.050 ± 0.081); on the other hand, blood meal was low in fiber (0.050 ± 0.008) but very rich in proteins (76.250 ± 0.081). Growth response analysis reveal that treatment 1 (9.775 ± 1.525) and 2 (10.517 ± 1.783) had statistically similar growth performance while 3 (15.267 ± 1.000) and 4 (15.705 ± 0.255) had significantly (p≥0.05) higher growth performance than treatment 1 and 2. The feed gain ratio (FGR) was also found to be 5.439 ± 0.961, 3.221 ± 0.603, 2.652 ± 0.292 and 3.011 ± 0.004 respectively for treatment 1, 2, 3 and 4. Mortality was positively affected by amending the feed with blood meal. Thus, amending cassava peel meal with bovine blood meal improved the performance of the experimental animals.

Index Terms— bovine, blood meal, cassava peels, amendment, proximate analysis, growth response

1 Introduction

Good nutrition protects individuals against all forms of malnourishment; thus, reducing the incidence of non-communicable diseases (NCDs) like diabetes, heart disease, stroke and cancer. It also prepares individuals to effectively ward off communicable diseases by strengthening the immune system. Little wonder, poor nutrition have been linked to increased incidence of poor to health outcomes globally [1]. Carbohydrates, lipids and proteins are the major macronutrients in every balanced diet. Of these three macronutrients, proteins are usually the least available and most costly. They are the second most prevalent compound in the body after water and supply the body with approximately 10% to 15% of its dietary energy [2]; thus, underscoring the fact that, proteins which are made up of amino acid building blocks are a key component of a healthy diet. This is more so because in humans, amino acids stores are not available. As a result, amino acids are made when required either from de-novo synthesis or by modifying other already existing biological molecules or provided through the diet. Nine amino acids of about twenty predominant amino acid building blocks found in humans, namely, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine are known as the essential amino acids and must be supplied from food. This introduces the concept of "complete proteins".

Evidently, the composition of amino acids in foods is very variable. While some protein sources usually from animals sources are rich in both the essential and non-essential amino acids and are referred to as complete proteins, others are deficient in the essential amino acids. It is therefore not only important to consume adequate quantity of proteins; it is equally valuable to ensure that such servings of protein contain appropriate amounts of amino acids to maintain the health of the organism. Thus, even though the National Academy of Medicine recommends that adults get a minimum of 0.8 grams of protein for every kilogram of body weight per day, or just over 7 grams for every 20 pounds of body weight [3], 0.75 grams of protein for every kilogram of body weight per day [2]; it is equally important that portions of such proteins come from protein sources or blend of protein sources that contain adequate quantity of essential amino acids.

Proteins of animal origin are not indispensable. This is evident from the fact that some plants with complete proteins are still readily available. Nevertheless, the inclusion of animal products in the diet make it easier to ensure a wholesome diet. Precisely, a diet of only plant based food sources requires knowledge and some degree of dexterity in food selection in order to ensure an adequate diet. On the other hand, addition of small amount of proteins from animal sources can supply the essential nutrients, thereby making such plant based foods nutritionally adequate. In developed countries, in addition to greater exposure to knowledge on proper food choices, there is adequate supply of wholesome plant and animals

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proteins; thus, providing abundant dossier of food choice to all individuals irrespective of their food preferences. The same cannot be said of developing countries where foods are usually composed of large servings of carbohydrates with little or no proteins. Animal proteins here are usually seen as luxury to be enjoyed by the affluent. The implication of this is that there is widespread under-consumption of proteins in general and animal proteins in particular. Animal protein intake in these regions which are usually located in the warm humid tropics represents about one-tenth of the level of intake in the advanced countries [4]. It is therefore no surprise that there is an acute malnutrition amongst the greater percentage of the rural populace [5].

High incidence of protein energy malnutrition in developing countries has been attributed to the inability to meet the ever growing demand for animal proteins. Hence, to mitigate this obvious shortfall in supply, expeditious implementation of protocols to encourage livestock production is necessary. However, the desired increase in livestock production may not come without negative environmental consequences. This included deforestation and the release of greenhouse gases into the atmosphere. This is not to mention the tendency of livestock to compete with humans for available food and space. This is particular fueling a lot of crisis between livestock farmers and many crop farmers in many parts of developing nations. As a result of this, there is need for a more sustainable alternative. Micro livestock offers a viable option [6]. The above view was supported by Ebenebe [7], who recognized the need to explore, identify and integrate into the farming system non-conventional meat sources like snails. These authors are of the opinion that this will no doubt go a long way in mitigating the challenge of protein energy malnutrition which is prevalent in most developing countries of the world.

The availability of edible snails in the country, their widespread acceptance in the nation, the prospect of enormous foreign exchange earnings from export, including the emerging technologies for their production is presently driving a lot of interest towards snail farming in Nigeria [8]. There is also global upsurge in demand for snail meat [9]. The global demand for snail meat may not be unconnected to the fact that snail meat is nutrient dense and its nutritional composition is very similar to that of poultry egg and flesh in essential amino acids profile and digestible protein [9]. It is essentially rich in lysine, leucine, isoleucine, phenylalanine, arginine and tryptophan and contains high level of iron, calcium and phosphorus [10]. The galacton present in its abdominal gland serves as a medicinal substance of high immunological value. This biomolecule has been used successfully in the treatment of tuberculosis, ulcer, asthma and circulatory disorders [9]. Snail meat has also been linked to therapeutic effect on some human health challenges like anaemia, hypertension, asthma, etc. [11]. It is therefore unequivocally clear that the importance of improving snail production cannot be overemphasized.

Furthermore, the faecal matter of snail does not produce foul smell; neither does it make the environment filthy in any way. Consequently, snail farming can be conveniently done outdoors within one's compound; preferably, in the back yards. This is environmentally sustainable [12, 13] because snails are also good converter of vegetable protein to useful animal protein [14]. When compared to other forms of animal husbandry, snail farming requires little capital and is very profitable. This is more so because thousands of land snails can be raised in a small land space if intensively managed. There is also usually less need for medication since good housing, management and sanitation can effortlessly keep predators, parasites and diseases away. Thus, it has comparative advantages over other livestock.

A lot of progress has been made in America, Europe and Asia with regards to the culturing of snails; but in Africa, the same cannot be said [15]. Consequently, there is need for research efforts to be channeled in this direction. *Achatina marginata* of Nigeria and *Achatina achatina* of Ghana are the two largest species of snails in West Africa [4]. *Achatina achatina* is the tropical specie of snail that is most widely accepted in the global market [8]. Irrespective of the preferred snail specie, acceptable feed must be made available in order to ensure profitability.

Precisely, success in snail production as in all livestock production activities involve among other things proper nutrition. According to Olomu [16], proteins are required mainly for tissue growth, carbohydrates supply the energy needed for metabolic activities, while calcium is vital for shell growth [12]. It is recommended to use complete balanced feed in snail production [17, 18]. Feed tailor-made to meet the snails' precise nutritional requirement has the effect of enhancing the growth performance of the snails. The time required for the animals to reach maturity and hence attain market weight can equally be significantly diminished. Unarguably, the growth, development and reproduction of any animal for that matter are highly dependent on the quality of its feed. Thus, a major encumbrance to successful animal husbandry including heliculture is good feed that will meet the nutrient requirement of such confined animals while not distorting the food chain in a manner that compromises the ability of humans to meet their non-protein food needs. Hence, never than ever before, there is need to explore the use of unconventional feedstuff in animal husbandry. The use of unconventional feedstuff has a multiplicity of positive effect. For instance, it reduces competition between humans and livestock while also ensuring effective and efficient use of resources by channeling these feedstuffs, whose disposal would have increased the global carbon dioxide burden, into more sustainable use.

Nigeria is the worlds' largest producer of cassava with a

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production output of above 59 million tonnes, which is about 20% of global production output in 2017 [19]. A byproduct of cassava processing is cassava peels which constitute a sizeable chunk of the cassava root mass. As a result, tonnes of cassava peels are produced in the country annually. The challenge of managing this crop wastes could be mitigated if it can be channeled into animal husbandry in the form of replacement for conventional feedstock which is limited in supply. Hence there is the prospect of a synergy between livestock farmers and crop farmer. This will significantly diminish the competition between humans and livestock for these replaced conventional feed stocks and help institutionalize green livestock farming. As a result, a perceived waste can be converted to a resource, hence, this study. The aim of this study is to evaluate the response, in terms of growth performance and nutrient utilization of *Achatina achatina* fed died cassava peel meal amended with bovine blood meal.

2 Materials And Method

2.1 Study Area

This study was carried out at the Federal College of Agriculture, Ishiagu, Ivo Local Government Area of Ebonyi State, South-Eastern Nigeria. The study area is located at latitude $5^0$41-$5^0$5'W and longitude $7^0$29-$7^0$33E.

2.2 Sample Collection

Forty (40) African giant land snails (*Achatina achatina*) were purchased from a snail farm located in Afikpo, Ebonyi State. Cassava peel was obtained from the college cassava mill. Blood meal was prepared using blood samples collected immediately after the slaughter of cattle at Ishiagu slaughter slab located in Ishiagu. The blood samples were collected between 6:30 – 7:00am in a plastic container. Loamy soil was obtained from the locality (Ishiagu). The collected soil was subsequently sterilized using heat.

2.3 Proximate Nutrient Analysis

The proximate analyses of the samples were done. Parameters measured include; moisture content, ash content, crude fat, crude protein, crude fiber and carbohydrate. Each parameter was determined in duplicates according to the methods outlines below for the assay.

2.3.1 Moisture content

Moisture content was determined using the conventional method outlined in Association of Official Analytical Chemists (AOAC) Methods of Analysis [20]. Two (2) moisture cans were dried in the oven and then put into desiccators to cool before weighing. Exactly 5g of each sample was put in each of the moisture cans, placed in the oven and dried at 105^{o}C for 2 hours. After the 2 hours, the cans were removed from the oven and placed in a desiccator again to cool before weighing. The cycle of heating, cooling and weighing was repeated until constant weight was attained. The moisture content was then determined by the difference in weight and expressed as a percentage of the initial sample weighed. This is given by the formula;

$$\%\ Moisture\ Content = \frac{W_2 - W_3}{W_2 - W_1}\ X\ \frac{100}{1} \quad (1)$$

W1 = Weight of the empty moisture can
W2 = Weight of the can and sample before drying
W3 = Weight of can and sample after drying

2.3.2 Ash Content

The furnace incineration gravimetric method recommended by AOAC [20] was used in the determination of the ash content. The crucible was dried in the oven and cooled in the desiccator before weighing. Approximately 5g of the sample was weighed and put into the crucibles, covered and placed in a muffle furnace at a temperature of 550^o C. The temperature was maintained for 2 hours until a whitish ash was obtained. After 2 hours, the muffle furnace was switched off and the crucibles were removed and placed in sample desiccator to cool. The crucibles containing the samples were weighed and the percentage ash content was determined using the formula below;

$$\%\ Ash\ Content = \frac{W_2 - W_3}{W_2 - W_1}\ X\ \frac{100}{1} \quad (2)$$

W1 = Weight of the empty crucible
W2 = Weight of the crucible and sample
W3 = Weight of crucible and ash

2.3.3 Crude fat

The fat content was determined by the continuous solvent extraction in a soxhlet reflux apparatus [21]. Exactly 2g of the sample was weighed and placed in the thimble. The thimble containing the sample was then carefully placed inside a soxhlet reflux flask. The reflux was mounted on a weighed extraction flask containing 200ml of ether on an electro-thermal heating mantle. The setup was connected to a condenser so that when switched on, the petroleum ether will boil, vapourize, condense and fill up the reflux flask. The solvent will reflux, carrying along with it the oil extract to the boiling flask. The process of boiling, vapourization, condensation and subsequent oil extraction was allowed to go on continuously for 4 hours. After the 4 hours, the solvent was recovered and the extraction flask with its oil content was dried in the oven at 60^o C for 30 minutes. After cooling in a desiccator, the flask was re-weighed. The fat content was given by;

$$\%\ Fat\ Content = \frac{W_2 - W_1}{W_3}\ X\ \frac{100}{1} \quad (3)$$

W1 = Weight of the empty flask
W2 = Weight of the flask and the oil extract
W3 = Weight of the sample used

2.3.4 Crude Protein

This was determined by the micro-kjeldahl method described by James [21].
Exactly 2g of the sample was digested by mixing with 10ml of concentrated tetraoxosulphate (VI) acid (H_2SO_4) in a kjeldahl digestion flask. A tablet of selenium catalyst was added to it and the mixture was heated under fume cupboard. The digest was transferred into a 100ml volumetric flask and made up with distilled water. Exactly 100ml of the digest was mixed with equal volume of 45% sodium hydroxide (NaOH) solution and poured into a kjeldahl distilled apparatus.

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The mixture was distilled and the distillate was collected into a 4% boric acid solution containing 3 drops Zuazaga indicator (mixture of methyl red and bromocresol green) to obtain a total of 50ml distillate.
The distillate obtained was titrated against 0.02N tetraoxosulphate (VI) acid (H_2SO_4) solution. Titration was done from the initial green colour to a deep red or pink end point.
The total nitrogen was calculated and multiplied with the factor 6.25 to obtain the crude protein content.

$$\%\ Crude\ Protein = \%N\ X\ 6.25 \quad (4)$$

$$\%\ N = \frac{100\ x\ N\ x\ 14\ x\ V_F\ x\ T}{W\ x\ 1000\ x\ V_A} \quad (5)$$

W = Weight of the sample
N = Normality of the filtrate (H_2SO_4)
= 0.02N
VF = Total volume of the digest
= 100ml
VA = Volume of the digest distilled
T = Titre volume

2.3.5 Crude fibre determination

This was measured by the Weende method described by James [21]. Approximately 5g of each sample was defatted (during fat analysis). The defatted sample was treated with 200ml of 1.25% H_2SO_4 and boiled under reflux for 30 minutes. The resultant mixture was filtered by washing with several portions of hot water using a two-fold muslin cloth to trap the particles. The washed samples were carefully transferred to a beaker and boiled for 30 minutes with 200ml of 1.25M NaOH solution. The digested samples were washed severally with hot water. The washed samples were carefully scrapped into a weighing porcelain crucible and dried in the oven at 105° C for 3 hours, cooled in a desiccator and weighed. After which the cooled sample was ashed in a muffle furnace at 550° C for 2 hours, cooled in a desiccator and re-weighed.
The crude fibre content was determined thus;

$$\%\ Crude\ Fibre = \frac{Loss\ in\ Weight}{Weight\ of\ Sample}\ X\ \frac{100}{1} \quad (6)$$

$$\%\ Crude\ Fibre = \frac{W_2 - W_3}{W_2 - W_1}\ X\ \frac{100}{1} \quad (7)$$

W1 = Weight of the crucible
W2 = Weight of the crucible and sample after washing and drying in oven
W3 = Weight of the crucible and sample ash

2.3.6 Carbohydrate determination

The carbohydrate content of the test sample was determined by estimation using the arithmetic difference method described by James [21]. The carbohydrate was calculated and expressed as the Nitrogen Free Extract (NFE) as shown below;

$$\%\ CHO = \%\ NFE = 100 - \%(a+b+c+d+e) \quad (8)$$

a = % protein content
b = % fat content
c = % ash content
d = % crude fibre content
e = % moisture content.

2.4 Feed Preparation

The dry cassava peels waste collected was sun dried. The particle size was subsequently reduced by grinding the dried cassava peel waste.
Similarly, the blood collected was first heated in a pot to coagulate and reduce the moisture content. The coagulated blood was then sun dried. Afterwards, the particle size was reduced by grinding the dried cattle blood to get the blood meal.
To get the experimental diet, the dried cassava peel waste was amended with graded levels of the blood meal.
Treatment 1 had only dried cassava peel waste. Treatment 2 had 10% blood meal. Treatment 3 had 20% blood meal while treatment 4 (control) served as the control. Poultry starter feed obtained from Eke market Ishiagu served as the control feed.

2.5 Experimental Design

Forty (40) snails were randomly assigned to four (4) treatment groups with two replicates each in a completely randomly design (CRD). Eight (8) plastic pens were used and each pen had five (5) snails. Each pen was an experimental unit.

A week before the assignment of the snails, the pens were thoroughly washed, disinfected and dried under sun. The floor of the pens was covered with loamy soil to about 6cm high from bottom. The feeders and drinkers were thoroughly washed and dried. Seven (7) days trial feeding was done before the commencement of the experiment to allow for physiological adjustments.

The snails were weighed at the onset of the experiment and subsequently on a weekly basis.

Water was provided ad libitum and each treatment group was fed with a particular diet daily for four (4) weeks.

The parameters measured were weight gain (growth response), feed intake, length and width. The weight was determined by using digital sensitive weighing balance while the length and width was measured on weekly basis using Vernier Caliper. The feed intake was determined weekly by a weigh back technique. The quantity of fresh feed given to each experimental unit on weekly bases was weighed and recorded. At the end of the week, the left over in the feeders as well as feed wasted on the floor was collected, weighed and recorded. In this way, the quantity of feed consumed was calculated as (quantity given- quantity left over).This was the routine for feeding the snails throughout the experimental period, which lasted for four (4) weeks.

The drinkers and feeders were emptied and washed on daily basis before new feed and water were served. The same quantity of water was also sprinkled on the floor (soil) on daily basis in each pen to maintain adequate humility and temperature.

International Journal of Scientific & Engineering Research, Volume 12, Issue 1, January-2021
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2.6 Statistical Analysis

Results obtained were analyzed using one-way analysis of variance at 95% confidence interval. Significant means were separated using Duncan multiple correlation. All results are expressed as mean ± SEM.

3 RESULTS

3.1 Proximate Analysis

Prior to the commencement of the treatment of the experimental animals with the various feed materials the proximate properties of the feeds were determined. The result is as contained in table 1 below. The result reveals that the cassava peel meal, blood meal and poultry starter feed respectively had percentage moisture content of 6.640 ± 0.081, 5.520 ± 0.081 and 8.610 ± 0.381, crude protein of 8.050 ± .081, 76.250 ± 0.081 and 17.12 ± 0.456, crude fat of 0.280 ± 0.006, 1.725 ± 0.202 and 2.470 ± 0.352, crude fiber of 13.320 ± 1.218, 0.050 ± 0.008 and 6.290 ± 0.237, ash of 5.310 ± 0.156, 3.010 ± 0.081 and 6.130 ± 0.543, carbohydrate of 64.700 1.224, 13.42 ± 0.081 and 59.050 ± 0.497.

TABLE 1
PROXIMATE PROPERTIES OF THE VEGETABLE MARKET WASTE, BLOOD MEAL AND POULTRY STARTER FEED

PARAMETERS	CASSAVA PEELS	BLOOD MEAL	STARTER POULTRY FEED
MOISTURE CONTENT (%)	6.640 ± 0.081[a]	5.520 ± 0.081[b]	8.610 ± 0.381[c]
CRUDE PROTEIN (%)	8.050 ± 0.081[a]	76.250 ± 0.081[c]	17.120 ± 0.456[b]
CRUDE FAT (%)	0.280 ± 0.006[a]	1.7250 ± 0.202[b]	2.470 ± 0.350[b]
CRUDE FIBER (%)	13.320 ± 1.218[a]	0.050 ± 0.008[a]	6.290 ± 0.237[b]
ASH (%)	5.310 ± 0.156[a]	3.010 ± 0.081[a]	6.130 ± 0.543[b]
CARBOHYDRATE (%)	64.700 ± 1.224[a]	13.420 ± 0.081[a]	59.050 ± 0.497[c]

Means in the same row with the same letter(s) are not statistically significant (p≥0.05).

3.2 Growth Performance

Table 2 contains the result of the average weight (grams) and weight gain (growth in grams) of the snails. Treatment 1, 2, 3 and 4 had growth performance was found to be 9.775 ± 1.525, 10.517 ± 1.783, 15.267 ± 1.000 and 15.705 ± 0.255g respectively after four (4) weeks.

TABLE 2
AVERAGE WEIGHT GAIN (GRAMS) OF THE SNAILS

PARA-METERS	TREATMENT 1	2	3	CONTROL
INITIAL LIFE WEIGHT (g)	29.100 ± 0.823[a]	30.500 ± 1.046[a]	30.900 ± 0.781[a]	29.600 ± 1.087[a]
FINAL LIFE WEIGHT (g)	38.875 ± 1.028[a]	41.017 ± 1.071[a]	46.167 ± 0.822[b]	45.311 ± 0.911[b]
GROWTH (g)	9.775 ± 1.525[a]	10.517 ± 1.783[a]	15.267 ± 1.000[b]	15.705 ± 0.255[b]

Means in the same row with the same letter(s) are not statistically significant (p≥0.05).

3.3 Shell Length

The result of the growth in shell length is contained in table 3. Growth is shell length after four (4) weeks was found to be 0.460 ± 0.040, 0.660 ± 0.080, 1.160 ± 0.027 and 0.962 ± 0.018cm for treatment 1, 2, 3 and 4 respectively.

TABLE 3
AVERAGE LENGTH OF THE SNAIL SHELLS (CM)

PARA-METERS	TREATMENT 1	2	3	CONTROL
INITIAL LENGHT (cm)	5.240 ± .542[a]	5.240 ± 0.427[a]	5.240 ± 0.581[a]	5.260 ± 0.562[a]
FINAL LENGHT (cm)	5.700 ± 0.108[a]	5.900 ± 0.073[b]	6.4000 ± 0.045[c]	6.222 ± 0.046[c]
GROWTH (cm)	0.460 ± 0.040[a]	0.660 ± 0.080[b]	1.160 ± 0.027[d]	0.962 ± 0.018[c]

Means in the same row with the same letter(s) are not statistically significant (p≥0.05).

3.4 Shell Width

The result of the growth in shell width is contained in table 4. Growth in shell width after four (4) weeks was found to be 0.470 ± 0.030, 0.388 ± 0.045, 1.323 ± 0.234 and 1.210 ± 0.070bcm for treatment 1, 2, 3 and 4 respectively.

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International Journal of Scientific & Engineering Research, Volume 12, Issue 1, January-2021
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TABLE 4
AVERAGE WIDTH OF THE SNAIL SHELLS (CM)

PARA-METERS	TREATMENT			CONTROL
	1	2	3	
INITIAL LENGHT (cm)	2.980 ± 0.044[a]	2.990 ± 0.053[a]	3.060 ± 0.072[a]	3.040 ± 0.085[a]
FINAL LENGHT (cm)	3.450 ± 0.065[a]	3.383 ± .054[a]	4.383 ± 0.048[b]	4.244 ± 0.044[b]
GROW-TH (cm)	0.470 ± 0.030[a]	0.388 ± 0.045[a]	1.323 ± 0.234[b]	1.210 ± 0.070[b]

Means in the same row with the same letter(s) are not statistically significant (p≥0.05).

3.5 Feed Growth Ratio (FGR)

Quantity of feed consumed was noted. This was captured as the feed intake of the experimental organisms and was determined weekly by a weigh back technique. In this way, the quantity of feed consumed was calculated as (quantity given- quantity left over). Estimated average total feed intake [per snail was hence determined. Table 5 contains the above results. The result indicates that treatment 1, 2, 3 and 4 consumed an average of 51.700 ± 1.100, 32.800 ± 0.600, 40.200 ± 1.800 and 47.300 ± 0.700g of feed respectively per snail. From the feed consumption data, the feed/gain ratio was arrived at. This was found to be 5.439 ± 0.961, 3.221 ± 0.603, 2.652 ± 0.292 and 3.011 ± 0.004 for treatment 1, 2, 3 and 4 respectively. Mortality of the experimental animals was also found to be 80.000 ± 0.000, 40.000 ± 0.000, 40.000 ± 0.000 and 10.000 ± 10.000 for treatment 1, 2, 3 and 4 respectively.

TABLE 5
AVERAGE FEED INTAKE (GRAMS)

PARA-METERS	TREATMENT			CONTROL
	1	2	3	
TOTAL WEIGHT GAIN (g)	9.775 ± 1.525[a]	10.517 ± 1.783[a]	15.267 ± 1.000[b]	15.705 ± 0.255[b]
AVE-RAGE TOTAL FEED INTAKE /SNAIL (g)	51.700 ± 1.100[c]	32.800 ± 0.600[a]	40.200 ± 1.800[b]	47.300 ± 0.700[c]
FEED/ GAIN RATIO (FGR)	5.439 ± 0.961[b]	3.221 ± 0.603[ba]	2.652 ± 0.292[a]	3.011 ± 0.004[a]
MORTA-LITY (%)	80.000 ± 0.000[c]	40.000 ± 0.000[b]	40.000 ± 0.000[b]	10.000± 10.000[a]

Means in the same row with the same letter(s) are not statistically significant (p≥0.05).

4 Discussion

The proximate analysis of the dried cassava peels and blood meal used was determined. The proximate properties of the dried cassava peel meal, blood meal and the starter poultry feed used as contained in table 1 was analysed using one-way analysis of variance (ANOVA) and the significant means separated using Duncan multiple correlation (p≥0.05). It reveals the nutritional composition of the alternative feedstock in comparison to the poultry starter feed. The fiber content of dried cassava peel meal was found to be 13.320 ± 1.218 while that of blood meal and the poultry starter feeds were found to be 0.050 ± 0.008 and 6.290 ± 0.237 respectively. These samples were also found to have carbohydrate contents of 64.700 ± 1.224, 13.420 ± 0.081 and 59.050 ± 0.497 for cassava peel meal, blood meal and poultry starter feed respectively. This reveals that dried cassava peel meal was higher in fiber and carbohydrate while blood meal had the least concentration of these nutrients. The carbohydrate content of the dried cassava peel meal was significantly higher than that of the poultry starter feed. On the other hand, blood meal is high in protein (76.25 ± 0.014), as much as over four (4) times the protein composition of the poultry starter (17.12 ± 0.79) feed, and as much as nine (9) times the protein content of the dried cassava peel meal (8.05 ± 0.14). Hence, while the dried cassava peel meal can serve as a good source of carbohydrate, the blood meal is a very good source of supplemental protein. The fat content of the blood meal (1.725 ± 0.202) was similar statistically to that of the poultry starter feed (2.470 ± 0.352) and these were found to be significantly higher than that of the cassava peel meal (0.280 ± 0.006). The mineral content of the cassava peel meal (5.310 ± 0.156) on the other hand was found to be statistically similar to that of the control feed (6.130 ± 0.543); and this was significantly higher than that of the blood meal (3.010 ± 0.081). These findings underscore the need to identify an optimum blend of the two alternative feedstuffs. This is more so as their nutrient composition seem complementary.

Amending cassava peel meal with blood meal led to a concentration dependent positive effect on the growth performance of the experimental animals as contained in table 2. This is revealed from the result of the growth performance obtained. Precisely, the growth in weight as determined from the data obtained during the experiment indicates that treatment 1, 2, 3 and 4 had growth performance of 9.775 ± 1.525, 10.517 ± 1.783, 15.267 ± 1.000 and 15.705 ± 0.255 respectively after four (4) weeks. This result reveals that amendment with 10% blood meal had no statistically significant effect on the growth performance of the experimental animals. However, increasing the quantity of blood meal to 20% had a statistically significant positive effect on the growth performance of the experimental organisms. In fact, amendment of cassava peel meal with 20% blood meal led to a growth performance statistically similar to that of the control fed with poultry starter feed.

Shell length and width in centimetres was measured weekly. From the data obtained, the average weekly shell length and width was determined. The growth in length and width of the shell was determined as a difference in length and width of animal shell at the end of the last week of treatment and the initial shell length or width of the animals prior to treatment. This result is as contained in

International Journal of Scientific & Engineering Research, Volume 12, Issue 1, January-2021
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table 3 and 4 above respectively. The results reveal that amendment with blood meal had a concentration dependent positive effect on shell area with treatment 3 having the best performance. Precisely, the growth in shell length was found to be 0.460 ± 0.040, 0.660 ± 0.080, 1.160 ± 0.027 and 0.962 ± 0.018cm respectively for treatments 1 to 4; while the growth in shell width was found to be 0.470 ± 0.030, 0.388 ± 0.045, 1.323 ± 0.234 and 1.210 ± 0.070 for treatment 1, 2, 3 and 4 respectively. Treatment 1 and 2 had statistically similar growth in shell width.

Average quantity of feed consumed was estimated. This was captured as the estimated total feed intake per snail. This was determined weekly by a weigh back technique. The quantity of fresh feed given to each experimental unit on weekly bases was weighed and recorded. At the end of the week, the left over in the feeders as well as feed wasted on the floor was collected, weighed and recorded. In this way, the quantity of feed consumed was calculated as (quantity given- quantity left over). Total feed intake was hence determined. Table 5 contains the above results. The result indicates that treatment 1and 4 consumed the largest quantity of feed, 51.700 ± 1.100 and 47.300 ± 0.700 respectively, which were found to be statistically similar. Treatment 2 (32.800 ± 0.600) had the least feed consumption followed by treatment 3 (40.200 ± 1.800). This indicates that the experimental organisms find the cassava peel meal palatable.

However, the high palatability of the cassava peel meal did not translate into better feed conversion efficiency. This is more so as even though treatment 1 that was fed only the dried cassava meal waste consumed quantities of feed similar to that of the control, it did not translate to better performance or similar growth performance or feed growth ratio (FGR). Group 2 and 3 fed cassava peels amended with 10% and 20% blood meal even though they consumed less feed than treatment 1 had better performance with particular reference to feed growth ratio as contained in table 5. Precisely, the FGR which is 5.439 ± 0.961, 3.221 ± 0.603, 2.652 ± 0.292 and respectively for treatment 1 to 4 was found to be improved in a concentration dependent manner with treatment 3 having a statistically similar result to the control. Amendment also diminished the mortality even though the control still had better mortality result.

5 Conclusion

The experimental animals find the dried cassava meal palatable. However, it seems to contain inadequate quantity of protein. The lower protein content may have led to negative consequences on the metabolism of the organism. As a result of this, the feed conversion ratio was negatively impacted. Hence, amendment with blood meal is very useful. Amendment with 20% blood meal (treatment 3) is optimal. The feed growth ratio of treatment 3 when compared to the control experimental animals fed poultry starter feed, had no statistically significant difference.
Hence, this preliminary studies reveal that dried cassava peel meal amended with 20% blood meal could be used to replace poultry starter feed mash as feed for the experimental animals. This is still subject to further confirmatory research.

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