# Evaluation of the Performance of African Giant Land Snail (*Achatina Achatina*) Fed Rice Bran Amended With Graded Levels of Bovine Blood Meal

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**Abstract**— Performance of African Giant Land Snail (*Achatina achatina*) fed rice bran amended with graded levels of bovine blood meal was evaluated. Forty (40) snails were randomly assigned to four (4) treatment groups with two (2) replicates each in a completely randomized design (CRD). Treatment 1, 2, 3 and 4 were fed with: only rice bran, rice bran amended with 10% blood meal, rice bran amended with 20% blood meal and poultry starter feed respectively. The parameters measured were weight gain, feed intake, length, width and feed / gain ratio. Also, the proximate characteristics of the samples were determined. All results were analyzed using one-way analysis of variance ($p \geq 0.05$). Proximate analysis revealed that rice bran is high in fiber (23.460 ± 0.006) and low in protein content (11.607 ± 0.006) when compared with the blood meal. It also has a higher percentage of carbohydrate (45.395 ± 0.009) than the blood meal (13.420 ± 0.081), even though this percentage carbohydrate content is less than that of the control diet which was 59.050 ± 0.497. Result of the growth response indicated that treatment 1, 2, 3 and 4 had 11.050 ± 0.450, 10.242 ± 0.508, 16.900 ± 0.700 and 15.075 ± 0.075g gain in weight respectively. The feed / gain ratio (FGR) was also found to be 6.582 ± 0.947, 5.692 ± 0.390, 3.339 ± 0.032 and 3.138 ± 0.062 respectively for treatment 1, 2, 3 and 4. Amendment with 20% blood meal was found to be optimal.

**Index Terms**—amendment, bovine blood meal, growth response, proximate analysis, rice bran



## 1 INTRODUCTION

Snails belong to the group, mollusk. They lack endoskeletons, but have exoskeletons in the form of shells which they drag along as they move. Such animals like the snail that lack endoskeletons and hence have no vertebral column are also referred as invertebrates. This invertebrate animal, the giant African land snail is referred to in local parlance as '*Congo meat*'. *Congo meat* is an important source of animal protein in most coastal communities in Nigeria and other parts of Africa [1]. It is predominantly seen in these places as a category of bush meat to be consumed irregularly rather than as a nutritious meat to be enjoyed daily just like the meat from more popular sources like livestock [2]. Even though some ethnic groups have superstitious beliefs that discourage the consumption of snail meat entirely or certain species of snails, there is still very high demand for snail meat. One of the reasons that can be adduced for this may be the increasingly expensive cost of conventional animal protein sources like beef, goat, pork and poultry due to high demand as a result of increase in population and shortfall in supply due to a number of factors which conspicuously includes high feed costs which limits livestock production [3].

Sustainable mitigation of the increasing cost of conventional meat sources due to increasing population and shortfalls in supply requires provision of a cheaper source of protein for human consumption. This could be done by tilting the balance of present animal husbandry mix in favour of intensive system of rearing alternative sources of animal protein, in the form of bush meat and snail meat. This is more so as depending on hunting and gathering from the wild can no longer meet demand for these protein sources [4].

The flesh of the giant land snail is a source of protein that is enjoyed by many people. Put differently, snails are important sources of animal protein and contain almost all the essential amino acids required by man [5]. Its meat is palatable and rich in essential amino acids such as lysine, leucine, isoleucine and phenylalanine as well as high iron contents [6,7,8]. It also contains high levels of magnesium, phosphorus and potassium but low levels of sodium, fat and cholesterol [9,10,11]. The low fat and cholesterol contents of snail meat make it good for the prevention of blood vessel diseases like hypertension, stroke and cardiac arrest [12]. Obviously, snails are not only enjoyed because of their palatability and nutrient dense nature, they have been linked to a number of medicinal benefits. Precisely, snails have been used in the treatment of hypertension, conjunctivitis, diabetes and iron-deficiency anemia [13]. Also supporting the above assertion, it has been found that snails have been used with success against inflammations especially against cough and cold, bronchitis, catarrhs, asthma, tonsillitis, pharyngitis, hoarseness, sore throat, influenza, croup, nervous cough of children, lung diseases, such as pneumonia, and stomach or intestinal cramps, gastritis, gastero-enteralgia, headaches coming from disorders of the stomach, cough that follows or comes with inflammatory skin disorders, measles, scarlet fever, small pox, erysipelas, etc. singers find them to be very active aids against several alterations of the voice [14]. However, the nutritional value of snail is mainly attached to its high protein value [13].

Nigeria is rich in different breeds of snail that have the capacity to efficiently convert nutrients into high quality protein [15]. However, the availability of snails, especially the African indigenous species like the giant land snail, is decreasing gradually due to indiscriminate hunting, harmful

agricultural practices like bush burning and deforestation which destroys the snail's natural habitat [16]; snail productivity in the natural habitat is also affected by seasons. As a result of this and more, it has become apparent that snails collected from the wild can no longer meet man's demand for snails as a source of protein. Therefore, there is need to rear snails intensively. This requires the domestication of snails. Such domesticated snails will be kept in conducive enclosures in addition to supplying them with acceptable feeds.

Hence, to successfully rear any animal, feeding plays a vital role in the survival, growth and reproduction of such domesticated animals. However, the feed conversion rate (FCR) of snails is quite high when compared to some other micro-livestock [17]. Thus, in addition to the high demand for snails, the high FCR of snail is also a major incentive to potential snail farmers. Snail normally feed on organic materials like leaves, fruits, tubers, kitchen wastes and compounded feed. Purchasing compounded feed is very expensive while plant materials are seasonal. As a result, there is need for concerted efforts to be made towards feeding snails with cheap locally available feedstock that are rich in nutrients to mitigate the effect of high cost of compounded feed and the seasonality of plant materials. Such feedstocks that do not attract competition in consumption between humans and livestock are highly desirable. This will ensure continuity in snail production all year round. Hence, this study investigates the performance of African giant land snail (Achatina achatina) fed with rice husk amended with bovine blood meals.

Rice is a choice food for many people in Nigeria. As a result, the country consumes almost eight million (8,000,000) tonnes of rice annually [18]; making her the largest rice consumer in Africa and also the largest rice importer in the continent [19]. This is because, in order to meet the huge demand for the commodity in the nation, she relies on importation. Little wonder that as at 2015, Nigeria spent at least one billion naira (N1,000,000,000.00) on rice importation [20]. And there was no end in sight considering the fact that demands for the commodity continued to increase. Apparently, this practice is obviously unsustainable as it depletes the nations' foreign reserve significantly; thereby, denying her of fund which could be channeled into other developmental projects. To stem this continuous unsustainable drift, a lot of efforts were channeled into not only encouraging local production, but also supporting local rice production. This is yielding positive results as revealed by the fact that spending on importation of rice has declined [20]. This is more so as Nigeria is now the largest rice producer in Africa and produces as at 2017 about 5.8 million tons of the 7.9 million tones required annually20.

Nevertheless, this increase in rice production creates a new challenge for sustainable management of the waste generated. Precisely, the husk of rice constitutes twenty percent (20%) of paddy rice [21]. That is to say that at a production capacity of 5.8 million tones of rice per annum, about 1.45 million tones of rice husk is generated annually. Hence, this massive waste which no doubt have massive negative effect on the ecosystem due to current difficulty in effective and efficient disposal system can become a wealth if it can be harnessed.

## 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 snail (*Achatina achatina*) were purchased from a snail farm located in Afikpo, Ebonyi State.

Rice bran was obtained from Ishiagu rice 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 the morning.

### 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 [22]. 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 [22] 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 [23]. 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° 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 [23].
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.
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 (H2SO4) = 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 [23]. 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 [23]. 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 rice bran was collected fresh and used as soon as possible to limit requirement for the storage of the sample.
Blood collected from Ishiagu slaughter slab was first heated in a pot to coagulate and reduce the moisture content. The coagulated blood was afterwards sun dried. The particle size was next reduced by grinding the dried cattle blood to get the blood meal.
To get the experimental diet, the rice bran was amended with graded levels of the blood meal. Treatment 1 had only the rice bran, treatment 2 feed was amended with 10% blood meal while treatment 3 feed was amended with 20% blood meal.

Treatment 4 served as the control. Poultry starter feed obtained from Eke Market in Ishiagu was used as control diet.

### 2.5 Experimental Design

Forty (40) African giant land snails were randomly assigned to four (4) treatment groups with two (2) replicates each in a Completely Randomized 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 the sun. The floor of the pens was then covered with loamy soil to about 6cm high from the bottom. The feeders and drinkers were also thoroughly washed and dried.

Seven days trial feeding was done before the commencement of the experiment to allow for physiological adjustments of the snails.

The snails were weighed at the onset of the experiment and subsequently on a weekly basis. Water was provided adlib 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 vennier caliper. The feed intake was determined daily by a weigh back technique. This means that a known quantity of fresh feed given to each experimental unit was weighed and recorded. In the morning of the next day, the left over in the feeder 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 was served. The same quantity of water was also sprinkled on the floor (soil) on daily basis in each pen to maintain adequate humidity and temperature.

The proximate properties of the samples were determined.

### 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.

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## 3 RESULTS

### 3.1 Proximate Analysis

The proximate -analysis of the feed materials was determined. The proximate properties of rice bran, blood meal and the poultry starter feed used is as contained in table 1 below. The results shows that the rice bran, blood meal and the poultry starter feed had moisture content of 5.720 ± 0.006, 5.520 ± 0.081 and 8.610 ± 0.381, crude protein of 11.670 ± 0.006, 76.250 ± 0.081 and 17.120 ± 0.456, crude fat of 3.790 ± 0.006, 1.725 ± 0.202 and 2.470 ± 0.352, crude fiber of 23.460 ± 0.006, 0.050 ± 0.008 and 6.290 ± 0.237, ash of 9.965 ± 0.009, 3.010 ± 0.081 and 6.130 ± 0.543, carbohydrate of 45.395 ± 0.009, 13.420 ± 0.081 and 59.050 ± 0.497 percent respectively.

TABLE 1

PROXIMATE PROPERTIES OF THE RICE BRAN, BLOOD MEAL AND POULTRY STARTER FEED

| PARAMETERS | RICE BRAN | BLOOD MEAL | STARTER POULTRY FEED |
|---|---|---|---|
| MOISTURE CONTENT (%) | $5.720 \pm 0.006^{a}$ | $5.520 \pm 0.081^{a}$ | $8.610 \pm 0.381^{b}$ |
| CRUDE PROTEIN (%) | $11.670 \pm 0.006^{a}$ | $76.250 \pm 0.081^{c}$ | $17.120 \pm 0.456^{b}$ |
| CRUDE FAT (%) | $3.790 \pm 0.006^{a}$ | $1.725 \pm 0.202^{b}$ | $2.470 \pm 0.352^{b}$ |
| CRUDE FIBER (%) | $23.460 \pm 0.006^{c}$ | $0.050 \pm 0.008^{a}$ | $6.290 \pm 0.237^{b}$ |
| ASH (%) | $9.965 \pm 0.009^{c}$ | $3.010 \pm 0.081^{a}$ | $6.130 \pm 0.543^{b}$ |
| CARBOHYDRATE (%) | $45.395 \pm 0.009^{b}$ | $13.420 \pm 0.081^{a}$ | $59.050 \pm 0.497^{c}$ |

*Means in the same row with the same letter(s) are not statistically significant ($p \geq 0.05$).*

### 3.2 Growth Performance

The experimental animals were weighed on weekly bases. Prior to the commencement of the experiment, the initial weight of the animals was noted. From the data obtained, the average weekly weight was arrived at. Growth in weight was thus determined as a difference in weight of animals at the end of the last week of treatment and the initial weight of the animals. This result as contained in table 2 below reveals that treatment 1, 2, 3 and 4 had growth performance of 11.050 ± 0.450, 10.242 ± 0.508, 16.900 ± 0.700 and 15.075 ± 0.075g respectively.

TABLE 2
AVERAGE WEIGHT GAIN (GRAMS) OF THE SNAILS

| PARA-METERS | TREATMENT 1 | 2 | 3 | CONTROL |
|---|---|---|---|---|
| INITIAL LIFE WEIGHT (g) | 33.200 ± 0.611[a] | 33.300 ± 0.668[a] | 33.100 ± 0.407[a] | 33.400 ± 0.670[a] |
| TERMINAL LIFE WEIGHT (g) | 44.000 ± 0.577[a] | 43.500 ± 0.742[a] | 50.200 ± 0.663[b] | 48.333 ± 0.624[b] |
| GROWTH (g) | 11.050 ± 0.450[a] | 10.242 ± 0.508[a] | 16.900 ± 0.700[b] | 15.075 ± 0.075[b] |

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

### 3.3 Shell Length

Growth in shell length of the experimental animals was determined and found to be 0.200 ± 0.120, 0.280 ± 0.090, 0.920 ± 0.060 and 0.520 ± 0.020 respectively for treatment 1, 2 3 and 4. This result is contained in table 3 below.

TABLE 3
AVERAGE LENGTH OF THE SNAIL SHELLS (CM)

| PARA-METERS | TREATMENT 1 | 2 | 3 | CONTROL |
|---|---|---|---|---|
| INITIAL LENGHT (cm) | 5.250 ± 0.076[a] | 5.270 ± 0.076[a] | 5.280 ± 0.083[a] | 5.260 ± 0.056[a] |
| FINAL LENGHT (cm) | 5.400 ± 0.115[a] | 5.840 ± 0.129[b] | 6.040 ± 0.103[b] | 5.800 ± 0.055[b] |
| GROWTH (cm) | 0.200 ± 0.120[a] | 0.280 ± 0.090[a] | 0.920 ± 0.060[b] | 0.520 ± 0.020[ab] |

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

### 3.4 Shell Width

Growth in shell width of the experimental animals was determined. The above result is as contained in table 4 below. Growth in shell width was found to be 0.295 ± 0.025, 0.37cm, 0.353 ± 0.134 cm and 0.800 ± 0.000 cm for treatment 1, 2, 3 and 4 respectively.

TABLE 4
AVERAGE WIDTH OF THE SNAIL SHELLS (CM)

| PARA-METERS | TREATMENT 1 | 2 | 3 | CONTROL |
|---|---|---|---|---|
| INITIAL LENGHT (cm) | 3.180 ± 0.055[a] | 3.230 ± 0.040[a] | 3.190 ± 0.046[a] | 3.190 ± 0.062[a] |
| FINAL LENGHT (cm) | 3.433 ± 0.088[a] | 3.600 ± 0.071[a] | 3.960 ± 0.068[b] | 4.000 ± 0.069[b] |
| GROWTH (cm) | 0.295 ± 0.025[a] | 0.353 ± 0.134[a] | 0.768 ± 0.018[b] | 0.800 ± 0.000[b] |

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

### 3.5 Feed Growth Ratio (FGR)

The result of the feed intake is as contained in table 5. The result reveals that, treatment 1, 2, 3 and 4 had estimated average feed intake of 72.300 ± 7.500, 58.100 ± 1.100, 56.400 ± 1.800 and 47.300 ± 0.700g respectively. From the feed consumption data, the feed/gain ratio was arrived at. This was found to be 6.582 ± 0.947, 5.692 ± 0.390, 3.339 ± 0.032 and 3.138 ± 0.062 for treatment 1, 2, 3 and 4 respectively. Mortality of the experimental animals was also found to be 70.000 ± 10.000, 50.000 ± 10.000, 50.000 ± 10.000 and 10.000 ± 10.000 for treatment 1, 2, 3 and 4 respectively.

TABLE 5
AVERAGE FEED INTAKE (GRAMS)

| PARA-METERS | TREATMENT 1 | 2 | 3 | CONTROL |
|---|---|---|---|---|
| TOTAL WEIGHT GAIN (g) | 11.050 ± 0.450[a] | 10.242 ± 0.508[a] | 16.900 ± 0.700[b] | 15.075 ± 0.075[b] |
| ESTIMATED AVERAGE TOTAL FEED INTAKE / SNAIL (g) | 72.300 ± 7.500[a] | 58.100 ± 1.100[ab] | 56.400 ± 1.800[b] | 47.300 ± 0.700[b] |
| FEED / GROWTH RATIO (FGR) | 6.582 ± 0.947[b] | 5.692 ± 0.390[b] | 3.339 ± 0.032[a] | 3.138 ± 0.062[a] |
| MORTALITY (%) | 70.000 ± 10.000[b] | 50.000 ± 10.000[ba] | 50.000 ± 10.000 [ba] | 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 rice bran and the blood meal used was determined. The result of the proximate properties of the rice bran, blood meal and the starter poultry feed is as contained in table 1. It reveals the nutritional composition of the alternative feedstock in comparison to the poultry starter feed. The fiber content of rice bran was found to be 23.460 ± 0.006 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 45.390 ± 0.009, 13.420 ± 0.081 and 59.050 ± 0.497 for rice bran, blood meal and poultry starter feed respectively. This reveals that rice bran was higher in fiber and carbohydrate than blood meal. However, the carbohydrate content of the rice bran even though it was higher than the carbohydrate content of blood meal was less than that of the poultry starter feed. Precisely, the carbohydrate content of rice bran is about 76.9% of the carbohydrate composition of the poultry starter feed. The implication of this is that in order to meet their carbohydrate requirement, the experimental animals will have to consume more rice bran to make up for the deficit of about 23.1% of their carbohydrate requirement as contained in the poultry starter feed. Alternatively, a blend of carbohydrate sources can also be used in order to meet the carbohydrate requirement. On the other hand, blood meal was found to be very high in protein (76.250 ± 0.081), as much as over four (4) times the protein composition of the poultry starter feed (17.120 ± 0.456), and about six (6) times the protein content of the rice bran (11.670 ± 0.006). As a result, blood meal seems a very good source of supplemental protein for the animals while the rice bran can serve as a good source of carbohydrate even though it was found to be high in fiber. Rice bran was also found to be rich in mineral composition. It had a good mineral composition as revealed by the ash content which was found to be 9.965 ± 0.009. This was found to be significantly higher than the ash content of blood meal and poultry starter feed which were 3.010 ± 0.081 and 6.290 ± 0.237 respectively. Hence, this will go a long way in ensuring the amended feed has adequate mineral for the optimal performance of the experimental organisms.

Growth performance of the experimental animals was evaluated. The result of the performance evaluation of the treatment animals as contained in table 2 reveal that amendment with blood meal had positive effect on the growth of the experimental animals. To arrive at this conclusion, the experimental animals were weighed on weekly bases. The initial weight of the animals was noted prior to the commencement of the experiment. From the data obtained, the average weekly weight was determined. The growth in weight was determined as the difference in weight of animals at the end of the last week of treatment and the initial weight of the animals. This result reveals that treatment 1, 2, 3 and 4 had growth performance of 11.050 ± 0.450, 10.242 ± 0.508, 16.900 ± 0.700 and 15.075 ± 0.075g respectively. When compared to the control, the growth performance of treatment 1 and 2 were significantly lower. The growth performance of this two treatments when compared to each other was statistically not significant. Treatment 3 on the other hand, had a growth performance that was significantly higher than that of treatment 1 and 2 but statistically similar to that of the control.

Average growth in shell length was found to be 0.200 ± 0.120, 0.280 ± 0.090, 0.920 ± 0.060 and 0.520 ± 0.020 cm respectively, while average growth in shell width was found to be 0.295 ± 0.025, 0.353 ± 0.134, 0.768 ± 0.018 and 0.800 ± 0.000 cm for treatment 1, 2, 3 and 4 respectively. These results are contained in table 3 and 4 respectively. Growth in shell area as revealed from the shell length and shell width data as contained in table 3 and 4 above seemed to improve in a concentration dependent manner with regards to amendment of rice bran with blood meal. However, while treatment 3 amended with 20% blood meal had better growth in shell area than treatments 1 and 2, its growth in shell area and that of the control were statistically similar.

Average quantity of feed consumed was estimated and captured as the estimated total feed intake per snail. Table 5 contains the above results. This result indicates that treatment 1, 2, 3 and 4 had estimated average total feed intake / snail of 72.300 ± 7.500, 58.100 ± 1.100, 56.400 ± 1.800 and 47.300 ± 0.700g. Treatment 1consumed the largest quantity of feed and this was significantly higher than the feed consumed by the control. However, the estimated average total feed intake / snail for treatment 2 and 3 were found to be statistically similar to that of the control. This indicates that the experimental organisms found the rice bran palatable. However, the high palatability of the rice bran did not translate into better feed growth ratio. This is more so as even though treatment 1 that was fed only rice bran consumed the highest quantity of feed than all the treatments, it did not translate to better performance or similar growth performance or feed growth ratio (FGR). Precisely, treatment 1 to 4 had feed gain ratios of 6.582 ± 0.947, 5.692 ± 0.390, 3.339 ± 0.032 and 3.138 ± 0.062 respectively. This result reveals that treatment 1 and 2 had a statistically similar feed gain ratio and this was significantly lower than the feed gain ration of the control (treatment 4). The feed gain ratio of treatment 3 on the other hand was not significantly different from that of treatment 4 which served as the control treatment. Hence, amending the rice bran with 20% blood meal seems optimal from the result of the feed gain ratio. It was however observed that the control still had better mortality result and that amendment did not significantly affect the mortality of the experimental animal.

## 5 CONCLUSION

Even though rice bran had high fiber content, it also has a valuable amount of carbohydrate. As a result, it may be a useful substitute for conventional carbohydrate sources like maize, sorghum, millet, etc, which are also staple food for humans and feedstock for other industrial uses. However, to mitigate any negative effect which its high fiber content may have on the feed quality and digestibility, it may be necessary to use rice bran as only partial substitute for carbohydrate and not a complete substitute of the carbohydrate in feed formulation. Alternatively, feed supplementation with enzymes to aid in the degradation of the fiber component of

rice bran in order to make its rich carbohydrate reservoir easily accessible to the experimental animal also has a lot of promise. Amendment of rice bran with bovine blood meal had an overall positive effect on growth performance of the experimental animals. In fact, treatment 3 amended with 20% blood meal posted the best growth performance ahead of even the control treatment. However, it still had a higher mortality than the control. This underlines the need for further evaluation to ascertain the cause of the observed irregularities. Nevertheless, amendment of rice bran with 20% blood meal shows a lot of promise.

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