GROWTH PERFORMANCE, NUTRIENTS DIGESTIBILITY, AND CARCASS CHARACTERISTICS OF RABBITS FED DIETS CONTAINING PAR-BOILED AND NON-PARBOILED RICE MILLING BY-PRODUCTS

ABSTRACT

A feeding trial was conducted for 84-days to investigate the feeding value of rice milling by-products on growth performance, digestibility, carcase characteristics, organ characteristics, blood profile and economics of feeding on growing rabbits in Makurdi. Fourty two (42) weaner rabbits weighing between 412 – 420 g were randomly allocated to 7 treatment diets with each treatment replicated 6 times in a completely randomize design (CRD). Each rabbit constituted a replicate and each treatment was made up of three males and three females. The treatments were, $D_{1,}$ control, D_2 contained parboiled rice offal (PRO), D_3 contained parboiled rice bran (PRB), D_4 contained parboiled grain rejects (PGR), D_5 contained non-parboiled rice polishing (NPRP), D_6 contained non-parboiled rice bran (NPRB)and D_7 contained non-parboiled grain rejects (NPGR). Result of growth performance revealed that Significant ($P<0.05$) dietary influence were observed on average daily weight gain and feed conversion ratios. In both parameters (ADWG and FCR) performances were significantly($P<0.05$) poor (11.0 g and 6.69 respectively) in rabbits fed PRO. Result of digestibility by the rabbits fed diets containing RMBPs were similar ($P>0.05$) to the rabbits fed the control diet and this similarity was observed across the treatment groups. No significant ($P>0.05$) dietary influence was observed on carcass parameters measured It was concluded that, the combination of rice milling by-products (RMBPs) with other feed materials provided cheaper diets that are nutritionally adequate for enhance growth, good carcass development and yield of rabbits at levels equivalent to the reference diet. It is recommended therefore that, feed manufacturers and Rabbit farmers can incorporate up to 25% of rice offal, rice bran and rice grain rejects in the diets of rabbits.

Key words: Rabbits, par-boiled, non-parboiled, rice milling by-products (RMBPs), growth, digestibility.

1. Introduction

Comment [S1]: The introduction is not strong enough because the author does not explain enough about rice milling by product, especially in relation to his research. The author should convey existing findings that are still relevant to the results of his research, so that when the author wants to state that this research is important to carry out, it is based on the results of previous research. Thus, it needs to be added so that the introduction has more bite.

World population continues to grow in geometric progression and, thus, places ever increasing pressure on arable land, water, and the other resources required to provide the necessities of life such as healthy food, potable water, and clean air (1). Consequently, there is insufficient supply of feedstuffs at economic prices and this has continued to limit the production and thus, availability of animal protein in the diets of humans in the developing countries of the world. All stakeholders in the animal production industry are interested in issues of availability and quality of feed. There is, therefore, great interest in the potential of any material to serve as feed ingredients (2). Thus, the use of agricultural by products in animal feed production is one major strategy that holds great potential for bringing down feed cost (3). Since by-products are generally cheaper than the originating commodity, the use of agro by-products will lower price of animal protein, by reducing feed cost (4). This will in turn raise animal protein consumption levels and ultimately improve the health and productivity of the general populace and children in particular. Rice milling by-products (such as rice offal, rice grain rejects, and rice bran) are some of the cheapest and readily available agro-industrial by product that could be used to feed both ruminants and monogastric animals such as rabbits. With the current intervention on industrial rice production in the country, the processing of paddy rice into edible product in Nigeria is increasing rapidly. Recently, rice mills have grown in number and sophistication, in response to increased production of paddy rice, resulting in higher volumes and varieties of by-products. In this study, attempt was made to nutritionally determine the feeding value of rice milling by products (RMBPs) in the diet of growing rabbits.

2 Materials and Methods

2.1 Location of the Study

The study was conducted at the Rabbit Unit of Oracle Farms, km 5, Makurdi-Naka Road, Makurdi, Benue State. Makurdi lies within the Southern Guinea Savannah Agro ecological zone of Nigeria.

2.2 Test Materials

The rice milling by-products (Rice offal) were obtained from small scale rice mills in various locations in Makurdi. Parboiled Rice bran and parboiled grain rejects were purchased from a commercial rice mill; MIKAP rice processing plant, makers of MIVA rice located along kilometre 5 Gboko Road, Makurdi while non-parboiled rice bran, non-parboiled grain rejects and non-parboiled rice polishing were purchased from Oracle Rice Mill located at KM 3, Industrial layout, Makurdi-Naka road, Makurdi. Other ingredients; maize, brewers dried grain (BDG), Soybeans Meal (SBM), palm kernel cake (PKC) were purchased from the market within Makurdi metropolis. Bone charcoal, common salt, Synthetic Methionine, Synthetic Lysine, vitamin/mineral premix, and drugs required for medications were purchased from a veterinary and livestock feed shop within Makurdi.

2.3 Experimental Animals, Design, and Management

Forty-two (42) cross breed (Chinchilla x New ZealandWhite) weaner rabbits aged between five to seven weeks ranging in live weights between 412~~.00~~ g to 420~~.00~~ g obtained from rabbit farms within Makurdi were used for the study. The physical appearances of the animals, the disease history, and other management practises of the various farms were taken into consideration in choosing the animals to be purchased. This was to ensure that the rabbits were healthy and suitable for experimental purposes. The rabbits were housed in individual cages made of iron bars/wire netting measuring 60 cm x 60 cm x 90 cm raised 60 cm above the floor. The rabbits were allowed seven days to get acclimatised to the new environment and diets after which six rabbits were randomly allocated to each treatment, balancing for sex, and minimising live weight differential. Each rabbit served as a replicate. The completely randomised design (CRD) model was adopted. Standard rabbit husbandry practices including feeding standards, hygiene, medications, and externalorinternal parasite control measures were strictly observed throughout the experimental period. Feed and water were provided *ad-libidum.*

2.4 Experimental Diets

Seven experimental diets coded D_1, D_2, D_3, D_4, D_5, D_6, and D_7 were formulated with D_1 having no rice milling by-product ~~and served as the~~(control), D_2, D_3, D_4, D_5, D_6, and D_7 containing parboiled rice offal (PRO), Parboiled rice bran (PRB), Parboiled grain reject (PGR), none parboiled rice bran (NPRB), none parboiled rice polishing (NPRP), and none parboiled grain reject (NPGR) at 25% inclusion respectively. The ingredients and calculated nutrient and energy composition of the diets is presented in Table 1

Table 1: Ingredients and Calculated Nutrient Composition of Experimental Diets

Ingredients (%)	**Diet 1**	**Diet 2**	**Diet 3**	**Diet 4**	**Diet 5**	**Diet 6**	**Diet 7**
	Control	**25.~~00~~% PRO**	**25.~~00~~% PRB**	**25.~~00~~% PGR**	**25.~~00~~% NPRP**	**25.~~00~~% NPRB**	**25.~~00~~% NPGR**
Maize	26.6	14.6	13.6	12.6	13.6	13.6	13.6
Soybean meal	12.1	11.1	11.1	13.1	10.1	11.1	12.1
palm kernel cake	20.4	16.4	16.4	15.4	16.4	16.4	15.4
Brewers dried gain	22.2	18.2	17.2	16.2	16.2	17.2	16.2
PRO	-	25.0	-	-	-	-	-
PRB	-	-	25.0	-	-	-	-
PGR	-	-	-	25.0	-	-	-
NPRP	-	-	-	-	25.0	-	-
NPRB	-	-	-	-	-	25.0	-
NPGR	-	-	-	-	-	-	25.0
Soybean straw	13.6	8.55	12.6	12.6	13.6	12.6	12.6
Palm oil	1.00	2.00	2.00	1.00	1.00	2.00	1.00
Bone charcoal	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Methionine	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Table salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vit. /Min. premix®	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25	0.25	0.25	0.25
TOTAL	**100**	**100**	**100**	**100**	**100**	**100**	**100**
CALCULATED	**ANALYSIS**						
Crude Protein (%)	17.1	16.9	17.9	16.1	16.6	17.9	16.1
Energy (kcal/kg)	2637	2405	2500	2726	2686	2500	2726
Crude Fibre (%)	12.8	17.2	13.5	11.3	11.4	11.3	11.4
Ether extract (%)	4.63	4.87	7.11	4.98	5.81	7.11	5.81

®Vit-Min Premix (Nutrpoult) Vitamin A10,000,000IU, Vitamin D_3 2,000,000IU, Vitamin E 40,000mg, Vitamin K_3 2,000mg,Vitamin B_1,500mg, Vitamin B_2 5,0000mg, Vitamin B_{12} 20mg, Vitamin B_6 40,000mg, Niacin 40, 000mg, Calpan 10,000mg, Folic acid 1, 000mg, Biotin 100mg, Antoxidant 100, 000mg,Cholin chloride 300,000mg, Cobalt 300mg, Selenium 200mg, Iodine 800mg, Iron 40,000mg, Manganese 80,000mg, Copper 80,00mg, Zinc 60,000mg. D_1-D_5=Treatments 1,2,3,4 and 5. RO= Rice Offal; RB=Rice Bran, GR=Grain Rejects, NPRB-none parboiled rice bran, NPRP-none parboiled rice polishings, NPGR- none parboiled grain rejects.

2.5 Parameters Measured

a. Weight gain

The rabbits were weighed at the beginning of the trial and weekly thereafter. The weight at the beginning of the week was termed initial weight (IW), and that at the end of the week was called present weight (PW), while the weight at the end of the final week was termed final weight

(FW). Weight gain (WG) was calculated by difference: WG= PW – IW. Average daily weight gain (ADWG) over the entire study period was calculated as: ADWG= [(FW – IW) ÷ 84] (84 days was the duration of the study).

b. Feed intake

Comment [S4]: Write down the references

A known quantity of feed termed feed supplied (FS) was set aside for each rabbit at the beginning of the week and the rabbit was offered feed from it during the week. The left-over feed (LOF) at the end of the week was weighed, and feed consumed/intake (FI) calculated by difference. FI= [(FS – LOF). Daily feed intake was computed by dividing feed intake by number of days (84days). ADFI= [(FS – LOF) ÷ 84] (84 days was the duration of the study).

c. Feed conversion ratio

Comment [S5]: Write down the references

The feed to gain ratio was computed by dividing feed intake (FI) by the weight gain, (WG) of the animals; as given in the formula, FCR=FI÷WG.
Where; FCR= Feed Conversion Ratio; FI= Feed Intake; WG= Weight Gain.

2.5.1 Nutrient digestibility

Comment [S6]: Write down the references

At the end of the 12th week of the study, a digestibility trial was carried out. From each treatment, four rabbits (two males and two females), with mean live weight closely approximate to the treatment mean, were selected for the trial. The rabbits were starved for eighteen (18) hours to clear the gut of previous feed residues. During the following five days, seventy-five per cent (75 %) of their daily feed intake was offered to the rabbits and the corresponding faeces voided were collected by placing plastic netting under the cages. The weights of the fresh faeces collected for each rabbit was recorded, oven dried to a constant weight. At the end of the trial the faecal sample for each rabbit was pooled milled and sampled for proximate analysis as outlined by (5). Determination of apparent nutrient digestibility was calculated using the formula below:

Apparent digestibility = [(Nutrient intake – Nutrient voided) ÷ Nutrient intake] x100

2.5.2 Carcass and visceral organ characteristics

Comment [S7]: Write down the references

At the end of the feeding period, three rabbits (blocking for sex; 2 males and 1 female) which live weight most closely approximate their treatment mean were randomly selected from each treatment, starved overnight and then slaughtered. The rabbits were weighed to obtain their live weight, and then stunned with a blow at the back of the head. Their jugular veins were severed with a sharp knife and allowed to bleed thoroughly under gravity. The carcasses were eviscerated, weighed, singed, and, then weighed again to obtain the dressed weight using an electronic weighing balance. The dressed carcasses were reduced into the traditional cuts; head, neck, forelimbs, rack/ribs, back/loin and hind limbs and the weights of the various cuts were recorded except the tail. These carcass cuts were expressed as percentage of the dressed weight as given by the formula;
% Carcass cut= [Carcass cut ÷ Dressed weight] x 100
The visceral organs (the heart, lungs, kidneys, liver, intestines, stomach, oesophagus, caecum and the spleen) were each removed, trimmed free of fats and adhering connective tissues, weighed and expressed as percentage of live weight.

2.6. Statistical Analysis

The data collected was analyzed by one-way analysis of variance (ANOVA) using (6) and where significant differences occurred, treatment means were separated using Duncan Multiple Range Test of the same statistical software.

Comment [S8]: Write down the references

3. Results and discussion

3.1 Growth performance of rabbits fed diets containing RMBPs, 0-12 weeks of feeding

Result of growth performance of rabbits fed diets containing RMBPs revealed a significant (P<0.05) dietary influence on average daily weight gain and feed conversion ratios. In both parameters (ADWG and FCR), performances were significantly(P<0.05) poor in rabbits fed diet D_2 containing parboiled rice offal (PRO).

Table 2: Growth Performance of Rabbits Fed Diets Containing RMBPs, 0-12 weeks of Feeding

Parameters	D1 (Cont.)	D_2 PRO	D_3 PRB	D_4 PGR	D_5 NPRP	D_6 NPRB	D_7 NPGR	SEM	P
IWt, (g)	413	420	412	419	419	415	415	24.8	1.00
FWt (g)	1577	1342	1774	1817	1674	1635	1598	45.6	0.12
ADFI (g)	70.4	69.2	77.5	73.1	70.3	76.9	58.8	1.97	0.19
ADWG (g)	13.9^{a}	11.0^{b}	16.2^{a}	16.6^{a}	14.8^{a}	14.5^{a}	14.1^{a}	0.44	0.01
FCR	5.10^{ab}	6.69^{b}	4.79^{a}	4.43^{a}	4.77^{a}	5.79^{ab}	4.28^{a}	0.22	0.04

ab=Means on the same row with different superscripts are significantly (P<0.05) different, NPRB-non parboiled rice bran, NPGR-non parboiled grain rejects, NPRP-non parboiled rice polishing, PRB-parboiled rice bran, PGR-parboiled grain rejects, PRO-parboiled rice offal. IW-initial weight, FW-final weight, ADWG-average daily weight gain, ADFI-average daily feed intake, FCR- feed conversion ratio

Rabbits fed diet D_2 recorded significantly (p<0.05) lower average daily weight gain. Similar to the report of this study (7) also reported a significant difference in the daily weight gain of rabbits fed shea butter nut cake. Values obtained in this study ranged between 11.0 -16.6 g/rabbit/day. These values were however higher than 5.81-12.1 g/rabbit/day reported by (7) but agreed with the values reported by (8) for rabbits fed diets containing rice milling by-products. The lower weight gain observed in rabbit on diet D_2 could be attributed to low energy content of the diet and thus, poor conversion into meat. Energy is regarded as the main dietary requirement of all animals for both maintenance and other productive functions. The poor ADWG of rabbits on PRO diet could also have resulted from the higher CF and lower digestible carbohydrate content of the diet. Thus, this affirms an earlier report by (9) who noted that, the high digestibility of corn-based diet was because of high availability of digestible carbohydrates content. The higher the fibre level in the feed of the rabbit, the more quickly it passes through the digestive system and the lower the digestibility (10). This implies poor efficiency of feed utilization by the animals.

Comment [S9]: Explain the relationship between the higher CF and lower digestible carbohydrate content of the diet on rabbit ADWG?

It was expected that the high fibre and low metabolizable energy contents of diet ($D_{2)}$ to have an influence on feed intake. This could have supported the findings of different scholars. While (11) reported that high fibre diets tend to increase feed intake in rabbits, (12) observed that, rabbits have the ability to adjust their feed intake voluntarily to meet their energy requirements (13) also reported that, various by-products with high fibre can affect voluntary feed intake depending on the nature of fibre. The present study however did not observe any significant difference in intake of feeds across treatments including rabbits on D_2. This report suggests that, both the rabbits on diets containing RMBPs and the control were similar in palatability /acceptability, rabbits were of similar age and the duration of the experiment was long enough to warrant adaptation to the feeds/diets provided. This finding was therefore consistent to the report of Alawa and (14) who had earlier reported that the ability of the rabbit to utilize highly fibrous diets may depend on the source of the fibre, age of the rabbits and length of adaptation of their digestive system to the fibre source. The values revealed in this study were similar to 67.9-79.4 g/rabbit/day reported by (8) who also reported similarities across treatment in ADFI of rabbits fed RMBPs. The similar feed intake observed across the treatment can also be explained on the basis of fibres ability to induce gut fill. Supporting the findings of (15) who reported that, fibre is an intrinsic component of animal feeds and depending on the chemical structure and physiochemical properties, fibre may affect both gut physiology and feed intake. In some species however, viscous soluble fibres are linked to an increased satiety caused by gastric distention and slower passage rate, and thereby a reduced feed intake. Significant ($P<0.05$) dietary influence was observed on feed conversion ratio. This report contradicts earlier reports of (16, 17 and 8). Values obtained in the study range between 4.28-6.69 and significantly ($P<0.05$) lower in rabbits fed diet D_2. These values were better than 4.72-9.14 reported by (7) but, were in line with the reports of. (18) when fresh and succulent stems of *Fiscus thonningi* were fed to growing rabbits. The high fibre and low energy contents of the diet D_2 could be implicated in the poor FCR observed in this study as reflected in the daily weight gain of the rabbits. In addition to the energetic inefficiency characterising the utilization of fibre and low metabolizable energy in D_2, the low weight gain of the rabbits on D_2 could be responsible for the poor value recorded for feed conversion ratio observed in the study. Aside the effect of feed characteristics/quality on voluntary feed intake and utilization, the animal's environment has also been implicated on voluntary feed intake and utilization. This observation was in line with that of (19) who observed that, one of the factors affecting feed conversion is the temperature of an animal's environment. Animals perform optimally when there are minimal variations in environmental temperature over a 24-hour period of time (19). According to them, on one hand, during cool weather conditions, animals will eat more feed but, much of the energy they obtain from the consumption of the feed is used to maintain body temperature and thus not converted into meat (weight) nor other productive functions (19). On the other hand, animals consume less feed and convert less efficiently at high environmental temperatures (19). This biological cooling mechanisms that animals use during hot conditions require energy just as the warming mechanisms do during cool weather conditions. It therefore suggests that, the variations in environmental temperature during the days and nights within the period of experimentation can be implicated in the differences observed in the present study with previous findings.

Overtly, the positive growth characteristics of rabbits on the diets containing both the parboiled and non-parboiled RMBPs compared with the rabbits on the control, observed in this study gives a good indication that the experimental diets (save D_2) sufficiently supplied the nutrients that supported growth and good performance of the rabbits.

3.2 Digestibility coefficient of rabbits fed diets containing RMBPs, 0-12 weeks of feeding

It was observed in this study that there was a considerable reduction in the digestibility coefficient of the rabbits at the 12th week of the study. At week 12, the result of digestibility by the rabbits fed diets containing RMBPS were similar (P>0.05) to the rabbits fed the control diet and this similarity was observed across the treatment groups (Table 3).

Table 3: Nutrients Digestibility by Grower Rabbits Fed Diets Containing RMBPs

Parameters (%)	D1 (Cont.)	D_2 PRO	D_3 PRB	D_4 PGR	D_5 NPRP	D_6 NPRB	D_7 NPGR	SEM	P
DM	65.4	65.8	67.6	79.4	62.9	75.2	62.3	1.99	0.16
NFE	57.2	45.7	53.2	74.3	47.7	53.4	45.9	3.04	0.15
CP	84.4	78.6	84.3	87.1	77.7	87.4	78.3	1.20	0.07
EE	80.6	88.2	91.4	86.3	81.1	91.1	89.3	1.58	0.36
CF	77.4	80.2	73.8	86.5	79.0	83.2	74.8	1.39	0.15

abcd=Means on the same row with different superscripts are significantly (P<0.05) different, NPRB-non parboiled rice bran, NPGR-non parboiled grain rejects, NPRP-non parboiled rice polishing, PRB-parboiled rice bran, PGR-parboiled grain rejects, PRO-parboiled rice offal. DM- dry matter, NFE-nitrogen free extract, EE- ether extract, CF-crude fibre

The values of DM digestibility reported in this study were slightly lower than 74.1 to 83.4% reported by (20) but higher than 36.7 to 66.0%, reported by (21). Digestibility can be influenced by many factors, notably, age, quantity of feed consumed by the animals at the time of metabolic trial. There appears also to be age differences in the ability of the rabbits to utilize the feed consumed. This observation validates an earlier finding of (19) that, animals of higher live weight due to age differences required higher amount of feed, even to attain a constant weight gain. Obviously, young and fast-growing animals have a far more favourable FCR in the early fattening stage than when near slaughter weight.Moreover, the maintenance requirements become high and are also responsible for the quick increase in FCR (22); which is a total reflection of the amount of nutrients made available to the rabbits' body for maintenance and production (growth) functions.

Conversely with the other nutrients, there was a remarkable improvement in the numerical value for digestibility of crude fibre by the experimental animals. Implying that, the digestibility of crude fibre could be dependent on the age of the rabbit. The development of the caecum and of course its microbial population responsible for fermentation of plant cell wall components can therefore be said to correspond to the age of the rabbit. This aligns to an earlier report of (23) in an experiment to determine the functional, anatomical and histological development of caecum in rabbits. They observed that, the complete physiological developments of the rabbit caecum were evidenced at 12 weeks of age. Implying therefore that, the caecum of the rabbit is fully developed and will be more efficient in the utilization of plant cell wall as the rabbit's age progresses. (23) further observed that, increasing feed intake will increase hindgut fermentation and activate microbial metabolism which may stimulate the development of caeca and colonic weights. As feed intake is also reported to correspond with age and body mass, the above observation can also be implicated in this study. Aside the above observation, the longer period of the rabbits on these diets allowed them opportunity to adopt fully to the diets and perhaps the conditions of the experiments within the study duration therefore leading to no difference in fibre digestion as well as the other nutrients.

3.3 Carcass Characteristics of Rabbits fed Diets Containing RMBPs

Resultof carcass characteristics is presented in Table 4. There was no significant (P>0.05) dietary influence on carcass parameters measured. Rabbits fed diets containing RMBPs showed values for dressed weight (953.40 g - 1088.33 g) and dressing percentage (61.31 % - 65.55 %) save for rabbits on diet D_2 (842.00 g and 60.51 % respectively).

Table 4: Carcass Characteristics of Rabbits Fed Diets Containing RMBPs

Parameters (%)	**D1 (Cont.)**	**D_2 PRO**	**D_3 PRB**	**D_4 PGR**	**D_5 NPRP**	**D_6 NPRB**	**D_7 NPGR**	**SEM**	**P**
FLW(g)	1521	1389	1717	1688	1656	1572	1456	44.6	0.35
DW(g)	920	842	1088	1037	1024	1011	953	32.4	0.51
DP	61.2	60.5	63.3	61.3	61.8	64.3	65.6	0.55	0.15
Head	12.7	12.5	10.9	11.7	11.8	11.2	11.9	0.23	0.38
Neck	3.78	3.40	3.41	3.73	3.81	4.10	3.59	0.10	0.63
Ribs/Rack	15.0	14.6	14.7	14.4	13.7	14.9	16.2	0.37	0.76
Back/Loin	14.6	14.0	15.9	15.8	14.6	15.5	13.4	0.33	0.35
Forelimbs	14.3	13.8	13.0	14.6	13.8	14.0	13.4	0.19	0.43
H. limbs	30.3	30.8	30.4	30.0	29.8	29.6	29.4	0.17	0.39

FLW-fasted live weight, DW-dressed weight, DP-dressing percentage, NPRB-non parboiled rice bran, NPGR-non parboiled grain rejects, NPRP-non parboiled rice polishing, PRB-parboiled rice bran, PGR-parboiled grain rejects, PRO-parboiled rice offal, SI-small intestine, LI-large intestine, H.limbs-hind limbs. carcass parameters were expressed as percentage of dressed weight.

The influence of feeding diets containing rice milling by-products to growing rabbits on carcass has been established. It shown in this study that the use of RMBPs in the diets of rabbits lead to similar (P>0.05) responses in final live weight gain across treatment groups. This result is consistent with an earlier report of (24) who also reported similarities in most of the parameters measured with the exception of the forelimbs. This observation indicates that rabbits fed diets containing RMBPs had fast rate of metabolism and thus growth similar to those fed on control hence, similarities in fasted live weight, dressed weight, dressing percentage and all parameters measured. This implies that, the use of rice milling by-products in rabbit nutrition did not negatively result to the modification of body parts that would affect consumer demand and preferences. Values for dressed weight and dressing percentage were in the range of 920.00 to

1088% and 60.5 to 65.6% lower than 1009 to 1122 g and 64.9 and 68.7% reported by (24) respectively. As reported by (25), the development rate of different body tissues and meat quality features can be modified through adequate feeding regime based on synchronizing different protein levels in connection to associated dietary energy levels. The body parts were however not modified in this study. The diets, therefore, proved their adequacy in meeting the needs of the rabbits for optimal development of body tissues.Also, supporting this observation, (26) explained that all factors which can influence growth potentials, by changing the relative growth of tissue and organs, leads to modifications of the carcass. The loin and legs are the most economically important portions of the carcass and also provide the greatest portion of edible meat in rabbits (27). The inclusion of RMBPs in the diets of the rabbits did not show any negative influence on the relative weight of these economic parts (loin and legs). Age and weight at slaughter and experimental procedures could partly explain differences observed in the present study with previous findings.

4. Conclusion

Comment [S10]: Very good

i. The result of this study revealed that, the inclusion of 25% PRB, PGR, NPRB, NPRP and NPGR in the diets of growing rabbits improved growth performance of the rabbits at levels equivalent to conventional ingredients or reference diet.
ii. The digestibility by rabbits the proximate fractions of RMBPs for growth and maintenance was not adversely affected at 25% inclusion.
iii. The result of this study also revealed a reduction in the cost of producing a kg live weight of the rabbits and total production cost. Rabbits can therefore be reared at cheaper cost, better rate of return and high profit made with the inclusion of RMBPs at 25%.

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