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Growth performance and nutrients digestibility of Japanese quail chicks *(Coturnix coturnix japonica)* fed diets containing raw and processed pigeon pea seed meal based diets with enzyme (Vegpro) supplementation

[1*]Akintunde, A. R., [1]Oguntoye, M. A., [2] Adeoye, S.O. and [3]Azuaga, C.I.

[1]*Department of Animal Science, Taraba State University, Jalingo.*
[2]*Ogun State Agricultural Development, Abeokuta.*
[3]*Department of Science Education, Taraba State University, Jalingo*

Corresponding Author: fola_akintunde@yahoo.com ***Phone No.:*** 07036895725

Target Audience: Feed millers, Nutritionists, Poultry producers, Researchers.

Abstract

A total of 720 one week old Japanese quail chicks were used to investigate the growth performance and apparent nutrient digestibility of the quail chicks fed diets containing raw and processed pigeon pea seed meal (PPSM) supplemented with enzyme (Vegpro$^{(R)}$). They were randomly allotted to 8 dietary treatments groups with 3 replicates per treatment and 30 birds per replicate. Raw pigeon seed was processed separately by soaking for 24 hours, 48 hours and 72 hours, fermentation for 3 days, boiling for 60 minutes and roasting for 30 minutes and dried to become PPSM. Experimental diets were formulated using raw and the remaining 6 processed PPSM to contain 25 % crude protein with a control to constitute 8 dietary treatments. All the diets except the control were supplemented with enzymes at 0.1g/kg diet and fed the quails for 28 days. The results showed that processed PPSM supplemented with enzyme significantly (P<0.05) influenced the performance parameters measured across all the treatments. Birds on the diets T1 (134.83g), T2 (130.667g), T3 (129.43g) and T7 (130.33g) were comparable and significantly (P<0.05) higher in final live weight and average daily body weight gain than those in other treatments. Birds on T1 and T4 had significantly (P<0.05) lower average daily feed intake (11.73g and12.03g respectively), better feed to gain ratio (2.94 and 3.18 respectively) and feed cost per kg gain (₦235.81 and ₦289.16 respectively). Birds on T5 had significantly (P<0.05) the highest age at first egg (34.67 days). First egg weights of birds fed PPSM diets supplemented with enzyme were comparable and significantly (P<0.05) higher than those on the control group (6.67g). Mortality was significantly (P<0.05) higher in birds fed T2, T3, T4 and T6 compared to other treatments. Dry matter (61.94 %), crude fibre (61.49 %), ether extract (78.41 %) and ash digestibility (80.63 %) were significantly (P<0.05) lower in birds on T3 compared to those in other treatments. However, the least crude protein (CP) digestibility was recorded in birds fed T2 (79.94 %) and T3 (77.62 %) while significantly (P<0.05) lower NFE digestibility was recorded in birds fed T3 (49.37 %) and T6 (49.30 %) compared to other treatments. It was therefore concluded that raw and processed PPSM diets with enzyme supplementation improved performance and nutrient digestibility of quail chicks without adverse effect.

Keywords: Growth performance, Japanese quails, pigeon pea seeds, digestibility, nutrients.

Description of Problem

Among many challenges facing livestock sector, acute shortage and high cost of feed ingredients have been identified as a major obstacle to the expansion of the poultry industry in Nigeria and by extension in most

developing countries of Africa [1].

It has been reported by (2) that feed cost accounts for over 65-70% of the total cost of poultry production constituting a large part of the entire expenses in poultry production. This however has created a wide gap between the demand and supply of animal protein in Nigeria and many under-developed countries of the world. Thus, average animal protein intake of 8.6g of persons in most of these countries is far below the recommended 53.3g by nutritionists [3]. There has therefore, been calls for a substantial increase in animal protein intake by man in developing countries [4].

Conventional protein sources like soybean meal, groundnut cake, fish meal and others which are expensive currently occupy a central role in the feeding of monogastric animals in many countries [5]. The increasing human demand for these protein sources, coupled with its exorbitant cost has turned the attention of animal nutritionists to the exploration of other non-conventional protein sources in an attempt to improve livestock production. One of such non-conventional protein sources is pigeon pea.

Pigeon pea (*Cajanus cajan*) is one of the widely grown legumes with a crude protein values of 20.6 – 27.7 % and is desirable due to its high nutrient profile [6]. Like most tropical legumes, the utilization of pigeon pea seeds for good growth and performance of poultry species may be limited due to the presence of anti-nutritional factors such as protease inhibitors (trypsin, chymotrypsin inhibitors), lecithin, tannins and non starch polysaccharides [7]; [8]. Hence, the need for processing through various methods such as boiling, roasting, soaking and germination, dehulling and chemical treatments which exerts beneficial effects by reducing or destroying the inherent anti-nutritional factors [9]. Effective reduction of levels of anti-nutritional factors present in formulated rations and the quality of the feed therefore will be determined by the effectiveness of the processing methods employed.

Enzyme supplementation of poultry diets has been investigated and found to have significant beneficial effect on the nutrient utilization and growth performance of monogastric animals [10]. Commercial brand of exogenous enzymes which have been discovered to be greatly effective in the feed industry for better growth performance and economic efficiency of feed are Allzyme SSF, Vegpro (Allzyme®)vegpro), Maxigrain, Nutrasexyla, Rovabio and Roxazyme G2G [11]

Vegpro is an enzyme complex that improves the digestibility of feed. It contains an enzyme complement to aid pigs and poultry in digestion of vegetable protein feed ingredients such as soybean meal and other legume sources of protein. It improves digestibility of protein, amino acids, energy of vegetable protein ingredients. Major enzyme activities in vegpro include protease, cellulase, pentosanase, (xylanase), Galactosidase and amylase. The enzymes present work together in synergy to break down the different substrates resulting in a greater release of nutrients from the diets, thus improving growth and economic efficiency. The trial however aimed at determining the effect of feeding diets containing raw and processed pigeon pea seeds meal supplemented with enzyme (vegpro) on the growth performance and nutrients digestibility of Japanese quails chicks.

Materials and Methods

Experimental Site

This study was conducted at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, Ahmadu Bello University, Samaru, Zaria, Kaduna State. It is located within the Northern Guinea Savanna zone of Nigeria, Latitude 11^0 12^1N and Longitude 7^0 23^1E, at an altitude of 610m

above sea level. The climate is relatively dry, with a mean annual rainfall of 700-1400mm, occurring between the Months of April and September. The dry season begins around the middle of October, with wet seson that ends in February. This is followed by relatively hot – dry weather from March to April, before the onset of rain. The mean maximum temperature ranges from 14^0C to 24^0C during the wet season while the mean maximum daily temperature is from 19^0C to 36^0C during the hot dry season. The relative humidity varies between 19 – 35 % during the dry seasons and 63 - 80 % in the wet season as reported by [12].

Source of Pigeon Pea Seeds

The Pigeon pea seeds used for this study were purchased from Samaru Market in Sabo Gari Local Government Area of Kaduna State, Nigeria.

Processing of Pigeon Pea Seeds

Four processing methods of pigeon pea seeds were employed. Thirty kilogram of raw pigeon pea seeds were milled and bagged. Another batch of 30 kg pigeon pea seeds were soaked in 75 litres of cold clean water for different hours; 24, 48 and 72 hours at room temperature. The water was drained after each soaking duration and the seeds were sun dried for four days on a clean concrete floor at the onset of dry season. Seeds were then milled and bagged. The next batch of 30 kg pigeon pea seeds were soaked in 75 litres of water for 24 hours at room temperature. The water was allowed to drain and the seeds bagged and put into an air – tight polythene bag and allowed to ferment for three days. After 72 hours, the seeds were then sun dried on a clean concrete floor for four days. For boiling method of processing, 30 kg pigeon pea seeds were boiled for 60 minutes. The 75 litres of water was allowed to boil at a temperature of 100^0C using fire wood as the source of heat. The seeds were then poured into the boiling water, covered and then allowed to boil again for a specific duration of 60 minutes. The cooked sample was removed after draining the water and dried on a concrete floor for four days. The last batch of 30 kg raw pigeon pea seeds were roasted in a silver pot on a big tripod stand with fire wood as the heat source. The seeds were constantly stirred with a big silver spoon so as to have uniform roast and prevent the seeds from burning. The roasting was done for 30 minutes. The processed pigeon pea seeds were incorporated into the different dietary treatments at 30 % level of inclusion.

Experimental Animals, Design and Management of Experimental Birds

A total of seven hundred and twenty (720) one week old Japanese quail chicks purchased from National Veterinary Research Institute (NVRI) Vom, Jos were used for the study. Ninety birds were randomly assigned to each of the eight dietary treatments which had 30 chicks per replicate in a completely randomized design. The birds were raised in 75cm long × 75cm wide × 60cm high cages which were thoroughly cleaned and disinfected. Kerosene stoves were used to provide additional heat while electric bulb were installed in each pen to provide light and heat during the brooding period; feed and water were provided *ad libitum*, necessary drugs were administered as necessary and all other routine management practices were observed. The experiment lasted for 28 days. The birds were weighed at the beginning of the experiment and their average initial weights were taken. The chicks were subsequently weighed every week to determine the weight gained. Feed supplied and the left over were also weighed weekly to determine the weekly feed intake. Average final weight, feed intake, weight gain, feed to gain ratio, and percentage mortality were computed. The cost /per kg of feed and cost of feed /kg gains were also

computed for each dietary treatment. Eight experimental diets were formulated which contain 25% crude proteins based on the standard requirement [13]. The experimental diets were ~~is~~ as shown in Table 1. Milled pigeon pea seeds processed by different methods as described above were incorporated into the dietary treatments at 30% of diet. Enzymes (Vegpro) were supplemented in the diets at the level of 100g/ton of feed as recommended by the manufacturers. The enzymes were first thoroughly mixed with a little quantity of the required ration. The quantity of the rations was gradually increased until all were thoroughly mixed with the enzyme. Diet 1 was formulated with soybean seed meal and groundnut cake as the main vegetable protein source and served as the control. Diet 2 contained raw pigeon pea seeds, while diets 3, 4, and 5 contained pigeon pea seeds soaked for 24, 48 and 72 hours respectively. Diet 6 contained pigeon pea seeds soaked and fermented for 3 days. Diet 7 contained pigeon pea seeds boiled for 60 minutes while diet 8 contained pigeon pea seeds roasted for 30 minutes. All the diets were supplemented with enzymes except the control.

Growth response and apparent nutrient digestibility

Weight gained and feed intake were determined weekly. Feed conversion ratio was calculated as a ratio of feed consumed to weight gained. At the expiration of the feeding trial (the 5^{th} week), 9 birds per dietary treatment and a total of 72 birds were randomly selected and housed in individual wire metabolism cages. Prior to the commencement of the trial, birds were acclimatized for two days adjustment period in the metabolic cages followed by five days collection period. Five hundred grammes of the experimental diets were supplied to the birds in each cage daily for five days. The faeces were collected daily from each cage and dried overnight at 60^{o}C. The total dried faecal output for each pen was bulked together. The samples of the feeds and faecal were collected separately, pooled and used for proximate analysis according to the procedures of [14].

Chemical Analysis

The proximate composition of the test ingredient (raw pigeon pea seeds) and experimental diets as well as the faecal samples were determined using the procedures of the [14].

Statistical Analysis

All the data obtained in this study were subjected to analysis of variance using the general linear model procedure of SAS [15]. Significant differences among treatment means were separated using Tukey model.

Table 1: Composition of Quail Starter Diets Containing Differently Processed Pigeon Pea Seed Meal with Enzyme (Vegpro) Supplementation (2 - 6 weeks)

Ingredients	Treatments							
	1 Control	2 Raw PPSM + Vegpro	3 SoakPPM (24hrs) + Vegpro	4 Soaked PPSM (48hrs) + Vegpro	5 Soaked PPSM (72hrs) + Vegpro	6 Soaked + Fermentation+ Vegpro	7 Boiled PPSM (60 mins) + Vegpro	8 Roasted PPSM (30 mins) +vegpro
Maize	47.97	30.29	30.29	30.29	30.29	30.29	30.29	30.29
SBM	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
PPSM	0.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
GNC	37.53	25.21	25.21	25.21	25.21	25.21	25.21	25.21
Bone	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Limestone	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Common Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Methionine	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Vit. Premix*	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Total (%)	100	100	100	100	100	100	100	100
Enzyme	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Determined Analysis								
M.E (Kcals/Kg)	2933	2976	2971	2965	2881	2927	2975	2955
Crude protein ((%)	25.12	25.88	26.13	26.68	24.87	24.68	25.06	24.50
Crude Fibre (%)	5.73	5.64	5.00	5.45	6.70	6.00	5.94	6.25
Ether Extract (%)	4.54	4.16	3.92	4.00	4.34	3.85	3.77	4.08
Calculated Analysis								
Calcium (%)	1.39	1.40	1.40	1.40	1.40	1.40	1.40	1.40
Phosphorus (%)	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Lysine (%)	1.22	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Methionine (%)	0.74	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Cysteine (%)	0.41	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Feed cost/kg (₦)	80.20	90.69	90.69	90.69	90.69	90.69	97.36	97.36

*Biomix chick premix provided per kg of diet: Vit A. 10,000 I.U; Vit D_3 32,000 I.U; Vit E 23,000 mg; Vit K 2,000mg; Vit. B_1 1,800 mg; Vit. B_2 5,000mg; Pantothenic acid 7,500mg; Vit.B_{12} 150mg; Folic acid 750mg; Biotin 100mg; Choline chloride; 300,000mg; Cobalt 3,000mg; Iodine 1,000mg; Iron 20,000mg; Manganese 40,000mg; Selenium 200mg; Zinc 30,000mg; Antioxidant 1250mg.
SBM = Soybean meal, PPSM = Pigeon Pea Seed Meal, ME = Metabolizable Energy, GNC = Groundnut cake

Results and Discussion

Growth Performance and Apparent Nutrients Digestibility of Quail Chicks

The performance of the quail chicks fed diets containing differently processed pigeon pea seeds meal with enzyme supplementation is presented in Table 2. The result showed that there were significant ($P<0.05$) differences in all the parameters measured. The final body weight and weight gain followed the same trend. Birds fed diets T1 (control), diets T2 (raw PPSM), T3 (soaked PPSM for 24 hours), and T7 (boiled PPSM) supplemented with enzymes were similar and had significantly ($P<0.05$) higher final body weight and daily body weight gain respectively compared to

those on other dietary treatments. The significantly higher final weight and weight gain observed in birds fed T1, T2, T3 and T7 may be due to higher reduction of anti-nutrients in pigeon pea seeds as a result of processing which enhanced better nutrient utilization in the diets. However, the improved weight and weight gain observed in birds fed diet T2 disagreed with the report of [16] and [9] who reported that raw or improperly heated legume seeds fed as the major source of protein in diet for monogastrics can depress growth and efficiency of feed utilization.

Feed intake was significantly (P<0.05) lower in birds fed diets T1 11.73 g/bird/day and T4 12.03 g/bird/day compared to those on other enzyme supplemented diets which were similar. The higher feed intake observed in birds fed PPSM based diets supplemented with enzymes compared to those in the control group may be attributed to the effect of enzyme supplementation on processed pigeon pea seeds, which improved taste and consequently the feed intake. This result agreed with [17] and [9] who reported that processing improved the utilization of proteins and energy contained in legumes**.** It was also reported that smell and taste were critical traits in food selection [19].

However, feed to gain ratio and feed cost per kg gain were lower and significantly (P<0.05) better in birds fed diets T1 (2.94, ₦235.81) and T4 (3.18, ₦289.16) compared to those in other treatment groups. The significantly better feed to gain ratio observed with birds on diets T1 (control) and T4 could be attributed to improved rate of utilization of the dietary nutrients and conversion to gains. It may also be an indication that birds in the two treatments (T1 and T4) were able to eat and convert the feed to flesh more effectively compared to those in other groups. The significantly better feed cost per kg gain observed in birds fed diets T1 and T4 could be as a result of better feed conversion ratio; hence lower feed cost per kg gain. Age at first egg (days) was similar among birds across the dietary treatments except those on T5 (soaked PPSM for 72 hours with enzyme) which was significantly (P<0.05) higher (34.67 days). However, first egg weights were comparable among birds fed diets containing differently processed pigeon pea seed meal (PPSM) with enzyme supplementation and these were significantly (P<0.05) higher than those in the control group (6.67g).

The result also showed that birds across the dietary treatments came to lay at early age and this ranged between 32.67 – 34.67 days. The significantly higher first egg weight observed in birds fed processed PPSM based diets compared to those on the control may be attributed to good nutrient utilization enhanced by processing and enzyme supplementation. This result agreed with the findings of [20] who reported that the addition of enzyme like amylase and xylanases enhanced the utilization of non-starch polysaccharides (NSP) components while proteases enhanced the utilization of proteinaceous components of feeds. Mortality was significantly (P<0.05) different across all the treatments. The low mortality recorded in this study agreed with the fact that quails are hardy birds and perhaps less disease – prone than other poultry birds [21]. It was also observed that the dietary treatments had no negative effect on the performance and health status of the birds.

The result of the apparent nutrients digestibility trial is presented in Table 3. The result showed that enzyme supplementation of PPSM had significant (P<0.05) effect on the apparent nutrient digestibility by quails. Percentage dry matter digestibility by birds fed diets T7 (boiled PPSM with enzyme) and T8 (roasted PPSM with enzyme) were similar and comparable to those of other dietary treatments but significantly (P<0.05) higher than those on diet T3 (soaked PPSM for 24 hours with enzyme). The observed similarity and higher

percentage dry matter digestibility observed in birds across the treatments except those on T3 may be attributed to the beneficial effect of enzyme supplementation on processed pigeon pea seed meal (PPSM) as reported by [20].

Percentage crude protein digestibility by birds on dietsT1, T4, T5, T6, T7and T8 were comparable and these were significantly ($P<0.05$) higher than those on diets T2 containing raw PPSM with enzyme (79.94 %) and T3 containing soaked PPSM for 24 hours with enzyme (77.62 %). The similarity observed in percentage crude protein digestibility by birds across the treatments except those on diets T2 and T3 was an indication that enzyme supplementation and processing of PPSM reduced anti nutritional factors. For instance, crude protein digestibility values were similar for quails fed diet T1 (81.32%; control), soaked pigeon pea seeds for 48 hours + vegpro (81.17%; T4), soaked pigeon pea seeds for 72 hours + vegpro (81.17%; T5), soaked and fermented pigeon pea seeds + vegpro (80.88%; T6) and the last two treatments in which pigeon pea was processed with heat application namely boiling for 60 minutess + vegpro (83.69%; T7) and roasting for 30 minutes + vegpro (83.76%; T8). The soaking and heat applications reduce the potency of the most of the ANFs through their susceptibility to heat and leaching into water [18]. The combined effects of processing and the enzyme proteolytic activities on the feed no doubt made the nutrient very much available hence improved digestibility of the nutrients in the processed pigeon peas. Percentage crude fibre digestibility was comparable among birds across the dietary treatments except those on diet T3 (61.49 %) which was significantly ($P<0.05$) lower.

Percentage ether extract and ash digestibility by birds followed the same trend with crude fibre digestibility where birds on diet T3 had significantly ($P<0.05$) lower values (78.41 %, 72.90 %) compared to those in other treatments. The similarity observed in the percentage digestibility of crude fibre, ether extract and ash by birds across the treatments except those on diet T3 was an indication that enzyme supplementation reduced anti nutritional factors in pigeon pea seed hence, enhanced nutrients digestibility. However, percentage nitrogen free extract (NFE) digestibility was similar and significantly lower in birds fed diets T3 and T6 compared to those in other treatment groups. Generally, this result showed that utilization of pigeon pea could be enhanced by soaking and enzyme supplementation in Japanese quail's diet. This agreed with the findings of [17] and [9] who reported that processing improved the utilization of proteins and energy contained in legumes.

Table 2: Effect of Diets containing Differently Processed Pigeon Pea Seed Meal with Enzyme Supplementation on Growth and Early Laying Performance of Quail Chicks (2 – 6 weeks)

Parameters	TREATMENTS								
	1 (Control)	2 RPPSM +Vegpro	3 SPPSM (24hrs) +Vegpro	4 SPPSM (48hrs) + Vegpro	5 SPPSM (72hrs) +Vegpro	6 S+FPPSM + Vegpro	7 BPPSM (60mins)+ Vegpro	8 RPPSM (30mins) +Vegpro	SEM
Initial Weight (g/bird)	23.00	23.00	23.00	23.00	23.00	23.00	23.00	23.00	0.00
Final Body Weight (g/bird)	134.83^{a}	130.67^{a}	129.43^{a}	128.43^{b}	127.80^{b}	127.37^{b}	130.33^{a}	127.47^{b}	3.16
Total Weight Gain (g/bird)	111.83^{a}	107.67^{a}	106.43^{a}	105.43^{b}	104.80^{b}	104.37^{b}	107.33^{a}	104.47^{b}	3.12
Average Daily Weight Gain (g/bird/day)	3.99^{a}	3.85^{a}	3.80^{a}	3.77^{b}	3.74^{b}	3.72^{b}	3.83^{a}	3.73^{b}	0.10
Total Feed Intake (g/bird)	328.55^{b}	386.90^{a}	401.43^{a}	336.78^{b}	404.00^{a}	388.73^{a}	385.94^{a}	392.45^{a}	27.45
Average Daily Feed Intake (g/bird/day)	11.73^{b}	13.82^{a}	14.33^{a}	12.03^{b}	14.43^{a}	13.88^{a}	13.78^{a}	14.01^{a}	0.97
Feed to Gain Ratio	2.94^{b}	3.59^{a}	3.77^{a}	3.18^{b}	3.86^{a}	3.72^{a}	3.60^{a}	3.75^{a}	0.26
Feed Cost (₦)/Kg Gain	235.81^{b}	325.79^{a}	341.76^{a}	289.16^{ab}	350.19^{a}	336.97^{a}	350.53^{a}	368.80^{b}	24.93
Age at First Egg (days)	33.00^{b}	33.00^{b}	32.67^{b}	33.00^{b}	34.67^{a}	32.67^{b}	33.33^{b}	33.33^{b}	0.72
First Egg Weight (g)	6.67^{b}	8.33^{a}	8.33^{a}	7.60^{ab}	7.83^{ab}	7.83^{ab}	7.33^{ab}	6.93^{ab}	0.44
Mortality (%)	1.11^{ab}	2.22^{b}	2.22^{b}	2.22^{b}	0.00^{a}	2.22^{b}	1.11^{ab}	1.11^{ab}	0.42

ab = Mean within the same row with different superscripts are significantly different (P<0.05), SEM = Standard Error of Mean

Table 3: Effect of Diets containing Differently Processed Pigeon Pea Seed Meal with Enzyme Supplementation on Nutrients Digestibility by Quail Chicks

Parameters %	TREATMENTS								
	1 (Control)	2 RPPSM + Vegpro	3 SPPSM (24hrs) + Vegpro	4 SPPSM (48hrs) + Vegpro	5 SPPSM (72hrs) + Vegpro	6 SFPPSM + Vegpro	7 BPPSM (60mins)+ Vegpro	8 RPPSM (30mins) +Vegpro	SEM
Dry Matter	70.98^{ab}	67.29^{ab}	61.94^{b}	67.72^{ab}	69.58^{ab}	65.13^{ab}	73.22^{a}	71.43^{a}	3.42
Crude Protein	81.32^{a}	79.94^{b}	77.62^{b}	81.17^{a}	81.17^{a}	80.88^{a}	83.69^{a}	83.76^{a}	2.02
Crude Fibre	78.30^{a}	71.23^{ab}	61.49^{b}	72.76^{a}	75.52^{a}	78.58^{a}	81.38^{a}	78.01^{a}	3.02
Ether Extract	89.02^{a}	88.06^{a}	78.41^{b}	87.97^{a}	89.05^{a}	85.25^{a}	87.28^{a}	86.34^{a}	1.60
Ash	80.63^{a}	79.75^{a}	72.90^{b}	78.11^{a}	81.01^{a}	78.97^{a}	79.86^{a}	80.71^{a}	2.38
NFE	59.19^{a}	53.13^{a}	49.37^{b}	55.13^{a}	56.03^{a}	49.30^{b}	61.13^{a}	59.00^{a}	4.81

ab = Mean within the same row with different superscripts are significantly (P < 0.05) different, SEM = Standard Error of Mean, RPPSM = Raw Pigeon Seed Meal, SPPSM = Soaked Pigeon Pea Seed meal, SFPPSM = Soaked + Fermented Pigeon Pea Seed Meal, BPPSM = Boiled Pigeon Pea Seed Meal

Conclusion and Application

From the results of this study, it was concluded that:

1. Inclusion of raw and differently processed PPSM with enzyme supplementation in quail diets improved digestibility of nutrients and growth performance of quails.
2. In addition, inclusion of raw pigeon pea seeds with enzyme

supplementation in quail diets at chick phase is energy saving by removing stress of processing and poses no threat to performance and health status of quail birds.

3. Enzyme supplementation of diets containing raw and processed pigeon pea seeds meal (PPSM) is therefore recommended for improved nutrients digestibility and optimum growth performance in quail diets.

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