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Performance of Weaner Rabbits Fed Diets Containing Raw and Processed Pigeon Pea Seed Meal (*Cajanus cajan*)

F.O. Ahamefule., J.A. Ibeawuchi, I.A. Ukweni and D.U. Umunnakwe
College of Animal Science and Animal Production,
Michael Okpara University of Agriculture, Umudike, Nigeria

Abstract: The performance of weaner bucks fed raw and processed pigeon pea based diets were evaluated in a 60-day trial. Twenty four 6-week-old rabbits averaging 550 g in weight were randomly divided into four groups of 6 animals each and assigned 4 pigeon pea based diets in a completely randomized design. The diets generally contained maize, wheat offal, soya meal, blood meal, oyster shell, common salt as well as 20% raw, boiled, toasted and soaked pigeon Pea Seed Meal (PSM), respectively. The Crude Protein (CP %) and metabolizabble energy (Kcal DE kg^{-1} DM×103) contents of the diets were 13.2, 2.63; 18.3, 2.67; 14.3, 2.71 and 16.4, 2.61, respectively. The parameters measured were Average Daily Feed Intake (ADFI), Average Daily Gain (ADG), Feed Conversion Ratio (FCR) as well as carcass characteristics. Results showed that ADFI (g), ADG (g) and FCR differed significantly ($p<0.05$) among treatment groups. The values were 64.4, 10.1, 7.15; 78.5, 13.2, 5.97; 85.0, 12.4, 6.85 and 81.8, 11.7, 6.98 for rabbits fed raw, boiled, toasted and soaked PSM based diets, respectively. Rabbits fed diet containing boiled PSM had significantly ($p<0.05$) lower FCR and higher ADG than those of other treatment groups. The animals subsisting on boiled PSM diet also had significantly higher ($p<0.05$) dressed percentage as well as superior ($p<0.05$) shoulder, loin and thigh weights relative to their counterparts in other treatment groups. Rabbits were generally favorably disposed to diet containing boiled pigeon pea seed meal in terms of relative performance.

Key words: Average daily feed intake, average daily gain, bucks, pigeon pea

INTRODUCTION

Daily animal protein consumption of about 90% of Nigerians, in a country with a population of over 130 million people, is below recommended level (Akinmutmi, 2004). Efforts made by successive Governments in bridging the yawning gap between the present intake of 10 g d^{-1} and the recommended consumption of 35 g d^{-1} (FAO, 2000) through mass importation of frozen fish and poultry products did not succeed due to low purchasing power of a greater proportion of the populace. Any intervention programme geared towards improving the animal protein consumption of Nigerians should encourage rapid domestication and multiplication of livestock species, especially those with short generation intervals and high fecundity. Rabbit, a high producing herbivore, with short generation interval, can be exploited to meet Nigeria's animal protein needs.

Rabbit production in Nigeria is however, constrained by a number of factors prominent among which are high cost of feed and management. The conventional protein feedstuffs, which constitute a major component of rabbit diet, are scarce, competitive and exorbitant. This has generated great concern to rabbit farmers and has consequently opened research interest in the use of non-conventional protein sources for rabbit production.

Pigeon pea (*Cajanus cajan*), a relatively underutilized legume, is undergoing nutritional trials with several livestock species including rabbits in Nigeria, as an alternative protein source for livestock production. There are variations in the chemical composition of the seeds as this is influenced by geographical location, cultivar and growth condition (Salunkhe *et al*., 1985). The crude protein content of the seed ranges from 17.1-30.0% (Siegel and Fawcett, 1976; Geervani, 1983; Salunkhe *et al*., 1985; Obioha, 1984). Like other grain legumes, it contains anti-nutritional factors like trypsin and protease inhibitors, which tend to limit its use in the raw state for livestock nutrition (Ologhobo, 1992; D'mello, 1992). Thirty percent of raw pigeon pea has been fed to rabbits without deleterious effect on carcass characteristics (Amaefule *et al*., 2004). There is however, paucity of information on the best acceptable form of pigeon pea for rabbits.

This study therefore, is aimed at comparing the performance of rabbits fed raw and processed pigeon pea based diets.

Corresponding Author: F.O. Ahamefule, College of Animal Science and Animal Production,
Michael Okpara University of Agriculture, Umudike, Nigeria

MATERIALS AND METHODS

Experimental site: This study was conducted at livestock unit of the Teaching and Research Farm of Michael Okpara University of Agriculture, Umudike. Umudike is geographically located in Abia state of Nigeria, on latitude 05°29° north, longitude 33° east at altitude of 122 m above sea level. It falls within the humid rain forest zone of West Africa, which is characterized by long duration of rainfall (April-October) and short period of dry season (November-March). Average rainfall is 2169.8 mm in 148-155 rain days. Average temperature is 26°C with maximum of 32°C and minimum of 22°C. Relative humidity ranges from 50-95%.

Experimental animals and management: Twenty four New Zealand White×Chinchilla weaner bucks, averaging 0.55 kg in weight and aged between 5-8 weeks were randomly divided into 4 groups of 6 animals per group and used in this study. Each animal was housed in a standard hutch of 120 cm by 150 cm and raised 120 cm from the ground in a three-tier hutch system. They were provided with feeders and drinkers. Each animal was vaccinated against mange and other prevalent undercurrent diseases. They were also dewormed and given acaricide bath prior to the experiment.

Processing of pigeon pea seeds: Pigeon pea seeds of the white variety were purchased from the local markets in Aba and Umuahia in Abia state of Nigeria and processed as follows:

Raw: Ten kilogram of raw pigeon pea seed was subjected to milling and the product used in this study as raw pigeon pea seed meal.

Boiled: Ten kilogram of raw pigeon pea, in mammoth pot, was subjected to boiling at 100°C for 30 min. It was subsequently sun-dried for 3 days to reduce the moisture content (10-15%) of the seed. The sun-dried pigeon pea seeds were milled and then used as boiled pigeon pea seed meal.

Toasted: Another 10 kg of raw pigeon pea was subjected to frying for 20 min at 110°C. The resultant product was air cooled on a flat surface, milled and used as toasted pigeon pea seed meal.

Soaked: Ten kilogram of raw pigeon pea was soaked in a large basin containing clean water. After 24 h, the water was decanted using a sieve. The resulting product was drained of water, sun dried to about 10-15% moisture content, milled and used as soaked pigeon pea seed meal.

Table 1: The composition and proximate constituents of the experimental diets

Ingredient	RP	BP	TP	SP
Maize	38.0	38.0	38.0	38.0
Wheat offal	22.0	22.0	22.0	22.0
Pigeon pea	20.0	20.0	20.0	20.0
Soya bean meal	15.0	15.0	15.0	15.0
Blood meal	1.50	1.50	1.50	1.50
Oyster shell	1.00	1.00	1.00	1.00
Bone meal	2.00	2.00	2.00	2.00
Salt	0.25	0.25	0.25	0.25
Vitamin mineral premix*	0.25	0.25	0.25	0.25
Total	100	100	100	100
Analyzed contents (%)				
Dry matter	90.3	91.0	89.7	90.5
Crude protein	13.2	18.3	14.3	16.4
Crude fibre	10.9	11.7	11.0	11.3
Ether extract	3.70	3.60	2.85	3.15
Nitrogen free extract	52.1	47.5	51.6	49.8
Ash	10.4	9.85	9.00	9.70
ME (Kcal DE kg^{-1} DM×103)	2.63	2.67	2.71	2.62

*To provide the following per kg diet: Vit, A, 1500IU; Vit E, 11.0 mg; Riboflavin, 9.0 mg; Biotin, 0.25; Pantothenic acid, 11.0mg; Vit k3, 3.0 mg; B2, 2.5mg; B6, 0.3mg; B12, 8.0mg; Nicotinic acid, 8.0 mg; Fe, 5.0 mg; Mn, 10.0 mg; Zn, 4.5 mg; Co, 0.2 mg; Se, 0.01 mg, ME = Metabolizable Energy, RP = Raw PSM based diet, BP = Boiled PSM based diet, TP = Toasted PSM based diet, SP = Soaked PSM based diet

Experimental diets: Four diets were formulated from maize, wheat offal, soya cake, blood meal, oyster shell, bone meal, vitamin premix and common salts. In addition, the diets contained 20% raw, boiled, toasted and soaked pigeon pea seed meals, respectively. The compositions and the proximate constituents of the experimental diets are given in Table 1.

Experimental design: The 24 New Zealand White×Chinchilla weaner bucks were randomly divided into 4 groups of 6 animals per group and assigned the 4 test diets in a completely randomized design. Each animal received an assigned diet for 60 days. Weekly weights were taken and daily feed consumption recorded, average daily feed intake, average daily weight gain and feed conversion ration were also determined for each treatment group.

Carcass evaluation: At the end of the 60-day feeding trial, three rabbits from each treatment group were randomly selected and subjected to carcass evaluation as in Agunbiade *et al.* (2000). The selected rabbits were starved over-night to clear the guts. Live weight was recorded before stunning and sacrificing by cutting the jugular vein. The tail was cut very close to the base before removing the pelt, the head and the feet. The body was skinned to remove the fur. Evisceration of the rabbit carcasses were carried out and all internal organs were separately weighed.

Chemical/data analysis: Experimental diets were analysed for proximate composition using the methods of AOAC (1990). All data collected were subjected to

Analysis of Variance (ANOVA) procedure for a Completely Randomized Design (Steel and Torrie, 1980). Differences between treatment means were separated using Duncan's Multiple Range Test (Duncan, 1955).

RESULTS

The proximate compositions of the experimental diets are summarized in Table 1. The ether extract values of the diets, save for the toasted PSM diet, were roughly the same.

Nitrogen free extract values were however, fairly evenly distributed among diets. The highest and lowest energy levels were recorded in diets containing toasted and soaked PSM, respectively.

The performances of weaner rabbits fed experimental diets are shown in Table 2. Average Daily Feed Intake (g d^{-1}) (ADFI) was highest for rabbits fed toasted PSM diet, which however, did not differ ($p>0.05$) from the consumption of rabbits fed soaked PSM based diet. The raw PSM diet was consumed ($p<0.05$) significantly less than the boiled, the toasted and the soaked PSM based diets. Average Daily Gain (g d^{-1}) (ADG) was nevertheless highest for rabbits fed boiled PSM diet and this differed significantly ($p<0.05$) from rabbits receiving other treatment diets.

Table 2: Performance characteristics of weaner bucks fed diets containing raw and processed pigeon pea seed

Parameter	RP	BP	TP	SP	SE M
ADFI (g d^{-1})	64.4^{c}	78.5^{b}	85.0^{a}	81.8^{ab}	1.11
ADG (g d^{-1})	10.1^{d}	13.2^{a}	12.4^{b}	11.7^{b}	0.21
FCR	7.15^{a}	5.97^{b}	6.85^{a}	6.98^{a}	0.27

^{abc}Means on the same row with different superscripts differ significantly ($p<0.05$), ADF1 = Average Daily Feed Intake, ADG = Average Daily Gain, FCR = Feed Conversion Ratio, SEM = Standard Error of the Mean, RP = Raw PSM based diet, BP = Boiled PSM based diet, TP = Toasted PSM based diet, SP = Soaked PSM based diet

Table 3: Carcass and organ weights of weaner bucks fed diets containing raw and processed pigeon pea seed meal

Characteristics (g)	RP	BP	TP	SP	SEM
Initial weight	473	510	550	518	73.3
Final weight (kg)	1.15	1.40	1.35	1.22	118
Dressed weight	533^{c}	730^{a}	625^{b}	580^{c}	76.8
Dressed percent	46.3^{b}	52.2^{a}	46.2^{b}	47.3^{b}	5.36
Head	120	129	133	121	8.04
Skin	95.6	130	130	115	16.2
Feet	36.3	45.5	46.5	40.0	3.07
Heart	2.40	3.65	3.50	3.51	0.31
Lung and trachea	7.30	8.40	7.50	7.00	0.66
Thigh	119^{c}	300^{a}	138^{c}	170^{b}	33.0
Loin	43.3^{c}	99.3^{a}	80.0^{b}	71.6^{b}	9.79
Pancreas	0.43	0.35	0.41	0.60	1.01
Shoulder (empty)	62.2	82.0	89.9	78.1	8.60
Intestine	198	181	223	218	18.2
Shoulder	83.3^{c}	130^{a}	95.5^{c}	106^{b}	19.7
Liver	47.5	29.0	35.9	33.8	7.09

^{abc}Means on the same row with different superscripts differ significantly ($p<0.05$, RP = Raw PSM based diet, BP = Boiled PSM based diet, TP = Toasted PSM based diet, SP = Soaked PSM based diet

Table 3 shows the carcass characteristics of weaner bucks fed diets containing raw and processed pigeon Pea Seed Meal (PSM). Rabbits fed raw, toasted or soaked PSM based diets had significantly ($p<0.05$) lower dressed weights than those fed the boiled PSM based diet; there was however no significant difference ($p>0.05$) between the dressed weights of rabbits fed raw and soaked PSM based diets. The Dressing Percentage (DP) of rabbits fed boiled PSM was also superior ($p<0.05$) to all other treatment groups. Critical evaluation of jointed parts showed that thigh, loin and shoulder weights were heaviest for rabbits fed boiled PSM based diet. However, rabbits fed toasted PSM based diet did not differ ($p>0.05$) from the control group in thigh and shoulder weights, respectively.

DISCUSSION

The Dry Matter (DM) content of the raw, boiled, toasted and soaked pigeon pea based diets compared favorably well. The Crude Protein (CP %) and Crude Fiber (CF) contents of the experimental diets fell within the recommended ranges of 12-17 and 10-20%, respectively (Aduku and Olukosi, 1990) for optimum growth and performance of rabbits. Even though the inclusion levels of PSM were the same (20%) for all diets, the diet containing boiled PSM had relatively the highest CP level while the least was the diet with the raw PSM. Amaefule (2002) made similar observations.

The highest and lowest energy levels which were recorded in diets containing toasted and soaked PSM, respectively, were also in consonance with the observations of Amaefule (2002). Meanwhile, the metabolizable energy content of the treatment diets were within the stipulated range of 2390-2500 Kcal DE recommended (Aduku and Olukosi, 1990) for optimum growth and performance of weaner rabbits. Rabbits generally require high maintenance energy because of their high surface to body weight ratio (Leng, 2006); therefore diets which supply low metabolizable energy tend to depress performance in rabbits.

Average daily feed intakes (g d^{-1}) were 5.60, 5.61, 6.30 and 6.70% of live weight for the raw, boiled, toasted and soaked PSM diet, suggesting therefore that the dietary treatments provided adequate nourishment for the rabbits. This is in agreement with the report of Iribeckel (2001) cited by Leng (2006) who observed that for concentrate diets, feed intake in rabbits should be in excess of 5% live weight day^{-1} to ensure nutrient availabilities above maintenance. The extent of utilization of these 'available nutrients' by rabbits would however depend on peculiar nature of each of the treatment diets.

Average daily gain (g d^{-1}) for all the PSM based concentrate diets were however, generally low when compared with the values reported by Asuquo (1997) for all forage based diets. He, Asuquo obtained 20.8, 20.6, 18.3, 14.7 and 12.5 ADG when he fed *Ipomea batata*, *Tridax procumbens*, *Centrosema pubescens*, *Emilia sanchifolia* and *Pueraria phaseoloides*, respectively to 5 groups of rabbits. He attributed the low ADG value recorded for *Pueraria phaseoloides* to high level of crude fibre content which depressed intake. Generally, rabbits consume more and perform better on forage than concentrate diets. This may be due to the preference the herbivore shows for succulent nature and palatability of forages. Studies have however shown that adequate nutrient availabilities (above maintenance) for rabbit, on forage based diets, can only be ensured if the herbivore consumes 8-10% live weight of diet day^{-1} (Pok *et al*., 2006). It is perhaps in cognizant of this need to derive from available nutrients and also to satisfy its high maintenance (energy) requirement that rabbits are disposed more to forage than concentrate diets.

The diet containing boiled PSM influenced the best overall performance relatively. The superiority of boiled PSM diet in promoting least cost weight gain in this study was buttressed by the FCR value, which was the lowest. Similar findings have also been recorded with other livestock species. Amaefule and Onwudike (2000) fed raw, boiled, toasted and soaked pigeon pea based diets to broilers and observed that birds fed boiled pigeon pea seed based diet had significantly lower feed conversion ratio than those of other treatment groups. Udedibie and Mba (1994) had in an earlier investigation reported that boiled pigeon pea seeds improved growth rate and performance of broilers. This observation may also be relevant to rabbits, as the result of this study would portray. Studies have shown that trypsin inhibitor, the anti-nutritional factor found in most non-conventional legume seeds and which is present in pigeon pea, is destroyed after boiling (Amaefule, 2002). Toasting and soaking on the hand, inactivate about 28% of trypsin inhibitor and 75% haemaglutinin activity, respectively in legume seeds (Kakode and Evans, 1990). The superior performance of rabbits fed boiled pigeon pea seed based diet over those of other treatment groups indicate that pigeon pea seeds should best be boiled before being incorporated into rabbit diets. The optimum level of inclusion would however, form the focus of a subsequent study.

CONCLUSION

In conclusion boiling rather than toasting or soaking, is the best processing method of pigeon pea for rabbits. Contrary to earlier report, rabbits fed raw pigeon pea, even at 20% level of inclusion, showed significant differences in carcass characteristics.

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