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Effect of feeding different processed pigeon PEA (Cajanus cajan) supplemented with Maxigrain® on the performance and carcass characteristics of weaner rabbits.

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Abstract

This study was carried out to evaluate the effect of differently processed Pigeon pea (*Cajanus cajan*) with enzyme, Maxigrain® supplementation on the performance and carcass characteristic of weaner rabbits. The pigeon peas used were raw, boiled and soaked with and without Maxigrain® supplementation, respectively. A total of 42 weaner rabbits (6 weeks old) of mixed breed and sexes with average initial weight 450 g, were randomly assigned to seven - dietary treatments in a complete randomized design. Dieats consisted of 0%, 30% (raw with Maxigrain®), 30% (boiled with Maxigrain®), 30% (soaked with Maxigrain®), 30% (raw without Maxigrain®), 30% (boiled without Maxigrain®) and 30% (soaked without Maxigrain®) representing treatments T1(control diet), T2, T3, T4, T5, T6 and T7, respectively. Each dietary treatment was replicated 6 times, with rabbits housed in individual cages. The trial lasted for 8 weeks. The average daily weight gains in treatments with pigeon pea based diets (T2, T3, T4, T5, T6 and T7) were all similar while T1 had the lowest average daily weight gain. The feed to gain ratio and feed cost per kg gain were highest for T1 compared to the other treatments. The mortality was significantly higher in T4 compared to all other treatments. There was no significant difference in the final weight, average daily feed intake, water intake, and water to feed ratio for all the treatments. There were significant differences in the pre-slaughter weight, slaughter weight, dressing percentage, head, skin, tail, liver, kidney, heart, lungs, empty intestine, stomach, heart and chest. The dressing percentage, head, kidney, thigh, were significantly lower in T6 compared to all other treatments. There were no significant differences in the carcass characteristics of the dressed weight, full intestine, length of intestine, length of intestine and loins. The result indicates that pigeon pea can be used effectively to replace groundnut cake as a protein source in rabbit nutrition at 30% inclusion, either raw or processed with or without Maxigrain®. Also pigeon pea in rabbit nutrition will reduce the cost of production and does not have any harmful effect on the rabbit.

Key words: rabbit, pigeon pea, Maxigrain®, processing methods

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Introduction

One of the major challenges facing the livestock industry is the problem of ever increasing cost and scarcity of conventional feedstuffs. This has directly led to the increase or rise in the cost of animal production (Oyenuga, 1982). Therefore, the success of the livestock industry would depend on the availability of qualitative and relatively inexpensive feed ingredients for livestock feed. There is also the need to pay attention to the faster and cheaper ways of increasing animal production as wells as to increase the availability of animal protein.

Number of conventional sources of plant protein for feeding have very high human food preference which has made them highly competitive, expensive and in turn very scarce. Examples of these conventional feed stuffs are soya beans and groundnut. Pigeon pea, a leguminous seed crop is now gaining wide use among farmers especially livestock farmers. This is due to the fact that it is a source of crude protein with a high energy level (Amafule and Obioha, 2005). It is a legume which has a low human food preference. Therefore it is a good source for use in animal feed formulation. Moreover, there is a high similarity in the energy content and amino acid profile of this grain legume with other conventional feedstuff such as soya bean meal (Evans, 1985; Visitpanich et al., 1985; Johnson and Eason, 1990; Ravindran and Blair, 1992; Igbesan and Guenter, 1996).

However, the utilization of grain legumes by feed industry is limited because of uncertainty about their nutritional value (Farrington, 1974). Though, the analysed amino acid and energy content of grain legumes are quite similar, the quality of metabolized energy values are quite variable, which may be highly influenced by the presence of different quantities of anti-nutritional factors such as protease inhibitor, lectins, tannins and non-starch polysaccharide (NSP). Pigeon pea contains anti-nutritional factors such as trypsin and protease inhibitor (D'Mello, 1992; Ologhobo, 1992; Grimaud, 1998). Stychose and raffinose that are flatulence causing sugars which are also contained in pigeon pea (ICRISAT, 1991). Birk (1998) reported that these toxic factors when present in feed depresses growth and causes pancreatic hypertrophy in monogastric species. It has been also noted that when significant amount of anti-nutritional factors are taken in by poultry or pigs, weight gain is reduced and feed to gain ratio is increased (Breenes et al, 1993; Igbesan and Guenter, 1996).

Processing of legumes in different forms improves the utilization of proteins and energy contained in them (Omeje, 1999; Kaanuka et al., 2000). Cooking of grain legumes also improves the nutritional value by destroying most of the anti-nutritional factors present in them (Ogundipe, 1980; Amafule and Obioha, 2001).

Enzymes are added to feedstuffs to breakdown and release more nutrients for the use of the animals. Addition of enzymes to monogastric animal feed reduced viscosity of ingesta in the intestine and showed marked improvements on the various morphological effects of feeding fibrous materials to non-ruminants

(Allen et al., 1997). The enzyme to be used for this study is Maxigrain®. It is made up of cellulose, betaglucanase, xylanase and phytase.

This study aimed to determinie the effect of pigeon pea in feed formulation for rabbits, with and without enzymes (Maxigrain®) supplementation, on the performance and carcass characteristics of weaner rabbits.

Materials and Method

Location of the experiment

This experiment was conducted at the livestock unit of the Department of Animal Science, Ahmadu Bello University, Zaria, Kaduna State, Nigeria. Zaria is located on latitude 11^{o} 11^{I}N and 7^{o} 38^{I}E; altitude 686 m above sea level. It has mean annual rainfall of 1100 mm. Mean temperature fluctuates from 18 ^{o}C in cold seasons to 31 ^{o}C in hot seasons (Oluwasemire, 1999).

Preparation of pigeon Pea

Pigeon pea was purchased from a local market in Kaduna, Kaduna State, Nigeria. Specific quantities were taken for processing. A 50 kg lot was taken and poured into 100 liter of boiling water in a drum to cook for 30 minutes. Another 50 kg lot was soaked in about 100 litres of water for 24 hours. Finally, the last 50 lot kg quantity was milled raw without processing. The boiled and soaked pigeon peas were sun dried and then milled.

Treatment composition

Table 1 shows the percentage ingredients composition and calculated analysis of the experimental diets listed below.

TI: Control
T2: Raw Pigeon pea with Maxigrain®
T3: Boiled Pigeon pea with Maxigrain®
T4: Soaked Pigeon pea with Maxigrain®
T5: Raw Pigeon pea without Maxigrain®
T6: Boiled Pigeon pea without Maxigrain®
T7: Soaked Pigeon withoout Maxigrain®

The Maxigrain® enzyme used in this study was purchased from Rebson feedmil, Samaru, Zaria, Kaduna State, Nigeria. It comprises of the following;

Cellolose – (10,000IU/100g)
Betaglucane – (200IU/100g)
Xylanase – (10,000IU/100g)
Phytase – (2500IU/100g)

Animal house preparation

The room, in which the experiment was conducted, was well washed and disinfected before the arrival of the rabbits. They were housed in wire cages. Each cage contained a feeder and a drinker which were

cleaned and thoroughly disinfected for each rabbit. Rabbits were allowed one week of adjustment period on a common diet. Each rabbit was inspected for good health and were then tagged.

Table 1. Composition of differently processed pigeon pea diet with and without Maxigrain®

Ingredients	T1	T2	T3	T4	T5	T6	T7
Wheat offal	15	15	15	15	15	15	15
Limestone	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Bone meal	2	2	2	2	2	2	2
Salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Lysine	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Methionine	0.3	0.3	0.3	0.3	0.3	0.3	0.3
*Premix	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Pigeon pea	-	30	30	30	30	30	30
Maize	58.60	41.25	41.25	41.25	41.25	41.25	41.25
GNC	23	10.35	10.35	10.35	10.35	10.35	10.35
Total	100	100	100	100	100	100	100
Cost per Kg	59.40	60.60	60.60	60.60	60.50	56.29	60.50
Calculated analysis							
Parmeters	T1	T2	T3	T4	T5	T6	T7
ME (Kcal/Kg)	2781.45	2900.96	2900.96	2900.96	2900.96	2900.96	2900.96
Crude protein (%)	18.4	18	18	18	18	18	18
Crude Fibre (%)	3.958	5.255	5.255	5.255	5.255	5.255	5.255
Calcium	0.913	0.923	0.923	0.923	0.923	0.923	0.923
Phosphorus	0.824	0.782	0.782	0.782	0.782	0.782	0.782
Methionine	0.554	0.570	0.570	0.570	0.570	0.570	0.570
Lysine	0.870	1.104	1.104	1.104	1.104	1.104	1.104

*Bio-mix premix supllied per Kg of diet: Vitamin A 12500 I.U; Vit D_3 2500 I.U; Vit E 50 mg; Vit K_3 2.5 mg; Vit B_1 3.0 mg; Vit B_2 6.0mg; Vit B_5 6.0 mg; Niacin 40.0 mg; Calcium pantothenate 10.0 mg; Biotin 0.80 mg; Vit B_{12} 0.25 mg; Folic acid 1.0 mg; Choline chloride 300 mg; Manganese 100 mg; Iron 50 mg; Zinc 45 mg; Copper 2.0 mg; Cobalt 0.25 mg; Iodine 1.55 mg; Selenium 0.1 mg.

Table 2. Proximate composition of Pigeon pea diets

	Treatments						
		Pigeon pea + Maxigrain®			Pigeon pea - Maxigrain®		
Parameters	T1(Control)	T2(Raw)	T3(Boiled)	T4 (Soaked)	T5(Raw)	T6(Boiled)	T7(Soaked)
Dry matter	89.20	90.20	90.07	90.18	90.35	89.39	89.75
Crude Protein	18.00	17.97	17.89	18.08	18.03	17.81	17.96
Crude Fibre	3.89	6.04	6.22	7.29	6.07	5.33	5.59
Ether extract	4.78	5.22	4.79	6.01	5.00	4.87	4.84
Ash	4.54	4.28	4.19	5.77	4.27	6.31	4.83
NFE[1]	68.79	66.49	66.91	62.85	66.18	56.68	66.78

[1]NFE: nitogen free extract

At the end of the adjustment period, just before the commencement of the experiment, each rabbit was weighed.

Growth studies

A total of 42 weaner rabbits of mixed breeds and sex (averaging 450 g) after the period of adjustment were randomly allocatted to seven treatment groups, each consisting of six different rabbits, in a completely randomised design. Each rabbit was offered daily from a measured out feed of 1 Kg. The leftover was then subtracted from it to calculate the weekly feed intake, from which the daily feed intake was deduced. Also,

500mL of water was offered to each rabbit and daily water intake was calculated from the leftover. Precautions were taken to guide against feed spillage. At each feeding time, the spilled but clean feed from the previous feeding of any of the rabbits was returned to the feeder. Contaminated feed was recovered dry (if wet), and weighed. Data were collected weekly on weight gain and mortality. Feed conversion ratio was calculated weekly for each rabbit as a ratio of weekly feed intake to weekly weight gain.

Carcass studies

At the end of the experiment, 3 rabbits from each treatment were taken to the meat laboratory and slaughtered. Cleaning of the rabbit was carried out using the skinning method. The measurements were taken from the carcass, kidney, liver, lungs, heart, leg, tail and stomach and weighed with the use of weighing scale. The loin, chest and thigh weights were also taken. The intestine was weighed when it was both full and empty. The gut length was measured with a ruler.

Economic studies

This is concerned with feed cost studies and economic gains due to the inclusion of pigeon pea in the diet of weaner rabbits. The cost of each ingredients used in the diet was determined and the total cost of the various diet was determined in Naira (₦). The cost of daily feed intake was determined and used to estimate the cost of daily feed intake per daily weight gain.

The cost of daily feed intake was determined by multiplying the cost of diets by the total feed intake. Other non feed cost was taken to be the same for all dietary treatments. The cost of total feed intake explains the total expenditure in all dietary treatments for the experimental period.

Proximate analysis

Proximate analysis of pigeon feed was done at the Animal Science Biochemical laboratory, Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Zaria, according to A.O.A.C (1990).

Statistical Analysis

Data collected were subjected to analysis of variance as described by Steel and Torriel (1980). Significant difference was determined by applying Duncan Multiple Range Test (Duncan, 1955) across treatments.

Results and Discussion

Proximate composition of Pigeon pea diet

The proximate composition of differently processed pigeon pea with and without Maxigrain® supplementation is shown in Table 2. Dry matter contents were similar for all dietary treatments, ranged from 89.2 to 90.3% which in agreement with the report of Nwokolo (1987).

The highest dry matter was observed in T5 (raw-Maxigrain®) and lowest in T1 (control) which was the control diet. Crude protein in the dietary treatments were similar, but crude fibre was very lower in T1 (control diet) 3.89% compared to T4 (soaked + Maxigrain®) was the highest. The mineral content in T6 (boiled-Maxigrain®) is highest. The soluble carbohydrates (NFE) was lowest for T6 (boiled-Maxigrain®) and highest for T1 (control).

Performance of rabbits

The result of performance of differently processed pigeon pea with and without Maxigrain® supplementation is given in Table 3. There were significant ($P < 0.05$) differences in the average daily weight gain, feed-to-gain ratio, feed cost per Kg gain and mortality between the dietary treatments, while there were no significant differences in all the other studied parameters studied.

The average final weight for T7 was the highest numerically which agrees with Ologhobo (1992) and Matthew (2006). The average daily feed intake for treatments with Maxigrain® was relatively high (Esuga, 2007). The rabbits fed soaked pigeon pea without Maxigrain® (T7) and raw pigeon pea with Maxigrain® (T2) had higher average daily weight gain compared to rabbits fed the control diet. The T2, T3, T4, T5, T6 and T7 diets were statistically similar for most of the parameters except for mortality. Rabbits on the control diet had significantly reduced weight gain than those with pigeon pea with and without Maxigrain® supplementation. This may be related to the low fiber content of the feed. This finding is in agreement with Taiwo et al. (2005), who observed reduced growth rate in weaned rabbits fed low fiber diet.

Rabbits fed control diets had significantly ($P < 0.05$) higher values for feed to gain ratio (9.17) compared to T2, T3, T4, T5, T6 and T7. This may be linked to the low fiber content in the feed thereby affecting the diets (Taiwo et al., 2005). The feed to gain ratio and feed cost per Kg gain in the control diet (T1) were significantly ($P < 0.05$) higher compared to the treatment with and without Maxigrain® supplementation compared to the other treatments. The feed cost/Kg gain for raw pigeon pea with Maxigrain® was smaller compared to raw without Maxigrain® supplementation. The feed cost per Kg gain for T4 was lowest Therefore considering the average weight gain it gave, it will be cheapest to use diet of soaked pigeon pea with Maxigrain® supplementation.

Mortality figures across the treatments were significantly ($P < 0.05$) different. The highest value of 50.0% occurred in T4 which was closely followed by the control (T1). All other treatments in which pigeon pea were used as protein source, either with or without Maxigrain® supplementation had similar mortality figure of 16.67%. The observed mortality figure cannot be readily explained, but since the control also gave a high figure the diet may not be the responsible factor. The relatively unnoticeable influence of the enzyme on the performance of the rabbits fed differently processed pigeon pea with and without enzyme may be an indication that the quantity of enzyme was not enough (Timbrell, 1992). He reported that there could be instances where enzyme supplementation or treatment adds little to particular ingredient or fails to result in improved performance.

Table 3: Effects of feeding differently processed Pigeon pea (Cajanus cajan) diet supplemented with Maxigrain® enzyme on performance of weaner rabbits.

Parameter	Pigeon pea +Maxigrain®				Pigeon pea - Maxigrain®			SEM	LOS
	T1(Contro)	T2(Raw)	T3(Boiled	T4(Soaked)	T5(Raw)	T6(Boiled	T7(Soaked)		
Average initial weight (g)	525.0	550.0	520.0	600.0	560.0	550.0	520.0	134.7	NS
Average final weight(g)	820.0	1210.0	1046.0	1250.0	1130.0	1284.0	1294.0	47.79	NS
Average daily weight gain	7.46^{b}	13.54^{a}	10.73^{ab}	12.67^{ab}	11.03^{ab}	12.80^{ab}	13.82^{a}	1.73	*
Average daily feed intake (g)	53.35	52.46	50.78	59.50	49.42	64.11	53.50	6.44	NS
Feed to gain ratio	9.17^{a}	3.84^{b}	4.17^{b}	4.69^{b}	4.45^{b}	5.31^{b}	3.90^{b}	0.76	*
Water intake(ml)	96.33	131.22	137.34	117.43	119.17	118.96	213.55	39.62	NS
Water to feed ratio	1.90	2.49	2.96	1.95	2.34	1.84	3.75	0.67	NS
Feed cost per Kg gain (₦)	544.55^{a}	238.89^{b}	305.91^{b}	234.41^{b}		298.90^{b}	238.83^{b}	45.42	*
Mortality (%)	33.33^{b}	16.67^{c}	16.67^{c}	50.00^{a}	16.67^{c}	16.67^{c}	16.67^{c}	0.53	*

abc : means with different superscript are significantly ($P < 0.05$) different.
SEM : Standard error of means
LOS : Level of significance
*: $P < 0.05$

Table 4: Effect of Feeding differently processed pigeon pea (Cajanus cajan) diet supplemented with Maxigrain® enzyme on carcass characteristic of weaner rabbits.

Parameter	Pigeon pea + Maxigrain®				Pigeon pea - Maxigrain®			SEM	LOS
	T1 (control)	T2(Raw)	T3(Boiled)	T4(Soaked)	T5(Raw)	T6(Boiled)	T7(Soaked)		
Pre slaughter wt (g)	940.0^{c}	1225.0^{abc}	1115.0^{abc}	1100.0^{bc}	1150.0^{abc}	1360.0^{ab}	1360.0^{ab}	52.43	*
Slaughter wt (g)	900.0^{b}	1150.0^{ab}	1035.0^{ab}	1025.0^{ab}	1035.0^{ab}	1275.0^{a}	1275.0^{a}	92.25	*
Dressed wt (g)	410.0^{b}	535.0^{ab}	490.0^{b}	460.0^{b}	1150.0^{a}	570.0^{b}	570.0^{b}	51.88	NS
Dressing (%)	44.1	43.3	44.1	41.3	41.1	41.9	41.9	1.51	*
Head (%)	9.8^{a}	8.2^{b}	8.9^{ab}	9.1^{ab}	8.6^{ab}	8.3^{b}	8.3^{b}	0.38	*
Leg (%)	3.7	3.2	3.8	3.8	3.9	3.5	3.5	0.21	*
Skin (%)	6.7^{ab}	8.1^{a}	7.3^{ab}	7.2^{ab}	7.6^{ab}	8.4^{a}	8.4^{a}	0.63	*
Tail (%)	0.4^{c}	0.6^{b}	0.5^{b}	0.4^{c}	0.8^{a}	0.6^{b}	0.6^{b}	0.05	*
Liver (%)	3.8^{a}	2.8^{cd}	3.7^{ab}	3.2^{bc}	2.5^{d}	3.0^{cd}	3.0^{cd}	0.17	*
Kidney (%)	0.8	0.7	0.8	0.8	0.7	0.8	0.8	0.04	*
Heart (%)	0.2^{b}	0.3^{a}	0.3^{b}	0.3^{a}	0.3^{a}	0.1^{c}	0.1^{c}	0.03	*
Lungs (%)	0.8^{b}	0.6^{b}	0.7^{b}	0.8^{b}	1.0^{a}	0.7^{b}	0.7^{b}	0.08	*
Int. Empt. (%)	5.2^{abc}	5.4^{ab}	5.4^{ab}	6.2^{a}	6.0^{ab}	5.0^{bc}	5.0^{bc}	0.33	*
Int. Full. (%)	23.1	21.5	21.5	21.0	21.0	24.0	24.0	1.64	NS
Int. Length (cm)	324.0	349.5	363.5	398.0	364.0	411.5	411.5	26.40	NS
Stomach (%)	8.6^{a}	5.7^{bc}	6.5^{abc}	4.1^{c}	6.8^{ab}	5.7^{bc}	5.7^{bc}	0.78	*
Thigh (%)	17.1	15.5	17.1	16.9	15.2	16.5	16.5	0.91	*
Loins (%)	8.8	10.9	9.9	9.5	10.0	9.5	9.5	1.05	NS
Chest (%)	14.6^{ab}	16.2^{a}	17.1^{a}	14.9^{ab}	14.8^{ab}	16.2^{a}	16.2^{a}	1.59	*

abcd : means with different superscripts in the same row are significantly ($P < 0.05$)
SEM : Standard error of means
*: $P < 0.05$
NS : Not significant; Int. Full- full intestine; Int. Length-length of intestine; Int. Empt-Empty intestine

Effect on Carcass Characteristics

The data on the carcass characteristics of rabbits fed pigeon pea with and without Maxigrain® supplementation is given in Table 4. There were no significant differences in the weight of intestine, dressed weight, loin and intestine length (P>0.05). There were significant differences in the pre slaughter weight, with the treatment fed boiled pigeon pea – Maxigrain® which has the highest pre slaughter weight, followed by the those fed soaked pigeon pea without Maxigrain® and of raw with Maxigrain® (P<0.05). The control had the lowest pre-slaughter weight. Soaked pigeon pea without Maxigrain® had the highest slaughter weight and dressed weight with the lowest found in fed control.

The percentage weight of skin was significantly higher for those fed soaked pigeon pea without Maxigrain® and raw with Maxigrain® ($P<0.05$). The lowest weight of skin was found in boiled pigeon pea without Maxigrain®. The intestines of T7 were significantly longer than the other treatments, with the smallest in the control group ($P<0.05$). The percentage of thigh weight was significantly lower in the T6 group compared to all other dietary treatments ($P<0.05$). There were significant differences in the percentage weight of head, leg, tail, liver, heart, lungs, empty intestine and stomach across the treatment without a particular trend ($P<0.05$).

Conclusion

It was noticed that the unprocessed pigeon pea performed in a similar and even in some parameters better way despite the presence of anti-nutritional factors, compared to the processed pigeon pea. The unnoticeable influence of Maxigrain® in processed and unprocessed pigeon pea on the performance of weaner rabbits may be due to low quantity of the enzyme prescribed by the manufacturer per tone of feed (100 g/tone). For further study, it may be necessary to increase the quantity of enzymes applied per tone of feed. 10 to 30% increase in the quantity of enzyme may be necessary.

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