International Journal of Academic Health and Medical Research (IJAHMR)
ISSN: 2643-9824
Vol. 7 Issue 2, February - 2023, Pages: 94-98

Effect of Feeding Diets containing Graded Levels of Alkali-Treated Coffee Pulp Meal on Growth Performance and Carcass Characteristics of Weaner Rabbits

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Abstract: This electronic document is a "live" template and already defines the components of your paper [title, text, heads, etc.] in its style sheet The effect of graded levels of alkali treated coffee pulp meal (ATCPM) on growth performance and carcass characteristics of weaner rabbits was studied for the period of twelve weeks. Thirty-six (36) mixed breed and sexes' weaner rabbits of mean live weight of 534.50g were used for the trial. The rabbits were randomly assigned to four dietary treatments containing alkali treated coffee pulp meal (ATCPM) at 0%, 4%, 8% and 12% inclusion levels. Each of the treatments was replicated thrice. Feed and water were given adlibitum. The data collected include body weight and feed intake while the mean daily body weight gain, feed conversion ratio (FCR) and cost of feed per kilogram body weight gain were calculated. At the end of the feeding trial, the rabbits were dressed and carcass information was also analysed for response to feed treatments. There were significant (P<0.05) differences in most of the parameters measured with rabbits fed 8% ATCPM. Best performance in terms of average daily live weight gain (22.22g), feed conversion ratio (4.47) and cost per kilogram body weight gain (₦1017.80) was recorded on T_3 diet. Results of carcass evaluation also revealed that T_3 was better utilized as most of the values recorded were positively affected by the diet at that inclusion level. The best results were obtained in rabbits fed 8% ATCPM thus indicating that up to 8% ATCPM can be included in the diet of weaner rabbits without any deleterious effect on growth performance and carcass characteristics.

Keywords— Alkali; Coffee pulp; Carcass characteristics; Weaner rabbits

1. INTRODUCTION

Protein (animal) consumption per head is reportedly low in many tropical countries including Nigeria. This was said to be the resultant effects of rapid human population growth versus shortfall in livestock production. According to FAO [1], this has been an issue of concern to nutritionists and individuals. Ruminant (cattle, goat and sheep) production has not been able to meet the animal protein requirement of the increasing population growth in most of developing countries, because of their long production cycle [2]. Ajala *et al.* [3] opined that this shortfall could be augmented by the increase in the production of monogastrics like rabbit, quails which have short life span. Production and consumption of rabbits has been described as an authentic way of mitigating animal protein insufficiency in the tropics [3]. Rabbits have a short production cycle with high litter size. If rabbits are allowed to breed freely, they can produce about five to six times in a year with average of six to seven weaners per period. Their meat has low cholesterol, low fat, low energy and high protein value [4]. Despite these potential and good attributes, high price of conventional feed ingredients is a major factor limiting the production of rabbit in the tropics [5]. The problem is been aggravated by increasing competition among human, livestock and industry for the conventional feed stuffs such as maize, soybean and groundnut. This situation is increasingly degenerating by increasing human population with livestock sector at a disadvantage [6]. This unpalatable situation consequently informs a continuous search for agricultural waste materials can serve as close substitute for major and basal ingredients in animal feedstuff.

Coffee pulp is inherently rich in fibre, proteins, carbohydrates and minerals especially potassium. Its nutrient composition per dry matter necessitated the listing of coffee pulp as substitute in animal feeds. Coffee pulp has been reported to contain some polyphenols which are antinutitional in nature. These components include among others: caffeine, tannin and few other phenolic compounds [7]. Coffee pulp is a by-product of coffee crop which is obtained usually during wet processing of depulping operation of the coffee cherries to remove the beans. The pulp is always considered valueless, hence a waste. This by product (pulp) is often burnt by most local industries in an attempt to avoid cost of disposing their waste. Other industries with streams nearby empty this into the stream, thereby causing serious environmental pollution and loss of aquatic animals. [8]. Previous studies on utilization of raw coffee pulp in animal feeds have produced deleterious effects on animal growth and health, and this was attributed to the presence of anti-nutritional factors [9]. This challenge will therefore be addressed by this study, as coffee pulp will be treated and incorporated in the diets of weaner rabbits. Effects of the treatment on carcass characteristics and economic benefit of feeding the treated coffee pulp on rabbit will be determined.

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2 MATERIALS AND METHODS

2.1 Experiment Site

This experiment was carried out at the Cocoa Research Institute (CRIN), Ibadan, Oyo State. CRIN is located within latitude 70 30'N and longitude 30 54'E at an altitude of 200m above sea level. It falls within the humid rain forest zone of the Nigeria with mean solar radiation of 18mj/day. Ibadan has a mean annual rainfall of about 2000 mm.

2.2 Source of Experimental Materials

Thirty-six (36) mixed breed weaner rabbits were purchased from Adeeko Farm, Ibadan, Oyo State. These rabbits were then conveyed down to the experimental cage at the animal unit pen within the Institute. The rabbits were then allowed to acclimatize for seven days while they were fed commercial feed. Freshly processed coffee pulp was collected from the pulping unit of the Institute and was spread thinly on a concrete slab to reduce the moisture content before treatment. Undesirable particles like sand and broken coffee seeds were removed to the barest minimum. 25 kg of pure dry coffee pulp was taken and subjected to alkali treatment.

2.3 Processing of Coffee Pulp

The weighed pulp was sterilized in an autoclave at 1210C for 15 minutes and then allowed to cool down to room temperature (250C). Solution of high concentration of potash (K_2CO_3) was made by soaking cocoa pod ash in water overnight at Ash: Water ratio 1:3. The potash solution was mixed thoroughly with water with the use of long wooden spatula. This was allowed to settle down until a clear solution was obtained. The solution was then collected into a container without the residue. 25kg of sterilized coffee pulps was thoroughly mixed with the alkali solution by steering the mixture with wooden spatula. This was then allowed to ferment for a period of 12 hours. The pulp was then removed, washed and sun dried to less than seven percent moisture content. Treated pulp was then milled into fine particles using grinding machine with 600µm mesh screen size, and was cooled and stored in air tight container.

2.4 Management of Experimental Animals

Thirty-six (36) rabbits were randomly divided into four treatment groups. Each group comprised of nine rabbits. Each of the group was further sub-divided into three, such that replicate groups of three rabbits were obtained for each treatment with three rabbits per replicate. The rabbits were housed in cages, 1.5 m high with galvanized mesh base. The cages were enclosed in a house with cemented floor under intensive management. The pen was well-ventilated. Before the commencement of the experiment, the rabbits were acclimatized for the period of seven days, and were all fed control diet. The rabbits were also treated against endo and ecto-parasites using sodex (dewormer) and ivomectin respectively. In addition, medications were administered when necessary. The feeding trial lasted for the period of twelve weeks.

2.5 Experimental Diets and Treatments

The grounded alkali treated coffee pulp meal (ATCPM) was mixed into rabbit rations at 0, 4, 8 and 12% inclusion level designated T1, T2, T3, and T4 respectively (Table 1). All diets were formulated to meet the nutritional requirements of weaner rabbits based on [10] recommendations and the diets were pelleted, using 4 inches mesh size pelletizer and later dried in an open air. The animals were fed ad libitum.

Table 1: Feed composition and calculated nutrient values of the experimental diets

Parameters	**T_1 (0% CPM)**	**T_2 (4% CPM)**	**T_3 (8% CPM)**	**T_4 (12% CPM)**
Maize	38.00	37.00	36.00	36.00
Soybean meal	27.00	26.55	25.85	25.00
Fish meal	3.35	2.80	2.50	2.50
CPM	0.00	4.00	8.00	12.00
Rice bran	28.00	26.00	24.00	20.85
Bone meal	2.50	2.50	2.50	2.50
Premix	0.25	0.25	0.25	0.25
Salt	0.50	0.50	0.50	0.50
Methionine	0.20	0.20	0.20	0.20
Lysine	0.20	0.20	0.20	0.20
Total	100.00	100.00	100.00	100.00
Calculated analysis				
Crude protein	18.06	18.03	18.05	18.01
Gross energy	3003.05	3001.00	3000.55	2999.85
Crude fibre	10.95	11.05	11.10	11.25

CPM: Coffee Pulp Meal

2.6 Experimental Design

The experimental design was a complete randomized design (CRD).

2.7 Statistical Analysis

Data from all treatments were subjected to one-way analysis of variance (SAS, 2008 version 9.2). Duncan multiple range test [11] was used to separate treatment means.

3 RESULT AND DISCUSSION

Table 1 contained the experimental feed formula which revealed that all diets were isonitrogenous. The result of productive performance of weaner rabbits fed graded levels of alkali-treated coffee pulp meal (ATCPM) as shown in table 2 revealed that final body weight and average daily body

weight gain were significantly (P<0.05) influenced by alkali-treated diets. Daily intake ration of the alkali-treated diets did not negatively affect the rabbits across treatment. This was evidenced in the values for mean daily feed intake and feed conversion ratio which were not significantly (P>0.05) affected by the levels of incorporation. Highest final body weight (2400g) was recorded in rabbits fed 8% ATCPM (T3). This was followed respectively by T4 (4% ATCPM) and T1 0% (control) with close values (2050g and 1920g). Rabbits fed diet 4 (12% ATCPM) however had the least (1750g) value for live weight gain. This might be due to percentage inclusion of the treated pulp in the diet which might probably have started to suppress the weight gain in the fed rabbit. Report of Adeyeye *et al*. [12] could lend credence to this observation when he reported a retarded growth rate in rabbits fed high dietary caffeine.

Average daily body weight gain (14.46 - 22.22g/day) observed in this study was in line with 17.96 – 22.40g/day recorded by Ekwe *et al*. [13] but higher than the value (11.5 – 13.6g/day) reported by Ogunsipe *et al*. [14]. Rabbits fed 8% and 4% ATCPM recorded the highest daily feed intake of 105.2g and 102g respectively which were however similar (P>0.05) to 0% (control) with 95.70g. Rabbits fed 12% ATCPM had the least value (86.0g). Treatment of coffee pulp in alkali solution is suspected to have improved the nutritional quality of the pulp. This is because rabbits fed 8% alkali treated coffee pulp meal (T_3) consume more quantity of feed than those rabbits fed 5% (T_2) and control (T_1). This is in agreement with finding of Oloruntoba *et al*. [15] who said that reduction of anti-nutritional factors content in feed ingredient will undoubtedly increase the intake of such feed ingredient. At 12% inclusion of alkali treated coffee pulp, average daily feed intake was however noticed to reduce. This observed decrease implied that as the inclusion level of alkali treated coffee pulp increase to 12%, the content of anti-nutritional factor such as tannin in the feed might have increased beyond the nutritional safe level of rabbits, suggests that the feed may have bitter taste because of increasing anti nutritional factor which render the feed unacceptable to rabbits. Anti-nutritional factor such as tannin reduce feed intake by decreasing palatability of diets because of its astringent effect on oral cavity [16].

The effect of graded levels of alkali treated coffee pulps on carcass characteristics of rabbits are shown in table 3. The rabbits fed 8% alkali treated coffee pulps (ATCPM) significantly (P< 0.05) recorded the highest live weight (2400g), empty body weight (1750g) and dressed weight (1380g) at the end of the trial period. This followed by rabbits fed 4% ATCPM, 0% ATCPM (control) and 12% ATCPM respectively with values of 1950g, 1920g and 1750g for the live weight and 1585g, 1520g and 1410g for the empty body weight. Dressed weights were also followed the same trend. The outstanding performance of rabbits fed 8% ATCPM implies that rabbits utilized the feed maximally to enhance live and dressed weight which proved that any factor that affect feed quality and utilization will consequently affect carcass yield [17]. A significant (P< 0.05) lower dressed weight recorded in those rabbits fed diet containing 12% ATCPM is an indication that 12% ATCP did not support a relatively better growth rate in rabbits' production. There was no significant (P>0.05) difference in the dressing percentage of the rabbits, so also is the thigh, shoulder, loin and the rib had no significant (P>0.05) difference across the dietary treatment. The dressing percentages (49.70-54.50%) recorded in this study was higher than 39.39 - 43.83% reported by Kaga [17]. The differences in these results could be attributed to the nutritional quality of the feed ingredients and breeds of the rabbits. The weight of internal organs such as liver, kidney, heart, lungs and spleen decrease progressively with increase in inclusion levels of alkali treated coffee pulps in the diets. This might be attributed to cyanogenic glycoside in coffee pulp which on hydrolysis releases hydrogen cyanide (HCN) which has ability to cause reduction in the weight of organs [18]. The result of intestinal length and weight showed no significant (P> 0.05) difference. The result showed that toxicology effect of residual anti nutritional factor of coffee pulp did not reduce length and weight of intestine compared to other internal organs. This could be attributed to effects of intestinal viscosity and the process of caecotrophy in rabbits which have reduced the harmful effect of suspected residual nutritional factor on the gastro intestine tract. This is in conformity with the report made by Yegani *et al*. [19] that the gastrointestinal tract has the most uncover superfices in the body and regularly exposed to different kinds of strongly harmful substances.

Table 2: Growth performance of weaner rabbits fed graded levels of alkali treated coffee pulp meal

Parameters	T_1 (0% CPM)	T_2 (4% CPM)	T_3 (8% CPM)	T_4 (12% CPM)	SEM
Initial Body Weight (g)	535.33	533.67	533.67	535.33	21,35
Final Body Weight (g)	1920.00^{b}	2050.00^{b}	2400.00^{a}	1750.00^{c}	120.50
Average Daily Body Weight Gain (g/day)	16.48^{b}	18.05^{b}	22.22^{a}	14.46^{c}	1.60
Average Daily Feed Intake (g/day)	95.70^{ab}	102.00^{a}	105.20^{a}	86.00^{b}	4.96
Feed Conversion Ratio	5.90^{a}	5.67^{a}	4.74^{a}	5.99^{a}	0.56

^{a,b,c} : means in the same row with different superscripts are significantly (P < 0.05) different, SEM : Standard Error of the Mean , CPM: Coffee Pulp Meal

Table 3: Carcass characteristics of rabbit fed graded levels of alkali-treated coffee pulp meal

Parameters (g)	T_1 (0% CPM)	T_2 (4% CPM)	T_3 (8% CPM)	T_4 (12% CPM)	SEM
Live weight	1920[b]	1950[b]	2400[a]	1750[c]	120.5
Empty body weight	1520[b]	1585[b]	1750[a]	1410[c]	39.1
Dressed weight	1002[c]	1120[b]	1380[a]	950[c]	30.8
Dressing %	49.70	54.50	50.00	49.70	4.76
Thigh	218.59	205.00	224.00	231.00	34.01
Shoulder	102.00	112.00	109.00	103.00	28.62
Loin	247.00	254.00	240.00	246.00	43.18
Rib	192.0	225.0	226.0	177.00	27.36
Liver	43.28[a]	44.11[a]	38.68[b]	36.50[b]	2.05
Kidney	19.64[a]	17.00[b]	17.32[b]	15.16[c]	1.86
Heart	4.29[a]	3.86[b]	3.88[b]	3.51[c]	0.20
Lungs	14.75[a]	15.08[a]	14.11[b]	13.67[c]	1.15
Spleen	0.87[a]	0.92[a]	0.81[b]	0.78[b]	0.02
Intestinal weight	78.41	80.78	83.02	77.34	4.23
Intestinal length (cm)	288.00	304.00	308.00	283.00	11.36

[a,b,c] : means in the same row with different superscripts are significantly (P < 0.05) different, SEM : Standard Error of the Mean, CPM: Coffee Pulp Meal

Table 4: Economic benefits of weaner rabbits fed graded levels of alkali treated coffee pulp meal

Parameters	T_1 (0% CPM)	T_2 (4% CPM)	T_3 (8% CPM)	T_4 (12% CPM)	SEM
Feed Intake (Kg)	8.04[b]	8.57[a]	8.68[a]	7.20[c]	0.12
Cost /Kg Feed (₦/Kg	245.00[a]	230.00[a]	215.00[ab]	200.00a[b]	4.02
Total Cost of Feed (₦)	1969.60[a]	1971.60[a]	1899.50[b]	1444.80[c]	8.65
Body Wt Gain (g)	1384.70[c]	1516.30[b]	1866.30[a]	1214.70[d]	15.05
Cost /Kg Body Wt Gain (₦/Kg	1427.70[a]	1300.2[b]	1017.80[d]	1187.6[c]	17.45

[a,b,c] : means in the same row with different superscripts are significantly (P < 0.05) different, SEM : Standard Error of the Mean, CPM: Coffee Pulp Meal

4 CONCLUSION AND RECOMMENDATION

The finding of this study revealed that inclusion of alkali-treated coffee pulp in the diet of weaner rabbits up to 8% has no adverse effect on growth performance and carcass characteristics. Additional advantage recorded was that, as the level of alkali-treated coffee pulp increases in the diet, feed cost and feed cost per kilogram body weight gain decreases. Therefore, livestock farmers (particularly rabbits) can gain more as return on investment by substituting expensive basal ingredients like maize with alkali-treated coffee pulp. In addition, further researches should be intensified on other processing methods of coffee pulp with a view of making it more valuable in the livestock industry.

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