

**Performance and Economic Analysis of Weaner Rabbits Fed Diets Containing Different Proportion of Rubber Seed Cake Supplemented With *Pueraria Phaseoloides****Orimoloye, P.O.¹, Afolabi, K.D.² and Okoruwa M.I.³¹*Cocoa Research Institute of Nigeria, Ibadan, Nigeria.*²*Department of Animal Science, University of Uyo, Uyo, Nigeria*³*Department of Animal Science, Ambrose Alli University Ekpoma, Nigeria**Corresponding Author: philoorimoloye1@gmail.com

Abstract: A total of 48 cross bred weaned rabbits were used to access the effect of replacing soya bean meal (SBM) with rubber seed cake (RSC) supplemented with *Pueraria phaseoloides* in a nine week feeding trial. Four dietary treatments (1, 2, 3 and 4) were formulated and were allotted in 3 replicates per treatment group with 4 rabbits each in a completely randomized design. Treatment diets 1, 2, 3 and 4 were formulated to contain 0, 25, 50 and 75% RSC in place of SBM and each diet was supplemented with 200g of *Pueraria phaseoloides* forage per day. Data collected on growth performance and economy were subjected to analysis of variance (ANOVA) at P<0.05. The results showed that the highest (P<0.05) average live weight of 2.15kg was obtained in diet 2 and lowest in diet 1 and 4. Daily and Total feed intake of rabbits were significantly (P<0.05) higher in diet 1 as compared with diets 2, 3 and 4. The highest daily weight gain and protein efficiency ratio was obtained in rabbits on diet 3 while diet 1 was significantly (P<0.05) higher in feed conversion ratio than other treatment diets. Cost of production was least (#1592.35) in rabbits fed diet 4 and highest (#1664.35) in those on control group. Net profit realized was highest (#907.65) in rabbits fed diet containing 75% RSC and lowest (#835.65) in rabbits fed control diet. It can therefore be concluded that up to 75% replacement of Soya bean meal (SBM) with rubber seed cake (RSC) as protein source in the diets supplemented with *Pueraria phaseoloides* improved growth performance and gave better economic returns of weaner rabbits.

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INTRODUCTION

The Nigeria livestock sub-sector occupies a strategic position in the food supply value chain within the cities, town and villages across the country. Despite this benefit, there is still shortage of animal protein intake for human consumption in Nigeria. Many attempts have been undertaken to overcome this problem, among which the national veterinary research institute as noted by Balarabe *et al.* (2021) who recommended that diversification into production of livestock with short generation interval will be a viable tool in ameliorating shortage of protein among the populace in developing counties. However, the major problem facing livestock producers in the tropical areas is availability of good nutrition for their animals, most especially during the dry season when feedstuffs are limited in their nutritional quality (Adeyemi *et al.*, 200). The persistent shortage of conventional feedstuff for livestock feeding as a result of competition between man and livestock for these feed ingredients has made the prices of livestock feeds especially in Nigeria to be on the high side, thereby lowering birth weight and culminating into high

cost of livestock production. This has therefore forced animal nutritionists to intensify research efforts into the feeding value of potentially useful, attractive, cheaper and readily available protein and energy resources of unconventional feed stuffs such as palm kernel cake, groundnut meal, pigeon pea meal, mango seed (kernel) meal, rubber seed meal among others that can be used for feeding livestock especially poultry, pigs and rabbits as part of the ways to improve their productivity with encouraging result (Adeyemi *et al.*, 200; Mimereole, 20081). Rubber seed cake (RSC) that is obtained from rubber tree seed (*Hevea brasiliensis*) is one of such unconventional feedstuffs. It has been reported (Igeleke and Omorisi, 2007), that rubber seeds have potential as source of plant or vegetable protein for livestock production in the tropics. Rubber trees are found in southern Nigeria where the latex is produced for domestic and export purposes, but their seeds which are abundantly produced from the trees are usually discarded as waste in the areas. Recently, report (RRIN, 2011) had shown that about 75,000 metric tons of the seeds could be produced annually in Nigeria as a country.

However, the amount of the seed that could be produced annually in any year is influenced by factors such as powdery mildew disease, abnormal leaf disease, phytophthora disease, genetic factor and weather (Chanjula *et al.*, 2011).

Pueraria phaseoloides otherwise known as *Puero Kudzu* is a valuable fodder plant that had given excellent results in the wet tropics. Puero forage can be used as a fodder for ruminants and pseudo ruminants in Nigeria. Furthermore, since rabbits are pseudo ruminants, they can efficiently convert forage and vegetative materials into meat. Thus, the need to evaluate the potentials of rubber seed cake supplemented with *Pueraria phaseoloides* for cheaper and better quality rabbit meat production hence, this research work. The study was therefore to assess the performance and economy of production of weaner rabbits fed with different levels of rubber seed cake as replacements for soya bean meal supplemented with *Pueraria phaseoloides*.

MATERIALS AND METHODS

Experimental Site: The experiment was conducted at the Rabbitary Unit of livestock section in the Teaching and Research Farm, Faculty of Agriculture, Ambrose Alli University Ekpoma, Nigeria.

Experimental Animals and Design: A total of forty-eight (48) cross bred weaner rabbits with an average weight of 2.01 ± 0.25 kg were used for the study. The rabbits were quarantined for two weeks. Twelve rabbits each were assigned to each of the four treatment diets which were replicated three times with four rabbits per replicate in a completely randomized design (CRD). The four (4) rabbits each were housed separately in a well ventilated, cleaned and disinfected cell or units of the hutch of 45 * 30 * 40 cm in size. Routine medication with the use vitamin and de-wormer were administered through water to ease stress and worm infestations from source. However, antibiotics and vaccinations were administered subcutaneously. Other routine management practices such as cleaning and changing of wood shavings on the floor every one week were also carried out during the feeding trial.

Experimental Diets and Feeding: The rubber seed cake was sourced from the Rubber Seed Processing Unit of the Rubber Research Institute of Nigeria (RRIN),

Iyanomo, Benin City, Nigeria, while other feed ingredients that were incorporated into the treatment diets were purchased in an open market at Ekpoma. *Pueraria phaseoloides* forage commonly known as African kudzu was cut on a daily basis around the vicinity of the study area. It was chopped into smaller pieces of about 3 to 5cm using cutlass and allowed to wilt over night before used as supplement. A total number of four treatment diets were formulated. Diet 1 served as the control which contained 0% level of rubber seed cake (RSC). Diets 2, 3 and 4 contained RSC at inclusion levels of 25, 50 and 75% respectively in place of SBM. The diets were formulated to contain levels of protein and energy as reflected in Table 1. A total of 200g each of *Pueraria phaseoloides* forage were offered to rabbits in each of the treatment replicates at 12 noon daily during the experimental period. The rabbits were offered respective treatment diets at about 8.00am in the morning and 5.00pm for the nine weeks the study lasted. Fresh drinking water was provided *ad-libitum* throughout the feeding trial.

Data Collection: Weight of individual rabbit was measured at the onset of the trial and subsequently on weekly basis. Feed of known weight was offered and residual weight was taken as well on daily basis. Hence, data were collected and calculated to determine the following parameters: body weights, total feed intake, weight gain, feed conversion ratio, protein efficiency of rabbits.

Economic Analysis: Data on cost of feed/kg, cost of feed consumed per rabbit, cost of feed per kg weight gain, cost of production and net gain were computed. Thereafter, cost and benefit analysis of the experimental diets were done by the addition of the cost of all ingredients in each diet in comparison to the metabolic weight gain of the rabbits in the diets.

Chemical Analysis: The proximate composition and gross energy of rubber seed cake were determined according to standard procedures (Van Soest *et al.*, 1991; SAS, 2000).

Statistical Analysis: Data obtained in the study were subjected to a one way analysis of variance (ANOVA) using the general linear procedure (AOAC, 1990) and means were separated using DMRT of the software.

Table 1: Gross composition of the experimental diets (% DM)

Ingredients (%)	Replacement Levels of RSC (%)			
	0	25	50	75
	Diets			
	1	2	3	4
Maize	45.00	45.00	45.00	45.00
Soya bean meal	16.00	12.00	8.00	4.00
Rubber seed cake	0.00	4.00	8.00	12.00
Fish meal	2.50	3.000	3.50	4.00
Palm kernel cake	13.00	13.00	13.00	13.00
Rice offal	18.00	17.50	17.00	16.50
Bone meal	3.00	3.00	3.00	3.00
Oyster shell	1.50	1.50	1.50	1.50
Premix	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00
Calculated analysis;				
Metabolizable Energy (Kcal/kg)	2530	2530	2531	2531
Crude protein (%)	16.74	16.67	16.60	16.54

ME = Metabolisable Energy; RSC = Rubber seed cake

RESULTS

As indicated in Table. 2, is the proximate composition of Rubber Seed Cake (RSC) and *Pueraria phaseoloides* used in the study. Rubber seed cake (90.37%) and *Pueraria phaseoloides* (80.26%) dry matter content recorded were quite high. The crude protein value that was found to contain 39.23% in RSC was considerable higher than the value of 22.00% recorded in *Pueraria phaseoloides*. The RSC was lower in crude fiber (7.87%) but higher in ash (6.57%) content as compared with crude fiber (46.05%) and ash (3.60%) values obtained in *Pueraria phaseoloides*. Ether extract and nitrogen free extract that registered 9.27 and 27.43% respectively in RSC had remarkable higher content than 2.11% of ether extract and 6.50% of nitrogen free extract values observed in *Pueraria phaseoloides*. However, 2.82 and 3.75 kcal/g metabolizable energy (ME) obtained in RSC and *Pueraria phaseoloides* respectively were similar in values though RSC was slight higher than *Pueraria phaseoloides*. The control diet had low calculated ME(2530 kcal/g) but high crude protein (16.74%) as compared with average values of ME (2531 kcal/g) and crude protein (16.60%) obtained in test diets (2,3 and 4) in Table 1.

The performance characteristics of rabbits as influenced by dietary treatments are shown in Table 3. The average live weight of rabbits that ranged between 1.80kg and 2.15kg were significantly ($p < 0.05$) higher in diets 2 and 3 than diets 1 and 4. The daily and total Feed Intakes that ranged from 97.98 to 104.25g and 5.50 to 5.97kg respectively varied significantly ($p < 0.05$) with rabbits on control diet 1 higher in values than those on test diets 2, 3 and 4. Daily weight gain of 17.02, 17.14, 17.48 and 16.67g were recorded for weaner rabbits fed diets 1, 2, 3 and 4 respectively. However, values recorded in treatment diets 1,2, and 3 were similar and significantly ($p < 0.05$) higher than the one obtained in diet 4. Total weight gain that ranged between 0.74 and 1.07kg were not significantly ($p > 0.05$) influenced by treatment diets in this study. The feed conversion ratio was significantly higher $p < 0.05$ in diet without RSC (6.13) as compared with diets that consisted RSC which were 2 (5.73), 3 (5.79) and 4 (5.89). Protein efficiency ratio values (1.01 – 1.05) varied significantly $p < 0.05$ with rabbits on treatment diets 2 and 3 had better protein efficiency ratio than those placed on treatment diets 1 and 4.

Table.3: Proximate composition (%DM) of Rubber Seed Cake (RSC) and *Pueraria phaseoloides*

Proximate fraction	RSC	P. phaseoloides
Dry matter	90.37	80.26
Crude protein	39.23	22.00
Crude Fibre	7.87	46.05
Ash	6.57	3.60
Ether Extract	9.27	2.11
NFE	27.43	6.50
Metabolizable Energy (kcal/g)	2.82	2.75

Table 3: Growth performance characteristics of rabbits fed dietary treatments

Parameters	Inclusion levels of RSC (%)				SEM±
	0	25	50	75	
	Diets				
	1	2	3	4	
Average live weight (kg)	2.00 ^b	2.15 ^a	2.10 ^{ab}	1.80 ^c	0.05
Daily feed intake (g)	104.25 ^a	99.76 ^{ab}	101.25 ^{ab}	97.98 ^b	1.70
Total feed intake (kg)	5.97 ^a	5.59 ^b	5.74 ^{ab}	5.50 ^b	0.09
Daily weight gain (g)	17.02 ^a	17.41 ^a	17.48 ^a	16.67 ^b	0.76
Total weight gain (kg)	1.07	0.91	0.91	0.74	0.04
Feed conversion ratio	6.13 ^a	5.73 ^b	5.79 ^b	5.89 ^b	0.57
Protein efficiency ratio (%)	1.02 ^b	1.04 ^{ab}	1.05 ^a	1.01 ^b	0.003

abc; Means in the same row with varying alphabets differ significantly (P<0.05)

SEM = standard error of mean

The economic analysis in Naira (N) of rabbit fed experimental diets is presented in Table 4. The cost of feed (N67.43 – N74.43/kg), cost of feed consumed (N372.35 – N444.35), cost of feed intake per kg body weight gain (N50.06 – N79.69) and cost of production (N1592.35 – N1664.35) decreased as the levels of RSC inclusion increased in the diets. However, the net profit increased with the inclusion of RSC up to 75% replacement value for soybean meal in rabbit's diet.

DISCUSSION

The proximate composition of Rubber Seed Cake (RSC) and *Pueraria phaseoloides* had appreciated content in terms of dry matter. This could probably explain the better retained nutrient content of the feeds. The crude protein value of RSC was lower than the average crude protein of 40% obtained from five different commercial oil seed cake as reported by Adegun and Aye. (2013). This differences could be traced to plant variety,

geographical source, processing condition and level of endogenous substances. However, *Pueraria phaseoloides* crude protein was within the ranged values of 15 to 40% reported in literature by Ogbe and Affiku (2011), for most leguminous forage plants found in the tropics. The higher crude fibre content obtained in *Pueraria phaseoloides* than RSC confirmed the report of Ogbe and Affiku (2011) that most forage plants are higher in fiber than most of agro-industrial by product feeds. The ash, ether and nitrogen free extract that were better in RSC showed that rubber plant is richer in those nutrient content than *Pueraria phaseoloides*. The metabolizable energy (ME) average value of 2.82 reported by Ironkwe *et al.* (2004) for RSC was similar to the value observed in this study. Moreover, the calculated crude protein and ME of the formulated experimental diets in this study (Table1) are within the dietary recommended levels for growing rabbits in the tropics as noted by BawaL *et al.* (2017).

Table 4: Cost-benefit analysis of rabbit in Naira (N) as influenced by the rubber seed cake (RSC) dietary treatments

Parameters	Inclusion levels of RSC (%)			
	0	25	50	75
	Diets			
	1	2	3	4
No of Rabbits	12	12	12	12
Cost of weaner rabbits (N)	1,100.00	1,100.00	1,100.00	1,100.00
Cost of feed (N/100 kg)	7,424.00	7,209.00	6,994.00	6,779.00
Cost of feed (N/kg)	72.24	72.09	69.94	67.79
Cost of feed (N/25kg)	1,806.00	1,802.25	1,748.50	1,694.75
Cost of feed (N/tonne)	74,240.00	72,090.00	69,940.00	67,790.00
Cost of feed consumed (N)	443.21	402.98	401.46	372.85
Cost of feed (N/kg weight gain)	70.53	58.39	60.85	44.06
Other Expenses (N)	120.00	120.00	120.00	120.00
Cost of Production (N)	1,663.21	1,622.98	1,621.46	1,592.85
Value of Matured Rabbit (N)	2,500.00	2,500.00	2,500.00	2,500.00
Net Profit (N)	836.79	877.02	878.54	907.15

The higher daily and total feed intake observed in diet 1 which was control group could be an indication that rabbits still prefer Soya Bean Meal (SBM) to Rubber Seed Cake (RSC) in the concentrate feeds, which could have resulted in almost similar total weight gained observed between rabbits on control and test diets. Rabbits on test diets 2 and 3 had remarkable improved daily weight gained than those rabbits on control diet 1 and test diet 4. This variation could be attributed to the low level of residual anti nutritional factors and better fiber combination in the diets that influenced feed utilization and heavier weight gain of rabbits on those treatment diets. This confirmed the report of Bawa *et al.* (2007) that higher feed intake with good combination level of fiber in diets of rabbits improve growth performance of rabbits. In the same vein, this is also in line with the assertion that rabbits eat to meet their energy requirement to sustain rapid growth and development, hence better nutrient combination in feeds improved intake and weight gain. The Feed Conversion Ratio (FCR) for rabbits fed diet without RSC (control group) was higher than what were obtained for those rabbits fed with RSC diets. This vividly showed that rabbits on test diets could convert this test ingredient feed at lesser unit for better weight gain than the control group which was without the test ingredient feed. This observation was in consonance with the report of Chanjula *et al.* (2011) who noted that RSC is good in ration of rabbits but stressed the need for processing method that reduce the cyanide content as the major anti-nutritional factor in rubber seed. The Protein Efficiency Ratio (PER) of rabbits fed various levels of RSC inclusion in treatment diets were significantly improved than the control group that was fed with soya

bean meal (Tamaburawa *et al.*, 2017). This indicates that soya bean meal might not be superior to RSC as protein source feed ingredient in rabbit feeding, if well harness and process. Babatunde *et al.* (1990) noted similar observation that RSC can effectively replaced soya bean meal efficiently as protein source up to 30% level in the diets of swine. The higher positive changes observed in daily weight gain, FCR and PER among rabbits placed on various levels of RSC inclusions in the diets could probably enhanced by *Pueraria phaseoloides* forage supplement in the treatment diets. This evidence could further proved that RSC could conveniently replaced soya bean meal in diets of rabbits that was *Pueraria phaseoloides* forage without precipitating any negative effect on the animals. It was also noted by [9] that when diets of rabbits consists of a mixed forage and concentrate regime increase weight gain than when diets of concentrate or forage is consume alone. This was demonstrated by (Omoikhoje, 2006), when a significant ($P < 0.05$) higher weight gain is obtained in rabbits fed 50% level of *Syndrella nodiflora* forage inclusion in concentrate diets.

Replacement of Soya bean meal (SBM) up to 75% with rubber seed cake (RSC) as protein source in the diet of rabbits supplemented with *Pueraria phaseoloides* improved the general performance and economy of production as it elicited the least feed conversion ratio, least cost of feed intake per kg body weight gain and the least cost of production with the highest net profit. The cost of feed was reduced by between 2.5% in diet 2 (25% RSC inclusion) and 8.7% in diet 4 (75% RSC inclusion). Similarly, production costs were reduced by 2.45 % per rabbit in diet 1 and 4.23% per rabbit in Diet 4. This observation lends

support to the findings of (Omoikhoje, 2008) who stated that the inclusion of 30% level of unpeeled cassava waste meal in the diets of rabbits can lead to reduction in the cost of feed, cost of feed/kg weight gain, cost of production and improvement in the profit margin. These may look small in the micro scale, but where commercial production is the target, it could make a lot of differences. As pointed out in some reports (Madubuike *et al.*, 2006) the cheaper cost and the non-competition with man for rubber seed cake and abundance of rubber seeds in Southern Nigeria could make RSC a potential solution to the high cost of rabbit meat production in Nigeria.

CONCLUSION

Data from this study showed that there is a great potential for improvement in growth and economy performance of weaner rabbits on diets with rubber seed cake inclusion levels than those on control diet without rubber seed cake. However, replacement of Soya bean meal (SBM) up to 75% with rubber seed cake (RSC) as protein source in the diet of rabbits supplemented with *Pueraria phaseloides* improved the general performance and economy of production, as it elicited the least feed conversion ratio, least cost of feed intake per kg body weight gain and the least cost of production with the highest net profit.

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