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Effect of replacing maize with graded levels of sweet potato vine – cassava composite meal on growth performance, nutrient digestibility, carcass characteristics and economics of production of weaned rabbits

*[1]Shaahu, D. T. and [2]Tiough, S. M.
[1]Department of Animal Production, Federal University of Agriculture, Makurdi, PMB 2373, Makurdi, Benue State, Nigeria
[2]Animal Husbandry Department, Akperan Orshi College of Agriculture, Yandev, PMB 181Yandev-Gboko, Benue State, Nigeria
Corresponding author: dtshaahu@gmail.com;
+2347039239677, +2347035982717

Abstract

The study was carried out to determine the feed value of replacing maize with graded levels of sweet potato vine – cassava composite meal (SPV-CCM) to rabbits. Five treatment diets were formulated to contain SPV-CCM inclusion levels of 0% (control), 25%, 50%, 75% and 100%. Thirty weaned rabbits of mixed breeds and sexes were used for the experiment. They were randomly allocated to five dietary treatments with one rabbit as a replicate in a completely randomized design. Feed and water were provided ad libitum. Parameters measured were that of growth, digestibility, carcass and economics of production. The result showed that there was no significant (P>0.05) difference effect on final weight, total weight gain, daily weight gain and feed conversion ratio across the dietary treatments. There was no significant (P>0.05) difference on crude protein digestibility, crude fibre and ether extract which were within the required values for rabbit. There was no significant (P>0.05) difference on live weight at slaughter, dressing percentage, heart, liver, kidney, lungs/trachea, esophagus, stomach, small intestine, caecum, large intestine and visceral fat, there was however, a significant (P<0.05) difference in dressed weight, pancreases, spleen and kidney fat. A high cost of feeding, cost per kilogram diet and production was recorded in T_1 and low cost of feeding, cost per kilogram diet and production in T_5. The result showed that maize could be replaced by SPV-CCM up to 100% without any adverse effect on their performance, nutrient digestibility and carcass characteristics. However, the optimum performance was observed when 75% SPV-CCM replaced maize in the diet. Replacement of maize with SPV-CCM has relative cost advantage over the control diet and so should be incorporated in the diet of rabbit up to the level considered in this study.

Keywords: Rabbit, Sweet potato vine, Cassava, Unconventional, Maize.

Introduction

Rabbits have been recognized to have a very important role to play in the supply of animal protein to Nigerians especially in the rural and peri-urban areas. They have different converters of feed to meat and can utilize up to 30% crude fibre as against 10% by most poultry species (Egbo *et al.,* 2001).

Recently, the rabbit has come under focus as an animal with enormous potential because of its attributes such as small body size, short generation intervals, high reproductive potentials, rapid growth rate, genetic diversity and ability to utilize forage. Rabbit as an economic source of high quality animal protein in the nutrition of human populations in most of the tropical regions is gradually expanding (Amadi *et al.,* 2016).

The major hindrance to animal production in developing countries such as Nigeria is attributed to high cost of feedstuffs. Feeds accounts for about 70-80% of the cost of animal production (Akinmutimi, 2001;

Shaahu *et al.,* 2017). This has been attributed to escalating prices of conventional feed ingredients especially the energy sources such as maize, sorghum etc. (Akinmutimi, 2006), which also serve the roles of human food staples (Shaahu *et al.,* 2008). Maize grain has remained the major source of energy in rabbit feeds in Nigeria (Mohammed *et al.,* 2008), maize is usually accounted for over 40% of the total diets of rabbits and is expensive (Adegbola and Okonkwo, 2002). There is therefore an urgent need to develop alternatives to these conventional livestock feed resources, so that the production and consumption of animal products may continue in the desirable path of rapid growth (Shaahu *et al.,* 2017). Nutritious animal feed are essential for full development and productivity of animals. Since farmers go into animal production for profit, they need to obtain feed at prices to make reasonable profit thus the need for quality balanced concentrate diet yet cheap. The present study is therefore aimed at evaluating the utilization of cassava roots and sweet potato vines as partial replacement for maize on performance and economic of production of rabbit.

Materials and methods

The study was conducted at the Rabbit Unit of Livestock Teaching and Research Farm, University of Agriculture, Makurdi, Benue State. Thirty weaned rabbits of both sexes, mixed breed which the exact genetic make-up was unknown because of random and indiscriminate breeding practice were obtained from Mr. Bajas farm within Makurdi metropolis and used for the study. The rabbits were balanced for weight, which were between six to eight weeks of age and weighed between 225-500grams.

The 30 rabbits were randomly allocated to five dietary treatments with one rabbit as a replicate in a Completely Randomized Design. The feeding trial lasted for 84 days and the rabbits were housed individually in cages. The hutch was 62 centimeter above the ground to facilitate the ease of cleaning and circulation of air. During the feeding trial, the rabbits were fed once a day with experimental diets and fresh water, which was served *ad-libitum.*

The maize grains were crushed with a milling machine to reduce the particle size; full fat soya bean was toasted for about 30 minutes to reduce the anti-nutritive factor and was crushed for particle size reduction. Cassava tubers were harvested washed to remove sand and to reduce silicate. The unpeeled cassava tubers were chipped, sundried to reduce hydrogen cyanide level in the tuber. The sweet potato vine was air dried in a shade to maintain its nutritive content. sundried chipped cassava root meal were crushed separately, the sundried chipped cassava root meal and sweet potato vine were mixed in a ratio of 2.65:1 respectively and 1% palm oil was mixed to reduce the dustiness and also boost the energy level. The mixture of crushed cassava root meal and sweet potato vines formed sweet potato vine-cassava composite meal (SPV-CCM).

The rabbits were subjected to one week acclimatization period to enable them adapt with the diets and all the necessary vaccination and treatments were administered. After the adaptation period each animal was weighed and their initial weights were recorded before the commencement of the experiment, thereafter the rabbits were weighed on a weekly basis. Feed and water were provided *ad libitum*, fresh water was refilled on a daily basis and the left over feed was weighed on weekly basis to determine the weekly feed intake by each animal.

Five experimental diets were formulated with treatment one (T_1) being the control

diet with maize as the major energy source. T_2, T_3, T_4 and T_5 diet had maize replaced with composite cassava meal at graded levels of 25%, 50% 75% and 100%, respectively.

Table 1: Percent and proximate composition of experimental diets

	Level of inclusion of SPV-CCM				
Ingredients	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T5 (100%)
Maize	38.66	28.04	18.69	9.34	-
SPV-CCM	-	9.34	18.69	28.04	37.38
FFSB	32.59	32.87	32.87	32.87	32.87
B/Ash	3.00	3.00	3.00	3.00	3.00
Palm Oil	-	1.00	1.00	1.00	1.00
Salt	0.50	0.50	0.50	0.50	0.50
V/Premix	0.25	0.25	0.25	0.25	0.25
Rice Offal	25.00	25.00	25.00	25.00	25.00
Total	100.00	100.00	100.00	100.00	100.00
	Calculated	**Proximate Analysis**			
CP	16.81	17.41	18.25	18.84	19.65
CF	11.07	12.59	13.60	14.61	15.61
EE	8.27	8.55	8.84	5.83	6.13
Ash	11.93	11.57	11.38	11.20	5.27
Moisture	5.58	6.14	5.56	5.95	6.12
Metabolizable energy	2402.28	2325.95	2284.26	2242.57	2200.93

SPV-CCM= Sweet Potato Vine-Cassava Composite Meal, CP=Crude Protein, EE=Ether Extract, CF=Crude Fibre, BDG=Brewer Dried Grain, FFSB=Full Fat Soya Bean

Results and discussion

The results of the growth performance of weaned rabbits to the experimental diets are presented in Table 2, nutrient digestibility by rabbit is presented in Table 3, carcass characteristics of rabbits feed the experimental diet is presented in Table 4 while the economics of production of rabbits fed the experimental diets are presented in Table 5.

Table 2: Effect of replacing maize with graded levels of sweet potato vinecassava composite meal on growth performance of weaned rabbits

	Level of inclusion of SPV-CCM						
Parameters	T_1 (0%)	T_2 (25%)	T_3 (50%)	T_4 (75%)	T_5 (100%)	SEM	P-value
Initial weight (g)	559.33	452.50	443.00	434.17	457.33	18.47	0.99
Final weight(g)	1319.0	1388.20	1263.0	1521.70	1276.20	52.21	0.49
Total weight gain (g)	759.67	935.70	820.00	1087.50	818.87	49.52	0.15
Daily weight gain (g)	9.04	11.14	9.76	12.94	9.75	0.59	0.17
Daily feed intake(g)	66.28	71.32	77.90	83.24	74.99	2.22	0.12
Feed conversion ratio	7.33	6.40	7.98	6.43	7.69	0.36	0.15

SEM= standard error of the mean. SPV-CCM= Sweet Potato Vine-Cassava Composite Meal.

The result showed that there was no significant (P>0.05 difference) effect on final weight, total weight gain, daily weight gain and feed conversion ratio across the dietary treatments. The final weight gain which ranges from 1276.20 – 1521.70 g was superior to that 1220.60 – 1288.60 g of Olabanji *et al.* (2007) who fed weaned rabbits with different levels of wild sunflower leaf blood meal mixture and lower compared to 1544.83-2088.83 of Tiough *et al.* (2016) who fed rabbit with diet containing cassava root-forage composite meals.

The dietary daily feed intake differed significantly (P<0.05) among the treatments. The daily feed intake of rabbit fed diet in T_4 differed significantly (P<0.05) from T_1, T_2, T_3 and T_5 but there was no significant (P>0.05) difference between T_2, T_3 and T_5. T_4 had the highest daily feed intake (83.24 g) and T_1 had lowest intake of 66.28 g, this may be as a result of palatability of the experimental diet at 75 percent inclusion. The daily feed intake range from 66.28-83.24 g was higher than that of 48.24-74.36 g reported by Shaahu *et al.* (2017) this may be as a result of the palatability of the experimental diet.

The daily weight gain of the rabbit had no significant difference among the dietary treatments (P>0.05). Rabbit fed diet T_4 had the highest daily weight gain; the daily weight gain which ranges from 9.04 – 12.94 g was higher than that of 4.95-5.23g reported by Uchegbe and Iyeghe-Erakpotobor (2015) who fed rabbit with sweet potato vine-based diet supplemented with methionine and lysine. This may be as a result of high consumption and conversion of the experimental diet (SPV-CCM) than when sweet potato vines were supplemented with methionine and lysine. The daily weight was also higher than 2.31-9.72 g reported by Shaahu *et al*. (2014).

Feed conversion ratio across the dietary treatments had no significant difference (P>0.05) among the treatments. There was a better conversion ratio in T_2 (6.40). The feed conversion ratio range of 6.40-7.90 was higher than that of 2.67-8.73 reported by Shaahu *et a*l. (2014). The significantly better feed conversion ratio for the rabbits may be attributed to lower feed intake and higher weight gain of the rabbits.

Table 3: Apparent nutrient digestibility by rabbits fed graded levels of sweet potato vine-cassava composite meal

	Level of inclusion of SPV-CCM						
Parameters	T_1(0%)	T_2(25%)	T_3(50%)	T_4(75%)	T_5(100%)	SEM	P-value
Crude protein	98.24	98.40	97.83	96.74	97.35	0.42	0.77
Ether extract	99.20	99.44	98.97	98.09	98.46	0.38	0.0006
Ash	93.45^a	93.96^a	91.19^a	61.52^c	71.90^b	8.01	0.005
Crude fibre	88.82	93.12	90.14	83.98	86.28	6.12	0.22

The crude protein digestibility had no significant (P>0.05) across the treatment, the crude protein digestibility values (96.74 % - 98.40 %) is higher than that of 83.03 % - 84.58 % reported by Fanima *et al*. (2003) who fed rabbit with cashew apple waste. This may be explained since the fibre content was within a normal range or the SPV-CCM was not too high to affect protein digestibility.

The crude fibre digestibility of the experimental diet across the treatment had no significant difference (P>0.05). The crude fibre digestibility values of 83.98 % - 93.12 % observed was higher than that of 80.60 % - 85.96 % reported by Fanima *et al.* (2003), this may be because the crude fibre level was within the required values for the

rabbit. The ether extract digestibility by rabbit had no significant difference (P>0.05) across the experimental diet. The ether extract digestibility values of 98.09 % - 99.44 % recorded is higher than 81.70-83.10 % of Ramchurn *et al.* (2000) who fed rabbit with multi nutrient blocks as a feed supplement. This may be as a result of oil additions to the diet as oil is reported to improve digestion of cassava (Agunblade and Bello, 1997).

Table 4: **Effect of replacing maize with graded levels of sweet potato vine-cassava composite meal on relative internal organ weights of rabbits**

	Level of inclusion of SPV-CCM						
Parameters	T_1(0%)	T_2(25%)	T_3(50%)	T_4(75%)	T_5(100%)	SEM	P-value
LWS	1349.0	1421.0	1436.5	1604.5	1391.0	41.36	0.40
DW	741.00^{ab}	773.50^{ab}	791.50^{ab}	947.00^{a}	689.50^{b}	34.46	0.14
DP	54.98	54.23	55.02	59.01	49.94	1.30	0.33
Heart	0.30	0.26	0.24	0.34	0.18	0.03	0.73
Liver	1.93	2.01	1.81	1.84	1.81	0.03	0.27
Kidney	0.52	0.60	0.46	0.50	0.46	0.30	0.64
Pancreas	0.16^{ab}	0.04^{b}	0.14^{a}	0.06^{ab}	0.08^{ab}	0.01	0.09
Spleen	0.04^{b}	0.04^{b}	0.14^{a}	0.06^{ab}	0.08^{ab}	0.01	0.08
Lungs/trachea	0.59	0.68	0.69	0.57	0.52	0.03	0.48
Oesophagus	0.15	0.14	0.14	0.09	0.11	0.009	0.24
Stomach	1.41	1.20	1.22	1.38	1.52	0.05	0.21
Small intestine	2.45	2.83	2.03	2.23	2.76	0.13	0.28
Ceacum	1.63	1.64	1.32	1.25	1.24	0.08	0.36
Large intestine	1.15	1.16	1.31	1.02	1.13	0.12	0.98
Kidney fat	0.45^{b}	0.46^{b}	1.05^{b}	2.09^{a}	0.46^{b}	0.23	0.03
Visceral fat	0.89	0.54	0.95	1.41	0.72	0.14	0.44

^{ab} means in the same row having different superscripts differ (P0.05), LWS= live weight at slaughter, DP= dressing percentage, DW= dressed weight. SPV-CCM= Sweet Potato Vine-Cassava Composite Meal.

The result revealed that there was no significant difference (P>0.05) in live weight at slaughter (LWS), dressing percentage (DP), heart, liver, kidney, lung/trachea, oesophagus, stomach, small intestine, caecum, large intestine and visceral fat respectively. However, a significant (P<0.05) change was observed in dressed weight (DW), pancreas, spleen and kidney fat. The dressed carcass weight of rabbit fed diet T_5 differs significantly (P<0.05) from T_1, T_2, T_3 and T_4 with rabbit fed diet T_4 having the highest dressed weight (947.00g). The dressed weight range of 689.50 g - 947.00 g was higher to that of 512.50 g - 700.00 g reported by Shaahu *et al*. (2017) who fed rabbit with decorticated and cooked lablab seeds on performance and cost of producing rabbit, this is because SPV-CCM had no adverse effect on dressing weight of rabbit. The dressed weight was lower compared to that of Tiough *et al.* (2016) who fed rabbit cassava root-forage composite meal in replacement of maize and reported a dressed weight range of 1204.00 g - 1555.33 g. The carcass dressing percentage of the rabbit fed dietary treatment had no significant difference (P<0.05) across the experimental treatment. The dressing percentage in this research (49.94 % - 55.02 % was lower than that of Tiough *et al.* (2016) who recorded the dressing percentages of 65.77 g - 71.31 g. The weight of the heart, liver, kidney, lungs/trachea, esophagus, small intestine, ceacum, large intestine and visceral fat were not significantly (P>0.05) affected as the level of SPV-CCM replacement

increased in the diet. Pancreas weight of rabbit fed diet T_3 differed significantly ($P<0.05$) from T_2 but there was no significant difference ($P>0.05$) between T_1, T_2, T_4 and T_5. The kidney Fat weight of rabbit fed experimental diet T_4 differ significantly ($P<0.05$) from T_1, T_2, T_3 and T_5 but no significant ($P>0.05$) effect exist between T_1, T_2, T_3 and T_5 the weight range of 0.46 g -2.01 g was higher than that of 0.45 g - 0.66 g recorded by Shaahu *et al*. (2017).

The spleen weight of rabbit fed T_3 diet differ significantly ($P<0.05$) from T_1, T_2, T_4 and T_5. T_3, T_4 and T_5 were discovered to be similar on one hand while T_1, T_2, T_4 and T_5 are also similar. The spleen weight range of 0.04 g - 0.16 g was also higher than that of 0.05-0.07 g reported by Shaahu *et al.* (2017).

A high cost of feeding was recorded in T_1 (N595.84) and low cost of feeding in T_5 (N462.04). High cost per Kilogram diet was observed in T_1 (N133.79) and lowest cost per Kilogram diet in T_5 (N74.17). The cost per kilogram weight gain do follow a definite trend as high cost was observed in T_1 (N 784.34) and lowest in T_4 (N525.86).

A high total cost of production was observed in T_1 (N2195.34) and low total cost of production in T_5 (N2062.04). It can be observed from the recorded data that as percentage inclusion of the test ingredients increased across the treatment, the cost of feeding, cost per kilogram diet and total cost of production decreased across the experimental treatment respectively. The reduction in feed cost observed from the sweet potato vine-cassava composite diets was due to the relatively little or minimal cost incurred in obtaining the feed ingredients. This means that cheaper feeds can be produced with SPV-CCM without adverse effect on the growth performance of rabbits. This finding corroborates the report of Tiough *et al*. (2016) that the cost of cassava products is more economical and better to use. The profit observed may be due to the high total cost of production which is as a result of percentage cost of weaned rabbit, but is highest with treatment T_4 whose cost of production even though slightly higher than T_5 yields more profit and therefore more economical.

Table 5: Effect of replacing maize with graded levels of sweet potato vine-cassava composite meal on rabbit economics of production

	Level of inclusion of SPV-CCM				
Parameters	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**
Cost of feeding (□)	595.84	590.58	590.03	571.61	462.04
Total feed intake(g)	4454	5990.60	6544	6992.17	6299.40
Cost/kg diet (□)	133.79	98.58	90.17	81.75	74.17
Total weight gain(g)	759.67	935.70	820.00	1087.50	818.87
Cost/kg weight gain (□)	784.34	631.16	719.55	525.86	564.24
Other cost of production(□)	300	300	300	300	300
% cost of weaner rabbit	59.20	59.35	59.36	59.86	63.04
% cost of feed	27.13	26.96	26.94	26.32	22.40
Total cost of production (□)	2195.34	2190.58	2190.03	2171.61	2062.04
Profit (□)	179.76	308.18	83.37	567.45	235.12

SPV-CCM= Sweet Potato Vine-Cassava Composite Meal

Conclusion

The study showed that there is a great potential for improvement in feed intake and growth rate of rabbit fed sweet potato vine-cassava composite meal as replacement for maize. It has also shown that maize could be replaced with sweet potato vine-cassava composite meal up to 100% without any adverse effect on their performance, nutrient digestibility, carcass yield and economics of production. However, the optimum performance was observed when 75% cassava composite meal replaced maize in the diet.

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