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PROXIMATE COMPOSITION AND CARCASS CHARACTERISTIC OF RABBITS FED GRADED LEVELS OF SWEET POTATO VINE SUPPLEMENTED WITH METHIONINE AND LYSINE

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ABSTRACT

A ten week feeding trial was carried out to investigate composition and carcass characteristic of seventy-two (72) weaned mixed breed rabbits of both sexes. The initial live weight of the rabbits ranges from 600g to 1130g, and were randomly allocated to twelve treatment diets in a 3 x 2 x 2 factorial arrangement experiment in a completely randomized design. The factors were: (1) Sweet potato vine at levels of 0, 15 and 30%, (2) methionine at low (0.07kg) and high (0.10kg) supplementary levels and (3) lysine at low (0.12kg) and high (0.15kg) supplementary levels. Abdominal fat deposit decreased as level of sweet potato vine increased. 15% sweet potato vine inclusion level supported intestine weight and 0% sweet potato vine gave highest kidney weight. Carcass composition parameters except moisture were highest in rabbits fed 30% sweet potato vine inclusion level. The sweet potato vine and methionine interaction showed that at 15% sweet potato vine inclusion and low methionine level, moisture content was highest and high crude protein proportion. Thirty percent sweet potato vine and low lysine level supported crude protein and ash deposition in carcass. Thirty percent sweet potato vine, high methionine and high lysine improved crude protein deposition only. Thirty percent sweet potato vine, low methionine and low lysine level supported ether extract deposition, while thirty percent sweet potato vine, high methionine and low lysine encouraged ash deposition in carcass of rabbit. It was therefore concluded that feeding sweet potato vines to rabbits with lysine and methionine improves the deposition of nutrients in carcass.

Keywords: sweet potato vine, carcass characteristic, proximate composition, methionine, lysine

INTRODUCTION

Rabbit sector in Nigeria if properly harnessed has the potential of improving the nation's economy and improving the health status of the poor populace by providing affordable source of protein (Taiwo *et al*., 2005; Akinmutimi *et al.*, 2007; Abubakar *et al*., 2009). In recent years there has been rising global awareness on the virtues of rabbit meat production in developing countries as an alternative means of alleviating world food shortages (Cheeke, 1980). This basic understanding is largely attributable to the rabbit's high rate of reproduction and early maturity, rapid growth rate, high genetic selection potential, efficient feed and land space utilization, limited competition with humans for similar foods and high quality nutritious meat (Cheeke, 1980).

The rabbit is a small herbivore that has evolved a digestive tract uniquely suited to the utilization of herbage (Robinson *et al*., 1985). Rabbits can utilize low-grain and high roughage diets (McNitt *et al*., 1996). Consequently, they are uniquely poised to provide animal protein for developing countries, where grains can only be justified for human use (Irlbeck, 2001). In spite of these

apparent advantages, rabbit production has not yet achieved its potential in the tropics (Cheeke, 1986).

Raharjo (1987) and Mutetikka *et al*. (1990) found that sweet potato [Ipomoea batatas (L) Lam] forage was very palatable to rabbits. The productive potential of certain varieties of sweet potato can reach from 24 to 36 tons/ha/crop of roots (Morales, 1980) and the foliage production can vary from 4.3 to 6.0 tons dry matter/ha/crop (Ruiz *et al*., 1980). The biomass yield of sweet potato is high and can reach up to 50 tonnes of foliage and 30 tonnes of roots/ha/year according to Hoang *et al.* (1993). Sweet potato vines can be harvested several times throughout the year (Dahniya 1981; Le Van *et al.,* 2003). Sweet potato is a perennial crop grown as an annual (Woolfe, 1992). It is a root crop that provides food to a large segment of the world population, especially in the tropics where the bulk of the crop are cultivated and consumed (Kocklar, 1981; Opeke, 2006).

Traditionally, sweet potato is grown exclusively for tuber production, mainly for human consumption, and the forage/vine (aerial part) was considered as a waste material after harvest (Ruiz *et al.,* 1981). Alternative uses for the vines can be to return them to the field for mulching or using them as feed for animals. The vines comprise both the leaves and stems. The crude protein content of the leafy part is between 26% to 33% of DM, while the CP content of the stem is 10% to 14% (Woolfe, 1992; Ishida *et al*., 2000).

Amino acids are important in many biological molecules, such as forming parts of coenzymes, as in S-adenosylmethionine, or as precursors for the biosynthesis of molecules such as heme (Leuchtenberger *et al.*, 2005).It was suggested that more methionine is needed to provide the greatest immune protection than is needed for maximum growth in broilers (Weissman *et al*., 2008). Lysine is the first limiting amino acid in feed for pigs and the second for poultry. The amount of lysine ingested on a daily basis has a direct influence on animal growth performance as this amino acid mainly serves to deposit body protein.

The objective of this study therefore, was to determine the carcass quality of rabbits fed graded levels of sweet potato vines supplemented with methionine and lysine.

MATERIALS AND METHODS

Study area

This study was carried out at Animal Science Farm Research Unit, Bayero University, Kano. It is located at the new site of the University, about 5Km West of Kano City in Ungogo Local Government Area of Kano State. Kano is located within the general area demarcated by the lines of longitude 8^0E and 9^0E and latitude 12^0N and 13^0N in the Northern Guinea Savannah Zone of Nigeria. The area has two seasons, a wet season (May-September) and dry season (October-April). The annual temperature and rainfall ranges between 21^0C and 39^0C and 787mm to 960mm (KNARDA, 2001).

Experimental design

A 3 x 2 x 2 factorial arrangement in a Completely Randomized Design was used for this study. The factors were sweet potato vine at 0, 15 and 30% level, methionine at low (0.07kg) and high (0.10kg) level, lysine at low (0.12kg) and high (0.15kg) level. The treatments were allocated to the experimental units completely at random.

Experimental animals and their management

Rabbits used for this study were obtained from a local farmer and a total of 72 rabbits mainly heterogeneous population breeds of both sexes of between six to seven weeks old with initial live weight ranging from 600g to 1130g were used. Six rabbits were allocated to three replicates with two rabbits per replicate for each treatment diet. . The animals were dewormed with Wormazine Hydro soluble Anthelmintic at a dosage of 1g/litre of drinking water, Keproceryl WSP (Hydro soluble mix of antibiotics and vitamins) at a dosage of 0.5g/litre of drinking water was given as antibiotics for 5 days and AnupcoVitalyte at dosage

of 10 to 20 litres of drinking water as an anti-stress factor. The rabbits were weighed on a pan scale [Capacity; 10Kg x 50g] before the feeding trial and the treatment diets were gradually given to the rabbits just to replace the feed they were used to for a week in order to allow the rabbits adjust to the experimental diets.

The rabbit were housed in thoroughly cleaned and disinfected cages with the dimensions of 0.5m x 0.5m x 0.5m ($0.125m^3$) and particle ceiling-board on the floor. The rabbits were fed and given clean water *ad libitum* in Aluminum feeder boxes with dimensions of 0.25m x 0.10m x 0.8m which were cleaned daily. Feed orts were collected, weighed every morning and used to determine feed intake. The sweet potato foliage was sun-dried and milled to obtain the sweet potato vine meal. The chemical composition of the sweet potato vine is shown in Table 1, while Table 2 shows the composition of treatment diets fed to the rabbits.

Table 1: Proximate composition of sweet potato vines

Parameter	(Dry matter %)
Dry matter	85.69
Crude protein	18.35
Crude fibre	14.14
Ash	12.10
Ether extract	0.27
Nitrogen free extract	40.83
Acid detergent fibre	22.90
Neutral detergent fibre	25.84
Hemicellulose	2.94

Table 2: Composition of treatment diets

Sweet potato vine (%)	**0**				**15**				**30**			
Methionine level	**Low**		**High**		**Low**		**High**		**Low**		**High**	
Lysine level	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Maize	21.97	21.97	21.97	21.97	21.97	21.97	21.97	21.97	21.97	21.97	21.97	21.97
Maize offal	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31
Wheat offal	14.66	14.66	14.66	14.66	12.46	12.46	12.46	12.46	10.26	10.46	10.26	10.26
Sweet potato vine	0.00	0.00	0.00	0.00	2.20	2.20	2.20	2.20	4.40	4.40	4.40	4.40
Rice bran	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31	18.31
Groundnut cake	23.03	23.03	23.03	23.03	23.03	23.03	23.03	23.03	23.03	23.03	23.03	23.03
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Palm oil	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Methionine	0.07	0.07	0.10	0.10	0.07	0.07	0.10	0.10	0.07	0.07	0.10	0.10
Lysine	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15	0.12	0.15
Calculated value	17.60	17.61	17.63	17.50	17.50	17.48	17.51	17.59	18.02	18.03	18.06	18.09
Crude protein	20.4.5	20.45	20.45	20.44	20.96	21.40	21.81	21.79	23.08	22.87	23.02	23.07
Crude fibre	2602.	25312	2531.2	2548.1	2548.1	2547.3	2549.0	2548.1	2564.1	2564.3	2565.1	2566.0
ME (Kcal/Kg)	10	0	0	0	0	0	0	0	0	0	0	0

Roche VM502 premix supplied per Kg diet; Vitamin A: 12000 I.U; Vitamin D_3: 12000 I.U; Vitamin E: 3.6 I.U; Vitamin K: 1.8 mg Vitamin B_2: 3.6 mg; Nicotinate: 18 mg; Calcium-d-Pantothenate: 9.6 mg; Biotin: 0.36 mg; Vitamin B_{12}: 0.12 mg; Choline chloride: 120 mg; Chloteteracycline: 4.8 mg; Manganese: 24 mg; iron: 48 mg; zinc: 96 mg; Copper: 60 mg; Iodine: 1.8 mg; Cobalt: 48 mg ;
ME = Metabolizable energy

Carcass Analysis

Two rabbits were randomly selected from each treatment for carcass analysis. Feed was withheld overnight before the rabbits were slaughtered. The live weights before and after fasting were taken and recorded. Carcass was weighed and recorded after skinning and dressing percentage was calculated. The carcass was shared into three cut-parts; (i) fore quarters consisting of fore arms, shoulder and neck. (ii) middle portion constituting loin, thoracic cavity and flanks. (iii) hind quarters made up of hind legs and pelvic region. Weights of cut-parts were recorded and later converted as percentage of carcass weight. The weights were obtained with the aid of an electronic weighing balance Model ADG 300L (Capacity weight = 3000g). Abdominal fat was cut out from the thoracic cavity, weighed and recorded. Organ weights (heart, liver, kidney, intestine and lungs) and pelt were weighed and recorded. Abdominal fat and organ weights were converted to percentage of live weight of rabbit. Portions of the skinned carcases (fore arm, hind legs, loin and flanks) were cut and analysed for nutrient composition [water, crude protein, ether extract (fat) and ash (mineral)] for each selected of the rabbit according to AOAC (1990) for quality determination.

Chemical Analysis

The sweet potato vines, diets, faecal droppings and rabbit carcass samples were analysed for chemical composition. The dry matter (DM), crude fibre (CF), ash, ether extracts (EE) and nitrogen free extract (NFE) were determined by method of AOAC (1990).The DM was determined by oven drying at 100°C to constant weight, fat by Soxhlet fat extraction method, Nitrogen–free extract (NFE) was calculated by the use of the following formula:

%NFE = 100 – (%CP + %CF + %EE + %Ash).

The acid detergent fibre (ADF), neutral detergent fibre (NDF) and hemicellulose were determined by the method of Van Soest *et al*. (1991). Hemicellulose was determined by the difference between NDF and ADF: NDF – ADF = Hemicellulose.

The nitrogen content was determined by the method of Kjeldahl (AOAC, 1990). Crude protein (CP) was calculated by multiplying the nitrogen content by 6.25.

Statistical Analysis

The means of initial weights range from 650g to 1130g and were used as covariance in order to adjust the values of final weights, weight gain, daily feed intake, average daily weight gain and feed conversion efficiency. All data collected were subjected to analysis of variance using the General Linear Model Procedure (PROC GLM), for factorial experiment in a complete randomized design packaged in SAS (1987). When analysis of variance indicated significance for treatment effects, specific differences between means were detected and separated by Pair-wise Difference (pdiff) and Duncan's Multiple Range as described by Steel and Torrie (1980) and Duncan (1955).

RESULTS

Table 3 presents the effect of sweet potato vine on carcass characteristics of rabbits. Live weight, carcass weight, liver, percentages of lungs, heart, kidneys, intestines and pelt were not affected by level of sweet potato vine. Rabbits on 0% sweet potato vine had higher dressing percentage than those on 15% sweet potato vine but similar to those on 30% sweet potato vine. Rabbit on 15 and 30% sweet potato vine had higher percent of hind quarters, fore quarters and middle portion than those on 0% sweet potato vine. Abdominal fat percent was higher in rabbits on 0% sweet potato vine, than rabbits on 15 and 30% sweet potato vine which were similar. This shows that high protein content of sweet potato vine in diet increased the crude protein intake which

led to low fat deposition in the abdominal cavity.

Table 3: Effect of sweet potato vine level on carcass characteristics of rabbits

	Sweet potato vine level (%)				
Parameters	0	15	30	SE	LOS
Live weight (g)	1172.58	1227.83	1192.83	0.05	0.20
Carcass Weight (g)	783.92	698.42	707.00	7.54	0.25
Dressing percentage	66.35[a]	56.53[b]	59.13[ab]	0.07	0.04
Proportion of carcass weight					
Hind quarters (%)	31.21[b]	37.41[a]	37.09[a]	1.49	0.01
Fore quarters (%)	10.38 [b]	13.68[a]	13.74[a]	0.70	0.01
Middle portion (%)	14.40[b]	17.97 [a]	17.17[a]	0.80	0.01
Abdominal fat (%)	0. 94 [a]	0.40 [b]	0.39 [b]	0.47	0.04
Proportion of live weight					
Lungs (%)	0.63	0.61	0.61	0.03	0.88
Liver (%)	1.71	2.10	2.15	0.16	0.14
Heart (%)	0.16	0.17	0.37	0.11	0.31
Kidneys (%)	0.55	0.51	0.54	0.03	0.72
Intestines (%)	11.59	13.33	12.27	0.83	0.34
Pelt (%)	7.58	7.79	8.60	0.42	0.22

[a,b,c]Means with the same superscript within the same row are similar, Cut-parts measured as percentage of carcass weight, Organs measured as percentage of live weight, LOS = Level of Significant, SE = Standard Error

Table 4 shows that the effect of methionine supplementation on live weight, carcass weight, and percentage of liver, lungs, heart, kidneys, intestines and pelt of rabbits was not significant. However, there was a significant effect of lysine supplementation on dressing percentage, fore quarters and liver except live weight, carcass weight, hind quarters, middle portion, abdominal fat and percentage of lungs, heart, kidneys, intestines and pelt. Dressing percentage, fore quarters and liver were significantly higher in rabbits on low lysine than in rabbits on high lysine level of supplementation.

Table 4: Effect of methionine and lysine supplementation on carcass characteristics of rabbits

	Methionine Level				Lysine Level			
Parameter	**Low**	**High**	**SE**	**LOS**	**Low**	**High**	**SE**	**LOS**
Live weight (g)	1204.17	1191.33	0.04	0.60	1218.67	1176.83	0.04	0.10
Carcass Weight (g)	744.39	715.17	5.85	0.52	1141.33	1090.94	6.47	0.13
Dressing percentage	61.77	59.58	0.06	0.48	64.68[a]	56.66[b]	0.06	0.02
Proportion of carcas weight:								
Hind quarters (%)	33.94	36.53	1.21	0.14	33.58	33.89	1.21	0.07
Fore quarters (%)	12.31	12.89	0.57	0.18	12.67[a]	12.52[b]	0.57	0.05
Middle portion (%)	16.13	16.90	0.65	0.42	16.58	16.44	0.65	0.88
Abdominal fat (%)	0.26	0.89	0.38	0.25	0.83	0.38	0.38	0.37
Proportion of live weight:								
Lungs (%)	0.62	0.62	0.02	0.84	0.65	0.58	0.02	0.06
Liver (%)	2.08	1.89	0.13	0.35	2.22[a]	1.75[b]	0.13	0.02
Heart (%)	0.18	0.29	0.09	0.36	0.18	0.28	0.09	0.42
Kidneys (%)	0.55	0.52	0.03	0.51	0.56	0.50	0.03	0.16
Intestines (%)	12.39	12.41	0.68	0.98	13.07	11.73	0.68	0.17
Pelt (%)	7.94	8.03	0.34	0.85	8.08	7.90	0.34	0.71

[a,b,c]Means with the same superscript within the same row are similar, Cut-parts measured as percentage of carcass weight, Organs measured as percentage of live weight, LOS = Level of Significant, SE = Standard Error

Table 5 shows the interaction between sweet potato vine level and methionine supplementation on carcass characteristics of rabbits. Dressing percentage decreased at 0% and 30% sweet potato vine with high methionine supplementation and was similar on 15% sweet potato vine at low and high methionine supplementation level. Carcass of rabbits on 30% sweet potato vine at high methionine had the least dressing percentage.

Table 5: Interaction between sweet potato vine level and methionine supplementation on carcass characteristics of rabbits

Sweet potato vine level (%)	0		15		30			
Methionine level	Low	High	Low	High	Low	High	SE	LOS
Parameter								
Live weight (g)	1174.83	1170.33	1245.33	1210.33	1192.33	1193.33	25.87	0.81
Carcass Weight (g)	828.83	739.00	649.83	747.00	754.50	659.50	52.14	0.16
Dressing percentage	71.92[a]	60.79[b]	54.50[b]	58.57[b]	67.63[a]	50.63[b]	4.87	0.04
Proportion of carcass weight								
Hind quarters (%)	28.92	33.51	38.58	36.24	34.33	39.85	2.10	0.15
Fore quarters legs (%)	10.25	10.50	13.41	13.95	13.27	14.21	0.99	0.940.70
Loin (%)	13.75	15.05	18.14	17.80	16.50	17.84	1.13	
Abdominal fat (%)	0.14	1.75	0.27	0.52	0.39	0.41	0.66	0.45
Proportion of live weight								
Lungs (%)	0.65	0.61	0.59	0.64	0.63	0.59	0.60	0.44
Liver (%)	1.87	1.58	1.99	2.21	2.41	1.89	0.23	0.76
Heart (%)	0.16	0.15	0.16	0.19	0.21	0.53	0.15	0.48
Kidneys (%)	0.57	0.53	0.49	0.54	0.58	0.49	0.05	0.35
Intestines (%)	11.07	12.12	12.63	14.04	13.46	11.08	1.17	0.23
Pelt (%)	8.16	7.01	7.58	8.00	8.10	9.10	0.04	0.20

[a,b,c]Means with the same superscript within the same row are similar, Cut-parts measured as percentage of carcass weight, Organs measured as percentage of live weight, LOS = Level of Significant, SE = Standard Error

Table 6 also presents the interaction between sweet potato vine level and lysine supplementation on carcass characteristics of rabbits. Dressing percentage decreased on 0% and 30% sweet potato vine at high lysine supplementation and was similar on 15% sweet potato vine at low and high lysine supplementation level. Carcass of rabbits on 30% sweet potato vine at high lysine had the least dressing percentage.

Table 6: Interaction between sweet potato vine level and lysine supplementation on carcass characteristics of rabbits

Sweet potato vine level (%)	0		15		30			
Lysine level	Low	High	Low	High	Low	High	SE	LOS
Parameter								
Live weight (g)	1188.17	1157.00	1256.00	1199.67	1211.83	1173.83	26.86	0.91
Carcass Weight (g)	858.33	709.50	685.50	711.33	816.67	597.33	0.66	0.09
Dressing %	71.92[a]	60.79[b]	54.50[b]	58.57[b]	67.63[a]	50.63[b]	4.87	0.03
Proportion of carca								
weight								
Hind quarters (%)	28.59	33.84	38.79	36.02	33.38	40.81	2.10	0.06
Fore quarters (%)	10.15	10.60	14.71	12.66	13.16	14.31	0.99	0.25
Middle portion (%)	14.00	14.80	19.48	16.46	16.26	18.08	1.13	0.10
Abdominal fat (%)	0.14	1.75	0.27	0.52	0.37	0.41	67.57	0.39
Proportion of live								
weight								
Lungs (%)	0.66	0.60	0.65	0.58	0.65	0.57	0.58	0.96
Liver (%)	1.88	1.54	2.30	1.90	2.48	1.82	0.23	0.76
Heart (%)	0.16	0.16	0.19	0.16	0.20	0.54	0.15	0.41
Kidneys (%)	0.55	0.56	0.54	0.49	0.60	0.47	0.05	0.30
Intestines (%)	11.59	11.60	13.60	13.06	14.03	10.52	1.17	0.29
Pelt (%)	7.65	7.52	8.00	7.58	8.60	8.60	0.04	0.94

[a,b,c]Means with the same superscript within the same row are similar, Cut-parts measured as percentage of carcass weight, Organs measured as percentage of live weight, LOS = Level of Significant, SE = Standard Error

Table 7 presents the interaction between sweet potato vine level, methionine and lysine supplementation on carcass characteristics of rabbits. Carcass weight and dressing percentage decreased at high lysine low methionine and increased on high lysine high methionine on 0 and 15% sweet potato vine and decreased at high lysine on low or high methionine on 30% sweet potato vine. Rabbits on 30% sweet potato vine at low methionine and high lysine supplementation had the least carcass weight and dressing percentage.

Hind quarters percentage was similar on low methionine, low and high lysine and high methionine, low lysine on 0% and 15% sweet potato vine while on 30% sweet potato vines it was similar on low methionine, high lysine and high methionine, low and high lysine levels. Rabbits on 0% sweet potato vine at high methionine and low lysine had the lowest hind quarter's percentage. Lungs percentage increased on low methionine, high lysine and decreased on high methionine high lysine at 0% sweet potato vine and at 15% sweet potato vine, it increased on high lysine

level on low and high methionine while it was similar on high and low lysine on low methionine and decreased on high lysine on high methionine at 30% sweet potato vine. Rabbits on 0 and 30% sweet potato vine at high methionine and high lysine had the lowest lungs percentage.

Table 7 also presents the interaction between sweet potato vine level and lysine supplementation on carcass characteristics of rabbits. Dressing percentage decreased on 0% and 30% sweet potato vine at high lysine supplementation and was similar on 15% sweet potato vine at low and high lysine supplementation level. Carcass of rabbits on 30% sweet potato vine at high lysine had the least dressing percentage.

Table 7: Interaction between sweet potato vine level and lysine supplementation on carcass characteristics of rabbits

Sweet potato vine level (%)	0		15		30			
Lysine level	Low	High	Low	High	Low	High	SE	LOS
Parameter								
Live weight (g)	1188.17	1157.00	1256.00	1199.67	1211.83	1173.83	26.86	0.91
Carcass Weight (g)	858.33	709.50	685.50	711.33	816.67	597.33	0.66	0.09
Dressing %	71.92[a]	60.79[b]	54.50[b]	58.57[b]	67.63[a]	50.63[b]	4.87	0.03
Proportion of carcass weight								
Hind quarters (%)	28.59	33.84	38.79	36.02	33.38	40.81	2.10	0.06
Fore quarters (%)	10.15	10.60	14.71	12.66	13.16	14.31	0.99	0.25
Middle portion (%)	14.00	14.80	19.48	16.46	16.26	18.08	1.13	0.10
Abdominal fat (%)	0.14	1.75	0.27	0.52	0.37	0.41	67.57	0.39
Proportion of live weight								
Lungs (%)	0.66	0.60	0.65	0.58	0.65	0.57	0.58	0.96
Liver (%)	1.88	1.54	2.30	1.90	2.48	1.82	0.23	0.76
Heart (%)	0.16	0.16	0.19	0.16	0.20	0.54	0.15	0.41
Kidneys (%)	0.55	0.56	0.54	0.49	0.60	0.47	0.05	0.30
Intestines (%)	11.59	11.60	13.60	13.06	14.03	10.52	1.17	0.29
Pelt (%)	7.65	7.52	8.00	7.58	8.60	8.60	0.04	0.94

[a,b,c]Means with the same superscript within the same row are similar, Cut-parts measured as percentage of carcass weight, Organs measured as percentage of live weight, LOS = Level of Significant, SE = Standard Error

There was no interaction effect between methionine and lysine supplementation on carcass characteristics of rabbits (Table 8).

Table 8: Interaction between methionine and lysine supplementation on carcass characteristics of rabbits

Methionine level	**Low**		**High**			
Lysine level	**Low**	**High**	**Low**	**High**	**SE**	**LOS**
Parameter						
Live weight (g)	1225.88	1156.78	1211.44	1196.89	0.54	0.28
Carcass Weight (g)	800.78	629.56	772.89	715.89	47.86	0.22
Dressing percentage	65.35	53.80	64.02	59.52	4.09	0.26
Proportion of carcass weight						
Hind quarters (%)	32.50	35.38	34.66	38.40	1.71	0.80
Fore quarters (%)	12.42	12.20	12.93	12.85	0.81	0.93
Middle portion (%)	16.03	16.23	17.14	16.66	0.92	0.71
Abdominal fat (%)	0.17	0.34	0.45	0.31	20.44	0.23
Proportion of live weight						
Lungs (%)						
Liver (%)	0.64	0.61	0.67	0.56	0.03	0.24
Heart (%)	2.24	1.91	2.19	1.60	0.19	0.48
Kidneys (%)	0.19	0.17	0.18	0.40	0.12	0.33
Intestines (%)	0.59	0.51	0.54	0.50	0.04	0.55
Pelt (%)	12.82	11.95	13.32	11.51	0.96	0.63
	8.18	7.71	7.98	8.09	0.49	0.56

[a,b,c]Means with the same superscript within the same row are similar, Cut-parts measured as percentage of carcass weight, Organs measured as percentage of live weight, LOS = Level of Significant, SE = Standard Error

Table 9 presents the effect of sweet potato vine level on carcass composition of rabbits. Moisture content in carcass of rabbit on 15% sweet potato vine was higher than on 0 and 30% sweet potato vine level. Crude protein, ether extract and ash were higher in carcass on 30% sweet potato vine level than on 0 and 15% sweet potato vine level. Crude protein, ether extract and ash content increased as level of sweet potato vine increased.

Table 9: Effect of sweet potato vine level on carcass composition of rabbit

	Sweet potato vine level (%)				
Parameters	0	15	30	SE	LOS
Moisture (%)	8.89[c]	9.64[a]	9.45[b]	0.02	<0.0001
Crude protein (%)	25.45[c]	25.62[b]	26.03[a]	2.96	<0.0001
Ether extract (%)	8.14[c]	8.83[b]	9.62[a]	2.35	<0.0001
Ash (%)	2.55[c]	4.06[b]	4.77[a]	2.48	<0.0001

[a,b,c]Means with the same superscript within row are similar, LOS = Level of Significant, SE = Standard Error

Table 10 presents the effect of methionine supplementation on carcass composition of rabbits. Moisture and ether extract content of carcass was higher in rabbits on low methionine supplementation than on high methionine supplementation. Carcass of rabbits on high methionine supplementation had higher crude protein and ash than those on low methionine supplementation. Table 24 also presents the effect of lysine on carcass composition of rabbits. Carcass of rabbits on high lysine supplementation had higher moisture, crude protein and ether extract content than those on low lysine supplementation. Rabbits on low lysine had higher ash content than those on high lysine supplementation level.

Table 10: Effect of methionine and lysine supplementation on carcass composition of rabbit

	Methionine Level				Lysine Level			
Parameter	**Low**	**High**	**SE**	**LOS**	**Low**	**High**	**SE**	**LOS**
Moisture (%)	9.95[a]	8.71[b]	0.02	<0.0001	8.46[b]	10.19[a]	0.02	<0.0001
Crude protein (%)	25.33[b]	26.07[a]	0.01	<0.0001	25.52[b]	25.87[a]	2.41	<0.0001
Ether extract (%)	9.15[a]	8.57[b]	0.01	<0.0001	8.85[b]	8.88[a]	2.09	<0.0001
Ash (%)	3.70[b]	3.88[a]	0.01	<0.0001	3.81[a]	3.78[b]	1.60	<0.0001

[a,b,c]Means with the same superscript within row are similar, LOS = Level of Significant, SE = Standard Error

There was significant interaction between sweet potato vine level and methionine supplementation on carcass composition of rabbits (Table 11). Moisture content decreased on 0 and 15% sweet potato vine at high methionine supplementation and remained similar on 30% at low and high methionine supplementation level. Moisture content was lowest in carcass of rabbits on 0% sweet potato vine at high methionine supplementation level. Crude protein content increased on 0% and 30% sweet potato vine at high methionine supplementation but remained similar on 15% sweet potato vine at low and high methionine supplementation level. Crude protein content of carcass was lowest in rabbits on 0% sweet potato vine at low methionine supplementation level. Carcass ether extract content decreased on 0% sweet potato vine at high methionine

supplementation but was similar at low and high methionine supplementation on 15% and 30% sweet potato vine level. Rabbits on 0% sweet potato vine at high methionine supplementation had the least ether extract content of carcass.

Ash content was similar on 0% and 15% sweet potato vine at low and high methionine supplementation and but increased on 30% sweet potato vine at high methionine supplementation level. Carcass of rabbits on 0% sweet potato vine at low methionine supplementation had the least ash content.

Table 11: interaction between sweet potato vine level and methionine supplementation on carcass composition of rabbits

Sweet potato vine level (%)	0		15		30			
Methionine level	Low	High	Low	High	Low	High	SE	LOS
Parameter								
Moisture (%)	10.15 [a]	7.63[b]	10.25[a]	9.03[b]	9.44[a]	9.45[a]	0.48	<0.0001
Crude protein (%)	25.10[b]	25.80[a]	25.63[ab]	25.61[ab]	25.27[b]	26.79[a]	0.20	<0.0001
Ether extract (%)	9.65[a]	8.01[b]	8.13[b]	8.15[b]	9.69[a]	9.55[a]	0.12	<0.0001
Ash (%)	2.54[c]	2.56[c]	4.03[b]	4.09[b]	4.54[a]	5.01[a]	0.01	<0.0001

[a,b,c]Means with the same superscript within row are similar, LOS = Level of Significant, SE = Standard Error

Table 12 depicts the interaction between sweet potato vine level and lysine supplementation on rabbit carcass composition. Moisture and ether extract content of carcass decreased on 0% sweet potato vine at high lysine supplementation and increased at 15 and 30% sweet potato vine with lysine supplementation level. Carcass of rabbits on 30% sweet potato vine at low lysine supplementation had the lowest moisture content, while those on 15% sweet potato vine at low lysine supplementation had lowest ether extract content. Crude protein content was higher on high lysine for all sweet potato vine levels. Carcass of rabbits on 0 and 15% sweet potato vine at low lysine had the lowest crude protein content. Ash content of carcass increased as sweet potato vine increased with lysine supplementation. Ash content was lowest in carcass of rabbits on 0% sweet potato vine at low lysine supplementation level.

Table 12: Interaction between sweet potato vine level and lysine supplementation on carcass composition of rabbits

Sweet potato vine level (%)	0		15		30			
Lysine level	Low	High	Low	High	Low	High	SE	LOS
Parameter								
Moisture (%)	9.10^{ab}	8.69^{b}	8.28^{b}	11.00^{a}	8.02^{b}	10.87^{a}	0.17	<0.0001
Crude protein (%)	25.20^{c}	25.70^{b}	25.20^{c}	26.04^{ab}	25.88^{ab}	26.18^{a}	0.02	<0.0001
Ether extract (%)	9.07^{b}	8.59^{b}	7.89^{c}	8.39^{bc}	9.58^{a}	9.66^{a}	0.06	<0.0001
Ash (%)	2.53^{c}	2.57^{c}	4.07^{b}	4.04^{b}	4.81^{a}	4.72^{a}	0.02	<0.0001

^{a,b,c}Means with the same superscript within row are similar, LOS = Level of Significant, SE = Standard Error

Table 13 depicts there was significant interaction between methionine and lysine supplementation on carcass composition of rabbits. Moisture was higher on low and high methionine at high lysine supplementation. Crude protein content, ash, ether extract were similar at low and high lysine supplementation on low and high methionine levels. Moisture content was lowest in carcass of rabbits on low methionine at low lysine supplementation, while crude protein content was lowest in carcass of rabbits on high methionine at low lysine supplementation level. Ether extract content was lowest in carcass of rabbits on low methionine at high lysine supplementation level while ash content was lowest in carcass of rabbits on high methionine at high lysine supplementation level.

There was significant interaction between sweet potato vine level, methionine and lysine supplementation on carcass characteristics of rabbits (Table 14). Moisture content was similar at low and high lysine supplementation on low and high methionine levels on 0% sweet potato vine but increased on high lysine at low and high methionine on 15% and 30% sweet potato vine level. Moisture content of carcass was lowest in rabbits on 0% sweet potato vine at high methionine and high lysine supplementation level. Crude protein content was higher, at high methionine and low or high lysine on 0% sweet potato level while on 15% and 30% sweet potato vine, it increased on high lysine for low and high methionine supplementation. Crude protein content was lowest in rabbits on 0 and 30% sweet potato vine at low methionine and low lysine supplementation level. Ether extract content and ash decreased on 0% sweet potato vine with methionine and lysine supplementation and was similar on 15% and 30% sweet potato vine with methionine and lysine supplementation. Ether extract content in carcass of rabbits was lowest on 0% sweet potato vine at high methionine and high lysine supplementation level. Ash content was lowest in carcass of rabbits on 0% sweet potato vine at low methionine and low lysine supplementation level.

Table 13: Interaction between methionine and lysine supplementation on carcass composition of rabbit

Methionine level	**Low**		**High**			
Lysine level	**Low**	**High**	**Low**	**High**	**SE**	**LOS**
Parameter						
Moisture (%)	8.17[b]	9.24[a]	8.75[b]	11.14[a]	0.24	<0.0001
Crude protein (%)	25.97[a]	26.17[a]	25.08[b]	25.58 [b]	0.13	<0.0001
Ether extract (%)	8.67[b]	8.47[b]	9.02[a]	9.28[a]	0.22	<0.0001
Ash (%)	3.88[a]	3.89[a]	3.73[b]	3.67[b]	0.31	<0.0001

[a,b,c]Means with the same superscript within row are similar, LOS = Level of Significant, SE = Standard Error

Table 14: Interaction between sweet potato vine level, methionine and lysine level supplementation on carcass composition of rabbits

Sweet potato vine level (%)	**0**				**15**				**30**					
Methionine level	**Low**		**High**		**Low**		**High**		**Low**		**High**			
Lysine level	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**SE**	**LOS**
Parameter														
Moisture (%)	10.02^{ab}	10.28^{a}	8.17^{b}	7.10^{b}	8.60^{b}	11.90^{a}	7.96^{b}	10.11^{a}	7.63^{b}	11.24^{a}	8.40^{b}	10.50^{a}	0.01	0.0063
Crude protein (%)	25.03^{b}	25.16^{b}	25.36^{a}	26.24^{a}	25.19^{b}	26.08^{a}	25.20^{b}	26.03^{b}	25.03^{b}	25.50^{a}	27.33^{a}	26.25^{a}	0.01	<0.0001
Ether extract (%)	9.52 ^{a}	9.70^{a}	8.64^{b}	7.38^{b}	7.87^{b}	8.39^{b}	7.92^{b}	8.38^{b}	9.70^{a}	9.67^{a}	9.45^{a}	9.66^{a}	0.01	<0.0001
Ash (%)		2.56^{c}	2.54^{c}	2.58^{c}	4.04^{b}	4.01^{b}	4.10^{b}	4.08^{b}	4.63^{b}	4.44^{b}	5.01^{b}	5.00^{b}	0.01	<0.0001

^{a,b,c}Means with the same superscript within the same row are similar. LOS = Level of Significant, SE = Standard Error

DISCUSSION

Dressing percentage

Dressing percentage of carcass of rabbits (45.81 to 77.08%) obtained in this study was good compared to 30.83 to 32.88% reported by Jegede *et al*. (2006). Abdominal fat deposit decreased as level of sweet potato vine increased. This could be as a result of high protein content of sweet potato vine in the diets which reduced the fat deposit in the abdominal cavity of rabbits. This agrees with Askov (1997) who reported that reduction in abdominal fat upon high protein content in the feed is possible in rabbits. Increasing protein content in feed of animals results in enhanced secretion of urea via the kidneys. This process requires energy, which is taken from the energy reserves of the body, thus resulting in less energy for other body functions such as building up fat deposits, Askov (1997).

Increase in methionine and lysine levels tends to elevate abdominal fat deposition, this is in disagreement with Xie *et al*. (2006) who reported that increase in dietary methionine, abdominal fat decreased linearly ($P < 0.05$). Also supported by Zhan *et al*., (2006) who stated that aaddition of methionine and betaine significantly increased the contents of creatine and free carnitine in liver, the activity of hormone-sensitive lipase in abdominal fat and the concentration of free fatty acid in serum and therefore reduces abdominal fat. Besides, low methionine and low lysine level gave the best live weight, carcass weight, dressing percentage and lowest abdominal fat. 15% sweet potato vine inclusion level supported higher intestine percentage and 0% sweet potato vine gave highest kidney percentage. Organs percentages were not affected by sweet potato vine level. It showed that the diets were adequate in nutrients. Low lysine level supported higher percentage of lungs, liver, heart, kidneys, intestine and pelt. However, organs percentages obtained in this current study were lower than the values reported by Ojebiyi *et al*. (2006).

Carcass Composition

Crude protein content of rabbit carcass in the present experiment ranged from 25.03 to 27.33%, which was higher than 22.5% reported by Nguyen (2003). The difference could be caused by feed sources and supplements. The inclusion levels of Sweet potato vine had a positive effect on rabbit carcass composition and quality. Other carcass composition parameters except moisture was highest in rabbits fed 30% sweet potato vine inclusion level. This agreed with Dominguez (1992) that sweet potato vine is a good source of vitamins and protein feed material.

Difference among carcass proximate composition obtained in this study revealed that methionine supplementation had a significant effect on carcass composition. High level of methionine supplementation in this study reduced moisture and ether extract content of rabbit carcass, but increased crude protein and ash proportion. The reverse was the case of low methionine supplementation level. On the other hand, high lysine supplementation level resulted in increase in moisture; crude protein and ether extract proportion of the carcass. Protein or amino acid content of a diet is directly related to the moisture level of the carcass, which is inversely related to the ether extract (fat) level (Noblet and Henry, 1977). Therefore, when a diet is deficient in certain amino acids or a low protein diet is fed to animals, carcass moisture level declines resulting in a concomitant increase in carcass fat or lipid levels.

The sweet potato vine and methionine interaction showed that at 15% sweet potato vine level and low methionine level moisture content was highest and high crude protein proportion. Highest crude protein and ash content was observed in carcass on 30% sweet potato vine and high methionine level, revealing that sweet potato vine is a good source of protein and methionine an essential amino acid for protein synthesis. Hence, adequate amount of amino acids especially methionine and lysine in diet encourage protein synthesis and utilization thereby high

crude protein deposition in carcass. The low level of methionine supports ether extract deposition and less ash in the carcass. There were differences among the means of the parameters as a result of the interaction between sweet potato vine and lysine, with moisture and ether extract proportion being highest in carcass of rabbits on 30% sweet potato vine at high lysine level. 30% sweet potato vine at low lysine level supported crude protein and ash deposition in the carcass. High level of both methionine and lysine encouraged high moisture, ether extract and crude protein and ash in carcass of rabbits. This could be as a result of high level of lysine supplementation in the treatment feed.

Fifteen per cent (15 %) sweet potato vine at low methionine and high lysine interaction supported high moisture content of carcass of rabbits. 30% sweet potato vine at high methionine and high lysine improved crude protein deposition. 30% sweet potato vine at low methionine and low lysine level supported ether extract deposition, while 30% sweet potato vine at high methionine and low lysine encouraged ash deposition in carcass of rabbit. The values of carcass composition observed in this current study shows that moisture content of carcass was lower than the value (75.5 to 75.6%) reported by Vansanthakumar *et al.* (1999). Crude protein, ether extract and ash contents were higher than Vansanthakumar *et al.* (1999); crude protein (20.3%), ether extract (1.9%) and ash (1.6%) values obtained in their study on effect of graded dietary levels of neem (*Azadirachta indica*) seed kernel cake on carcass characteristics of broiler rabbit.

CONCLUSION

In conclusion, feeding rabbit with the inclusion of sweet potato vine up to 30% level as well as supplementing with methionine and lysine did not lead to any deleterious effects on carcass quality and characteristics of rabbits but improved the deposition of some nutrients in the carcass.

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