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Effect of Concentrate and Forage Type on Performance and Digestibility of Growing Rabbits Under Sub-Humid Tropical Conditions

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Abstract: Growing crossbred rabbits were used to investigate the effect of concentrate and forage types on performance and digestibility of rabbits under sub-humid tropical conditions. The treatments comprised of two concentrate diets (rabbit meal and soybean cheese waste meal) and three forages (groundnut haulms, sweet potato forage and soybean forage) in a 2×3 factorial experiment. The rabbits were given 50 g of concentrate meal, 60 g of grass and 40 g of forage in separate feeders in the morning. Rabbits on soybean cheese waste meal consumed 6% more concentrate than those on rabbit meal. Grass, forage and total feed intake, weight gain and feed conversion efficiency were similar for the two concentrates. Feed cost and cost kg^{-1} gain were respectively, 27 and 37% lower for soybean cheese waste meal than rabbit meal. Dry matter, ether extract and nitrogen free extractives digestibilities were higher for rabbits fed soybean cheese waste meal than rabbit meal. Concentrate and total feed intake and feed cost were similar for all the forage types. Grass intake was 9% lower for rabbits fed groundnut haulms than those fed sweet potato forage. Forage intake was 6-7% higher for groundnut haulms than sweet potato and soybean forages. Feed cost kg^{-1} gain was 18-29% higher for sweet potato forage than groundnut haulms and soybean forage. Dry matter, ether extract, crude fibre and nitrogen free extractives digestibility was similar for all the forages. Crude protein digestibility was higher in soybean forage than sweet potato forage. Interaction between concentrate and forage was observed in forage intake and feed cost. There was no interaction between concentrate and forage on nutrient intake and digestibility. Dry matter, crude fibre and nitrogen free extractives digestibility were higher for rabbits at 21 weeks than 19 weeks. It is concluded that soybean cheese waste meal is potential concentrate meal for rabbits while feeding groundnut haulms and soybean forage were more cost effective than sweet potato forage for feeding rabbits.

Key words: Age, concentrate, forage, digestibility, nutrient, rabbits

INTRODUCTION

Rabbit production has over the years gained popularity in many tropical countries especially in Africa and West Africa in particular. Currently rabbit meat consumption is increasing because of its low cholesterol content. The meat does not form uric acid during metabolism therefore, it is being advocated to people for good health. The meat is prescribed for diabetic, hypertensive and middle aged people. To meet the rising demand for rabbits there is need to increase production however, a major constraint of rabbit production in developing countries is the high cost of feed.

Forage use in feeding rabbits is a common practice. The forage alfalfa is widely used as a major ingredient in rabbit diets with good performances recorded. Alfalfa is used either sole or in combination with other ingredients with resultant high daily weight gains of up to 35 g. Reports show that several tropical legumes such as *Desmodium distortum*, *Cassia tora*, *Clitoria ternate* have similar feeding value for weanling rabbits as alfalfa (Cheeke *et al*., 1983).

The effect of environment on performance of rabbits fed these feed resources cannot be ignored. Feeding rabbits solely on forages in the tropics has resulted in negative effect of weight loss (Adegbola *et al*., 1985; Bamikole and Ezenwa, 1999) and in some cases positive effects have been reported (Phimmmasan *et al*., 2004; Hue and Preston, 2006). The use of compounded concentrates alone has also not given optimum results. The use of high concentrate and low forage levels currently practiced by rabbit raisers produces very expensive rabbits that consumers are unwilling to purchase. This has become a problem given low price of selling rabbits compared with high cost of production therefore, making commercial production of rabbits an expensive and unprofitable venture. Slow growth of rabbits under tropical conditions has also made it impossible to produce fryers by nine weeks as obtains under temperate conditions. Fryer rabbits are sold between 20 and 25 weeks old. Most nutrition studies are conducted during the weaner phase when growth is high in rabbits and do not take into consideration the slow growth of rabbits between the ages of 3 and 5 months (Iyeghe-Erakpotobor *et al*., 2001) in the tropics.

Raising rabbits on forages with an energy supplement has been reported to be more appropriate in developing countries where commercial feeds are either not available or cost-prohibitive (Linga and Lukefahr, 2000). Agro-industrial by-products such as oil cake or cereal bran could be added to improve the nutrient quality of molasses blocks or crumbles (Sansoucy, 1986). However, in Nigeria molasses is very scarce, expensive and beyond the reach of the average farmer. Therefore, use of locally available agro-industrial products to reduce cost of producing rabbits in addition to forages is being practiced by the local farmers. Some of the commonly used agro-industrial by-products are soybean cheese waste and maize offal. Soybean cheese waste is a by-product of soybean cheese production. It is common practice for farmers to mix soybean cheese waste and maize offal and offer this to their animals. It is also used for fattening cattle and sheep produced for festivals. This product is readily consumed by livestock and also has the potential of reducing cost of concentrate intake by rabbits. There is a need to study the performance of rabbits on this simple diet compared with the more expensive compounded diet being advocated for farmers' use. This study was therefore designed to evaluate utilization of two concentrate types and three forages on performance and nutrient digestibility of growing rabbits.

MATERIALS AND METHODS

Site of Study

The experiment was conducted in the Rabbitry of the National Animal Production Research Institute (NAPRI), Shika, Nigeria, located in the Northern Guinea Savanna ecological zone. Shika lies between Latitudes 10° 11' N and Longitude 7° 8' E, about 650 m above sea level, with an annual rainfall of 1100 mm, spread from April to October. During the study, the mean minimum and maximum temperature ranged between 28 and 36°C. Relative humidity ranged between 60 and 75%.

Animals and Housing

Thirty 15-week old growing crossbred rabbits of average weight 1.5 kg were used. The rabbits were obtained from mating between New Zealand White, California and Chinchilla rabbits. The rabbits were individually housed in metal cages located in a well-ventilated house. The rabbits were treated in accordance with accepted standards for humane treatment of animals.

Experimental Procedure

The treatments comprised of two concentrate diets and three forages in a 2×3 factorial experiment in a completely randomized design. The concentrates were rabbit meal (21% CP) and soybean cheese waste meal (12% CP), while the forages were groundnut haulms, sweet potato vines and soybean

Table 1: Composition of concentrate diets fed to growing rabbits

	Proportion (%)	
Ingredients	Rabbit meal	Soybean cheese waste meal
Maize	39.24	-
Groundnut cake	42.26	-
Soybean cheese waste	-	15.07
Maize offal	15.00	84.64
Bone meal	3.00	-
Salt	0.25	0.29
Vit./Min. premix*	0.25	-
Feed cost kg^{-1} (₦)	30.00	11.59

*Vitamin/mineral premix content per kilogram ration: Vit. A 1251 IU, Vit. D3 2750 IU, Vit. E 151 IU, Vit. K 0.002 g, Vit. B_2 0.006 g, Nicotinic acid 0.035, Calcium D-Pantothenate 0.01 mg, Vit. B_6 0.0035 g, Vit. B_{12} 0.02 g, Folic acid 0.001 g, Biotin 0.0005 g, Vit. C 0.025 g, Cholin chloride 0.39 g, Zinc bacitracin 0.02 g, Methionine 0.2 g, Avatec (Lasolocid) 0.09 g, Manganese 0.1 g, Iron 0.05 g, Zinc 0.04 g, Copper 0.002 g, Iodine 0.00153 g, Cobalt 0.000225 g, Selenium 0.0001 g. ₦-Naira. ₦ 180 = 1 Euro

Table 2: Proximate composition of concentrate and forages fed to growing rabbits

Forages fed	Dry matter	Ash	Ether extract	Crude fibre	Crude protein
Rabbit meal	96.57	6.68	12.61	10.13	21.94
Soybean cheese waste meal	96.10	6.14	20.28	10.26	12.53
Rhodes grass	97.50	5.58	6.54	47.81	1.41
Groundnut haulms	96.94	12.77	10.35	30.43	10.84
Sweet potato forage	96.80	8.99	10.73	26.33	11.19
Soybean forage	96.57	9.92	8.85	35.38	11.58

forage. Rhodes grass (*Chloris gayana*) was fed to all the groups. The rabbits were given 50 g of concentrate, 60 g of Rhodes grass and 40 g of forage in separate feeders and allowed to adjust their intake of the feed offered.

All the forages were fed as hay. Groundnut, sweet potato forage and Rhodes grass were harvested, dried, chopped and bagged for the study. Soybean forage used was obtained after harvesting and threshing. Composition of the concentrate diets is shown on Table 1 while the proximate composition of concentrates and forages is shown on Table 2.

Concentrates, grass and forages were weighed and fed separately in flat bottom earthen pots in the morning (08.00 h). Intake of the concentrate meal, grass and forage were monitored daily. Feed and forage leftovers and or wastage were weighed daily before feeding. Water was supplied daily in earthen pots. The rabbits were treated routinely against ecto- and endo-parasites using ivomec (Ivomectin) and coccidiostat (Amprolium). Weekly weights of rabbits were taken during the study. Parameters determined were feed intake, weight gain, feed conversion efficiency (weight gain/feed intake), feed cost and feed cost kg^{-1} gain. The study lasted six weeks.

Digestibility Study

Digestibility study was conducted using eighteen rabbits at 19- and 21-weeks old corresponding with the fourth and sixth weeks of the study for four days. Fecal samples were collected daily. Samples collected were stored at -20°C in a deep freezer immediately after collection. At the end of each collection period, the samples were bulked for each animal for proximate analysis according to AOAC (1980) procedures. Nutrient composition of the concentrates, chloris, groundnut haulms, sweet potato forage and soybean forage was also done according to AOAC (1980). Parameters determined were feed and nutrient intake and nutrient digestibility coefficients of rabbits.

Data Analysis

Data collected were subjected to analysis of variance using general linear model procedure (PROC GLM), for factorial experiments in a completely randomized design for the growth and digestibility

studies. Effect of age of rabbits on nutrient digestibility was also considered using general linear model procedure. Pair-wise difference (pdiff) method was used to separate significant means (SAS, 1987).

RESULTS

Rabbits on soybean cheese waste meal consumed 6% more ($p<0.05$) concentrate than rabbit meal (Table 3). Grass, forage and total feed intake, weight gain and feed conversion efficiency were similar for the two concentrate meals. Feed cost and cost kg^{-1} gain were 27 and 37% lower ($p<0.05$) for soybean cheese waste meal than rabbit meal. Nutrient intake and digestibility of rabbits fed the concentrate types is shown on Table 3. Dry matter and nitrogen free extract intakes were similar for the two concentrates. Intake of ash, crude fibre and crude protein were higher ($p<0.05$) for rabbits fed rabbit meal than soybean cheese waste meal. Ether extract intake was however, higher ($p<0.05$) for soybean cheese waste meal than rabbit meal. Dry matter, ash, ether extract and nitrogen free extract digestibility were higher ($p<0.05$) for rabbits fed soybean cheese waste meal than rabbit meal. Crude fibre and crude protein digestibility were similar for the two concentrate diets.

Concentrate and total feed intake were similar for all the forage types (Table 4). Grass intake was 9% lower ($p<0.05$) for groundnut haulms fed rabbits than sweet potato forage fed rabbits. Forage intake was 6-7% higher ($p<0.05$) for groundnut haulms than sweet potato and soybean forages. Feed cost was also similar for all the forages while feed cost kg^{-1} gain was 18-29% higher for sweet potato forage than groundnut haulms and soybean forage.

Dry matter, crude fibre, crude protein and nitrogen free extractives intake (Table 5) were similar for rabbits fed the forages. Ash intake was higher ($p<0.05$) for groundnut haulms, while ether extract intake was higher ($p<0.05$) for sweet potato forage than the other forages. Dry matter, ether extract, crude fibre and nitrogen free extractives digestibility were similar for all the forages. Crude protein digestibility was higher ($p<0.05$) in soybean forage than sweet potato forage.

Table 3: Effect of concentrate type on performance, nutrient intake and digestibility of growing rabbits

	Concentrate type		
Parameters	Rabbit meal	Soybean cheese waste meal	SE
Concentrate intake (g day^{-1})*	45.4[b]	48.3[a]	0.64
Grass intake (g day^{-1})	23.2	21.6	0.59
Forage intake (g day^{-1})	33.9	33.2	0.59
Total intake (g day^{-1})	102.6	104.8	1.50
Weight gain (g day^{-1})	4.5	6.6	2.66
FCE (gain/intake)	0.040	0.068	0.024
Feed cost (₦ day^{-1})*	21.25[a]	15.52[b]	0.25
Feed cost (€ day^{-1})	0.118	0.086	0.0014
Feed cost kg^{-1} gain (N)*	230.21[a]	145.67[b]	19.46
Feed cost kg^{-1} gain (€)	1.28	0.81	0.108
Nutrient intake (g day^{-1})			
Dry matter	106.6	100.6	2.27
Ash	7.91[a]	7.22[b]	0.19
Ether extract	11.2[b]	14.3[a]	0.25
Crude fibre	25.7[a]	22.7[b]	0.84
Crude protein	15.4[a]	11.1[b]	0.39
Nitrogen free extract	46.4	45.2	0.99
Digestibility coefficient			
Dry matter	0.65[b]	0.71[a]	0.01
Ash	0.52[b]	0.62[a]	0.03
Ether extract	0.69[b]	0.76[a]	0.02
Crude fibre	0.49	0.53	0.02
Crude protein	0.68	0.70	0.02
Nitrogen free extract	0.74[b]	0.80[a]	0.01

Means with different superscript along rows are significantly different ($p<0.05$, *$p<0.01$); FCE: Feed Conversion Efficiency; SE: Standard Error; ₦180 = 1 Euro (€)

Table 4: Effect of forage type on performance of growing rabbits

	Forage type			
Parameters	Groundnut haulms	Sweet potato vines	Soybean forage	SE
Concentrate intake (g day^{-1})	45.9	48.0	46.6	0.82
Grass intake (g day^{-1})	21.5^{b}	23.7^{a}	22.0^{ab}	0.72
Forage intake (g day^{-1})	35.2^{a}	32.9^{b}	32.5^{b}	0.73
Total intake (g day^{-1})	105.0	105.0	101.2	1.82
Weight gain (g day^{-1})	7.94	5.60	3.14	3.31
FCE (gain/intake)	0.085	0.052	0.025	0.028
Feed cost (₦ day^{-})	18.65	18.41	18.10	0.30
Feed cost (€ day^{-1})	0.104	0.102	0.101	0.0017
Feed cost kg^{-1} gain (₦)	157.69^{b}	223.98^{a}	182.86^{b}	23.14
Feed cost kg^{-1} gain (€)	0.876	1.244	1.016	0.129

Means with different superscript along rows are significantly different ($p<0.05$); FCE: Feed Conversion Efficiency; SE: Standard Error; ₦180 = 1 Euro (€)

Table 5: Effect of forage type on nutrient intake and digestibility of growing rabbits

	Forage type			
Nutrients	Groundnut haulms	Sweet potato vines	Soybean forage	SE
Intake (g day^{-1})				
Dry matter	95.20	99.00	97.40	2.82
Ash	8.24^{a}	7.05^{b}	7.34^{b}	0.24
Ether extract	11.80^{ab}	12.60^{a}	11.60^{b}	0.31
Crude fibre	23.60	22.30	25.00	1.05
Crude protein	11.20	12.10	12.20	0.46
Nitrogen free extract	40.30	44.90	41.20	1.23
Digestibility coefficient				
Dry matter	0.68	0.67	0.69	0.02
Ash	0.63^{a}	0.51^{b}	0.59^{ab}	0.04
Ether extract	0.71	0.73	0.74	0.03
Crude fibre	0.51	0.50	0.51	0.03
Crude protein	0.69^{ab}	0.64^{b}	0.72^{a}	0.02
Nitrogen free extract	0.77	0.76	0.77	0.02

Means with different superscript along rows are significantly different ($p<0.05$); SE: Standard Error

Table 6: Effect of concentrate and forage type on performance of growing rabbits

	Rabbit meal			Soybean cheese waste meal			
Parameters	Groundnut haulms	Sweet potato vines	Soybean forage	Groundnut haulms	Sweet potato vines	Soybean forage	SE
Concentrate intake (g day^{-1})	43.74^{b}	47.71^{a}	44.82^{b}	48.14^{a}	48.35^{a}	48.43^{a}	1.09
Grass intake (g day^{-1})	21.79^{a}	24.72^{a}	22.98^{a}	21.13^{b}	22.76^{a}	20.97^{b}	1.0
Forage intake (g day^{-1})	35.01^{a}	34.83^{a}	31.54^{bc}	35.23^{a}	30.97^{c}	33.43^{ab}	1.01
Total intake (g day^{-1})	101.69^{ab}	107.42^{a}	98.79^{b}	108.30^{a}	102.67^{ab}	103.58^{ab}	2.54
Weight gain (g day^{-1})	4.58	5.71	3.14	11.30	5.48	3.14	4.42
FCE (gain/intake)	0.044	0.05	0.026	0.126	0.055	0.023	0.04
Feed cost (₦ day^{-1})	21.19^{a}	21.94^{a}	20.62^{a}	16.11^{b}	14.88^{b}	15.58^{b}	0.42
Feed cost (€ day^{-1})	0.12	0.12	0.11	0.09	0.08	0.09	0.002
Feed cost kg^{-1} gain (₦)	192.67^{b}	299.70^{a}	198.26^{b}	121.27^{b}	148.26^{b}	167.47^{b}	32.38
Feed cost kg^{-1} gain (€)	1.07	1.66	1.10	0.67	0.82	0.93	0.18

Means with different superscript along rows are significantly different ($p<0.05$); SE: Standard Error; ₦-Naira. ₦180 = 1 Euro

Interaction between concentrate and forage was observed in forage intake and feed cost. Concentrate intake was 8-10% lower ($p<0.05$) for rabbit meal groundnut haulms and rabbit meal soybean forage than the other treatment groups (Table 6). Grass intake was 4-14% lower ($p<0.05$) for soybean cheese waste meal groundnut haulms and soybean cheese waste meal soybean forage than the other treatment groups. Forage intake was 7-12% lower ($p<0.05$) for soybean cheese waste meal sweet

Table 7: Effect of concentrate and forage type on nutrient intake and digestibility of growing rabbits

	Rabbit meal			Soybean cheese waste meal			
Nutrients	Groundnut haulms	Sweet potato vines	Soybean forage	Groundnut haulms	Sweet potato vines	Soybean forage	SE
Intake (g day^{-1})							
Dry matter	95.46	103.11	102.96	96.02	95.21	91.86	3.96
Ash	8.43^{a}	7.52^{ab}	7.78^{ab}	8.12^{a}	6.61^{c}	6.90^{bc}	0.34
Ether extract	10.03^{c}	11.14^{bc}	10.33^{c}	13.72^{a}	14.10^{a}	12.94^{ab}	0.44
Crude fibre	24.43^{ab}	23.62^{ab}	27.40^{a}	23.13^{ab}	20.95^{b}	22.63^{b}	1.49
Crude protein	12.89^{a}	14.74^{a}	14.50^{a}	9.60^{b}	9.66^{b}	9.86^{b}	0.65
Nitrogen free extract	39.67^{b}	46.08^{a}	42.93^{ab}	41.45^{ab}	43.88^{ab}	39.53^{b}	1.73
Digestibility coefficient							
Dry matter	0.66^{bc}	0.59^{c}	0.67^{bc}	0.70^{ab}	0.72^{a}	0.71^{a}	0.03
Ether extract	0.71	0.68	0.68	0.71	0.77	0.80	0.04
Crude fibre	0.50	0.43	0.51	0.53	0.55	0.51	0.05
Crude protein	0.69^{ab}	0.59^{b}	0.71^{a}	0.69^{ab}	0.68^{ab}	0.74^{a}	0.03
Nitrogen free extract	0.75^{b}	0.69^{c}	0.76^{b}	0.80^{ab}	0.82^{a}	0.79^{ab}	0.03

Means with different superscript along rows are significantly different ($p<0.05$); SE: Standard Error

Table 8: Effect of age on nutrient intake and digestibility of growing rabbits fed concentrate and forages

	Age of rabbits (weeks)		
Nutrients	19	21	SE
Intake (g)			
Total dry matter	310.10	298.30	9.44
Ash	23.80^{a}	22.00^{b}	0.63
Ether extract	37.20	36.10	1.29
Crude fibre	72.20	73.50	2.70
Crude protein	40.90	36.90	2.52
Nitrogen free extractives	135.80	129.90	4.72
Digestibility coefficient			
Dry matter**	0.63^{b}	0.72^{a}	0.01
Ash**	0.50^{b}	0.62^{a}	0.03
Ether extract	0.69	0.75	0.02
Crude fibre**	0.45^{b}	0.57^{a}	0.02
Crude protein	0.67	0.71	0.02
Nitrogen free extractives**	0.72^{b}	0.81^{a}	0.01

Means with different superscript along rows are significantly different ($p<0.05$, $^{**}p<0.01$); SE: Standard Error

potato vines than the other groups. Total feed intake was 8-9% ($p<0.5$) lower for rabbit meal soybean forage than rabbit meal sweet potato vines and soybean cheese waste meal groundnut haulms groups. Daily weight gain and feed conversion efficiency were similar for all the groups. Feed cost was 27-28% lower ($p<0.05$) for the soybean cheese waste meal forage groups than the rabbit meal forage groups. Feed cost kg^{-1} gain was 34-59% higher ($p<0.05$) for rabbit meal sweet potato vines group than the other treatments.

There was no interaction between concentrate and forage on nutrient intake and digestibility. Dry matter intake (Table 7) was similar for all the groups. Ash intake was lower for soybean cheese waste meal sweet potato and soybean forage groups than other groups. Ether extract intake was low for rabbit meal forage groups while crude protein and crude fibre intake was low for soybean cheese waste meal forage groups. Dry matter digestibility was higher for soybean cheese waste meal forage groups than rabbit meal forage groups. Ether extract and crude fibre digestibility was similar for all the groups. Crude protein and nitrogen free extract digestibility was lower for rabbit meal sweet potato vines than the other treatment groups.

Nutrient intake was similar for rabbits at 19 and 21 weeks except for ash intake, which was higher ($p<0.05$) at 19 weeks than 21 weeks (Table 8). Dry matter, crude fibre and nitrogen free extractives digestibility were however, higher ($p<0.01$) for rabbits at 21 weeks than 19 weeks. Ether extract digestibility ($p = 0.07$) and crude protein digestibility ($p = 0.06$) were similar for rabbits at 19 and 21 weeks.

DISCUSSION

Higher intake of soybean cheese waste meal than rabbit meal by rabbits in this study, indicates that soybean cheese waste meal is likely more palatable than rabbit meal. Similar weight gain and feed conversion efficiency observed for the two concentrate meals agrees with the findings of Linga and Lukefahr (2000) who observed that final weight and gross feed conversion was not different for rabbits fed molasses blocks and crumbles diets. Considering the lower protein content of the soybean cheese waste meal compared to rabbit meal, it was expected that the rabbit meal group would perform better in terms of weight gain and feed conversion than the soybean cheese waste meal group. However, this was not the case. Higher digestibility of nutrients by soybean cheese waste meal fed rabbits than the rabbit meal group indicates a high potential of soybean cheese as a feed resource for rabbits.

Higher intake of groundnut haulms than sweet potato and soybean forages by rabbits in this study probably indicates that groundnut haulms was more palatable to rabbits than sweet potato and soybean forages. Weight gains obtained for rabbits fed the forages in this study are similar to those reported by Taiwo *et al.* (1999) for rabbits fed *Tridax procumbens*, *Centrosema pubescens* and *Calopogonium phaseloides* and Phimmmasan *et al.* (2004) with *Stylosanthes guianensis*. For all the forages, feed cost was similar and though feed cost kg^{-1} gain was slightly higher for rabbits on sweet potato forage than groundnut haulms and soybean forage, any of the forages could be used for feeding rabbits and it agrees with the results of Iyeghe-Erakpotobor *et al.* (2002) who reported similar weight gain when rabbits were fed groundnut haulms, lablab and mucuna forages. Similar dry matter, ether extract, crude fibre and nitrogen free extractives digestibility obtained for all the forages could explain the similar weight gains observed for rabbits on the three forages. Dry matter and crude protein digestibility obtained in this study are similar to those reported for temperate (Alfalfa and Clover) and tropical (*Leucaena leucocephala*, *Sesbania sesban* and *Albizza falcata*) legumes (Cheeke *et al.*, 1986).

The rate of gain in this study agrees with daily growth rate of 5-10 g reported during the grower phase under tropical conditions (Iyeghe-Erakpotobor *et al.*, 2001). Low growth performance of rabbits as a result of high ambient temperatures has been reported. Significant effect of temperature and day length on rabbit growth performance has been reported (McNitt and Lukefahr, 1993) with rabbits having lowest growth rate in summer and highest growth rates in early spring and late autumn. It is concluded from this study that soybean cheese waste meal has a great potential as a concentrate meal for rabbits. Though rabbits utilized all the forages for growth, feeding groundnut haulms and soybean forage were more cost effective than sweet potato forage.

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REFERENCES

Adegbola, T.A., E.U. Tibi and D.C. Asogwa, 1985. Feed intake and digestibility of rabbits on all-forage, forage plus concentrate and all-concentrate diets. J. Anim. Prod. Res., 5: 185-191.

AOAC., 1980. Official Method of Analysis. 13th Edn., Association of Official Analytical Chemists, Washington, DC.

Bamikole, M.A. and I. Ezenwa, 1999. Performance of rabbits on guinea grass and verano stylo hays in the dry season and effect of concentrate supplementation. Anim. Feed Sci. Technol., 80: 67-74.

Cheeke, P.R., D. Harris and N.M. Patton, 1983. Utilization of tropical forages and alfalfa meal by rabbits. Nutr. Abstr. Rev. Series B., 53: 812, Abstract No. 5943.

Cheeke, P.R., M.A. Grobner and N.M. Patton, 1986. Fibre digestion and utilization in rabbits. J. Applied Rabbit Res., 9: 25-30.

Hue, K.T. and T.R. Preston, 2006. Effect of different sources of supplementary fibre on growth of rabbits fed a basal diet of fresh water spinach (*Ipomoea aquatica*). Livestock Research for Rural Development, 18: http://www.cipav.org.co/lrrd/lrrd18/4/hue180.htm.

Iyeghe-Erakpotobor, G.T., O.A. Osinowo, M. Abdulmalik and B.I. Nwagu, 2001. Evaluation of growth rates of three breeds of rabbits raised in the northern guinea savanna of Nigeria. J. Anim. Prod. Res., 17: 78-88.

Iyeghe-Erakpotobor, G.T., M.E. Abdulmalik, J.O. Uguru and F.O. Abeke, 2002. Determination of optimum concentrate and forage combination for small holder feeding of rabbits. Trop. J. Anim. Sci., 5: 181-187.

Linga, S.S. and S.D. Lukefahr, 2000. Feeding of alfalfa hay with molasses blocks or crumbles to growing rabbit fryers. Livestock Research for Rural Development, 12: http://www.cipav.org.co/lrrd/lrrd12/4/ling124.htm.

McNitt, J.I. and S.D. Lukefahr, 1993. Breed and environmental effects on postweaning growth of rabbits. J. Anim. Sci., 71: 1996-2005.

Phimmmasan, H., S. Kongvongxay, C. Ty and T.R. Preston, 2004. Water spinach (*Ipomoea aquatica*) and Stylo 184 (*Stylosanthes quianensis* CIAT 184) as basal diets for growing rabbits. Livestock Res. Rural Dev., 15: http://www.cipav.org.co/lrrd/lrrd15/5/hong16034.htm.

Sansoucy, R., 1986. Manufacture of molasses-urea blocks. World Anim. Rev., 57: 40-48.

SAS., 1987. INSTITUTE Inc., SAS/STAST. Guide for Personal Computers Version. 6th Edn., pp: 697-978.

Taiwo, B.B.A., T.I. Ogundipe and O. Ogunsiji, 1999. Reproductive and Growth Performance of Rabbits Raised on Forage Crops. Ologhobo, A.D., G.N. Egbunike, M.K. Adewumi, A.M. Bamgbose, E.A. Iyayi and A.O.K. Adesehinwa (Eds.), Proceedings 4th Annual Conference of Animal Science Association of Nigeria (ASAN), IITA Conference Center, Ibadan, Nigeria, September 14-16, 1999, pp: 108-109.