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The Reproductive, Growth and Carcass Traits of Rabbits Fed Cassava-Based Diets Supplemented With Palm Oil

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ABSTRACT

New Zealand White Crosses (New Zealand × California) and Chinchilla crosses (Chinchilla × California), when fed a palm oil supplemented cassava-based diet with Stylosanthes guyanensis *(Stylo) as part of the dietary protein had comparable reproductive, growth and carcass traits as crosses fed a corn-based diet containing 8% fish meal. Fryer crosses ate more of the cassava-based diet and utilized their feed more efficiently.*

INTRODUCTION

The use of cassava, *Manihot esculenta* Grantz, as a source of energy for man and livestock is well known. However, long-term intake of cassava by man and animals results in several physiological disturbances induced by cyanide, the end product of the hydrolysis of cyanogenic glucosides present in cassava. The body has a remarkable ability to detoxify cyanide provided the protein source in the cassava-based diet is adequate and rich in sulphur amino acids (Oke, 1973; Adegbola, 1977). Sulphur is the limiting parameter in the utilization of cassava-based diets. The rabbit *Oryctolagus cuniculus* is increasingly being accepted as a source of meat in tropical Africa (Owens, 1981). In Nigeria it is regarded as a delicacy.

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Also, this small animal, with a growth rate as rapid as that of the broiler chicken, has a very efficient capacity for utilizing plant protein (Cheeke & Patton, 1981). Thus, raising rabbits on cassava-based diets serves the dual purpose of eliminating the competition with man for corn as an energy source and also of increasing the meat production for human consumption by raising rabbits on forage protein. This study was designed to investigate reproduction and growth on palm-oil-supplemented cassava-based diets. *Stylosanthes guyanesis* (stylo) was used to replace half of the fish protein in the diet.

MATERIALS AND METHODS

Cassava tubers from a bitter variety were harvested from the University of Ife Teaching and Research Farm at 12 to 15 months of age. These tubers were peeled, washed and ground in a local cassava grinder on the day of harvest. The ground product was dried at 50 °C for 48 h in a Gallenkamp Model V-445 oven. The product was turned over every 4 h during the drying process. The dried product was stored in jute sacks in a cool room at 28 °C until ready for use. Female rabbits, twenty New Zealand White and twenty Chinchilla, 4–5 months old, were randomly distributed singly into wire cages (150 × 40 × 40 cm). The rabbits were randomly assigned to one of two rations (Table 1) so that ten does of each breed were on the standard University of Ife rabbit farm ration and the other ten does were fed a 35% cassava-based ration. The experimental design was 2 × 2 factorial consisting of two rations and two breeds as factors.

The does on the cassava-based ration were given fresh stylo each morning as part of their dietary protein source. A hundred grams of stylo were fed during a 4-week pre-gestation period. This amount was increased to 150 g during the lactation and growth periods.

Feed and water were given *ad libitum* from clay crocks. The room temperature ranged from 27 to 29 °C and the animals had 13 h of natural daylight. The breeding of the does was done by mating each doe to two bucks on the same ration as the doe. The bucks were of the California breed and were selected at random from the University of Ife Teaching and Research Farm. The bucks had been previously used and were known good breeders.

The floor was cleaned every day, washed and disinfected with 'Izal' once a week. Kindling boxes (25 × 25 × 30 cm) with detachable covers, made

TABLE 1
Per Cent Composition of Test Diets Supplemented with Palm Oil and of *Stylosanthes guyanensis* Fed to Gestating, Lactating and Growing Rabbits

	Corn based		*Cassava based*	Stylosanthes guyanenses
	Ration no.			
	1	*2*	*3*	
Feed components				
Guinea corn	11·02	—	—	
Yellow corn	29·23	12·59	11·62	
Cassava flour	—	32·41	29·92	
Brewers' grains	29·23	—	—	
*Stylosanthes**	—	25·52	31·09	
Palm kernel meal	—	2·96	2·73	
Groundnut meal	14·70	16·16	14·96	
Fish meal	8·07	3·70	3·02	
Palm oil	1·15	4·62	4·62	
Dicalcium phosphate	2·31	0·46	0·46	
Oyster shell	2·31	—	—	
Mineral/vitamin premix	0·66	0·46	0·46	
Amprolium**	0·66	0·46	0·46	
Terramycin crumble***	0·66	0·46	0·46	
Methionine	—	0·20	0·20	
	100	100	100	
Calculated analysis				
Energy ME (kcal/kg)	3 488	2 716	2 616	2 580
Calcium (%)	1·38	0·40	0·40	1·44
Phosphorus (%)	0·61	0·43	0·43	0·22
Methionine/cysteine (%)	0·74	0·42	0·42	0·55
Lysine (%)	1·03	0·60	0·60	1·69
Crude protein (%)	22·53	16·06	17·16	20·12

* Dry matter basis.
** Coccidiostat.
*** Antibiotic.

out of soft wood, were used during the reproductive phase of the experiment. These boxes were washed with soapy water and disinfected with a dilute solution of 'Dettol' a day before being placed in the cages. *Stylosanthes guyanensis* (a grass legume), was cut from regrowths of plots from the University of Ife Teaching and Research Farm. The stylo was cut after 4–6 weeks of regrowth at 15 to 20 cm from the top of the plants. Each plot was cut once and just enough stylo was harvested each day for the use of the animals except on weekends when the stylo was cut for 2 days' use. The protein content of stylo was analyzed from bulked samples once a week.

RESULTS

The results in Table 2 show that there was no difference in the gestation periods of the corn-based or cassava-based diets or between the two breeds (about 30 days in each). Pups from the New Zealand White does that were fed on corn rations were significantly lighter ($P < 0{\cdot}05$) than all the others. The number born per doe was not significantly affected by ration or breed effects, but more were produced by those on cassava-based rations. None was born dead. Breed differences did not significantly affect the weaning weights and this is reflected in the livability of the young from birth to weaning.

Table 3 shows that significantly ($P < 0{\cdot}05$) more of the cassava-based ration was consumed by the growing rabbits than the corn-based ration, irrespective of the breed. Growth occurred on corn ration, with the young from New Zealand White does gaining more weight (though not a significant amount) than the young from Chinchilla. Significantly fewer ($P < 0{\cdot}05$) Chinchilla young lived between weaning (week 4) and market age (week 8), than the young from the New Zealand White. The overall livability shows that about half of the corn-fed young were lost by 8 weeks, whereas about a third of the cassava-fed young were lost (Table 3).

Table 4 shows that the ration or breed did not significantly affect the percent carcass yield, liver weights, kidney fat or thyroid weight. Kidney weights from the corn ration were significantly ($P < 0{\cdot}05$) heavier than those from cassava, and so also were those from Chinchilla relative to New Zealand White.

DISCUSSION

The gestation lengths (Table 2) for both breeds of rabbit used in this study were similar at 30 days' duration. Similar results were obtained by Wilson & Duddley (1952) who studied seventeen breeds and seventeen crosses of rabbits and showed that 72 % of all groups had gestation lengths of 31–33

TABLE 2
Effect of Palm Oil Supplemented Cassava-Based Rations on the Performance of Rabbits: Reproductive Traits

Breed	*Ration*	*Gestation length (days)*	*Birth weight (g)*	*Average number born alive per doe*	*Number born dead*	*Average weaning weight (g per rabbit)*	*Average number weaned per doe*	*Livability (birth to weaning)*
New Zealand	Cassava	29·80	49·56[b]	5·70	0	344·11	4·40	74·25
	Corn	30·80	44·69[a]	5·50	0	371·10	3·10	61·24
Chinchilla	Cassava	30·50	47·40[b]	6·20	0	348·14	4·20	71·50
	Corn	31·10	48·54[b]	5·20	0	365·64	3·30	63·84
SEM		0·26	1·34*	0·48	0	12·14	0·63	10·78
Breed means								
New Zealand		30·30	47·13	5·6	0	357·61	3·75	67·75
Chinchilla		30·80	47·97	5·7	0	356·89	3·75	67·67
SEM		0·19	0·94	0·34	0	0·12	0·44	7·62
	Ration means							
	Cassava	30·15	48·48	5·95	0	346·13	4·30	72·88
	Corn	30·95	46·62	5·35	0	368·37	3·20	62·54
	SEM	0·19	0·94	0·34	0	0·12	0·44	7·62

* Significant at $P < 0{\cdot}05$.
[a,b,c,d] Within a column means bearing the same superscript are not significant at $P > 0{\cdot}05$.

TABLE 3
Effect of Palm Oil Supplemented Cassava-Based Rations on the Performance of Rabbit Growth Traits

Breed	Ration	Feed intake (g/day)			Weight gain (g) (total)	Average daily weight gain (g)	Feed/gain ratio	Livability	
		Basal	Stylo	Dry matter (total)				Weaning to market weight	Birth to market weight
New Zealand	Cassava	57·67	48·23	64·36	615·86	22·00	2·93	93·00	69·68
	Corn	60·05		52·75	429·34	15·34	3·43	94·67	56·58
Chinchilla	Cassava	59·78	46·11	65·63	554·55	16·24	4·04	79·32	63·82
	Corn	62·35		54·79	449·77	16·06	3·41	62·81	49·69
SEM				3·74		1·24	0·94	10·05	9·73
Breed means									
New Zealand				58·56		18·67	3·18	93·84	63·13
Chinchilla				60·21		16·15	3·73	71·07	56·76
SEM				2·53		0·84	0·63	7·10*	6·88
	Ration means								
	Cassava			$64·99^{b}$		$19·12^{b}$	3·49	86·16	66·75
	Corn			$53·77^{a}$		$15·70^{a}$	3·42	78·74	53·14
	SEM			2·53*		0·84*	0·63	0·71	6·88

* Significant at $P < 0·05$.
[a,b,c,d] Within a column means bearing the same superscript are not significant at $P > 0·05$.

TABLE 4

Effect of Palm Oil Supplemented Cassava-Based Rations on the Performance of Rabbit: Carcass Traits

Breed	*Ration*	*Slaughter weight (kg)*	*Carcass† yield (%)*	*Liver weight (%)*	*Kidney weight (%)*	*Kidney fat as per cent kidney weight*	*Kidney fat (%)*	*Thyroid weight (%)*
New Zealand	Cassava	0·77	48·83	3·02	0·71[a]	10·48	0·07	0·06
	Corn	0·74	40·99	3·52	0·76[a]	5·26	0·06	0·07
Chinchilla	Cassava	0·74	40·78	3·69	0·81[b]	7·76	0·06	0·07
	Corn	0·73	40·68	3·51	1·26[c]	7·45	0·04	0·07
SEM		0·08	1·84	0·18	0·10*	3·66	0·03	0·01
Breed means								
New Zealand		0·76	44·9	3·27	0·74[a]	7·87	0·07	0·07
Chinchilla		0·74	40·8	3·60	1·03[b]	7·61	0·05	0·07
SEM		0·05	1·30	0·13	0·07*	2·59	0·02	0·003
	Ration means							
	Cassava	0·76	44·81	3·35	0·76[a]	9·12	0·07	0·07
	Corn	0·74	40·8	3·52	1·01[b]	6·36	0·05	0·07
	SEM	0·05	1·30	0·13	0·07*	2·39	0·02	0·003

* Significant at $P < 0·05$.

† All carcass trait data were expressed as per cent slaughter weight.

[a,b,c,d] Within a column means bearing the same superscript are not significant at $P > 0·05$.

days and 93% littered after 30–33 days of pregnancy. For the New Zealand White breed, 46% of the gestations terminated on day 31 while Chinchilla does kindled between 31 and 32 days. Templeton (1952) noted that only abnormal litters were born before day 29 or after day 35. The slightly shorter gestation days recorded for the New Zealand White does in this study probably resulted from the large litter sizes for Arrington & Kelley (1976) stated that smaller litters were carried longer. Breed effects on birth weight were minimal, although the weights of 47 g were much lighter than those of 64 g quoted for the young from these breeds (Arrington & Kelley, 1976). The litter sizes were small (five to six versus 8·6 young per litter compared with values generally observed for these breeds). Lamming *et al.* (1952) showed that vitamin A deficiency resulted in a loss of ova before implantation and so reduced litter size. These workers also observed resorption and absorptions during late pregnancies. There were no observable abortions in this study; rather, all young were born alive.

Weaning weight at 21–28 days has been shown to reflect doe milk yield. These weaning weights were comparable with weights of rabbits from these breeds (Arrington & Kelley, 1976), although fewer young were weaned at 4 weeks (three to four versus six to eight young per litter). Harvey *et al.* (1961) stated that prenatal effect accounted for none of the variability in mortality to 21 days and 56 days. The young might have died from disease such as enteritis, for Cheeke & Patton (1981) showed that about a third of the young were lost from birth to weaning due to enteritis. In our experiment a reduction in the livability included mortalities from the young from two Chinchilla does fed the corn-based ration and the young from a New Zealand doe fed the cassava-based rations that refused to remove hair (after parturition) or suckle young. In addition, several carcasses of young were found scattered around as a result of black rats either eating the young or else frightening the does which developed cannibalistic tendencies and subsequently cannibalised their young.

The efficient utilization of cassava carbohydrates, as well as corn carbohydrates, has also been shown by Eshiett *et al.* (1981) who incorporated up to 45% cassava root meal into rabbit rations. In this study, young from New Zealand White does but not those from Chinchilla does (Table 3) were more efficient in converting their feed into weight gains. The reason for this difference was not apparent. Cheeke & Patton (1981) showed that rabbits fed soluble carbohydrates without enough fibre had a slower rate of passage which made it possible for bacteria to ferment and grow in the caecum with the subsequent production of toxins and enteritis. The diets fed in this study had fibre in the form of brewers' dried grains or *Stylosanthes guyanensis* (Stylo). Palm oil has been shown to stimulate efficient utilization of diets (Thomasson, 1956; Hutagalung, 1977; Fomunyam, 1982). The efficient utilization of cassava-based diets in contrast to corn-based diets may have been due to the level of palm oil included in the cassava-based diets. On the other hand, the results presented here refer to one litter only. Probably differences between the two diets might become apparent if the experiment had been extended over several litterings. Pate *et al.* (1980) fed 40% stylo in a corn-based diet to rabbits and observed increased feed intake, growth and a feed efficiency of 3·3 as was similarly observed in this study. The quality of protein from stylo was probably adequate to support growth and detoxify the cyanide in the cassava. Also, from the economic point of view, feeding stylo to rabbits makes them highly non-competitive with other non-ruminants for the expensive and unavailable fishmeal. Table 2 shows that the carcass characteristics of rabbits fed the corn-based or cassava-based diets were similar for kidney fat. This suggests that both diets supported similar growth and development of organs, although changes may have occurred at the cellular level. The greater kidney fat from the New Zealand White crosses fed the cassava-based diets suggests greater fat deposition. The similarity of thyroid weights probably suggests that the thiocyanate level was not high enough to stimulate thyroid hyperplasia or the iodine content of the rations was inadequate to counteract the effects of thiocyanate.

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