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ESTIMATES OF NUTRIENT DIGESTIBILITY, GROWTH PERFORMANCE, SLAUGHTER TRAITS AND BLOOD PARAMETERS IN RABBITS FED DIETS CONTAINING VARIOUS LEVELS OF *CROTALARIA OCHROLEUCA*

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ESTIMATES OF NUTRIENT DIGESTIBILITY, GROWTH PERFORMANCE, SLAUGHTER TRAITS AND BLOOD PARAMETERS IN RABBITS FED DIETS CONTAINING VARIOUS LEVELS OF *CROTALARIA OCHROLEUCA*

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ABSTRACT

Nutrient digestibility and some blood parameters were determined in twenty four rabbits fed diets in which *Crotalaria ochroleuca* substituted sunflower seed cake (SSC) at rates of 0, 15, 30 and 45 %, in diets A, B, C and D, respectively. In another experiment, growth performance and slaughter traits were evaluated in thirty-two rabbits fed the same diets. Increasing level of *C. ochroleuca* meal in the diets decreased dry matter digestibility and crude protein digestibility (from 70 to 58 and 70 to 67 %, respectively). Bodyweight gain (15 g/d), feed conversion ratio (6.1) and carcass traits were not significantly ($P<0.05$) influenced by dietary treatments. Toxic effects of *C. ochroleuca* on the animals were evidenced by significantly alteration of some blood parameters and lesions in the gastro-intestinal tracts. The overall results indicated that although *C. ochroleuca* meal can be included in rabbit diets on the levels used in the study, there were some indications of toxicity and call for a longer study period.

Key words: *Crotalaria ochroleuca*; rabbit; digestibility; toxicity; growth performance

INTRODUCTION

Most rabbit producers in Tanzania operate on a small-scale subsistence level and feed the animals on local feed resources including forages. This practice could lower production costs in rabbit production if proper formulation of the diets is undertaken. *Crotalaria ochroleuca* is a leguminous plant commonly fed to animals and is a potential feed source in rabbit diets. Pohill (1982) details the characteristics of *C. ochroleuca*. The average dry matter yield of the plant is 20 tons/ha, when cut at 20-30 cm height from the ground and crude protein content of up to 30% dry matter. Levels up to 45% of *C.ochroleuca* in sheep diet improved live weight gains and feed conversion efficiency (Mkiwa, 1990). Limited information is available on the feeding value of *C. ochroleuca* to rabbits. The digestive system of the rabbit, although different from that of sheep, has relatively high passage rate of digesta and a big caecum whereby microbial digestion takes place, in addition to the practise of caecotrophy, rabbit is able to utilise nutrients present in forages efficiently (Lang, 1981). The presence of an alkaloid of the pyrrolizidine type in *C. ochroleuca*, which interferes with the animal physiology, may limit its use as livestock feed (Hungerford, 1975). The present study aimed at estimating the nutrient digestibility, growth performance, slaughter traits and blood parameters in rabbits fed diets containing increasing levels of *C. ochroleuca.*

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MATERIALS AND METHODS

Twenty-four female rabbits, crosses of Chinchilla, Newzealand and California White, aged 3.5 months and initial bodyweight range 2.4-2.8 kg were randomly allocated to four dietary treatments, in a complete randomised design. The diets were formulated in order to use C. ochroleuca in substitution of sunflower seed cake at rates of 0, 15, 30 and 45 % in diets A, B, C and D, respectively (Table 1). The four diets were balanced to be iso-nitrogenous and iso-caloric. C. ochroleuca was harvested before budding when was 1.5 m tall, then air dried, ground and mixed with the other ingredients.

Table 1: Physical composition of the experimental diets (g kg^{-1} as fed)

Ingredient	Diet			
	A	B	C	D
***C. ochroleucal* hay**	**0**	**150**	**300**	**450**
Sunflower seed cake	450	300	150	0
Maize bran	345	365	360	355
Rice polishing	155	135	140	145
Fish meal	25	25	25	25
Limestone	15	15	15	15
Salt	5	5	5	5
Vit/Min. premix	5	5	5	5
Calculated ME, MJ/kg	11.3	11.4	11.4	12.1

The animals were placed randomly in individual metabolic cages. A preliminary period of 10 days was followed by a collection period of 7 days. Feed allowance was established during preliminary period to be 80 g/day, an allowance, which the rabbits could finish without much leftover. This was fed daily at 9.00h and 15.00h. Clean water was supplied ad libitum. The animals were observed daily for any deviation from their normal condition. Total faeces and urine from each animal were collected daily at 8.00h, weighed, bulked separately and preserved in a refrigerator at 4°C. At the end of collection period the feed, faeces and urine were sampled for chemical analysis. Blood samples were drawn from three animals of each treatment weekly for five weeks, starting from the second week of the experiment. During blood sampling process care was taken to minimise frightening or exercising the animals in order to avoid changes in the constitution of the circulating blood and feed intake. Thereafter, the rabbits were slaughtered and samples of some internal organs were examined microscopically.

Proximate analysis of the feed ingredients, diets and faeces were performed according to procedures of AOAC (1990). Urine was analysed for nitrogen content. Packed cell volume (PCV) and haemoglobin (Hb) were analysed in the whole blood. PCV was measured using the standard microhematocrit method (Baker and Silverton, 1968). The blood samples were then centrifuged and the plasma was analysed for Glutamyl oxalate transaminase (GOT), Glutamyl pyruvate transaminase (GGT) and white blood cells (WBC) according to procedures of AOAC (1990).

—**Table 2:**Chemical composition of feed ingredients and experimental diets

Component	Chemical components (g kg^{-1} as fed)						
	DM	CP	CF	EE	ASH	Ca	P
Ingredient							
C. ochroleuca hay	865	233	283	20	41	5.4	1.7
Sunflower seed cake	905	242	273	69	38	5.9	6.2
Maize bran	908	111	40	55	45	7.2	5.7
Rice polishing	913	117	68	103	125	Na	Na
Fish meal	887	595	5	93	195	Na	Na
Diet							
A	859	179	160	42	90	12.9	7.3
B	887	181	168	39	93	10.8	6.5
C	908	186	170	36	103	9.4	5.2
D	913	189	189	40	115	12.4	6.0

Na = Not analysed

In a second experiment, 32 (16 female and 16 male) rabbits of the same origin were blocked by sex and allocated randomly to the four diets used in the digestibility study, in a completely randomised block design. The average initial age and weight of the rabbits were 2 months and 1158 ± 280g, respectively. Two rabbits were caged together and fed *ad libitum*. The amount of feed consumed and individual rabbit weights were recorded weekly for 8 weeks. Thereafter, the 16 male rabbits were slaughtered and the hot carcass and non-carcass components weighed and recorded.

RESULTS

The chemical composition of *C. ochroleuca*, raw materials and the experimental diets is shown in Table 2. Crude fibre (CF) and ash contents in the diets tended to increase slightly with increased levels of *C. ochroleuca* in the diet. The dry matter (DDM), organic matter (DOM) and crude protein (DCP) digestibility decreased with increased levels of *C. ochroleuca*. Crude fibre digestibility (DCF) was significantly ($P<0.05$) lower in Diet C compared with the other diets. The histological observations indicated that some rabbits on diets B, C and D had variable amounts of hydroperitoneum (10-20 ml) and some fibrin strands between the gut loops. Some lesions were also observed in the mucosa of the stomach and intestines of the animals. Animals fed diets B, C and D had significantly ($P<0.05$) lower values of haemoglobin (Hb) compared with those on Diet A (Table 3).

Table 3: Mean effects of treatment on nutrient digestibility and blood parameters of rabbits

Parameter	Diets				RSD
	A	B	C	D	Plus Sign.[2]
Digestibility (%)					
No. of animals	6	6	6	6	
DDM[1]	70.4[a]	68.7[a]	59.0[b]	57.8[b]	6.88***
DOM	79.5[a]	76.8[a]	65.2[b]	64.0[b]	8.64*
DCF	11.9[a]	11.1[a]	8.8[b]	10.1[ab]	5.28*
DCP	70.4	69.5	69.8	66.6	1.61ns
Blood parameters					
No. Animals	3	3	3	3	
GGT (IU/l)	19.09	20.72	24.25	22.19	6.88ns
GOT (IU/l)	50.80	57.20	61.33	53.19	9.01ns
WBC ($x10^9$/l)	7.63	8.09	8.71	8.12	2.6ns
PCV (l/l)	0.35	0.33	0.34	0.34	0.04ns
Hb (g/dl)	11.19[a]	10.01[b]	10.27[b]	10.01[b]	1.56**

In this and subsequent tables:

[1] a, b, c, d value implies that values in the same row bearing different superscript letters are significantly (P<0.05) different.

[2] *, ** and *** Means along the row are significantly different at (P<0.05), (P<0.01) and (P<0.001), respectively. ns = Means along the row are not Significantly (P<0.05) different.

Other haematological parameters, that is, GOT, GGT, WBC and PCV were not significantly (P>0.05) affected by the dietary treatments. Neither diets nor sex had significant effect on the overall mean growth rate and feed conversion ratio (FCR) of the rabbits (Table 4). The average slaughter weight was significantly (P<0.05) higher for animals on Diet B compared with those on the other diets. The carcass and non-carcass parameters were not affected (P>0.05) by the level of *C. ochroleuca* except the proportion of skin was significantly lower for animals on Diet C than those on the other diets.

DISCUSSION

The crude protein contents of the dietary treatments were higher than the range of 150-160 g/kg as fed recommended for growing rabbits by Lebas (1989). The crude fibre contents of the four experimental diets were slightly higher than the recommended value (140 g/kg as fed) for

growing rabbits (Lebas, 1989). High crude fibre levels (150-160 g/kg) caused proportionally 0.12 decrease in food conversion efficiency (Lang, 1981). The average crude protein digestibility of all diets (69% DM) observed in the present study compare well with the value (71% DM) reported by Ledin (1982), with dietary crude protein level of 180 g/kg DM. The decreased nutrient digestibility with increased levels of C. ochroleuca hay was associated with the increased crude fibre of the diets. The present results are in agreement with the review by Lang (1981), that digestibility of all components of a diet tend to decrease as the fibre level rises.

Table 4: Mean effects of treatment on growth performance and slaughter characteristics of the rabbits

	Treatment				RSD
	A	B	C	D	Plus Sign.[2]
Growth performance (g/d)					
No. of Animals	4	4	4	4	
Feed intake	91.4	92.3	94.4	91.2	9.6ns
Growth rate (n = 8)	14.24	16.75	14.14	14.05	11.17ns
FCR (Feed/gain)	6.38	5.45	6.16	6.59	0.85ns
Slaughter characteristics					
Slaughter wt (g)	2062^{ab}	2168^{a}	1983^{ab}	1899^{b}	36.4^{*}
Carcass wt (g)	1028	1059	1013	921	15.5^{ns}
Proportion (%)					
Dressing	49.2	48.5	51.0	48.5	1.78^{ns}
Gastrointestinal Tract	18.9	18.1	18.6	17.8	3.4^{ns}
Head	8.5	8.9	8.5	8.8	0.66^{ns}
Skin	10.1^{ab}	10.8^{a}	9.3^{b}	10.6^{a}	0.74^{*}
Liver	2.8	2.9	2.7	2.9	0.28^{ns}
Spleen	0.04	0.03	0.03	0.03	0.01^{ns}
Heart	0.3	0.3	0.3	0.3	0.06^{ns}
Kidney	0.7	0.5	0.5	0.6	0.10^{ns}
Kidney fat	0.7	0.8	0.5	0.7	0.04^{ns}
Lungs	0.4	0.4	0.4	0.4	0.10^{ns}

The average feed intake of 92.3 g/day observed in the present study was low compared with values reported by Lebas (1989) of 130 and 160 g/day for rabbit aged 11 and 15 weeks, respectively. The reasons for the low feed intake in the present study are not clear. However,

voluntary feed intake is affected by several factors, including the genetic make up of the rabbits, high temperatures and presence of unpalatable or toxic constituents of the diets (Lang, 1981; Lebas, 1989). This low feed intake might be responsible for the observed lower average weight gain of 15 g/day compared with the values (from 26 to 50 g/day) reported by Owen (1981). However, our results compare well with those observed by Mgheni (1982) using similar rabbits in the same environment. The observed decreased nutrient digestibility with increasing level of *C. ochroleuca* surprisingly showed no significant effect on the growth performance of the rabbits. This implies that the efficiency of utilisation of the absorbed nutrients improved with *C. Ochroleuca* inclusion, an observation, which requires further investigation. The significantly higher slaughter weight in animals fed on Diet B was associated with the relatively higher growth rate of these animals compared with those on other diets.

The shortcomings of the present study may only give an indication about the effects of inclusion of *C. ochroleuca*, since the number of replications was too low to support robust conclusions. The observed lesions in the GIT and higher serum concentration levels of GGT and GOT in the rabbits fed diets containing *C. ochroleuca* indicate early stages of PAs poisoning (Molyneux et al., 1991). This alkaloid is reported to lower growth performance in rats (Mkiwa, 1990). The significantly lower Hb values in the blood of the rabbits fed diets containing *C. ochroleuca* compared with the control diet could also be attributed to PAs poisoning (Harper, 1969). Although this alkaloid was not quantified in the plant materials used in the study, it has been reported to be present in some crotalaria species (Polhill, 1982).

It can be concluded that inclusion of *C. ochroleuca* meal in the rabbit diets for the short experimental period outlined significantly lower the nutrient digestibility of the diets but with less effect on the growth performance of the rabbits. Further studies are however, required to ascertain these results and study the long-term effects of feeding *C. ochroleuca* meal on rabbit performance, determination of its toxicity level and possible ways of reducing or detoxifying it.

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