INFLUENCE OF MIMOSINE AND 3-HYDROXY 4(1H) PYRIDONE FED THROUGH LEUCAENA LEAF MEAL ON GROWTH AND NUTRIENT UTILIZATION IN MEAT RABBITS

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Abstract - Experiments were conducted to study the effect of using untreated leucaena leaf meal (LLM) or LLM treated with 1.2 % $FeCl_3$ at 25 or 50 % level in complete feed pellets on growth, feed conversion efficiency and nutrient utilization. Five groups of 5 New Zealand White rabbits each were fed control (T-1), 25 (T-2) or 50 % (T-3) untreated LLM and 25 (T-4) or 50 % (T-5) treated LLM containing rations in an eight weeks growth cum metabolism study. No clinical symptoms of mimosine or 3-Hydroxy 4(1H) pyridone (3,4 DHP) were observed throughout the experimental period indicating large scale conversion of mimosine to 3,4 DHP and possibly to non toxic compounds in GI tract of rabbits. The average daily gain was significantly lower ($P < 0.05$) in T-3 (7.57 ± 0.64 g) as compared to control T-1 (10.64 ± 0.93 g), T-2 (10.64 ± 1.15 g), T4 (11.28 ± 1.18 g) and T-5 (12.59 ± 1.08 g). The daily DM intake was significantly lower ($P < 0.05$) in T-3 (54.64 ± 3.29 g) and was similar to control (55.67 ± 2.61 g) as compared to other groups, highest being in T-5 (68.23 ± 3.90). The feed : gain ratio was apparently similar in all the groups and ranged from 5.437 ± 0.659 in control to 7.410 ± 0.684 in T-3. The digestibility coefficients of DM (57.06 ± 1.45 in T-5 to 65.05 ± 1.24 in T-1) and CF (21.91 ± 0.75 in T-1 to 33.94 ± 1.83 in T-5) were statistically not different among different treatment groups. The digestibility of other nutrients was higher in T-1 and lowest digestibilities were recorded in the T-5. The study revealed that LLM at 50 % level adversely affected growth and the treatment of LLM with 1.2 % $FeCl_3$provided protection against mimosine and 3,4 DHP toxicity even at 50 % level of LLM feeding.

INTRODUCTION

Commercial rabbit farming is rather new in India and complete feed pellets conventionally fed to rabbits are difficult to get and very expensive. *Leucaena leucophela* also known as miracle tree is one such multipurpose tree species which can help in afforestation of wastelands and provide protein rich highly palatable fodder in addition to helping in soil and water conservation (NAS, 1981). However, potential attributes of leucaena are limited because of presence of toxic amino acid mimosine and its metabolic product 3-hydroxy 4(1H) pyridone (3, 4 DHP) particularly in nonruminants like poultry, swine and rabbits. When leucana replaced 40% alfalfa in the diet of rabbits an overall reduction in digestibility of nutrients was observed (HARRIS *et al.*, 1981). SZYSZKA *et al.* (1984) fed 0.13, 0.26 and 0.39% crystalline mimosine and reported reduced growth at 0.39 percent level. PARIGI-BINI *et al.* (1984) reported reduced daily gains and CP digestibility when leucaena formed 30 % of diet. RAHARDJO and CHEEKE (1985) found fresh leucana highly palatable in rabbits, and reported quite high digestibility of CP and energy (RAHARDJO *et al.*, 1986). TANGENDAJAJA *et al.* (1990) used 20, 40, and 60 percent leucana leaf meal (LLM) with or without hot water treatment and reported that mimosine was largely converted to 3,4 DHP in digestive tract and expected clinical signs were not observed though weight gain and feed conversion efficiency declined with increasing level of LLM. ONWUDIKE (1995), however, reported poor growth, alopecia, reddish brown urine and severe damage to liver and kidney on incorporation of only about 12 % leucaena in rabbit ration. The supplementation of LLM with ferric sulphate at 1.2 % level was reported to greatly improve the gains in poultry (ACAMOVIC and D'MELLO, 1981). In view of the conflicting reports in the present investigation the influence of incorporating LLM at 25 and 50 percent level with or without ferric chloride ($FeCl_3$) treatment in complete feed pellets on growth and nutrient utilization was studied in New Zealand White rabbits.

MATERIALS AND METHODS

Twentyfive New Zealand White rabbits were weaned at 42 days and used in the 56 day growth cum metabolism trial. They were randomly distributed in five groups of similar body weight. All rabbits were housed in specially designed aluminium cages with facilities for feeding, watering and excreta collection. Control ration (T-1) was prepared using conventional feed ingredients as per NRC (1977) and mixed with untreated or $FeCl_3$ treated LLM in mash form and subsequently pelleted (Table 1).

The LLM was treated with 1.2% $FeCl_3$. The 480 g $FeCl_3$ dissolved in one litre of water was uniformly sprayed over flatly spread 40 kg LLM and thoroughly mixed before incorporating in ration T-4 and T-5 in required proportions. All rabbits were fed on control ration during the first week, immediately after weaning so as to adopt them to new housing environment. There after, the five experimental rations were alloted to the five groups of rabbits. The pellets were offered *ad libitum*, clean drinking water was kept in cages and changed twice daily. Daily records of feed DM intake were maintained and body weights were recorded at weekly intervals. A digestibility cum metabolism trial was conducted during the eighth week of the experiment. The feed samples were analysed for mimosine and 3,4 DHP content on High Performance Liquid Chromatography as per the method of Tangendjaja and Wills (1980) with certain modifications (ATREJA *et al.*, 1991). The samples of feed and faeces were analysed for proximate constituents (AOAC, 1984) and urine for N by micro-kjeldahl's method. The data was analysed as per SNEDECOR and COCHRAN (1968).

Table 1 : Details of Experimental Rations

Treatment Group	Treatment Ration
T-1	Control ration
T-2	25% LLM + 75% control ration
T-3	50% LLM + 50% control ration
T-4	25% treated LLM + 75% control ration
T-5	50% treated LLM + 50% control ration

RESULTS AND DISCUSSION

The proximate composition, mimosine and 3,4 DHP profile of different experimental rations is presented in Table 2. All the experimental rations were rich in CP and contained reasonably good level of CF (NRC, 1977). The experimental rations contained fairly high amounts of mimosine and 3,4 DHP. No clinical symptoms of toxicity were observed in rabbits at any stage during the growth trial on any of the rations. The perusal of Table 3 shows that initial body weight of the rabbits in the five groups was similar, however, after 56 days of the growth trial the final weight was significantly lower in T-3 ($P < 0.05$). the average daily gain (ADG) in T-3 fed 50 percent untreated LLM were lowest whereas, in T-2, T-4 and T-5 the ADG was similar ($P < 0.05$). In fact, in T-5 the ADG was ever better than the control. The daily DM intake in T-2 and T-5 was highest, lowest being in control indicating that incorporation of LLM did not adversely affect the palatability (RAHARDJO and CHEEKE, 1985). TANGENDJAJA *et al.* (1990) also reported similar observations. The absence of clinical toxicity symptoms of mimosine could possibly be due to substantial conversion of mimosine to 3,4 DHP and may be further to non toxic compounds by caecal microbes as the flow of digesta in rabbits GI tract is very fast and will possibly allow little absorption of mimosine in the small intestine (PICKARD and STEVENS, 1972). The treatment of LLM with $FeCl_3$ is reported to form chelates with mimosine, thereby, resulting in increased excretion of mimosine (ACAMOVIC and D'MELLO, 1981). The feed to gain ratio was statistically insignificant, however, in T-1 , T-4 and T-5 it was better as compared to T-2 or T-3 fed untreated LLM.

Table 2 : Chemical composition (% on DM basis) of diets fed to rabbits

Parameter	Treatment groups				
	T-1	T-2	T-3	T-4	T-5
Organic matter	88.14	92.01	89.98	89.77	87.88
Crude protein	17.50	19.25	21.00	18.37	21.00
Crude fibre	11.13	11.73	11.56	11.44	12.91
Ether extract	5.53	5.32	5.29	5.42	5.21
Nitrogen free extract	53.98	55.71	52.13	55.54	48.76
Total ash	11.86	7.99	10.02	10.23	12.12
Calcium	2.70	2.30	2.40	2.40	2.40
Phosphorus	0.66	0.51	0.44	0.53	0.43
Mimosine	-	0.508	1.243	0.454	0.906
3, 4 DHP	-	0.216	0.388	0.240	0.338
Mimosine + 3, 4 DHP	-	0.724	1.631	0.694	1.244

The data on digestibility of various nutrients on different dietary groups is presented in Table 4. The OM digestibility was lower ($P < 0.05$) in T-5 as compared to other groups. The CP digestibility in LLM fed groups was lower than control and was lowest in T-5. Similarly EE digestibility was significantly higher in control ($P < 0.05$) as compared to other groups. The NFE digestibility was lowest in T-5 but similar in other groups. The reduced digestibility of various nutrients in T-5 possibly resulted from relatively higher DM intake in this group.

Table 3 : Intake, growth rate and feed conversion efficiency in rabbits on different dietary treatment groups

Parameters	Treatment groups					
	T-1	T-2	T-3	T-4	T-5	CD
Initial body weight (kg)	663.000 ± 58.670	714.000 ± 64.530	716.000 ± 52.900	688.000 ± 69.560	717.000 ± 51.570	NS
Final body weight (kg)	1259.000^{ab} ± 22.900	1310.000^{ab} ± 12.650	1140.000^{a} ± 46.220	1320.000^{b} ± 70.030	1422.000^{b} ± 31.030	151.980
Weight gain* (g)	596.000^{a} ± 52.280	596.000^{a} ± 64.240	424.000^{b} ± 36.240	632.000^{a} ± 66.360	676.000^{a} ± 68.950	157.640
Daily weight gain (g)	3.117^{a} ± 0.146	10.640^{a} ± 1.150	7.570^{b} ± 0.640	11.280^{a} ± 1.180	12.590^{a} ± 1.080	2.810
Total DM intake*	55.670^{a} ± 2.610	3.642^{b} ± 0.164	3.059^{a} ± 0.180	3.457^{ab} ± 0.147	3.821^{b} ± 0.218	0.475
Daily DM intake*	5.437 ± 0.659	65.040^{b} ± 2.990	54.640^{a} ± 3.290	61.730^{ab} ± 2.620	68.230^{b} ± 3.900	8.490
Feed: gain ratio	5.437 ± 0.659	6.360 ± 0.582	7.410 ± 0.684	5.666 ± 0.400	5.550 ± 0.478	NS

Table 4 : Nutrient digestibilities in rabbits in different dietary treatment groups

Parameters	Treatment groups					
	T-1	T-2	T-3	T-4	T-5	CD
Dry matter	65.05 ± 1.24	60.01 ± 0.81	61.81 ± 1.23	61.51 ± 3.18	57.06 ± 1.45	NS
Organic matter*	67.29^{a} ± 1.29	63.29^{a} ± 0.76	62.57^{ab} ± 1.06	62.99^{a} ± 3.00	57.98^{b} ± 1.44	4.89
Crude protein*	74.74^{a} ± 1.75	69.10^{ab} ± 1.22	66.43^{b} ± 2.47	68.30^{ab} ± 1.55	61.50^{b} ± 2.63	6.03
Crude fibre	21.91 ± 0.75	29.12^{a} ± 1.78	27.18 ± 3.05	24.68 ± 5.11	33.94 ± 1.83	NS
Ether extract*	90.57^{a} ± 0.59	84.21^{b} ± 2.27	70.08^{c} ± 0.78	76.32^{d} ± 2.36	71.80^{cd} ± 2.37	5.43
Nitrogen free extract*	70.20^{a} ± 1.51	66.05^{ab} ± 0.91	68.10^{a} ± 0.70	68.31^{a} ± 3.13	61.34^{b} ± 1.62	5.11

The crude fibre digestibility was similar in all the groups but apparently higher in LLM fed groups as compared to control. The results on N balance (Table 5) revealed that though the intake of N was similar, the faecal excretion was significantly higher in T-3 and T-5 ($P < 0.05$). The percentage of absorbed N retained in the body was similar in all the treatment groups. The study revealed that $FeCl_3$ treatment of LLM provides substantial protection against the toxic effects of mimosine, therefore, $FeCl_3$ treated LLM can be used in feeding meat rabbits, though further detailed investigations on the influence of even treated LLM on different organs and reproductive performance need to be carried out.

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