Influence of Iodine Supplementation on the Performance of Goats Fed *Leucaena* Leaf Meal Containing Diet

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ABSTRACT : In order to ascertain the influence of supplemental iodine on nutrient utilisation by goats fed a *leucaena leucocephala* leaf meal containing diet, 8 adult male goats (2 years; 22.3±1.73 kg) were randomly allocated into two groups, viz. control and experimental. Both the groups were fed a diet comprising of wheat bran, leucaena leaf meal and wheat straw ad lib. In addition, the experimental animals were given extra iodine at 0.04 mg/head/day (as KI soln.). A metabolism trial of 6 days duration conducted after 13 weeks of experimental feeding revealed that the daily DM intake ($g/W^{0.75}$) increased significantly due to iodine supplementation. Similar was the case with the intakes of DCP and ME. The digestibility of CP and EE showed significant improvement in the experimental group while that of DM, OM and total carbohydrates did not vary significantly between the two groups. The animals of control group were in negative nitrogen balance, which improved significantly and become positive in the experimental group. Moreover, the control animals lose weight apparently in contrast to the experimental animals, who maintained their weights. While iodine supplementation tended to enhance phosphorus retention that of calcium exhibited significant improvement. Conclusively, provision of extra iodine to *Leucaena* containing diet may prove beneficial in augmenting the nutrient utilization of this protein rich tropical forage. (*Asian-Aus. J. Anim. Sci. 2000. Vol. 13, No. 9 : 1245-1248*)

Key Words : Leucaena, Iodine, Nutrient Utilization, Goats

INTRODUCTION

Leucaena leucocephala, a protein rich tropical forage, is being propagated as a potential animal feed to supplement the primarily crop residue based livestock feeding system existing in many developing countries including India. However, its use as animal feed is handicapped by the presence of mimosine in it. Mimosine along with its rumen degradation product 3-hydroxy-4 (1H)-pyridone (DHP) are known to induce toxic symptoms in livestock upon long duration feeding, primarily through thyroid affections (Jones et al., 1976).

In order to mitigate the toxic effects of *leucaena* feeding, over a period of time, many physical, chemical and biological measures have been tried with varied degree of success. However, in spite of persistent and consorted efforts by animal nutritionists world over, it remains a problem and eludes an effective solution. Considering the involvement of thyroid gland affections, it is thought that provision of extra iodine to *leucaena* fed animals would constitute a simple and cost effective measure to ameliorate the toxic effects. Similar improvements in animal performance due to iodine supplementation of other goitrogenic feeds e.g., rapeseed meal have been reported (Hill, 1991). Limited studies conducted on this aspect by Holmes (1976) and Jones et al. (1978) using *leucaena* have shown varied response. Hence, the present experiment was taken up to study the influence of supplemental iodine in goats in terms of nutrient utilization, when their diet contained *leucaena* leaf meal.

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MATERIALS AND METHODS

Animals, feeds and feeding

Eight indigenous adult male goats of about 2 yr. of age and weighing 22.3±1.73 kg were used for the study. Before the onset of the experiment, all the animals were dewormed with anti-helminthic drug and underwent routine vaccinations against infectious diseases. The animals were then randomly assigned to two groups of four animals each. Both the groups received a diet containing 50 g/head of wheat bran and *leucaena* leaf meal to provide about 14 g DM/kg $W^{0.75}$ so as to meet the dietary CP requirements (NRC, 1981). Besides, the animals were offered wheat straw *ad lib.* as the basal diet. Additionally, the experimental animals received supplemental iodine @ 0.04 mg/head/day (as KI solution). The animals were housed in a well-ventilated cement floored animal shed having facilities for individual feeding and watering. Weighed amounts of wheat bran and *leucaena* leaf meal were offered daily at 0900 hours, and wheat straw at 1400 hours. Ad libitum intake of wheat straw was ensured by offering about 25% extra straw, compared to the consumption of the previous day.

Metabolism trial

Following 13 weeks of experimental feeding, a metabolism trial of 6 days duration was conducted

involving quantification of feeds offered, residues left and faeces voided and urine excreted, after ensuring proper adaptation of the animals in metabolism cages. Samples of feeds, residues, faeces and urine were aliquoted on 24 h basis and the pooled samples were processed and kept for further laboratory analysis.

Chemical analyses and statistics

Feeds, residues and faeces were analyzed for dry matter, nitrogen, ether extract and total ash and urine for nitrogen according to standard procedures (AOAC, 1990). Total carbohydrates was determined by difference. ME value of the diets were arrived at from digestible organic matter digestibility (DOMD) as per MAAF (1984). Calcium and phosphorus in the biological samples were also determined (Talapatra et al., 1940). Iodine content of the diet and mimosine content of *leucaena* leaf meal were determined as described elsewhere by Bedi (1999) and Brewbaker and Kaye (1981), respectively. Data were analyzed statistically adopting standard methodology (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Chemical composition

The chemical composition of the dietary ingredients is presented in table 1. The iodine content of the *leucaena* leaf meal was 0.323 ppm. Based on the DM intake, the net intake of iodine was 0.282 and 0.371 ppm for the control and experimental groups, respectively. The mimosine content of the *leucaena* leaf meal was 1.52 percent on DM basis. The CP and total ash content of the *leucaena* leaf meal were similar to existing reports (Dharmaraj et al., 1985; Dutta et al., 1999).

Nutrient intake and digestibility

The daily intake and digestibility of nutrients are given in table 2. While no significant difference was evident with respect to daily total intakes of *leucaena* leaf meal, the intake of wheat straw tended to increase by about 19 percent in the experimental group. Over all, the total DM consumption (g/kg $W^{0.75}$) improved significantly ($p<0.05$) in the experimental group. While the control goats just fell short of the recommended intake levels of DM (42-50 g/kg $W^{0.75}$); the experimental animals appeared to achieve the same. Moreover, the intake of digestible dry matter (DDM) and digestible organic matter (DOM) also showed significant ($p<0.05$) improvement in the iodine supplemented group compared to the control. The animals of experimental group exhibited significantly greater intake of DCP and ME which can partly be attributed to higher DM consumption besides the comparatively higher digestibility of organic nutrients as indicated by significantly ($p<0.01$) higher DDM and DOM intakes in comparison to the control group. The daily intakes of DCP was above the recommended requirement of 2.8 g/kg $W^{0.75}$ (NRC, 1981) for both the groups. However, in spite of the improvement due to iodine supplementation, the intakes of ME were below the required level of 100 kcal/kg $W^{0.75}$ (NRC, 1981). Reduced DM intake associated with *leucaena* feeding has been correlated to a drop in the levels of

Table 1. Chemical composition of dietary ingredients used in the experiment

	Leucaena leaf meal	Wheat bran	Wheat straw
Dry matter (%)	93.99	86.17	93.57
Proximate composition (% in DM)			
Organic matter	88.37	90.53	90.93
Crude protein	30.97	12.50	4.90
Ether extract	3.16	2.28	0.79
Total carbohydrates[1]	52.24	75.75	85.24
Total ash	11.63	9.47	9.07
Calcium	1.98	0.13	0.41
Phosphorus	0.28	1.29	0.14

[1] Total carbohydrates=OM-(CP+EE).

Table 2. Intake and digestibility of nutrients by goats fed *leucaena* leaf meal as influenced by iodine supplementation

	Control	Experimental
Daily intake of nutrients		
DM		
Leucaena meal (g)	136.2 ± 13.11	143.8 ± 15.13
Wheat bran (g)	44.0 ± 0.00	44.0 ± 0.00
Wheat straw (g)	223.8 ± 21.96	267.1 ± 52.70
Total (g)	404.0 ± 35.03	454.9 ± 65.91
As kg % BW	1.91 ± 0.04	2.01 ± 0.13
As g/kg $W^{0.75}$*	40.89 ± 1.30	43.60 ± 2.60
DDM g*	194.7 ± 8.63	231.7 ± 27.17
DOM g*	183.7 ± 7.89	216.7 ± 25.95
CP g/kg $W^{0.75}$	5.93 ± 0.19	6.08 ± 0.15
DCP g/kg $W^{0.75}$*	3.12 ± 0.06	3.44 ± 0.17
ME kcal/kg $W^{0.75}$**	66.99 ± 1.52	75.12 ± 5.08
Digestibility of nutrients (%)		
DM	48.65 ± 2.90	51.47 ± 1.93
OM	50.98 ± 2.86	53.37 ± 2.12
CP**	51.98 ± 2.78	57.30 ± 1.44
EE*	53.93 ± 2.03	58.34 ± 1.49
TCHO	50.47 ± 3.11	52.41 ± 2.33

*$p<0.05$; ** $p<0.01$.

DDM: Digestible dry matter, DOM: Digestible organic matter, DCP: Digestible crude protein, TCHO: Total carbohydrates.

ME=0.15 × %DOMD.

thyroid hormones in the blood (Holmes, 1980; Jones and Hegarty, 1984). The improvement observed in the voluntary intake at the present instance could, therefore, be attributed to a probable enhancement of circulating thyroid hormones as a result of the extra iodine made available to the experimental group.

The digestibility of DM, OM and total carbohydrates did not vary significantly due to dietary interventions. However the CP and EE digestibility improved significantly ($p<0.01$) as a consequence of iodine supplementation. Similar to the present observation, an enhancement of EE digestibility was also noted when diets of goats was supplemented with extra iodine (Bedi et al., 2000).

Live weight changes and retention of nutrients

Although no significant change was observed in the live weight (table 3) of animals of both the groups, the control animals appeared to lose weight where as the experimental animals maintained their weight.

The intake and outgo of nitrogen (table 3), both via faecal and urinary routes, were similar between the two groups. The apparently higher nitrogen excretion through urine in comparison to faeces could be attributed to a lower availability of energy in relation to protein. This could be ascertained by the observed DCP:ME ratio 1:21 as against the suggested ratio of about 1:35 (NRC, 1981) for efficient nitrogen utilization. The present observation is further supported by earlier findings of Kishan et al. (1988), who have reported a negative correlation between urinary nitrogen and energy availability in buffaloes. The control animals were in negative nitrogen balance whereas iodine supplementation brought about positive balance of nitrogen in the animals under experimental group. A similar picture was reflected when nitrogen retention between the two groups were compared in terms of percent of intake nitrogen. The significantly improved nitrogen utilization as a result of extra iodine could have been mediated by a probable enhancement of thyroid hormones through its action on somatotropin at the cellular level (McDonald, 1980). The improvement in nitrogen retention consequent to iodine supplementation have been reported earlier in young bulls (Koval'skii et al., 1972).

The retention of calcium was significantly ($p<0.05$) higher in animals given extra iodine while that of phosphorus, although non-significant ($p>0.05$), tended to be higher, underlining the positive influence of iodine on metabolism of calcium and phosphorus. Studies by Koval'skii et al. (1972) have also revealed beneficial effect of iodine supplementation on the calcium and phosphorus balance in crossbred bull calves.

It could be concluded from the present study that the provision of extra iodine to goats fed *leucaena* leaf meal may prove beneficial in terms of voluntary intake and nutrient utilization. However, it needs to be confirmed further in growing animals with assessment of appropriate biochemical and hormonal markers for iodine metabolism.

Table 3. Live weight changes and balances of nitrogen, calcium and phosphorus by goats fed *leucaena* leaf meal as influenced by iodine supplementation

	Control	Experimental
Live weight changes (kg)		
Initial	22.00 ± 1.89	22.67 ± 3.35
Final	21.17 ± 1.76	22.83 ± 3.54
Gain	-0.83 ± 0.17	0.17 ± 0.30
Nitrogen balance		
Intake (g/d)	9.38 ± 0.82	10.09 ± 1.12
Outgo		
Faecal (g/d)	4.42 ± 0.48	4.30 ± 0.47
Urinary (g/d)	5.96 ± 0.51	5.53 ± 0.52
Retention		
g/d*	-1.01 ± 0.14	+0.26 ± 0.58
As % N intake**	-10.72 ± 0.92	+2.05 ± 5.09
As % N absorbed**	-20.41 ± 2.45	+3.15 ± 8.68
Calcium balance		
Intake (g/d)	3.79 ± 0.37	4.01 ± 0.50
Outgo (g/d)	3.62 ± 0.44	3.58 ± 0.50
Retention (g/d)*	0.17 ± 0.09	0.43 ± 0.16
(As % intake)*	4.90 ± 3.06	11.08 ± 3.59
Phosphorus balance		
Intake (g/d)	1.26 ± 0.07	1.34 ± 0.11
Outgo (g/d)	1.21 ± 0.17	1.16 ± 0.05
Retention (g/d)	0.05 ± 0.12	0.18 ± 0.11
(As % intake)	4.93 ± 9.93	12.32 ± 6.88

* $p<0.05$; ** $p<0.01$.

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