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Medicated urea molasses mineral block and tannin on growth performance, nutrient utilization and nematodosis in goat kids

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ABSTRACT

Indigenous goat kids (20; 3 to 5 months, average body wt-12 kg) were offered *ad lib.* rice straw and berseem hay (40:60) to assess growth performance and nutrient utilization. Group 1 was fed concentrate mixture (100g/d). Groups 2,3,4 and 5 were supplemented with urea molasses mineral block (UMMB), medicated urea molasses mineral block (Med-UMMB containing fenbendazole @0.5g/kg), tannin (5% of DM) and UMMB plus tannin (5% of DM) respectively. The animals were given trickle infection (200L_3/d) of gastrointestinal nematodes (*Haemonchus* sp. and *Cooperia* sp. in the dose ratio of 9:1) for consecutive 10 days. Dry matter (DM) intake, total digestible nutrient (TDN) intake, growth performance and nitrogen (N) balance revealed no significance between treatment and control whereas digestible crude protein (DCP) intake, calcium (Ca) and phosphorus (P) balance for T_2, T_3 and T_5 showed significant improvement over control. Humoral immune response against calf red blood cells (CRBC) was significantly higher in T_4 as compared to control. Thus it may be concluded that dietary supplementation of med-UMMB and tannin have no effect on growth performance whereas tannin significantly improved the humoral immune response of kids.

Key words: Fenbendazole, Kids, Immune response, Tannin, Urea molasses mineral block

Nematode infection is rampant in most developing countries where poor pastures and the quantities of nutritious food consumed by animals do not meet out their nutritional requirements (Leng 1991). In addition, insufficient veterinary care and the environment are conducive to nematode growth and transmission (Fikru *et al*. 2006). There is 25–40% reduction in weight gains in infected animals and their productivity is considerably reduced (Suttle 1994). The present day concept of worm control programme is 'to live with worms' and worm burden is not allowed to rise to that level which hampers productivity. Currently, the primary control strategy for nematode infections is the use of chemical treatments.

The medicated urea molasses mineral blocks containing low doses of fenbendazole are highly effective in treatment and control of gastrointestinal nematodes (Sanyal and Singh 1993a, 1995a). Administration of benzimidazole anthelminitics in feed blocks reduced the labour involved in treating individual animals, spread the dose over days and obviated the possibility of ruminal bypass (Sanyal and Singh 1993b). Tannin has biological effects that may aid in the control of gastrointestinal nematodes. Condensed tannin (CT) binds proteins tightly at near neutral pH, such as occurs in the rumen, with dissociation in the acidic pH of the abomasum, freeing them for digestion. Condensed tannins extracted from various forages can markedly decrease the viability of the larval stages of several nematodes in sheep and goats. Plant CT may have direct or indirect effects on gastro-intestinal nematodes. Direct effects might be mediated through CT-nematode interactions, thereby affecting physiological functioning of gastro-intestinal nematodes (Min and Hart 2003). The highest efficacy (100%) against gastrointestinal nematodes was attained, with medicated urea molasses mineral block (Med-UMMB), tannin and UMMB plus tannin on day 15 post-treatment, whereas efficacy of 75% was recorded for UMMB against gastrointestinal nematodes (Roy *et al*. 2009). The present study was undertaken to assess growth performance and nutrient utilization in goat kids supplemented with med-UMMB and tannin.

MATERIALS AND METHODS

The experiment was conducted in the Department of Animal Nutrition, College of Veterinary Science and Animal Husbandry, Anjora, Durg (Chhattisgarh).

Non-descript 20 healthy goat kids of 3–5 months of age (average body wt-12 kg) were housed in well-ventilated shed with facilities for individual feeding under hygienic and uniform management conditions. All kids were sprayed

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Table 1. Dietary schedule of kids

Particulars	T_1	T_2	T_3	T_4	T_5
Kids	4	4	4	4	4
Rice straw: berseem hay (40:60)	*Ad lib*	*Ad lib*	*Ad lib*	*Ad lib*	*Ad lib*
Concentrate mixture (g/d)	100	-	-	100	-
Urea Molasses Mineral Block (UMMB)	-	*Ad lib*	*Ad lib*	-	*Ad lib*
Med-UMMB*	-	-	*Ad lib* (for 10days)	-	-
Tannin**	-	-	-	+(for 10days)	+(for10days)

*Medicated with fenbendazole 0.5g/kg, **tannin (condensed tannin) was incorporated @ 5% of DM.

Table 2. Chemical composition of diet (on DM basis)

Diet	CP	CF	EE	Ash	AIA	NFE	Ca	P	NDF	ADF
Basal diet	11.82	31.8	2.5	16.09	8.32	37.79	1.02	0.77	55.36	42.54
UMMB	35.85	3.88	0.23	20.99	2.12	39.04	12.28	4.95	29.12	11.90
Concentratemixture	19.96	2.62	1.13	5.66	0.57	70.63	1.21	0.35	-	-

with butox @ 3ml/litre of water at weekly interval for 3 weeks before the start of experiment to control the ectoparasites. The goat kids were randomly allocated on body weight basis to 5 groups of 4 animals each and were dewormed by albendazole @ 5 mg/kg body weight orally. All kids were ear tagged with metallic tags having identification numbers using ear tag machine. Five complete diets were prepared (Table 1). The animals were challenged with infection with third stage larvae (L_3) of gastro-intestinal nematodes (*Haemonchus* sp. and *Cooperia* sp. in the dose ratio of 9:1) @ 2000 L_3/animal for consecutive 10 days in T_1 to T_5 groups. The diets were fortified with mineral mixture (1%), salt (0.5%) and vitamin premix (@ 20g/q feed). Daily record of feed intake was done. All kids were weighed fortnightly for 3 consecutive days during the entire experiment. Feeding was continued for 90 days. UMMB consisted of urea (8 kg), molasses (40 kg), deoiled rice bran (22 kg), soybean cake (16 kg), lime (6 kg), dicalcium phosphate (5 kg) and mineral mixture (3 kg). Chemical composition of diet is given in Table 2. The feed ingredients were analyzed for proximate components (AOAC 1995), fibre components (Van Soest *et al.* 1991), calcium (Ca), phosphorus (P) (Fiske and Subba Rao 1925) and trace elements (Cu, Co, Mn, Zn, Fe, Mo) by atomic absorption spectrophotometer. At the end of the sixth week of the experiment a metabolism trial of 5 days was conducted. All kids were kept individually in the specially designed metabolic cages to collect the feed, faeces and urine. The samples of feed, faeces and urine were analyzed for N, Ca and P balance. Assessment of humoral immunity was done as per Hudson and Hay (1991).

Data analysis: The data were analyzed by complete randomized design (Snedecor and Cochran 1989).

RESULTS AND DISCUSSION

Dry matter (DM) intake revealed no significance between treatment and control (Fig. 1). Significant relationship was established (Poppi *et al*. 1985, 1986) between the severity of infection and the nutrient intake by the animals. The present study revealed that feed intake was greatly depressed as the level of infection increased from 0 to 30th day. The depression in the feed intake was probably due to the panic reaction by the kids. The gastrointestinal parasites (*H. contortus* and *Cooperia* sp.) while sucking the blood from deeper mucosa of abomasum and intestine resulted into profuse loss of nitrogen in the form of desquamated epithelial cells of damaged tissues, which consequently caused aggravated pain (Pathak and Tiwari 2013). Inflammation in gut wall in gastro-intestinal parasitosis can change absorption of some vitamins and minerals (Tanritanir *et al*. 2009). This caused reduction in the overall nutrient intake. The findings were in accordance to the earlier report (Rowe *et al*. 1988) in sheep infected with *H. contortus*.

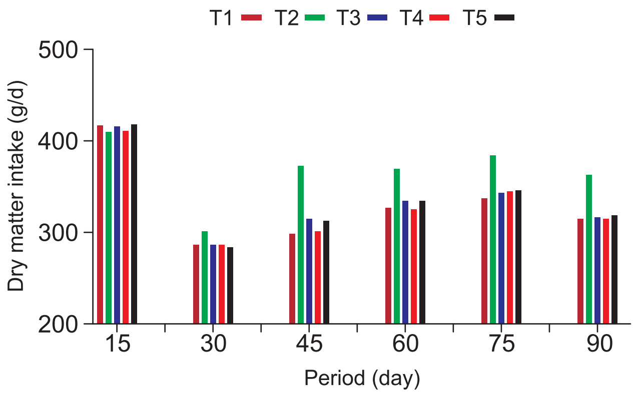

Fig. 1. Med-UMMB and tannin on dry matter intake (g) of kids.

Growth performance with respect to body weight gain and feed conversion efficiency (FCE) revealed no significance between treatment and control (Figs 2, 3). Swarnkar *et al.* (2007) also reported that there was no marked variation in body weight in sheep infected with *H. contortus* having tanniferous plant (*Prosopis cineraria*) in their diet in comparison to control. However, in the present

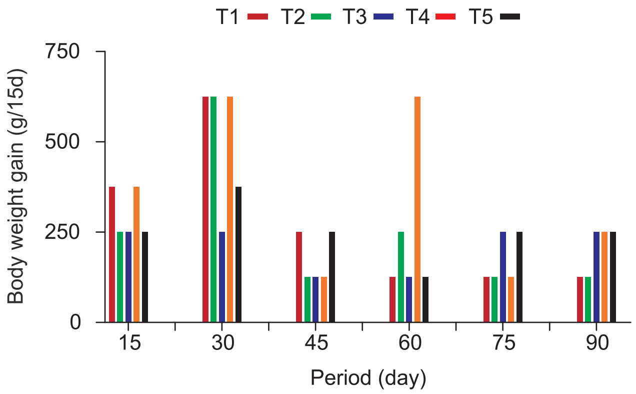

Fig. 2. Med-UMMB and tannin on fortnightly body weight gain (g).

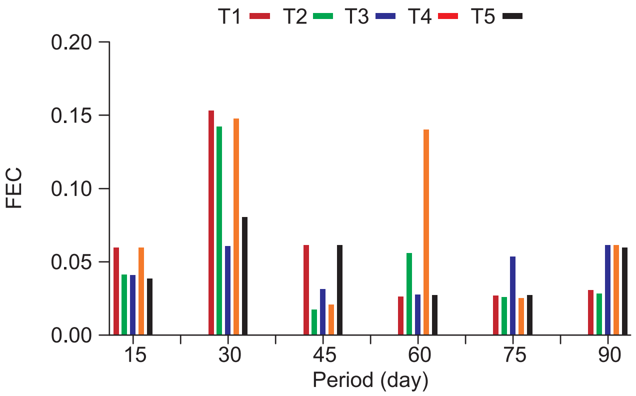

Fig. 3. Med-UMMB and tannin on feed conversion efficiency of kids.

study it was highest during 76–90d of the growth period. It might be due to zero parasitic loads in those groups. This in turn allowed a greater amount of protenious material to move to the caecum, thus decreasing the availability of amino acids to the kids affected the overall growth of animals (Preston and Leng 1987). A significant amount of protein is redirected for the repair of the damaged mucosa, synthesis of extra amount of specific serum protein and for production of immunoglobulin reducing the amount of protein deposition in the musculature required for collagen fibre synthesis. This reduced the body weight gain. Kioumarsi *et al*. (2011) concluded that molasses blocks could significantly improve the growth performance in the goats without having any negative effects on body function.

Digestible crude protein (DCP) intake for T_2, T_3 and T_5 showed significant ($P<0.05$) improvement over control whereas total digestible nutrient (TDN) intake revealed no significance between treatment and control (Table 3). Dutta *et al*. (1998) reported that voluntary feed intake of *H. contortus* infected lambs increased with increasing dietary crude protein than those fed lower protein diets. Ca and P balance for T_2, T_3 and T_5 showed significant ($P<0.05$) improvement over control whereas it was nonsignificant for N retention in kids. Parasites caused extensive protein losses and redirect protein synthesis away from skeletal muscle and therefore help in the repair of gut tissues leading to reduced N balance (MacRae 1993). However, several workers (Steel 1974, Coop 1982, Symons 1982, Pathak and Tiwari 2013) suggested that loss of endogenous nitrogen into the intestine was the major reason for reduced N gain.

Table 3. Med-UMMB and tannin on DCP intake, TDN intake, humoral immune response and N, Ca, P balance of kids

Particulars	T_1	T_2	T_3	T_4	T_5
DCP intake (g/d)	30.32±1.48^{b}	43.59±2.13^{a}	41.72±2.32^{a}	30.35±1.56^{b}	41.55±2.00^{a}
TDN intake(g/d)	203.80±13.11	207.46±18.17	191.69±16.91	204.07±13.74	191.76±16.75
HA titre	1.039±0.346^{b}	0.693±0.000^{b}	0.693±0.000^{b}	3.118±0.346^{a}	0.693±0.000^{b}
Nitrogen (g/day)					
Intake	7.13±0.79^{b}	10.55±1.99^{a,b}	12.32±2.19^{a}	7.97±0.42^{a,b}	8.62±0.98^{a,b}
Faecal outgo	3.16±0.07^{c}	4.51±0.22^{b}	5.70±0.06^{a}	3.16±0.11^{c}	4.34±0.09^{b}
Urinary outgo	1.59±0.12	2.25±0.44	2.91±0.63	1.58±0.18	2.33±0.42
Balance	2.37±0.83	3.78±1.65	3.70±2.04	3.22±0.69	1.93±0.57
Balance (%)	33.31	35.87	30.07	40.41	22.47
Calcium (g/day)					
Intake	3.73±0.51^{b}	16.81±3.53^{a}	20.60±4.27^{a}	4.26±0.26^{b}	12.39±2.17^{b}
Faecal outgo	2.63±0.26^{c}	7.51±0.19^{b}	8.82±0.791^{a}	2.64±0.09^{c}	6.87±0.11^{b}
Urinary outgo	0.17±0.04	0.27±0.08	0.46±0.18	0.35±0.10	0.29±0.09
Balance	0.92±0.37^{b}	9.02±3.53^{a}	11.30±3.56^{a}	1.27±0.23^{b}	6.71±0.66^{a,b}
Balance (%)	24.88	53.66	54.89	29.78	54.22
Phosphorus (g/day)					
Intake	1.95±0.32^{b}	7.35±1.49^{a}	8.98±1.74^{a}	2.15±0.11^{b}	5.95±0.86^{a}
Faecal outgo	0.61±0.07^{c}	1.02±0.08^{b}	1.02±0.07^{b}	0.50±0.02^{c}	1.26±0.06^{a}
Urinary outgo	0.22±0.10^{a}	0.08±0.01^{a,b}	0.08±0.00^{a,b}	0.03±0.01^{b}	0.08±0.03^{a,b}
Balance	1.34±0.33^{c}	6.32±1.41^{a,b}	8.24±1.94^{a}	1.80±0.14^{c}	4.32±0.82^{a,b,c}
Balance (%)	68.64	86.05	91.71	83.72	77.36

Superscripts are read row wise for comparison of mean. Different superscripts differed significantly ($P< 0.05$).

Sykes and Coop (1976 and 1977) also observed reduced N balance in their experiments in the parasitized animals. Barger (1973) found that the apparent absorption of Ca reduced with *Trichostrongylus colubriformis*. However, Reveron *et al.* (1974) obtained an adverse effect on P but not on Ca and Mg absorption; while Sykes and Coop (1976) showed that both Ca and P were less absorbed. Increased P balance may be due to the higher content of P (4.95%) in UMMB. As the infection persisted the P balance reduced (T_1) which might be due to the reduced intake and impairment of P absorption (Reveron *et al.* 1974). Reveron and Topps (1970) suggested that sheep infected with heavy infections of gut nematodes suffered from mineral disorders. Increased P retention also due to the effect of tannin (Waghorn and McNabb 2003).

Humoral immune response against calf red blood cells (CRBC) was significantly ($P<0.05$) higher in T_4 which was supplemented with tannin over other treatments and this report is corroborate with Niezen *et al.* (2002).

The plasma disposition profiles of the active metabolite of fenbendazole reached a plateau at around 24 h of feeding Med-UMMB, remained sustained thereafter followed by steep elimination within 24 h of withdrawing Med-UMMB from the animals (Fig. 4). Fenbendazole (FBZ) is a very safe and efficacious broad-spectrum benzimidazole anthelmintic. Studies on mode of action of benzimidazoles in ruminants indicated that sustained plasma levels of the parent compound and its active metabolites at minimum effective concentrations are more efficacious than a single therapeutic dose (Sanyal and Singh 1993a, Hennessy 1997). Advances in the technology of drug delivery have resulted in the formulation of various controlled release devices for effective management of helminth parasites (Zimmerman and Hoberg 1988). An alternative approach is to provide continuous low level of anthelmintic by incorporating the drug in UMMBs. FBZ is selected for incorporation in UMMB because of its insolubility in water, high safety index and chemical stability (Sanyal 1993a). Following detailed studies on pharmacokinetics of FBZ, Med-UMMB was formulated so as to deliver FBZ at 0.5 mg/kg body weight (Sanyal 1993b). The findings in the present study can be extrapolated in the effective use of Med-UMMB in goats at strategic points based on the epidemiological pattern of parasite prevalence so that incoming larvae from pasture are killed before establishment. This, in turn, is expected to reduce pasture contamination and increase productivity of the flock in the form of nutri-parasitic management of worms.

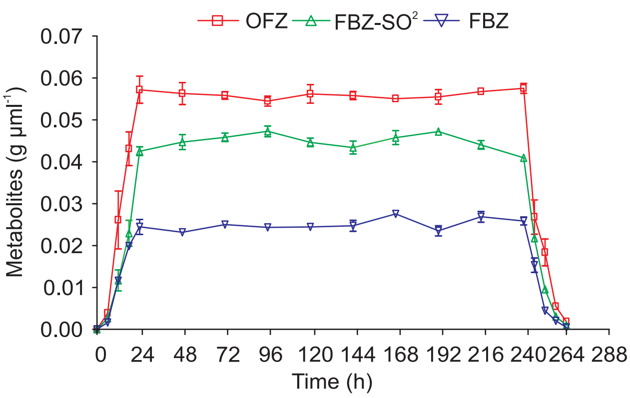

Fig. 4. Plasma concentration of fenbendazole metabolites at different hour intervals in group T_3.

From the present study it is concluded that condensed tannin has much beneficial effect on humoral immune response whereas growth performance with respect to body weight gain and feed conversion efficiency (FCE) was not influenced by dietary med-UMMB and tannin supplementation.

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