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Effect of replacement of concentrate mixture with isonitrogenous leaf meal mixture on growth, nutrient utilization and rumen fermentation in goats

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ABSTRACT

This study was conducted to examine the effect of replacing concentrate mixture with leaf meal mixture of *Leucaena leucocephala–Melia azedarach–Morus alba* in equal proportion on growth, nutrient utilization, blood and rumen metabolites in growing goats using completely randomized design. Twelve male non-descript goats were divided into two groups, control and experimental, consisting of six animals in each group. The control group was fed concentrate mixture whereas in experimental group 50% of concentrate mixture was replaced with isonitrogenous leaf meal mixture. The duration of experimental feeding was 45 days. Weekly body weights were recorded to assess growth rate of goats. After 30 days of experimental feeding a metabolism trial of 6 days duration was conducted to determine digestibility of nutrients and nitrogen, calcium and phosphorus balance. Blood samples were collected at 0, 7, 14, 21, 30 and 45 days of experimental feeding to study blood metabolites. Rumen liquor was also collected at 0 and 30 days to study rumen metabolites. The average daily gain (g) of control group (51.56) and experimental group (62.22) was statistically ($P > 0.05$) similar. The goat of control and experimental group had statistically ($P > 0.05$) similar intake (g/kg $W^{0.75}$/day) of dry matter (60.70 vs 64.64), concentrate mixture (40.16 vs 41.60) and wheat straw (20.53 vs 23.05), respectively.

The digestibility (%) of dry matter, organic matter, crude protein and ether extract was significantly ($P < 0.05$) depressed in experimental group of goat (65.60, 68.90, 65.62 and 63.05, respectively) as compared to control group (75.14, 77.41, 76.06 and 79.14, respectively). The digestibility (%) of neutral detergent fibre, acid detergent fibre and hemicellulose was similar in control (66.73, 65.49 and 64.97, respectively) and treatment group (58.21, 51.66 and 64.97, respectively). Animals of both the groups were in positive balance of nitrogen, calcium and phosphorus. Nitrogen balance (g/day) in control and treatment group of goat was similar (3.86 and 4.05, respectively) while calcium and phosphorus balance (g/day) was significantly ($P < 0.05$) higher in control group (2.34 and 1.02) than treatment group (1.06 and 0.22). There was no statistically significant ($P > 0.05$) effect of collection period and diet composition on the blood biochemical metabolites (hemoglobin, glucose, total protein, albumin, globulin and urea nitrogen) of goats. The pH of rumen fluid at 0 and 30 days of experimental feeding was 6.60, 6.60 for control group and 6.69, 6.33 for experimental group of goats. There was no significant difference ($P > 0.05$) in nitrogenous fractions (mg/dl) (ammonia nitrogen (19.27 vs 19.30), total nitrogen (101.52 vs 100.14), TCA-ppt nitrogen (50.24 vs 48.84) and non-protein nitrogen (50.06 vs 51.12) of rumen fluid collected at 30 days of experimental feeding of control and treatment group of goats, respectively.

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From present study it can be concluded that *Leucaena–Melia–Morus* mixture can replace 50% of concentrate mixture in the ration of growing goats without any adverse effect on growth, nutrient utilization, blood metabolites and rumen fermentation parameters.

1. Introduction

Goat keeping in tropical countries like India is undergoing a transformation from the traditional extensive browse-based feeding system to intensive stall feeding system because of many reasons like intensification of agriculture, shrinkage of grazing lands and reclamation of fallow lands for alternative uses. Hence, cereal straws are increasingly being used as basal feeds for goats. These straws are poor quality feeds because of their high fibre content, low protein and unbalanced mineral composition. Efficiency of utilization of these poor quality roughages can be maximized by the supply of deficient nutrients like nitrogen and other micronutrients in the ration of animals (Prasad et al., 2001). In this context, the role of fodder trees and shrubs in the diet of animals is considered particularly important in the developing countries like India, where small land holdings and large ruminant densities result in a severe problem of feed availability from more conventional sources like oil cakes and cereal by-products. A wide variety of multi-purpose tropical trees grown by farmers can be used as N sources in supplementary feeds (Ondiek et al., 2000).

These tree leaves, not only provide a cheap source of nitrogen, energy and micronutrients, but also have many other advantages like their wide spread on-farm availability and easy accessibility to farmers, and above all the merit of adding variety to the diet. The tree leaves can be harvested, sun dried and used in compounded protein supplements. The replacement of conventional ingredients by tree leaves will make such supplements cheaper than the commercial concentrates (Ondiek et al., 2000). However, the presence of anti-nutritional factors like mimosine in *Leucaena leucocephala*, triterpinoid derivatives (azadirachtin, nimbin) in *Azadirachta indica* and phenolics in most of the leaves limit their use as sole animal fodder. Farmers usually minimize and overcome these problems by feeding different leaves in mixtures in smaller quantities, which not only dilutes and reduces the problem of palatability and toxic effects (Lowry, 1990) but also extends feed base for animals.

In earlier experiments (Yusran and Teleni, 2000; Anbarasu et al., 2004; Patra et al., 2006) a mixture of fresh leaves (*Gliricidia sepium–L. leucocephala–Calliandra calothyrsus*) or a leaf meal mixture (*L. leucocephala–Morus alba–Tectona grandis* and *L. leucocephala–M. alba–A. indica*) has been successfully used as strategic supplements in the diet of cows and goats, respectively. However, an adherence to a fixed composition of leaf mixture is not practicable because of area specific distribution and seasonal availability and accessibility of various plant species to the farmers. Hence more studies are required involving growth responses of animals to test different potential sources and/or combinations of tree leaves to broaden the base of alternative quality feed resources for feeding of livestock. Further more, efficient management of locally available feed resources is the key for enhancing livestock productivity. With this background in view, the experiment was conducted to scrutinize the effects of partial replacement of concentrate mixture with isonitrogenous leaf meal mixture of *L. leucocephala–Melia azedarach–M. alba* in equal proportion on growth, nutrient utilization, rumen fermentation pattern and blood biochemical parameters in goats.

2. Materials and methods

2.1. Animal management and rations

Twelve non-descript local male goats, approximately 4–5 months of age and body weights between 10 and 15 kg, were divided into two groups consisting of 6 goats in each group. All the goats were kept under uniform management conditions by housing them in well ventilated cement floored sheds. The goats were treated for ecto- and endoparasites with Butox® spray and Panacur® bolus, respectively before the start of experimental feeding.

All the goats were fed with concentrate mixture and wheat straw in 1:1 ratio to meet their nutrient requirement for the body weight gain of 50–100 g/day as per Ranjhan (1998). In case of experimental group, 50% of the ingredients used in the concentrate mixture were replaced with leaf meal mixture on weight basis. Leaf meal mixture consists of equal parts of sun dried ground leaves of *L. leucocephala*, *M. azedarach* and *M. alba*. All the three tree leaves were harvested in one lot in the month of July–August from the Jammu region. Ingredients and chemical composition (%) of concentrate mixtures wheat straw and leaves are presented in Table 1.

2.2. Experimental procedure

Weighed quantities of respective concentrate mixtures were offered to kids at 09:00 h in a randomized complete block design (RCBD). Wheat straw was offered after the consumption of concentrate mixtures. *Ad libitum* water was provided and was changed twice daily throughout the experimental period. Concentrates and straw offered and residues were sampled weekly for subsequent analysis of DM to determine DM consumption during the experimental period. Body weight of each goat before feeding was recorded at weekly intervals to observe live weight changes and average growth rate throughout the experimental period of 45 days.

To determine the digestibility of nutrients and nitrogen, calcium and phosphorus balance, a metabolism trial was conducted after 1 month of experimental feeding for 6 days. Metabolism trial was conducted in stall having facility for separate manger and space for individual animal. Due to separation of space by brick wall the feed and water of one animal is not eaten by neighbor animal. The faeces of individual animal were collected from the floor of stall and urine was collected in urine collection bag. Representative samples of feed offered and remnants were taken daily in previously tared trays and kept in a hot air oven at $100 \pm 2\,^{\circ}C$ overnight for DM estimation. The dried material obtained during the trial period was pooled, ground and stored in polycarbonates bottles for proximate and fibre analysis.

The faeces voided in 24 h by the individual animal were collected in a previously weighed container. After weighing the fecal container, the faeces were thoroughly mixed and a representative sample from each animal was taken in a previously labeled polythene bags. From the sample a suitable aliquot (10%) of faeces was kept for drying at $100 \pm 2\,^{\circ}C$ in a hot air oven for dry matter determination. The dried fecal sample obtained daily was pooled, ground and used for chemical analysis. Another portion of aliquot (1% of fresh faeces) was thoroughly mixed with 10 ml of 1:4 sulphuric acid and kept for nitrogen estimation. Urine collected was