Effect of dietary concentrate level on body immune response in calves fed a wheat straw-based diet

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ABSTRACT

Twenty 9-month-old crossbred calves were divided into 2 equal groups (A and B; n = 10). The feeding trial was conducted for 119 days to study the effect of concentrate supplementation on body immune response and blood metabolites in calves. The concentrate and roughage (wheat straw) ratio in the diet of Groups A and B was 60:40 and 30:70, respectively. Daily dry matter intake was significantly (P < 0.01) higher in Group A than in Group B, which also resulted in significantly higher (P < 0.01) total body weight gain in the former group. Protein, albumin, globulin, total and differential leukocyte count in blood were similar in the 2 groups but blood glucose level was higher (P < 0.05) in the calves of Group A. There was no difference in body immune response between the groups, which indicated that body immune response of animals is not significantly influenced by restricted concentrate feeding.

Key words: blood metabolites, body immune response, calves, concentrate, wheat straw.

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Most livestock owners in India belong to the low-income group, and are therefore not able to feed the recommended amount of concentrate to their animals. The situation is further exacerbated by the diversion of grain for human consumption. Straw and other fibrous feeds are therefore commonly available as major feed resources for ruminants. Previous studies have shown that the concentrate content of diets positively affects voluntary feed intake, body growth and feed conversion efficiency of ruminants[9,13]. Malnutrition of the animals may result in lower productivity and lower disease resistance. A protein- and energy-deficient diet may adversely affect the immune response of growing animals[6]. Prevailing circumstances in developing countries often necessitate feeding animals on low-concentrate diets. The present study was conducted to evaluate the effect of dietary concentrate level on body immune response in growing crossbred calves.

Twenty 9-month-old crossbred (*Bos indicus* × *Bos taurus*) calves (166 ± 3.47 kg) were randomly divided into 2 groups (A and B) of 10 animals each according to a randomised block design with equal mean body mass of calves between the 2 groups. All the calves were dewormed and vaccinated against prevailing diseases at the onset of the feeding trial. The calves were fed for 119 days according to requirement for 500 g daily body weight gain[15]. Two concentrate mixtures (C1 and C2) were prepared that contained the same amount of total digestible nutrients but different levels of crude protein, so that both the 30 % concentrate diet and 60 % concentrate diet were isonitrogenous. Wheat straw was used as the basal roughage. The ratio of concentrate and wheat straw in the diet of Groups A and B were 60:40 and 30:70, respectively. The concentrate mixture (C1) offered to Group A contained 39 % crushed maize grain, 40 % wheat bran, 18 % groundnut cake, 2 % mineral mixture and 1 % common salt, while the concentrate mixture (C2) offered to Group B contained 26 % crushed maize, 7 % wheat bran, 64 % groundnut cake, 2 % mineral mixture and 1 % common salt. All the calves were fed individually at 09:00 and the mass of feed offered and refused were recorded daily. Clean drinking water was offered to the calves twice daily at about 08:30 am and 13:00. Blood samples were collected from all calves at 0, 60 and 119 days of experimental feeding. After 119 days of experimental feeding, calves were inoculated with rinderpest vaccine (C40 strain). This vaccine was selected because vaccination against rinderpest is mandatory for eradication of this extremely serious disease. Blood samples were collected on 0, 7, 14 and 21 days post-vaccination to estimate serum antibody titres. Feed samples were analysed for proximate principles[1], acid detergent fibre, neutral detergent fibre[19] and gross energy by ballistic bomb calorimeter (Gallenkamp). Blood samples were analysed for glucose[5], protein, albumin, globulins[7] and total and differential leukocyte count[8]. Serum antibody titres were estimated by indirect haemagglutination test[2,16]. Data were analysed to test the significance of differences between means using Student's t-tests[17].

The concentrate mixture C1, C2 and wheat straw contained 89.9, 90.2, 93.1 % organic matter, 16.1, 31.8, 3.1 % crude protein, 37.4, 37.9 and 81.7 % neutral detergent fibre, 10.4, 11.7, 51.1 % acid detergent fibre and 4.34, 4.28, 4.17 kcal gross energy per gram dry matter (DM), respectively. Daily DM intake was significantly higher (P < 0.05) in the calves of Group A (2.48 kg/100 kg body mass or 93.45 g/$Kg^{0.75}$) compared to Group B (2.25 kg/100 kg body masst or 83.31 g/$kg^{0.75}$) owing to the higher concentrate content in the former group[9,12,18]. This difference in feed intake was reflected in significantly higher (P < 0.01) total body weight gain of calves in Group A. The initial and final body masses of the experimental calves in Groups A and B were 166.10, 165.90 and 241.03, 215.10, with a total gain of 74.93 and 49.20 kg, respectively. There is a positive relationship between live weight gain and feed intake that increases with an increase in dietary concentrate intake by ruminants[11,14]. Feed conversion efficiency (kg DM intake/kg gain) was also significantly higher (P < 0.01) in Group A (8.23) than Group B (10.60).

There was no significant difference in total and differential leukocyte count between the high- and low-concentrate-fed groups with values within the normal range[8]. The low-concentrate diet had no

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effect on the total protein concentration or blood protein fractions of crossbred heifers fed an isonitrogenous diet[10]. In the present experiment, serum protein, serum albumin and serum globulin concentrations were almost equal between the 2 groups. Concentration of plasma glucose was significantly higher ($P < 0.05$) in the calves of Group A compared to Group B owing to a higher concentrate content in the diet of former group. Increasing the percentage of concentrate in the diet changed the rumen fermentation pattern, resulting in higher amounts of propionate production, which, together with increased starch flow to the intestine, could have resulted in higher blood glucose levels than those produced by a high forage diet[3,4]. The serum antibody titre in the calf serum of both groups increased spontaneously after vaccination against rinderpest. Apparently the antibody titre was higher at different intervals (at 7, 14 and 21 days after vaccination) in the calves of Group A in comparison to Group B, but the difference was not statistically significant owing to large variation in the reaction of experimental calves. The restricted concentrate feeding in this experiment had no effect on body immune response as described by Lebengarts[10].

From this experiment it appears that even a reasonably low level of concentrate feeding to crossbred calves may provide a satisfactory level of protection against pathogens.

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