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Change in body condition and carcass characteristics of cull ewes fed diets supplemented with rumen bypass fat

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ABSTRACT

Thirty Malpura ewes (>6 years age) distributed into three groups of 10 each were maintained on concentrate supplemented with rumen protected fat at 0 (T_1), 20 (T_2) and 40 (T_3) g kg^{-1} and chick pea straw for a period of three months. Towards the end of feeding experiment a metabolism trial was conducted on five representative ewes from each treatment. Blood and rumen liquor samples were analyzed at 0 and 90 days of feeding for blood biochemical and rumen metabolites. Five representative ewes were slaughtered at the initiation of the study and all the experimental ewes were slaughtered after termination of the experiment. The gain in weight (kg) and final body condition score was higher ($P<0.05$) in T_2 and T_3 as compared to T_1. The concentrate intake increased ($P<0.05$) with bypass fat (RBF) supplementation. The serum glucose and population of spirotrichs and total protozoa in rumen liquour sample increased ($P<0.05$) with concentrate as well as concentrate with RBF supplementation. Pre-slaughter weight, hot carcass weight, dressing percent, loin eye area, bone percent and carcass fat improved ($P<0.05$) with RBF supplementation. Composition of *Longissimus dorsi* muscle also revealed improvement when compared with 0 day composition. The feeding protocol also revealed higher returns by RBF supplementation. It is therefore concluded that RBF supplementation is advantageous in improving body conditions of cull ewes.

1. Introduction

Cull ewes are sold and slaughtered in unfinished condition having poor body condition and low body weights hence livestock owners do not consider them as valuable meat animals thus selling at lower price. Irrespective of breed, physiological stages and defined product utility all sheep are slaughtered at the end of their productive life cycle for meat production. About 40% of sheep slaughtered in India fall under category of cull animals with low body score, dressing yield and carcass fat content (Karim and Bhatt, 2012). The carcass of cull ewes is tough due to increased cross linking of collagen (Kopp and Bonnet, 1987), and tastes abnormally (sheepy) due to accumulation of volatile branched chain fatty acids (Sutherland and Ames, 1996), phenols and indoles (Young et al., 1997) and is lower in quality attributes than lamb.

Short-term feeding of starch based diet improved the body condition of cull ewes (Thornton et al., 1979). Improvement in body condition and carcass characteristics were also recorded in cull ewes fed high energy diet at 2.5% of body weight for a period of 90 days (Bhatt et al., 2012). Inclusion of fat in ruminant diets improve energy efficiency due to the lower methane production and direct use of long chain fatty acids in the metabolic pathways of fat synthesis (Machmuller et al., 2000).

Conventional fat inclusion in ruminant diet affects voluntary intake and fiber digestibility adversely (Bhatt et al., 2011) and inclusion of calcium improves fiber digestibility in the fat added diets by forming insoluble soaps, which protected the fatty acids (FA) from rumen degradation (Palmquist and Jenkins, 1980).

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Conditioning of cull ewes could be a profitable venture for sheep farmers as well as providing quality meat to the consumers. Therefore, the present experiment was planned to improve body condition by incorporating different levels of rumen by pass fat, studying its effect on plane of nutrition, nutrient utilization and carcass characteristics.

2. Materials and methods

2.1. Experimental materials and procedures

The experiment was conducted at the Central Sheep and Wool Research Institute, Avikanagar Rajasthan, India, located at 26°17′N latitude and 75°28′E longitude and 320 m above sea level. The climate is hot and semi-arid. The study was initiated in mid-June and ended in September 2011 after an experimental period of 90 days. During the experiment, average daily minimum and maximum ambient temperature ranged from 22.27 to 27.90 °C and 31.24 to 41.73 °C. Relative humidity varied from 33.70% to 89.58%. The animal care, handling and sampling procedures were approved by the Committee for the Purpose of Control and Supervision of Experiment on Animal (CPCSEA), India.

Thirty five cull Malpura ewes with initial body weight of 29.2.4 $\pm$ 0.89 kg were randomly selected from the Institute flock.Five ewes at random were slaughtered at 0 day to study the carcass traits and the remaining thirty ewes were divided into three groups of ten each in a completely randomized design. ll the ewes were above six years of age. The ewes were housed in three well ventilated sheds which was covered on all sides with brick wall, asbestos sheet roofing and mud flooring. During morning (6.00–8.00 h) and evening (17.00–19.00 h) time, ewes were kept in open coral adjoining to the shed.

2.2. Dietary treatment, feeding regimen, live weight and body condition recording

All the ewes were offered *ad libitum* roughage and concentrate in cafeteria system. The roughage was dry chick pea straw containing 80.1 g CP/kg dry matter. The ewes in group T_1 were offered concentrate without bypass fat whereas those in T_2 and T_3 were offered concentrate containing 20 and 40 g rumen by pass fat (RBF)/kg of concentrate, respectively. Rumen by pass fat was prepared from rice bran oil by the modified method of Naik et al. (2007). The process involved anhydrous calcium hydroxide (40% of the amount of oil to be treated) dissolved in 15 times tap water mixed with warm oil and sulfuric acid (3% of the amount of oil dissolved in five times tap water) stirred for 25 min on flame, filtered through muslin cloth, washed and dried. The prepared granular product consists of 63% oil and 37% mineral. The concentrate offered to control (T_1) consisted of maize 475, barley 450, groundnut cake 30, sesamum cake 30, mineral mixture 10 and common salt 50 g/kg of feed while in test groups T_2 and T_3 rumen by pass (RBF) fat was supplemented over and above per kg of feed. The animals had free access to clean drinking water during entire period of experiment. Daily record of concentrate and roughage intake was maintained during the experimental period of 90 days. Metabolizable energy intake (MEI) was calculated according to equation of Australian Agriculture Council (AAC) (1990) as MEI (MJ/kg DM)=[(digestible OM (g/kg DM))/1000] $\times$ 18.5 $\times$ 0.81.

Live weight was recorded at weekly intervals in the morning and the values were used to determine live weight gain. Body condition score was determined in all the ewes at 0 and 90 days of experimental period (Russel et al., 1969).

2.3. In vitro gas production, fermentation constants and methane emission

In vitro gas production test of the samples was done as per the procedure of Menke and Steingass (1988). Gas production was recorded at different time intervals up to 96 h and their potential gas production, rate constant and half time ($t_{1/2}$) were determined by Graph Pad Prism software. After determining the rate constants and half time ($t_{1/2}$) two sets of samples were incubated each in triplicate and sample incubated in 1st set was 200 mg and in 2nd 500 mg. The sample of gas from 1st set was analyzed for methane concentration with gas chromatography using flame ionizing detector. Before analysis of unknown samples the GC was calibrated with standard known samples of methane and standard curve was prepared with suitable regression equation. After injection of unknown samples the area of curves with retention time was recorded and methane concentration was calculated from standard curve using regression equation. The second set was incubated up to 24 h and gas production was recorded. The samples were transferred to spout less 600 ml beaker and the syringes were washed with neutral detergent solution (100 ml). The samples were boiled one hour, filtered, washed and dried to determine the dry matter digestibility of samples. After drying the samples were incinerated in muffle furnace at 600 °C temperature for 4 h and weighed after cooling for calculating organic matter digestibility. The methane production was expressed per 100 mg digestible dry matter. Partitioning factor is the ratio of *in vitro* gas production to the truly degraded substrate per g of sample (Blummel et al., 2003).

2.4. Sample collection and analysis

A metabolic trial for ten days with five days adaptation to metabolic cages and five days collection period was conducted after 70 d of experimental feeding on five ewes from each group. The metabolism cages had provision for individual feeding of concentrate and roughage, water, and collection of feces and urine separately. The samples of concentrate, roughage, and feces were dried in forced air oven at 70 °C till constant weight for dry matter determination. Samples were then ground to pass a 1 mm screen and preserved for later chemical analysis. Daily fresh samples of feces were preserved in 1:4 sulfuric acid for N assay. Similarly, aliquots of urine were preserved for estimation of N.

Rumen liquor samples (50 ml) were drawn on 0 and 90 days at 0 h (9.00 AM) and 4 h post-feeding (1.00 PM) from

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