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Effect of feeding protected fat and proteins on milk production, composition and nutrient utilization in Murrah buffaloes (*Bubalus bubalis*)

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ABSTRACT

Objective of this study was to investigate the effect of feeding protected fat and proteins on milk production, composition and nutrient utilization in Murrah buffaloes (*Bubalus bubalis*). Eighteen buffaloes were divided into two groups (9 each) on the basis of most probable production ability. Buffaloes in control group (C group; most probable production ability 2204 kg) were fed chaffed wheat straw, chopped maize fodder and concentrate mixture as per requirements. Buffaloes in supplemented group (S group; most probable production ability 2211 kg) were fed same ration as C group plus 2.5% rumen protected fat (on dry matter intake basis) and formaldehyde treated mustard and groundnut oil cake (1.2 g formaldehyde/100 g crude protein) in place of unprotected cakes. Group S buffaloes were supplemented rumen protected fat and protein 60 days pre-partum to 90 days post-partum and persistence of milk production was monitored up to 210 days of lactation. Milk yield during supplementation period (90 days) in S group was 13.11 kg/d and was 19% higher ($P<0.01$) than the C group (11.01 kg/d), whereas after supplement withdrawal (120 days), it was 11.04 kg/d and was 15% higher ($P<0.01$) than the C group (9.61 kg/d). There was no effect on total solid, protein, solid-not fat (SNF) and lactose contents in the two groups, whereas milk fat yield was increased ($P<0.05$) and level of milk urea nitrogen was decreased ($P<0.01$) in S group. Moreover, the supplement produced noticeable changes in the fatty acid profile of the milk fat, *i.e.*, reduction in the concentration of saturated fatty acids (SFA) by 19% and an increase in that of unsaturated fatty acids (USFA) by 36%. Besides, digestibility of dry matter, crude protein, acid detergent fiber and neutral detergent fiber were not affected, whereas ether extract digestibility was higher ($P<0.05$) in S group. There was no effect on plasma glucose, non-esterified fatty acids, triglycerides and cholesterol concentrations between two groups, whereas blood urea nitrogen concentration was lower ($P<0.01$) in S group. Supplementation of protected nutrients to buffaloes increased milk production and unsaturated fatty acids content in milk fat and persistence of lactation after supplements were withdrawn.

Abbreviations: ADFom, acid detergent fiber; BUN, blood urea nitrogen; CP, crude protein; DM, dry matter; ECM, energy corrected milk; EE, ether extract; FA, fatty acids; GNC, groundnut cake; LCFA, long chain fatty acids; MC, mustard cake; ME, metabolizable energy; MPPA, most probable production ability; MUN, milk urea nitrogen; aNDFom, neutral detergent fiber; NEB, negative energy balance; NEFA, nonesterified fatty acids; RDP, rumen degradable protein; SFA, saturated fatty acids; SNF, solid-not fat; TDN, total digestible nutrients; UDP, undegradable protein; USFA, unsaturated fatty acids.

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1. Introduction

Nutrient requirements of dairy animals must be met from dietary sources to get optimum productive and reproductive performance. During early lactation, the energy requirements for maintenance and milk production exceed the amount of energy obtained from dietary sources. Thus, the high energy requirement at the onset of lactation results in a negative energy balance (NEB) that begins a few days pre-partum and usually reaches its maximum few weeks postpartum (Tyagi et al., 2010; Remppis et al., 2011) which may adversely affect postpartum health and overall loss in milk yield of animals (Reist et al., 2002). Therefore, minimizing the extent and duration of NEB during early lactation could be beneficial for best productive performance from dairy animals (Beever, 2006; Grummer, 2007). Supplementing ration of lactating animals with protected fat enhanced the energy intake in early lactation which reduced the deleterious effect of acute NEB on lactation (Ganjkhanlou et al., 2009; Tyagi et al., 2010). Feeding of rumen protected fat and protein to lactating cows and buffaloes increased milk yield and milk composition (Chen et al., 2002; Garg et al., 2003; White et al., 2004; Thakur and Shelke, 2010; Mansoori et al., 2011). Formaldehyde treatment has proved to be an efficient and cheaper method for protecting highly degradable protein sources in rumen (Chaturvedi and Walli, 2001). It is now recognized that polyunsaturated fatty acids are essential for normal growth, and important for brain and vision development and immunity in infants; these fatty acids may also play a vital role in prevention and treatment of cardiovascular diseases in adults (Williams, 2000; Nordoy et al., 2001). In this direction many successful efforts have been made in the past to increase unsaturated fatty acids (USFA) and long chain fatty acids (LCFA) contents in milk fat by supplementing protected fat (Titi and Obeidat, 2008; Theurer et al., 2009; Mansoori et al., 2011).

The supplementation of protected fat increased milk yield and proportion of USFA but decreased milk protein percentage (Canale et al., 1990; Chen et al., 2002; Lohrenz et al., 2010). However, nowadays the trend in the dairy industry is toward adoption of a pricing system based on both fat and protein contents of milk rather than milk fat content alone. Consequently, this pricing system has generated interest in understanding how milk composition can be modified through nutrition. Efforts have been made in the past to increase milk yield as well as milk protein content of dairy animals by supplementing ruminally protected amino acids (Bertrand et al., 1998; Robinson et al., 2010).

It was hypothesized that supplementation of protected fat and protein during early lactation would improve yields of milk and milk components of dairy buffaloes and maintain persistence of the same after they were withdrawn. Objectives were to evaluate effects of protected fat and proteins supplement on milk production, composition, nutrient utilization and some blood constituents in Murrah buffaloes.

2. Materials and methods

2.1. Location of experiment

The study was conducted in the experimental cattle shed of National Dairy Research Institute, Karnal, India located at 29°42′20′N and 76°58′52.5′E at an altitude of 227 m amsl. Minimum and maximum ambient temperature range from near freezing point in winter to 45 °C in summer with annual rainfall of 700 mm. The experiment was conducted in winter as well as in summer (December–October) with daily minimum and maximum temperature averaging 13 °C and 36.5 °C, respectively.

2.2. Experimental animals, feeding and housing

Eighteen Murrah buffaloes (*Bubalus bubalis*) were selected from the herd maintained at National Dairy Research Institute, Karnal and divided into two groups (9 each) on the basis of most probable production ability (MPPA) and lactation number (2nd–4th lactation). Buffaloes in control group (C group; MPPA 2204 kg) were fed chaffed wheat straw (particle size: 1.5–2.0 cm), chopped green maize fodder (particle size: 2.0–2.5 cm) and concentrate mixture as per requirements (Kearl, 1982). However, animals in treatment group (S group; MPPA 2211 kg) were fed same ration as control group plus 2.5% rumen protected fat on dry matter (DM) intake basis and concentrate mixture containing formaldehyde treated mustard (MC) and groundnut oil (GNC) cake (1.2 g HCHO/100 g crude protein) in place of untreated cakes as a rumen protected protein source.

Composition (%) of the concentrate mixture was: maize 33, groundnut cake 21, mustard cake 12, wheat bran 20, deoiled rice bran 11, mineral mixture 2 and common salt 1. Green maize forage was fed separately whereas wheat straw and concentrate mixture were mixed before feeding and fed as per weekly calculated requirements (Kearl, 1982) of each buffalo. The concentrate mixture was offered two times a day in equal parts at the milking time *i.e.* 05:00 and 18:00 h. Rumen protected fat was fed through concentrate mixture at one time *i.e.* 05:00 h. Fresh green maize forage was fed at 10:00 and 19:00 h in addition to wheat straw, which was offered at 05:00 h. Left over, if any, was weighed next morning. DM content of forage and left over was determined to calculate the daily DM intake. Milk samples were collected fortnightly from each buffalo and pooled in proportion to the milk yield of individual buffalo and analyzed for broad chemical composition. Milk yield was converted in energy corrected milk (ECM) applying the equation proposed by Sjaunja et al. (1990). In the present study, metabolizable energy (ME) was calculated from total digestible nutrients (TDN) values using a factor of 1 kg TDN = 15.129 MJ ME (Paul et al., 2004). Buffaloes were housed in a well-ventilated paddock having individual feeding