Effect of rumen protected fat supplementation on nutrient utilization and body condition in dairy animals: A review

Harish Rohila, Amar Shroha and Rakesh Kumar

Abstract
Rumen Protected Fat (RPF)/bypass fat, used in dairy rations, is an alternate source of energy; however, its widespread use in dairy rations may limit milk and fat production. Dietary fats can be protected from rumen degradation by chemical modification, to increase the efficiency of production and to decrease the risk of negative energy balance. The present review paper discusses the utilization of Rumen Protected Fat (RPF) in the diet, with a focus on the effects on nutrient utilization, body condition and dairy animal performance. This review paper also presents examples of Rumen Protected Fat (RPF) sources and their utilization in dairy rations.

Keywords: Rumen protected fat, nutrient utilization, body condition and dairy animals

Introduction
Dairy animals, especially those in developing countries, depend on cereals and by-products of crops for their diet. Cereals and by-products of crops are the main sources of crude protein and energy. However, in many cases, the quality of the diet is poor because of the inherent low nutritive value and digestibility of the feed. This leads to substantial loss in body weight. Cereal grains and fats play an important role as sources of energy in dairy rations, and monogastric animals the alternate source of energy in dairy ration is supplemental fat. The inclusion of unprotected fat in dairy ration is limited to 3% of dry matter intake, beyond which digestibility of DM and fibre are reduced. So, diets containing rumen protected fat often stimulate energy intake, improved efficiency of utilization of energy without adversely affecting the DM intake and improved body condition in dairy animals.

Rumen Protected Fat (RPF) supplementation in the diet can help to increase energy density of the diet, which can lead to increased nutrient utilization, improved efficiency of nutrient utilization and improved body condition in dairy animals. However, the widespread use of Rumen Protected Fat (RPF) in dairy rations can lead to an increase in milk and fat production, which may result in negative energy balance. Hence, during early lactation, dairy animals are often forced to draw on body reserves to satisfy energy requirements (negative energy balance); this leads to substantial loss in body weight (Sirohi et al., 2010). Hence, during early lactation, dairy animals are often forced to draw on body reserves to satisfy energy requirements (negative energy balance); this leads to substantial loss in body weight (Sirohi et al., 2010). Cereal grains play an important role as source of energy but due to use of cereals for human consumption and monogastric animals the alternate source of energy in dairy ration is supplemental fat/RPF (Rumen Protected Fat)/bypass fat. And inclusion of unprotected fat in dairy ration is limited to 3% of dry matter intake, beyond which digestibility of DM and fibre are reduced. So, diets containing rumen protected fat often stimulate energy intake, improved efficiency of utilization of energy without adversely affecting the DM intake and improved body condition in dairy animals.

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It is stated that supplementing ration of lactating animals with bypass fat enhances energy intake in early lactation which reduces deleterious effect of acute negative energy balance on lactation (Tyagi et al. 2010) [36]. Diets containing supplemental fat often stimulate increased milk production because of increased energy intake, improved efficiency of utilization of energy, or both (Maiga and Schingoethe, 1997) [13]. Bypass fat in the form of calcium salts of fatty acids (Palm oil and others) has been known to increase energy density of the ration without adversely affecting the DM intake and digestibility (Naik et al. 2009) [16].

Effect of RPF on dry matter intake
Jenkins and Palmquist (1984) observed no significant difference in dry matter intake by addition of calcium soaps of fatty acids in rations of lactating Holstein cows [10]. Schauff and Clark (1992) found a linear decrease in dry matter intake when cows were fed rations containing 3, 6, and 9 per cent of protected fat as calcium soaps of long chain fatty acids and attributed to the worse palatability of the supplemental fat [19]. Schneider et al. (1988), Erickson et al. (1992) reported no difference in DM (Dry Matter) intake [24, 9]. Kim et al. (1993) reported reduction in DM intake attributable to dietary CSFA has been reported [11]. Garg and Mehta (1998) also did not find any significant effect of bypass fat on dry matter intake [8]. Sarwar et al. (2004) reported daily dry matter intake ranging from 10.8 to 11.0 kg in different groups of lactating Nili-Ravi buffalos fed 0 to 6 per cent ruminally protected fat, which was statistically non significant [24]. Tyagi et al. (2009) have reported that daily dry matter intake of the ration had remained unaffected on supplementing rumen bypass fat [23]. Most of the workers reported that the DM intake of dairy animals was not altered (Naik et al., 2007b; 2009a; Tyagi et al., 2009b; Thakur and Shelke, 2010; Sirohi et al., 2010; Mugal et al., 2012) on supplementation of bypass fat [15, 17, 39, 28, 14]. Chouinard et al. (1997) reported decrease and Tyagi et al. (2009a) reported increase in DM intake in dairy animals fed bypass fat [2, 38]. Bypass fat supplementation in the ration of lactating animal, enhances the energy intake and reduces the adverse effect of NEBAL during early lactation (Drackley, 1999; Ganjkhanlou et al., 2009) without affecting rumen cellulolytic bacterial activity (Thakur and Shelke, 2010) [4, 7, 35]. Shelke et al. (2011), Mugal et al. (2012), Ranjan et al. (2012) and Desai (2012), did not found significant effect onDMI [29, 14, 21, 3].

Effect of RPF on efficiency of nutrient utilization
Maiga and Schingoethe, (1997) reported that diets containing supplemental fat often stimulate increased milk production because of increased energy intake, improved efficiency of utilization of energy, or both [13]. Naik et al. (2007b) reported that no effect on DCP intake by the supplementation of bypass fat to dairy animals [15]. Naik et al. (2007b), Sirohi et al. (2010) reported that TDN intake was either not altered on supplementation of bypass fat in the diet of the dairy animals [15, 32]. Naik et al. (2009a) reported no increase in the DE and ME intake on bypass fat supplementation to buffaloes [17]. Tyagi et al., (2009a), Thakur and Shelke, (2010) reported that TDN intake was increased on supplementation of bypass fat in the diet of the dairy animals [38, 28]. Tyagi et al. (2009a; 2009b), Thakur and Shelke, (2010) reported no effect on CP intake and by the supplementation of bypass fat to dairy animals [38, 39, 28]. Tyagi et al. (2009a) reported decrease in the intake (kg) of DM (0.81 vs 0.78 and 0.82 vs 0.76); CP (0.12 vs 0.11; 0.12 vs 0.11) and TDN (0.52 vs 0.51; 0.52 vs 0.50) per kg of milk and FCM production in crossbred cows indicating better utilization of DM, CP and TDN due to bypass fat supplementation [38]. Sirohi et al. (2010) also observed decrease in the CP intake (130.72 vs 118.87, g) per kg FCM production in crossbred cows indicating better utilization of the dietary CP [32]. Sirohi et al. (2010) reported increase in CP intake (1.44 vs 1.60; kg/d) in lactating crossbred cows supplemented with bypass fat [32].

2.5 Effect of RPF on body weight and body condition
Komaragiri et al. (1998) reported that the addition of fat in early lactation diets is commonly thought to improve energy balance by reducing body fat mobilization and use of supplemental dietary fat for milk production [12]. Solorzano Kertz, (2005) reported that supplementation of fats is done to minimize the body weight loss and hasten body weight gain postpartum while maintaining milk production in dairy animals [34]. Purushothaman et al. (2008) reported no significant effect of feeding calcium salt of palm oil fatty acids on body weight change in dairy cows [20]. Ganjkhanlou et al. (2009) reported that bypass fat supplementation increases energy density of the diet which is reflected in improved BCS and productive performance of animals [7]. Wadhwa et al. (2012) reported that the body weight of the animals improved in the bypass fat supplemented group as compared to the control group (551 vs. 508, kg), though the differences were nonsignificant [41]. Vahora et al. (2013) reported that feeding of calcium salt of palm oil fatty acids significantly reduced (p<0.05) the loss in body weight (11.72 vs. 38.30) in comparison to that of control group [40]. Metabolic body weight at the beginning of experiment was more (p<0.05) in the control cows; however after 90 days of experiment the metabolic weight increased significantly (p<0.05) in the PF supplemented cows (Singh et al., 2014) [31]. Singh et al. (2014) reported that the decline in BCS (p<0.01) was more in control than the PF supplemented cows [31]. Figgens et al. (1993), Sharma et al. (2015) observed that additional dietary fat could result in better energy partitioning and improved energy balance in dairy animals [8, 27]. Garg and Mehta (1998) observed that the BSC of the cows improved due to bypass fat feeding indicating reduction in weight loss in the first quarter and helped gaining substantially after 90 days of feeding [8]. Naik et al. (2009b) reported better recovery in BW (-2.08 vs +14.13, kg) and BSC (-0.06 vs +0.02) in crossbred cows during early lactation in bypass fat supplemented group [42]. Thakur and Shelke (2010) reported that supplementation of calcium salts of soya acid oil fatty acids at 4% of DMI improved the ADG (553.10 vs 577.60, g) in Murrah buffalo calves owing to higher TDN intake (2.14 vs 2.42, kg/d) [28].

Conclusions
It may be concluded that by supplementation of bypass fat in the diet of dairy animals it is possible to alleviate problems of negative energy balance without adversely affecting the dry matter intake and rumen fermentation. Supplementation of bypass fat gives additional benefit due to increase in milk yield, efficiency of nutrient utilization, post-partum recovery of the body weight and body condition score of the dairy animals.
References
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