CONSEQUENCE OF PRILL FAT AND RUMEN PROTECTED CHOLINE SUPPLEMENTATION ON MILK YIELD AND ITS MAKEUP IN MURRAH BUFFALOES

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ABSTRACT

This study was conducted to analyze the consequence of prill fat and rumen protected choline (RPC) supplementation on performance of lactating Murrah buffaloes. Murrah buffaloes (n=18) were distributed into three groups (Control, T_1 and T_2) having six buffaloes in each, based on milk yield, fat per cent and stage of lactation. During the experimental period of 90 days, buffaloes in all the three groups were fed same basal diet, containing green fodder (Berseem), wheat straw and concentrate mixture to meet their requirements for maintenance and milk production. Buffaloes in Group T_1 were daily supplemented with prill fat 2.5% of total DMI whereas; buffaloes in Group T_2 were daily supplemented with 54 g rumen protected choline along with same quantity of prill fat fed as in Group T_1.

In contrast to the control group, overall milk yield (kg) of lactating Murrah buffaloes was significantly (P<0.01) increased by 0.99 and 1.78 kg in Group T_1 and T_2. The average 4% FCM (kg/d), ECM (kg/d) and fat yield (kg/d) was significantly (P<0.01) higher in Group T_2 followed by Group T_1 and Group control. There was no significant difference in milk composition of buffaloes except milk fat (%) and total solids (%) which were improved significantly (P<0.01) in supplemented groups. It was observed that prill fat supplementation in the ration helped to make better performance of early lactating Murrah buffaloes by enhanced milk yield and fat percent which can be further increased by supplementing the ration with rumen protected choline.

Keywords: *Bubalus bubalis*, buffaloes, prill fat, rumen protected choline, milk yield, milk fat

INTRODUCTION

Often the quantity of energy needed, in early lactating buffaloes, for maintenance of body tissues and milk productions higher than the amount of energy available from the diet (Goff and Horst, 1997), which forces mobilization of body fat reserves to satisfy energy requirement. At the same time, daily nutrient intake is not sufficient to match demands for milk production and energy balance become negative (Bell *et al*., 1995). The period of negative energy balance often get moving

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prior to calving due to depressed feed intake at the termination of gestation. The negative energy balance in early lactation impact on peak milk production and gross lactation performance apart from causing delayed post-partum ovarian activity (Garnsworthy and Webb, 1999). The degree of non-esterified fatty acids (NEFA) heightens in plasma as an effect of body fat mobilization and direct to hepatic lipidosis.

The balanced feeding during postpartum period affects the lactation performance of dairy animals. It has been found that Calcium salts of long-chain fatty acids are effective for lactating cows as ruminally inert fat supplements (Grummer, 1995). These salts improve productive performance as good source for increasing energy density of the diet. Prill fat remains inert in the rumen and resist hydrolysis and association with the bacterial cells of feed particles. Thus, total supplemented energy in diet of a lactating animal get available for the productive purposes (Singh *et al*., 2014). Prill fat is prepared by liquefying mixture of fatty acid and spraying it under pressure into a cooled atmosphere. It is a non-hydrogenated vegetable oil and contains more than 85% palmitic acid with high melting point which by passes rumen degradation and is digested in small intestine by lipase enzyme.

Fat metabolism can be improved with the help of choline for better energy production and also helps in improving milk production. Choline, plays an important role in very low density lipoprotein synthesis and thereby contributes to fat export from the liver. It is reported that choline can be synthesized by the animals even though the dietary supply of choline in early lactating dairy animals may be inadequate, (Pires and Grummer, 2008). The choline supplemented in the protected form as it degraded rapidly in the rumen, (Elek *et al*., 2008). The rumen protected form of choline has been developed to pass choline to the small intestine for absorption (Garg *et al*., 2012).

Considering the efffect of prill fat as an energy source in diet of lactating animals and role of choline in fat metabolism the aim of the present experiment was to find out the consequence of prill fat and rumen protected choline supplementation on milk yield and its composition in Murrah buffaloes.

MATERIALS AND METHODS

Eighteen Murrah buffaloes (n=18) were distributed into three groups (Control, T_1 and T_2) having six buffaloes in each, based on level of milk production, fat %, and stage of lactation (2 to 3 weeks post-partum). During the experimental period of 90 days, buffaloes in all the three groups were fed a same total mixed basal diet, comprising green fodder (Berseem), wheat straw and concentrate mixture to match the requirements for maintenance and milk production (Kearl, 1982). Buffaloes in Group T_1 were enriched with prill fat 2.5% of total DMI per animal per day while, buffaloes in Group T_2 were enriched with 54 g rumen protected choline along with equal quantity of prill fat fed as in Group T_1 in their basal ration.

The buffaloes were dewormed before the beginning of the experiment and standard basic practices were followed in the shed. All the experimental buffaloes were kept in a well-ventilated shed having cemented floor with individual feeding and watering arrangement. Weighed quantity of feed (concentrate and roughage) was offered to the buffaloes in morning and evening. *Ad-libitum* clean and fresh water was provided to the buffaloes during the study. The buffaloes were let loose for about 1 to 2 h daily in the surrounded paddock for exercise.

Milk samples were collected in 30 day interval from all the buffaloes in different treatments and were analyzed for fat (%), solids-not-fat (%), milk protein (%), density (g/cm^3) and lactose (%) content by using Lacto scan. Average daily milk yield of individual lactating buffaloes were documented and average milk production of individual animal was computed on fortnightly basis. Four percent fat corrected milk (4% FCM) was calculated by the following formula given by Gains (1928).

4% FCM (kg) = [(0.4 x total milk) + (15 x total fat)]

Energy corrected milk (ECM) was calculated as per the formula given by Tyrrell and Reid (1965).

ECM (kg) = [(7.2 x kg protein) + (12.95 x kg fat) + (0.327 x kg milk)]

The statistical analysis of the data was done using SPSS computer package (SPSS version 20.0, SPSS Inc., Chicago, USA) adopting standard statistical procedures (Snedecor and Cochran, 2004).

RESULTS

The data regarding fortnightly and overall milk yield in different groups of Murrah buffaloes is presented in Table 1. The fortnightly average milk yield (kg/d) in T_2 group was documented to be significantly ($P<0.01$) higher than T_1 and control group. The overall average milk yield (kg/d) of Group T_1 and T_2 was significantly ($P<0.01$) greater by 0.99 and 1.78 kg than that of Control group.

The mean monthly 4% FCM, ECM and fat yield in different groups of Murrah buffaloes is shown in Table 2. Mean 4% FCM (kg/d) was found to be significantly ($P<0.01$) higher in T_2 Group than T_1 and Control group. Within same treatment group highest mean 4% FCM was documented at 90th day followed by 60th and 30th day. Analysis of variance revealed significant ($P<0.01$) effect of period and treatment on ECM (kg/d) of buffaloes. The significantly ($P<0.01$) highest mean ECM (kg/d) was recorded in Group T_2 succeeded by Group T_1 and Control group. Mean fat yield (kg/d) was also significantly ($P<0.01$) highest in Group T_2 succeeded by Group T_1 and Control group. Mean fat yield (kg/d) in Control group at 60th and 90th day was undoubtedly ($P<0.01$) higher than that at 30th day. The milk composition of Murrah buffaloes in different groups is presented in Table 3. There was no significant change in milk composition of buffaloes in different groups except mean milk fat (%) and mean total solids (%) which were significantly ($P<0.01$) highest in Group T_2 followed by Group T_1 and Control group.

DISCUSSION

In this experiment treatment means of the average milk yield (kg/d) and fat corrected milk yield (kg/d) indicated that supplementation of basal diet with either prill fat alone or along with rumen protected choline in the diets of buffaloes undoubtedly ($P<0.01$) enhanced their milk yield and 4% fat corrected milk yield as compared to control group. Overall average milk yield (kg/d) was increased by 12.10 and 21.76% in prill fat alone and prill fat + rumen protected choline supplemented groups than the control group. The higher milk production in supplemented groups was attributed to more TDN intake in conjunction with prill fat which increased the energy density of ration and reduced deleterious effect of negative energy balance as evident from lower blood NEFA levels.

The significant increase in milk production in prill fat supplemental group is well corroborated with findings of many researchers reporting an increased milk yield between 0.40 to 3.11 kg/d in experimental cows (Fahey *et al*., 2002; McNamara *et al*., 2003; Mishra *et al*., 2004; Salem and Bouraoui, 2008; Shelke *et al*., 2011). Similarly, Kumar and Thakur (2007); Garg *et al*. (2008); Barley and Baghel (2009); Sirohi *et al.* (2010); Rajesh *et al.* (2014) also reported significant improvement in milk yield in different species of ruminants fed bypass fat. However, no improvement in milk yield in bypass fat supplemented cows have also been reported by some researchers (Klusmeyer *et al*., 1991; Sklan *et al*., 1992; Elliott *et al*., 1996), which could be due to different degree of inertness and amount of dietary fat offered.

Results regarding significantly ($P<0.01$) higher milk yield in rumen protected choline supplemented group are in agreement with Elek *et al.* (2008); Lima *et al.* (2007), who observed significant improvement in milk yield of dairy cows after supplementing rumen protected choline (RPC) to basal diet which can be correlated to the role of RPC in elevating the export of triglycerides from the liver and sparing methionine as a methyl donor (Pinotti *et al*., 2002). In present study, improvement in milk production in response to RPC supplementation may be attributed to its methyl donor sparing effect, thus enhanced intestinal supply of choline might have further improved milk production in Murrah buffaloes.

In present study, milk fat (%) and total solid (%) was significantly higher ($P<0.01$) in supplemented groups than the control. Milk lactose (%), SNF (%), density (g/cm^3) and protein (%) content were not influenced by feeding prill fat either alone or along with rumen protected choline. Significant ($P<0.01$) increase in milk fat and total solid (TS) of prill fat supplemented group is supported by Mishra *et al.* (2004); Garg *et al.* (2008); Sirohi *et al.* (2010). Lima *et al*. (2007); Garg *et al.* (2012) supports our results regarding significant higher milk fat (%) in RPC supplemented group. Non significant change in milk protein (%) of supplemented groups is supported by Sirohi *et al*. (2010).

The increase in milk fat content in prill fat or prill fat + protected choline supplemented group may be due to availability of more fatty acid (SFA and USFA) to the mammary gland and their incorporation into milk fat (Gulati *et al*., 2003). Further, as choline is used for phospholipid synthesis its supplementation facilitates lipid absorption and transport, thereby favouring milk fat synthesis.

The study has made it amply clear that high producing lactating buffaloes do need the bypass fat supplement in their diet, in order to meet their energy requirements fully to express their milk production potential, which was demonstrated by the significant increase in milk yield, FCM yield, fat percentage and TS percentage in milk as a result of feeding prill fat alone or along with rumen protected choline.

CONCLUSION

Present investigation reveled that supplementing prill fat in the ration of Murrah buffaloes helped in improving milk yield and fat per cent, which can be further increase by

Table 1. Fortnightly and overall average milk yield (kg/d) in different groups of Murrah buffaloes.

Fortnights	Control	T_1	T_2	Period Mean±SE
Initial	$06.31^{D}\pm0.24$	$06.61^{C}\pm0.43$	$06.79^{C}\pm0.35$	$06.57^{E}\pm0.19$
1	$07.08^{Cc}\pm0.26$	$08.13^{Bb}\pm0.49$	$09.21^{Ba}\pm0.16$	$08.14^{D}\pm0.28$
2	$07.79^{Bc}\pm0.24$	$08.76^{Bb}\pm0.20$	$09.83^{Ba}\pm0.17$	$08.79^{C}\pm0.23$
3	$08.66^{Ac}\pm0.44$	$09.71^{Ab}\pm0.24$	$10.62^{Aa}\pm0.09$	$09.67^{B}\pm0.25$
4	$09.29^{Ac}\pm0.30$	$10.45^{Ab}\pm0.14$	$11.21^{Aa}\pm0.11$	$10.32^{A}\pm0.22$
5	$09.14^{Ac}\pm0.18$	$10.33^{Ab}\pm0.30$	$11.11^{Aa}\pm0.08$	$10.19^{A}\pm0.22$
6	$09.01^{Ac}\pm0.18$	$10.18^{Ab}\pm0.26$	$10.95^{Aa}\pm0.15$	$10.05^{AB}\pm0.22$
Overall	$08.18^{c}\pm0.21$	$09.17^{b}\pm0.27$	$09.96^{a}\pm0.05$	

^{a,b,c} Means with different superscripts in the same row are significantly different (P<0.01).

^{A,B,C,D,E} Means with different superscripts in the same column are significantly different (P<0.01).

Table 2. Monthly average 4% FCM, ECM and fat yield in different groups of Murrah buffaloes.

Attributes	Periods			Treatment Mean± SE
	30th Day	60th Day	90th Day	
4% FCM (kg/d)				
Control	$09.87^{Cb}\pm0.31$	$12.29^{Ca}\pm0.43$	$12.80^{Ca}\pm0.26$	$11.65^{C}\pm0.36$
T_1	$11.47^{Bc}\pm0.46$	$14.43^{Bb}\pm0.20$	$15.38^{Ba}\pm0.38$	$13.76^{B}\pm0.45$
T_2	$13.23^{Ac}\pm0.22$	$16.18^{Ab}\pm0.12$	$17.25^{Aa}\pm0.26$	$15.55^{A}\pm0.43$
ECM (kg/d)				
Control	$10.14^{Cb}\pm0.29$	$12.59^{Ca}\pm0.41$	$13.13^{Ca}\pm0.27$	$11.95^{C}\pm0.36$
T_1	$11.75^{Bb}\pm0.44$	$14.89^{Ba}\pm0.23$	$15.64^{Ba}\pm0.40$	$14.09^{B}\pm0.45$
T_2	$13.55^{Ab}\pm0.24$	$16.55^{Aa}\pm0.18$	$17.41^{Aa}\pm0.24$	$15.84^{A}\pm0.42$
Fat Yield (kg/d)				
Control	$0.46^{Cb}\pm0.02$	$0.58^{Ca}\pm0.02$	$0.61^{Ca}\pm0.01$	$0.55^{C}\pm0.02$
T_1	$0.54^{Bc}\pm0.02$	$0.69^{Bb}\pm0.01$	$0.75^{Ba}\pm0.02$	$0.66^{B}\pm0.02$
T_2	$0.63^{Ac}\pm0.01$	$0.79^{Ab}\pm0.01$	$0.86^{Aa}\pm0.01$	$0.76^{A}\pm0.02$

^{a,b,c} Means with different superscripts in the same row are significantly different (P<0.01).

^{A,B,C,} Means with different superscripts in the same column are significantly different (P<0.01).

Table 3. Milk composition in different groups of Murrah buffaloes.

Attributes	Periods			Treatment Mean± SE
	30^{th} Day	60^{th} Day	90^{th} Day	
Fat (%)				
Control	$6.19^{Bc}\pm0.03$	$6.47^{Cb}\pm0.05$	$6.74^{Ca}\pm0.05$	$6.46^{C}\pm0.06$
T_1	$6.40^{ABc}\pm0.17$	$6.88^{Bb}\pm0.09$	$7.34^{Ba}\pm0.12$	$6.87^{B}\pm0.12$
T_2	$6.60^{Ac}\pm0.09$	$7.21^{Ab}\pm0.09$	$7.76^{Aa}\pm0.09$	$7.19^{A}\pm0.12$
SNF (%)				
Control	9.23±0.07	9.68±0.15	9.68±0.18	9.53±0.09
T_1	9.56±0.18	10.03±0.19	9.63±0.23	9.74±0.12
T_2	9.97±0.14	9.80±0.20	9.52±0.11	9.77±0.10
Total Solid (%)				
Control	$15.42^{Cb}\pm0.08$	$16.15^{Ca}\pm0.16$	$16.42^{Ca}\pm0.19$	$15.99^{C}\pm0.13$
T_1	$15.96^{Bb}\pm0.29$	$16.91^{Ba}\pm0.20$	$16.97^{Ba}\pm0.15$	$16.61^{B}\pm0.16$
T_2	$16.57^{Ab}\pm0.20$	$17.02^{Aa}\pm0.24$	$17.28^{Aa}\pm0.12$	$16.96^{A}\pm0.13$
Protein (%)				
Control	3.30±0.12	3.34±0.14	3.43±0.11	3.36±0.07
T_1	3.31±0.14	3.60±0.10	3.46±0.09	3.46±0.07
T_2	3.36±0.06	3.54±0.09	3.42±0.04	3.44±0.04
Lactose (%)				
Control	4.77±0.17	5.01±0.20	5.05±0.17	4.94±0.10
T_1	4.97±0.21	5.39±0.15	5.15±0.16	5.17±0.10
T_2	4.89±0.34	5.18±0.06	5.20±0.06	5.09±0.11
Density (g/cm^3)				
Control	1.033±0.001	1.033±0.001	1.032±0.001	1.033±0.001
T_1	1.033±0.001	1.032±0.001	1.031±0.001	1.032±0.001
T_2	1.033±0.001	1.031±0.001	1.031±0.002	1.032±0.001

^{a,b,c} Means with different superscripts in the same row are significantly different ($P<0.01$)

^{A,B,C,} Means with different superscripts in the same column are significantly different ($P<0.01$)

supplementing the ration with rumen protected choline chloride.

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