Influence of Supplementation of Bypass Fat on Nutrients Intake and Milk Yield and its Composition in Crossbred Lactating Cows

Patel A.P., Bhagwat S.R., Prajapati K.B., Sheikh A.S., Ashwar B.K., Pawar M.M., Chauhan H.D., Makwana R.B., Ingle P.B., Patel Suresh, Patel Gaja V., Choudhary Vijay, Joshi Sanjay, Emmanuel N.

[1]MV Sc Scholor, [2]Professor & Head, Animal Nutrition, [3]Research Scientist, LRS, SDAU, SKNAGAR, [4]Associate Professor & Head, Veterinary Extension, [5]Associate Professor, Veterinary Extension, [6]Assistant Professor Animal Nutrition, [7]Assistant Professor LPM, [8]Veterinary Officer, LPM, [9]MV Sc Scholor, [10]MV Sc Scholor, [11]MV Sc Scholor, [12]MV Sc Scholor, [13]MV Sc Scholor, [14]MV Sc Scholor, Department of Animal Nutrition, College of Veterinary Science & AH, SDAU, Sardarkrushinagar (BK)-385506

(Received on 16.05.2013; Accepted on 30.05.2013)

Abstract

An on-farm trial of 7 days preliminary feeding and 90 days experimental period was conducted in village Mumanvas, Vadgam Taluka of Banaskantha district of Gujarat during September to November 2012. Twelve lactating crossbred cows of uniform body weight, milk yield and with 2nd and/or 3rd lactation number in initial stage of lactation were selected for experiment to study the effect of bypass fat supplementation. Six healthy animals in each group allotted to two dietary treatments. Completely randomized design was followed for making treatment groups i.e. T_1: control (concentrate mixture + green fodder + dry fodder) and T_2: treatment (T_1+bypass fat@10 g/kg milk yield). The nutrient requirement of animals meets out as per the ICAR (1998) guideline. Milk yield of morning and evening was recorded daily and sampled every fort night interval. At the end of experiment, digestion trial of 7 days was under taken. The average daily DMI (kg/h), CPI (g/h), DCP intake (g/h) and TDNI (kg/h) in T_1 and T_2 groups were 13.80±0.20 and 14.07±0.43; 1786.70±32.48 and 1871.35±76.35; 1222.32±48.95 and 1329.80±77.60; 8.39±0.15 and 9.33±0.32, respectively. The DMI, CPI and DCPI were found statistically non significant between treatment groups. While as, TDNI was found to be significantly ($P<0.05$) higher in bypass fat group. The cumulative DMI, CPI, DCPI and TDNI (kg/90d) in T_1 and T_2 were 1242.32 ±18.28 and 1265.94±39.06; 160.80±2.92 and 168.42±6.87; 110.01±4.40 and 119.68±6.98; 755.38±13.33 and 839.78±28.67, respectively. The TDNI was differ statistically ($P<0.05$) between treatment groups while statistically non significant difference between treatment groups in terms of cumulative DMI, CPI, DCPI.

The average daily production of whole milk, 4% FCM, fat and SNF in experimental crossbred cows in groups T_1 and T_2 were, 15.67±0.43 and 17.78±0.81, 15.30±0.74 and 18.55±0.90; 0.60±0.04 and 0.77±0.04 and 1.31±0.03 and 1.53±0.06 kg/h/d, respectively and all values were statistically ($P<0.05$) significant and higher in bypass fat fed group than control group. The cumulative yield (kg/h/90d) for whole milk, 4% FCM, fat and SNF were, 1410.11±38.96 and 1600.01±72.88; 1376.85±66.31 and 1669.32±80.60; 53.57±3.81 and 69.05±3.66 and 118.32±2.56 and 138.02±5.72 in T_1 and T_2 groups, respectively. The cumulative yield was significantly ($P<0.005$) higher in bypass fat fed group as compared to control.The percent of milk fat, total solid and SNF of experimental cows in groups T_1 and T_2 were, 3.82±0.11 and 4.32±0.12; 12.24±0.22 and 12.94±0.13 and 8.40±0.06 and 8.64±0.09, respectively. The fat percentage, total solid percentage and SNF percentage were statistically ($P<0.05$) significant and higher in the group which was fed bypass fat supplementation.

Keywords: Bypass fat; SNF; DCP; TDN; Nutrients; Crop residues; Palability; Digestibility

Corresponding author: Corresponding author: Dr. A.P.Patel, Veterinary Officer, Banas Dairy Palanpur, (BK) -385001.

Email: ashokveti@gmail.com

Introduction

Livestock are an integral part of agriculture in India and likely to be the instrument of the economic growth and development of the country. The problem is not only about the feed availability, but also about feed quality and feed cost. The major feed sources available in India are crop residues including straws and stovers which are very inferior quality in terms of palatability, digestibility and supply of nutrients. To overcome the problem of feed shortage and to optimize essential nutrients supply to ruminants, we have to evolve newer feeds and have to device alternative technologies to increase nutrient supply through better utilization of feed resources. This can be achieved by modifying the feeds and feeding systems and by manipulating the digestive tract, especially rumen through active as well as passive manipulation. Supplementation of fat in the ration can increase its energy density. The levels of unprotected fat cannot be incorporated in the ration beyond 4%. High levels of unsaturated fat in diet are harmful to rumen microbes and causes inhibition of rumen fermentation, alter crude fibre digestibility, microbial protein synthesis and volatile fatty acid production. This can be successfully overcome by feeding protected fats to ruminants. Bypass fat technology involves feed management through passive rumen manipulation. Feeding of protected or inert fat or bypass fat is a means of rendering fats insoluble in the rumen from ruminal hydrolysis and bio-hydrogenation and make available in small GI tract for absorption resulting reduce negative energy balance and beneficial for various body function like production and reproduction. Bypass fat remains inert in the rumen and a good source of fatty acids for meeting energy needs of animals and fatty acids requirement for milk synthesis.

Diet	Group	Group	No
Home-made concentrate mixture + green fodder + dry fodder	Control	T_1	6
Home-made concentrate mixture + green fodder + dry fodder +Bypass fat @10g/kg of milk yield.	Bypass fat	T_2	6

In the light of above facts, the present experiment was conducted to study the effect of supplementation of bypass fat in the ration of lactating crossbred cows to study the influences of supplementing bypass fat during early lactation on nutrients intake and on milk yield and milk composition.

Materials and Methods

The present experiment was conducted on lactating crossbred cows at Mumanvas village of Vadgam Taluka of Banaskantha district, Gujarat between 16th September and 24thDecember 2012 for 90 days to know the effect of feeding commercial bypass fat (*Megalac*) to crossbred cows during early lactation. Twelve crossbred cows in early lactation (15-30d post-partum) were selected on basis of their 12-13 kg daily milk yield of last lactation. Initially both the groups of animals should had more or less similar average body weight, average milk yield and average fat yield to avoid biasness in experiment. The experimental animals were randomly allotted to two dietary treatments i.e. T_1: (control) and T_2: (treatment). Six animals in each follow

Table 1: Average DM intake of experimental cows during digestion trial

Animal No.↓	kg/d		kg/100 kg BW		kg/kg $W^{0.75}$	
Treatment→	T_1	T_2	T_1	T_2	T_1	T_2
1	13.89	13.98	3.66	3.68	3.17	3.15
2	12.86	12.98	3.06	3.25	2.90	2.84
3	14.20	15.27	3.16	3.40	3.32	3.08
4	13.92	14.04	3.76	3.70	3.18	3.17
5	14.22	15.29	3.00	4.02	3.46	3.05
6	13.73	12.84	3.62	3.21	2.87	3.11
Average	13.80±0.20	14.07±0.43	3.37±0.14	3.54±0.13	3.15±0.09	3.07±0.05

Table 2: Average daily crude protein intake of experimental cows during digestion trial

Animal. No.	g/ day		g/100kg B.wt		g/ kg $W^{0.75}$	
Treatment	T_1	T_2	T_1	T_2	T_1	T_2
1	1803.80	1868.60	474.68	491.74	408.56	423.24
2	1629.20	1668.90	407.30	397.36	359.90	373.17
3	1842.90	2083.40	409.53	462.98	400.11	452.33
4	1807.40	1864.60	475.63	503.95	412.09	422.33
5	1840.10	2082.10	484.24	438.34	394.17	471.60
6	1796.80	1660.50	449.20	436.97	406.98	371.29
Average	1786.70±32.48	1871.35±76.35	450.10±14.02	455.22±16.06	396.97±7.86	418.99±16.62

Completely Randomized Design.

The home-made concentrate mixture prepared daily by the farmer using cotton seed cake, compound concentrate mixture and maize bhardo for thirty lactating crossbred cows and equally distributed to experimental animals irrespective of milk yield. The ingredient composition of home-made concentrate mixture had been observed throughout the experiment. The wheat straw was fed *ad libitum*. The compound concentrate mixture was procured from Banaskantha District Co-operative Milk Producer's Union Limited and commercial bypass fat supplement (*Megalac*) from Optimaxnutricare limited, Rajkot.

All the experimental animals were individually offered a basal diet of green maize and wheat straw along with required quantity of concentrate mixture to reach out their protein and energy needs for maintenance and for milk production.[1] The bypass fat supplement *Megalac* was provided to cows of T_2 group @ 10gm/kg milk yield/animal as per recommendation of manufacturer.

The crossbred females of both groups were individually offered the daily allowance of home-made mixture at irrespective of their milk production during time of milking (both morning and evening) up to entire experimental period of 90 days. The green fodder was offered at 8.00 a.m. and 5.00 p.m; while the dry forage was offered two times a day after feeding green fodder. The leftover from all cows were weighed daily. The samples of concentrate, wheat straw and green were collected fortnightly for subsequent analysis of DM and DMI during experimental period. The feeding schedule was adjusted every fortnight according the milk yield of that animal for compensating nutrient requirement for maintenance and milk production. The clean, fresh and wholesome drinking water was made available to all the experimental animals *ad libitum* in water troughs fitted in front of them.

All the animals were housed in well ventilated *pukka shed*. The roof and floor was of cement concrete. All the animals had sufficient space for easy movement and were reared under stanchion system. All the experimental crossbred cows were hand milked twice daily (5.00 a.m. and 16.00 p.m.) and yields were recorded. The milk samples were drawn at fortnightly intervals from individual animals during both times of milking. After thorough mixing, a sample of 100-150 ml was taken for further analysis of fat, total solid and SNF content. The samples were stored at 4^{0}C with precaution of bottle, closely tight with rubber stopper. The fat content of milk samples was

Table 3: Average daily digestible crude protein intake of experimental cows

Animal. No. ↓	g/day		g/100kg B.wt		g/kg $W^{0.75}$	
Treatment →	T_1	T_2	T_1	T_2	T_1	T_2
1	1225.60	1343.00	322.53	353.42	277.60	304.19
2	987.90	1127.10	235.21	281.78	218.23	252.02
3	1328.80	1503.80	295.29	334.18	288.50	326.49
4	1274.00	1385.60	344.32	364.63	290.47	313.84
5	1247.90	1539.00	262.72	405.00	267.31	348.58
6	1269.70	1080.30	334.13	270.08	287.59	241.56
Average	1222.32±48.95	1329.80±77.60	299.03±17.55	334.85±20.95	271.62±11.25	297.78±17.28

Table 4: Average daily total digestible nutrient intake of experimental cows

Animal No ↓	kg/day		kg/100kg BW		kg/kg $W^{0.75}$	
Treatment →	T_1	T_2	T_1	T_2	T_1	T_2
1	8.75	9.28	2.30	2.44	1.98	2.10
2	7.84	8.08	1.87	2.02	1.73	1.81
3	8.68	9.13	1.93	2.03	1.88	1.98
4	8.62	9.53	2.33	2.51	1.97	2.16
5	8.39	9.45	1.77	2.49	1.80	2.14
6	8.09	10.51	2.13	2.63	1.83	2.35
Average	8.39^{a}±0.15	9.33^{b}±0.32	2.05±0.10	2.35±0.11	1.87^{a}±0.04	2.09^{b}±0.07

a ,b means with different super scripts in rows differ statistically

estimated by digital electronic milk testing machine "Milkotester" (REMI made). Total solids i.e. dry matter content of milk sample was estimated by gravimetric or evaporation method. A known quantity of milk was driven off its water and the residue which was left out was expressed as percent of total solids. About 5 g of milk sample was transferred to a pre weighed clean, dry empty silica dish and the weight of dish with sample was taken. The dish was placed in a boiling water bath for 30 minutes. The dish was removed; bottom was wiped and kept in hot air oven at 98-100°C for about 3 hrs. Then the dish was transferred to a desiccator to cool for about 30 minutes and the weight was taken accurately. The difference in the weight between the residue plus dish and empty dish was expressed as per cent of total solids.

Solid- Not- Fat (SNF)

% SNF= total solids-percent fat content

Fat-corrected milk yield

For the conversion of whole milk into 4% FCM, the equation derived by Gaines and Davidson (1923) as given below was used:

4% FCM (kg) = (0.4× M +15× F)

Where, M=milk yield in kg,F= weight of fat contained in it.

The digestion trial of 7-days collection period was conducted at the end of the feeding trial during which quantity of feed offered, leftover of the ration and total faeces voided by the animals were recorded on 24 hrs basis (Plate 3.9). The samples of the feeds and faeces were collected and preserved for proximate analysis. Based on data of feed ingested and their nutritive value; the intake of DCP and TDN by individual animal were worked out. DCP of a feed stuff express the amount of crude protein which gets digested after ingestion of 100 gms of that specific feed stuff.

DCP = (CP% of the feed × digestibility of CP)/100

Likewise DCF, DNFE, DEE were calculated and total digestibility of nutrient was calculated as:

TDN% = % DCP +%DCF +%DNFE +(%EE× 2.25)

Daily representative samples of concentrate mixture, green fodder (maize) fed to the animals and faeces were collected during digestibility trial and the pooled samples were analyzed for proximate principles. [2]

Table 5: Cumulative intakes of DM, CP, DCP and TDN (kg/h) of experimental cows

Ani. No. ↓	DM		CP		DCP		TDN	
Treat. →	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
1	1250.05	1257.92	162.34	168.17	110.30	120.87	787.20	835.37
2	1157.74	1168.10	146.63	150.20	88.91	101.44	705.28	727.23
3	1277.65	1374.46	165.86	187.51	119.59	135.34	780.88	821.87
4	1252.49	1263.80	162.66	167.82	114.66	124.71	775.67	857.84
5	1280.03	1376.01	165.61	187.39	112.31	138.51	755.67	850.78
6	1235.97	1155.35	161.71	149.45	114.27	97.22	728.04	945.59
Average	1242.32± 18.28	1265.94± 39.06	160.80± 2.92	168.42± 6.87	110.01± 4.40	119.68± 6.98	755.38^{a}± 13.33	839.78^{b}± 28.67

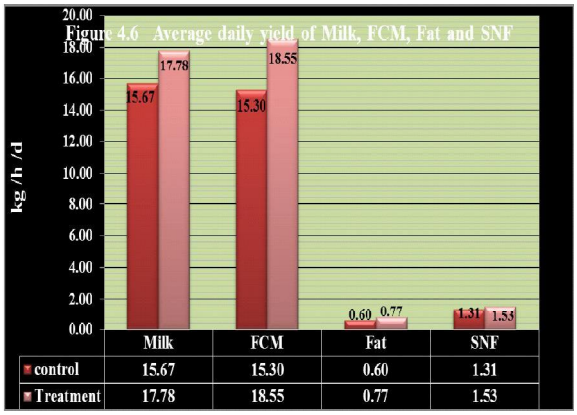
a, b means with different super scripts in rows differ statistically

Table 6: Average daily whole milk, 4% FCM, fat and SNF (kg/h/d) yield of experimental cows

Animal No ↓	Milk production		FCM		Fat		SNF	
Treat. →	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
1	16.25	20.48	18.26	21.56	0.79	1.35	1.35	1.76
2	15.03	15.80	15.26	17.54	0.58	1.28	1.28	1.40
3	14.98	19.43	14.33	20.59	0.56	1.28	1.28	1.70
4	15.73	16.10	14.52	15.78	0.55	1.30	1.30	1.43
5	14.56	16.57	13.09	17.10	0.48	1.24	1.24	1.42
6	17.45	17.90	16.33	18.71	0.62	1.44	1.44	1.49
Average	15.67^a ±0.43	17.78^b± 0.81	15.30^a ±0.74^a	18.55^b ±0.90	0.60^a ±0.04	1.31^b± 0.03	1.31^a± 0.03	1.53^b ±0.06

a, b means with different superscripts in rows differ statistically

Figure Average Daily Yield of Milk, FCM, Fat and SNF



The data generated during the experiment was analyzed, using methods given in Snedecor and Cochran (1994).[3]

Results and Discussion

The average daily DMI in terms of kg/h/d, kg/100kg BW and kg/$W^{0.75}$ were 13.80±0.20 and 14.07±0.43;3.38±0.14 and 3.54±0.1 and 3.15±0.09 and 3.07±0.05 in T1 and T_2 groups, respectively and the treatment differences were statistically (P<0.05) non significant. Similar results were also reported by Schneider *et al* (1988), Garg and Mehta (1998), Tyagi and Thakur (2007), Shankhpal *et al* (2009a), Shelke and Thakur (2011), Mudgal *et al* (2012) and Ranjan *et al* (2012).[4-10] However, Moallen *et al* (2007)[11] observed increase in DMI due to supplementation of bypass fat. The average daily CPI in terms of g/h/d; g/100kg BW and g/$W^{0.75}$ were 1786.70±32.48 and 1871.35±76.35; 450.10±14.02 and 455.22±16.06 and 91.46±2.92 and 89.13±1.84 in T_1 and T_2 groups, respectively. Thus, supplementation of bypass fat in ration of experimental cows indicating non significant difference between the groups in terms of crude protein intake.

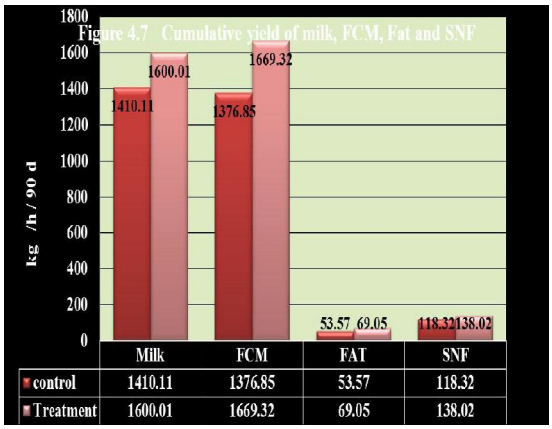
The average DCP intake in terms of g/h/d; g/100 kg BW and g/$W^{0.75}$ of experimental cows in T_1 and T_2 groups during digestion trial were 1222.32±48.95 and 1329.80±77.60; 299.03±17.35 and 334.85±20.95 and 271.62±11.25 and 297.78±17.28, respectively; which was statistically non significant between the treatment groups. Thus, supplementation of

Table 7: Cumulative yield of whole milk, 4% FCM, fat and SNF (kg/h) of experimental cows

Animal No ↓	Milk production		FCM		Fat		SNF	
Treatment	T_1	T_2	T_1	T_2	T_1	T_2	T_1	T_2
1	1462.50	1842.75	1643.79	1940.72	70.74	80.28	121.39	158.03
2	1352.97	1422.00	1373.63	1578.42	51.84	67.32	115.10	126.17
3	1348.47	1784.25	1289.79	1853.41	49.95	75.96	115.29	153.36
4	1415.97	1449.00	1306.72	1420.44	49.32	55.71	117.20	128.71
5	1310.22	1491.03	1177.83	1539.17	43.56	62.91	111.63	127.96
6	1570.50	1611.00	1469.33	1683.75	55.98	72.09	129.33	133.81
Average	1410.11 ^{a}± 38.96	1600.01^b ±72.88	1376.85^a± 66.31	1669.32^b ±80.60	53.57^a ±3.81	69.05^b ±3.66	118.32^a± 2.56	138.01^b ±5.72

a, b means with different super scripts in rows differ statistically

Figure Cumulative yield of whole milk, 4% FCM, fat and SNF (kg/h) of experimental cows



bypass fat in ration of experimental animals did not affect digestible crude protein intake. The average daily TDNI in terms of kg/h/d; kg/100 kg BW and kg/$W^{0.75}$ were 8.39±0.15 and 9.33±0.32;2.05±0.10 and 2.35±0.32 and 1.87±0.04 and 2.09±0.07 in T_1 and T_2 groups, respectively. The TDNI in terms of kg/h/d and kg/$w^{0.75}$ were statistically (P<0.05) differed. Whereas, in terms of kg/100kg BW the treatment different statistically (P>0.05) similar. Shelke and Thakur (2011) found significant effect on TDN intake with group fed rumen protected fat at 2.5% of DMI (2.03 kg/d) than in control group (1.75 kg/d). However, Shankhpal *et al* (2009a) reported non-significant difference for average TDNI (7.91, 8.56 and 9.11 kg/h).[8] Thus, supplementation of bypass fat in ration of experimental cows significantly increased TDNI.

The cumulative intake of DM, CP, DCP and TDN were (1242.32±18.28 and 1265.94±39.06; 160.80±2.92 and 168.42±6.87; 110.01±4.40 and 119.68±6.98; 755.38±13.33 and 839.78±28.67 kg/head/90d) in T_1 and T_2 groups, respectively; suggest differ statistically (P<0.05) in terms of cumulative TDNI while as statistically non significant difference between the treatment groups for cumulative DMI, CPI and DCPI. Thus, supplementation of bypass fat in ration of experimental cows increased the cumulative TDN intake while has no adverse effect on cumulative DMI, CPI and DCPI.

DMI percent of requirement for T_1 and T_2 was 112.49±4.61 and 118.06±4.28, respectively. The experimental crossbred cows received 12.49 and 18.06 percent more DM than requirement.

The DCP percent of requirement in T_1 and T_2 groups was 129.42±5.62 and 119.75±7.72, respectively. The experimental crossbred cows received 29.42 and 19.75 percent more DCP than requirement. The TDN intake percent of requirement in T_1 and T_2 was 105.76±2.72 and 105.37±5.35, respectively which was 5.76 and 5.37 percent more than the requirement.

The average daily production of whole milk, 4% FCM, fat and SNF in experimental crossbred cows in groups T_1 and T_2 were,15.67±0.43 and 17.78±0.81, 15.30±0.74 and 18.55±0.90; 0.60±0.04 and 0.77±0.04 and 1.31±0.03 and 1.53±0.06 kg/h/d, respectively and all values were statistically (P<0.05) significant between the treatment groups. Thus, the values of whole milk production, 4% FCM, fat and SNF yield were higher in bypass fat fed group than control group.

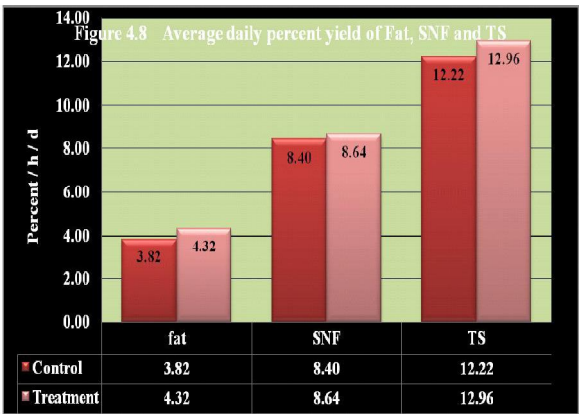
Andrew *et al* (1991), Garg and Mehta (1998), Garg *et al* (2002), Sahu *et al* (2010), Bhanderi *et al* (2011) and Shelke *et al* (2012) also observed increase in whole milk yield in dairy animals fed bypass fat.[12,13,4,14-16] Similarly, Schneider *et al* (1988), Sklan *et al* (1992), Wu *et*

Table 8: Average percent of milk fat, SNF and Total solid of experimental cows

Animal No. ↓	Fat %		SNF%		TS%	
Treat. →	T_1	T_2	T_1	T_2	T_1	T_2
1	4.28	4.35	8.30	8.58	12.58	12.93
2	3.82	4.73	8.51	8.87	12.33	13.60
3	3.63	4.27	8.55	8.60	12.18	12.87
4	3.55	3.87	8.28	8.88	11.83	12.75
5	3.69	4.22	8.52	8.58	12.21	12.80
6	3.93	4.48	8.24	8.31	12.17	12.79
Average	3.82^{a}±0.11	4.32^{b}±0.12	8.40^{a}±0.06	8.64^{b}±0.09	12.22^{a}±0.10	12.96^{b}±0.13

a, b means with different superscripts in rows differ significantly

Figure Average percent of milk fat, SNF and Total solid of experimental cows



al (1994), Mishra *et al* (2004), Tyagi and Thakur (2007), Shelke and Thakur (2011), Parnerkar *et al* (2011) and Desai (2012) reported a significant increase in whole milk and FCM yield in dairy animals fed bypass fat which is in agreement of present findings.[17-19,7,9,20,10,21] Parnerkar *et al* (2010), Sahoo *et al* (2010) and Ranjan *et al* (2012) found a significant increase in FCM yield in dairy animals fed bypass fat.[22,6,15] On contrary, Saxena *et al* (2009), Ranjan *et al* (2012) and Wadhwa *et al* (2012) reported no difference in milk yield when buffaloes were fed bypass fat.[23,6,24]

The cumulative yield (kg/h/90d) for whole milk, 4% FCM, fat and SNF were, 1410.11±38.96 and 1600.01±72.88; 1376.85±66.31 and 1669.32±80.60; 53.57±3.81 and 69.05±3.66 and118.32±2.56 and 138.02±5.72in T_1 and T_2 groups, respectively. The cumulative yield was significantly (P<0.005) higher in bypass fat fed group as compared to control.

The average percent of milk fat, Total solid and SNF of experimental cows in groups T_1 and T_2 were, 3.82±0.11 and 4.32±0.12;12.24±0.22 and 12.94±0.13 and 8.40±0.06 and 8.64±0.09, respectively. The milk fat percent, Total solid percent and SNF percent were found to be statistically (P<0.05) significant between the treatment groups and was higher in T_2thanT_1 group. Thus, supplementation of bypass fat in ration of experimental animal increased fat, Total solid and SNF percent of milk.

Similar results were also reported by Schneider *et al* (1988), Sklan *et al* (1992), Mishra *et al* (2004), Garg *et al* (2008), Shankhpal *et al* (2009a), Shelke and Thakur (2010), Parnerkar *et al* (2010), Bhanderi *et al* (2011) and Shelke *et al* (2012).[13,25,18,22,7-9,16] However, Kent and Arambel (1988), Andrew *et al* (1991), Wu *et al* (1994), Harrison *et al* (1995), Moallem *et al* (2007), Sirohi *et al* (2007), Tyagi and Thakur (2007), Lounglawan *et al* (2008), Purushothaman *et al* (2008) and Wadhwa *et al* (2012) observed similar milk fat percent in bypass fat and control group.[12,26-28,11,29,30,10,24,21]

Conclusion

The average daily DMI of crossbred cows did not differ in control and treatment groups. The CPI and DCPI were found to be similar in both treatment groups. The TDNI was statistically (P<0.05) significant and found higher in bypass fat fed group. Supplementation of bypass fat increased the digestibility coefficient of Ether extract, but digestibility coefficient of DM, OM, CP, CF and NFE were statistically (P<0.05) similar. The feed conversion efficiency in terms of DM, CP,DCP and TDN to whole milk and 4% FCM was statistically (P<0.05) significant and higher in bypass fat supplemented group as compare to control group. Provision of bypass fat to cows resulted in statistically (P<0.05) significant and higher in daily yield of whole milk, fat, SNF and 4% FCM as compare to control group. The daily percentage of milk fat, total solid and SNF were statistically (P<0.05) significant and higher in bypass fat fed group than control group.

References

1. ICAR. *Nutriment Requirements of Livestock and Poultry*. 2nd revised ed. Indian Council of Agricultural Research, New Delhi: 1998.
2. AOAC. *Official Methods of Analysis*. Association of Official Analytical Chemists.18th ed., Washington, DC: 2005.
3. Snedecor GM and GW Cochran. Statistical methods, (8th edition), Affiliated East West Press Iowa State University press, USA. Published by Oxford and IBN Publishing Co.

Kolkatta-16: 1994.

4. Garg MR and Mehta AK. Effect of feeding bypass fat on feed intake, milk production and body condition of Holstein Friesian cows. *Indian J Anim Nutr.* 1998; 15: 242-245.
5. Mudgal V, Baghel RPS, Ganie A and Srivastava S. Effect of feeding bypass fat on intake and production performance of lactating crossbred cows. *Indian J Anim Res.* 2012; 46: 103-104.
6. Ranjan A, Sahoo B, Singh VK, Srivastava S, Singh SP and Pattanaik AK. Effect of bypass fat supplementation on productive performance and blood biochemical profile in lactating Murrah buffaloes. *Trop Anim Health Prod.* 2012; 44: 109-114.
7. Schneider PL, Sklan D, Chalupa W and Kronfeld DS. Feeding calcum salts of fatty acids to lactating cows. *J Dairy Sci.* 1988; 71: 2143-2150.
8. Shankhpal SS, Gupta RS, Parnerkar S and Dhami AJ. Effect of supplementation of bypass fat on feed intake and digestibility of nutrients in lactating crossbred cows. *Proceedings of Animal Nutrition Association World Conference*, February 14-17, New Delhi, India: 2009; 69.
9. Shelke SK and Thakur SS. Economics of feeding rumen protected fat and protein to lactating Murrah buffaloes. *Indian J Anim Nutr.* 2011; 28: 278-282.
10. Tyagi N and Thakur SS. Effect of supplementing protected fat on nutrient utilization, lactation performance and reproductive performance of crossbred cows. *Proceedings of International Tropical Animal Nutrition Conference*, October 4-7, 2007, NDRI, Karnal, India: 2007; 269-270.
11. Moallem U, Katz M, Arieli A and Lehrer H. Effect of prepartum propylene glycol or fats differing in fatty acid profiles on feed intake, production, and plasma metabolites in dairy. 2007.
12. Andrew SM, Tyrrell HF, Reynolds CK and Erdman RA. Net energy for lactation of calcium salts of long-chain fatty acids for cows fed silage-based diets. *J Dairy Sci.* 1991; 74(8): 2588-2600.
13. Bhanderi BM, Sherasia PL and Garg MR. Effect of supplementing bypass fat with and without rumen protected choline chloride on milk yield and blood metabolites in crossbred cows. *XIV Biennial Conference of Animal Nutrition Society of India*, November 3-5, 2011, GBPUA & T, Pantnagar, India: 2011; 60.
14. Garg MR, Sherasia PL, Bhanderi BM, Gulati SK and Scott TW. Effect of feeding rumen protected nutrients on milk production in crossbred cows. *Indian J Anim Nutr.* 2002; 19: 191-198.
15. Sahoo B, Ranjan A, Singh VK, Srivastava S, Singh SP and Kumar R. Effect of bypass fat supplementation on productive performance and blood biochemicals of lactating Murrah buffaloes. *Proceedings of VII Biennial Animal Nutrition Association Conference*, December 17-19, OUAT, Bhubaneswar, India: 2010; 115.
16. Shelke SK, Thakur SS and Amrutkar SA. Effect of feeding protected fat and proteins on milkproduction, composition and nutrient utilization in Murrah buffaloes. *Anim Feed Sci Technol.* 2012; 171: 98-107.
17. Desai V. Effect of feeding bypass fat on milk production from buffaloes of tribal areas in Panchmahal and Vadodara district. *M.V.sc thesis.* Department of Animal Nutrition, college of veterinary science and animal husbandry, Anand Agricultural university, Anand: 2012.
19. Parnerkar S, Kumar D, Shankhpal SS and Thube H. Effect of feeding bypass fat to lactating buffaloes during early lactation. *XIV Biennial Conference of Animal Nutrition Society of India*, November 3-5, , GBPUA & T, Pantnagar, India: 2011; 60.
20. Sklan D, Ashkenazi R, Braun A, Devorin A and Tabori K. Fatty acids, calcium soaps of fatty acids, and cottonseeds fed to high yielding cows. *J Dairy Sci.* 1992; 75: 2463-2472.
21. Wu Z, Huber JT, Chan SC, Simas JM, Chen KH, Verela JG, Santos F, Fontes C and Yu P. Effect of source and amount of supplemental fat on lactation and digestion in cows. *J Dairy Science.* 1994; 77: 1644-51.
22. Parnerkar S, Kumar D, Shankhpal SS and Thube H. Effect of feeding bypass fat to lactating buffaloes during early lactation. *Proceedings of VII Biennial Animal Nutrition Association Conference*, December 17-19, OUAT, Bhubaneswar, India: 2010; 126.
23. Saxena N, Jyotsana, Chander M, Sharma ML, Kumar K and Lal D. (2009). Field study on supplementation of protected fat on production performance of high yielding buffaloes in Haryana. *XIII Biennial Conference*

of Animal Nutrition Society of India, December 17-19, NIANP, Banglore, India: 2010; 163.
24. Wadhwa M, Grewal RS, Bakshi MP and Brar PS. Effect of supplementing bypass fat on the performance of high yielding crossbred cows. *Indian J Anim Sci.* 2012; 82: 200-203.
25.. Garg MR, Sherasia PL, Bhanderi BM, Gulati SK and Scott TW. Effect of feeding bypass fat supplement on milk production and characteristics of butter fat. *Indian J Dairy Sci.* 2008; 61: 56-61.
26. Harrison JH, Kincaid RL, McNamara JP, Waltner S, Loney KA, Riley RE and Cronrath JD. Effect of whole cottonseeds and calcium salts of long-chain fatty acids on performance of lactating dairy cows. *J Dairy Sci.* 1995; 78: 181-193.
27. Kent BA and Arambel MJ. Effect of calcium salts of long-chain fatty acids on dairy cows in early lactation. *J Dairy Sci.* 1988; 71: 2412-2415.
28. Lounglawan P, Chullanandana K and Suksombat W. The effect of hydrogenated fat or Ca-salt of fatty acids on milk yield, composition and milk fatty acid of dairy cows during mid lactation. *Thai J Agric Sci.* 2008; 41: 29-36.
29. Purushothaman S, Kumar A and Tiwari DP. Effect of feeding calcium salts of palm oil fatty acids on performance of lactating crossbred cows. *Asian-Aust J Anim Sci.* 2008; 21: 376-385.
30. Sirohi SK, Thakur SS, Walli TK, Kohli RK and Malik R. Supplementation effect of bypass fat on nutrient utilization and milk production performance of Sahiwal cows. *Proceedings of International Tropical Animal Nutrition Conference*, October 4-7, 2007, NDRI, Karnal, India: 2007; 271-272.