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Effect of varying levels of bypass fat on digestibilities of nutrients and balances of N, P and Ca in lactating Jaffrabadi buffaloes

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ABSTRACT

Lactating Jaffrabadi buffaloes (24; first to fourth lactation and average body weight 650.0 kg) were randomly divided into 4 groups of 6 animals each as per completely randomized design and allocated to 4 dietary treatments as T1,T2, T3 and T4. Experimental buffaloes were offered commercial concentrate mixture and cotton seed cake in equal proportion (50:50) to fulfil the protein requirements as per ICAR (1998) along with the basal diet of 10 kg seasonal green and mature pasture grass hay *ad lib*. Commercial bypass fat was provided to all experimental buffaloes at the rate of 150g per animal for first 15 days prior to parturition and at the rate of 0, 10g, 20g and 30g / kg milk yield in T1, T2, T3 and T4 groups, respectively post partum. DMI, Per cent DMI and DMI/kg $W^{0.75}$ of lactating buffaloes remained non significant among different treatment groups during entire experiment. Lactating buffaloes also showed non-significant differences in body weight and biometry during different phases of experiment. Differences in water intake (l/day, l/100kg B.W., l/kg $W^{0.75}$ and l/kg DMI) by different levels of bypass fat supplementation were also non significant. Digestibility of the rations for DM, OM, CP, EE, CF and NFE were not significantly affected by addition of supplemental fat. Nitrogen, phosphorus and calcium balances were positive and non significant among different treatment groups. Plane of nutrition as per ICAR nutritional requirements for Indian buffaloes was comparable among different dietary treatments. Overall results indicates that bypass fat supplementation has positive but non significant effect on nutrient utilization in different groups.

Key words: Biometry, Body weight, Bypass fat, Digestibility, Jaffrabadi buffaloes

Negative energy is a major concern in early lactation period of high yielding buffaloes since the requirement of energy during this period for maintenance of body tissues and milk production often exceeds the amount of energy available from the diet leads to substantial loss in body weight and adversely affects production and reproduction. Bypass fat escapes hydrolysis and bio-hydrogenation in rumen and is one of the strategies to counteract negative energy in early lactation (Tyagi *et al.* 2010). Therefore, an experiment was conducted to study effect of varying levels of bypass fat feeding on nutrient utilization in Jaffrabadi buffaloes.

MATERIALS AND METHODS

Lactating Jaffrabadi buffaloes (24;1–4 lactation, average body weight 650.0 kg and 6 to 8 kg average milk production in early lactation) of Cattle Breeding Farm, Junagdah Agricultural University, Junagadh, were randomly selected and divided into 4 groups of 6 each. Experimental buffaloes were individually offered a basal diet of 10 kg seasonal green and mature pasture grass hay *ad lib*. Concentrate part of the ration (ICAR 1998) was offered through commercial concentrate mixture and cotton seed cake (50:50). Commercial bypass fat was provided to all experimental buffaloes @ 150g prior to post-partum and @ 0, 10g, 20g and 30g / kg milk yield in T1, T2, T3 and T4, respectively post partum. Lactating buffaloes received supplemental fat in second week of lactation. Chemical composition of bypass fat contained calcium soap of palm fatty acids (myristic acid -1.5%, palmitidc acid –44%, stearic acid-5%, oleic acid-40%, lineoleic acid-9.5 %, with NEl 5.75 Mcal/kg and ED 7.95 Mcal/kg).

Buffaloes of all the 4 groups were individually offered 2 equal portions of daily allowance (morning and evening) during the entire experimental period of 182 days (13 fortnights). Seasonal green silage was offered @ 10 kg at 11 am, while mature pasture grass hay was offered daily at 9 am, 5 pm and 11 pm. Ration schedules were adjusted every fortnight according to milk yield, fat per cent in milk and body weight of each animal. Clean drinking water was made available to all the animals *ad lib.* Water intakes of individual animals were measured for three consecutive

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days in liters at fortnight intervals during the experimental period. All the experimental animals were housed separately in clean individual sheds, tied all the time and were let loose for 2 h (7 to 9 am) in the morning for exercise.

Body weight (BW), heart girth (HG), body length (BL) and height at withers of experimental buffaloes was recorded for 2 consecutive days before feeding and watering at the beginning and there after every fortnight during the experiment. At the end of the experiment, three animals from each group were selected and a digestion cum metabolic trial of seven day collection period was conducted during which the quantity of feed and water offered, left over of the ration, urine and total faeces voided by the animals were recorded on the 24 h basis. Proximate analysis and phosphorus (AOAC 1995) and calcium (Talapatra *et.al.* 1940) of preserved samples of feeds, left over and feces was done. Milk fat was determined by ISI (1961). Data generated during the experiment was analyzed in CRD (Snedecor and Cochran 1994).

Table 1. Proximate composition of feed and fodder (% DM basis)

Nutrient	Cotton seed cake	Amul dan	Green maize	Mature pasture grass hay
CP	31.59	21.08	07.37	03.15
EE	07.95	03.07	01.91	02.39
CF	23.03	09.91	28.03	44.52
ASH	06.62	13.61	12.03	10.79
NFE	30.81	52.33	50.66	39.15
OM	93.38	86.39	87.27	89.21
Silica	0.80	03.84	2.63	08.03
Calcium	0.48	0.80	0.58	0.48
Phosphorus	0.60	0.50	0.30	0.15

RESULTS AND DISCUSSION

Proximate composition of feeds and fodders offered to lactating buffaloes is given in Table.1 and is found to be in normal range. There is a loss of body weight in T1, T2, T3 groups while the body weight of animals in T4 group remained constant at the end of experiment (Table 2). Changes in losses of body weight were non-significant. Lactating animals loose body weight during lactation, especially in early period. BW losses in the present experiment were higher in the early lactation but loss was compensated later. Prepartum feeding of bypass fat supplementation appeared to limit the loss of BW in early lactation also. Present findings are in agreement with Vahora (2013). Height at withers, body length and heart girth more or less remained similar and changes during different periods were statistically not significant (Table 2). Biometry observations of lactating Jaffrabadi buffaloes are in consonance with the values reported for biometry in Jaffrabadi buffaloes.

Milk fat per cent and milk production during the experiment were given in Table 3. Different levels of bypass fat supplementation had no significance on milk production

Table 2. Mean dry matter intake (DMI) and water intake, mean body weight and biometry of experimental lactating Jaffrabadi buffaloes

	Groups			
Attributes	T1	T2	T3	T4
DMI (kg/day)	17.54±0.73	18.08±0.55	16.87±0.39	16.90±0.66
DMI (kg)/100 kg bwt.	3.10±0.14	3.17±0.08	2.91±0.14	2.92±0.10
DMI (g)/kg$W^{0.75}$	150.58±3.85	154.73±2.76	142.52±5.24	142.89±3.56
Total water intake (l/day)	60.15±3.16	66.81±3.46	64.93±3.45	66.62±2.98
Water intake (l)/kg $W^{0.75}$	0.52±0.01	0.57±0.02	0.54±0.02	0.56±0.02
Water intake (l)/100 kg bwt.	10.62±0.40	11.73±0.33	11.12±0.39	11.53±0.61
Water intake (l)/kg DMI	3.46±0.04	3.72±0.15	3.88±0.16	4.02±0.20
Body weight (kg)				
Initial	583.33±49.87	595.33±35.35	592.83±32.42	577.33±28.29
Final	561.00±53.81	552.33±24.92	572.83±32.39	578.00±38.80
Gain / loss	22.33	43.00	20.00	-0.67
Height at wither (cm)				
Initial	143.00±2.63	141.67±1.89	142.33±2.08	142.50±1.73
Final	143.50±2.77	142.00±1.95	143.00±2.10	143.33±1.58
Gain / loss	-0.50	-0.33	-0.67	-0.83
Heart girth (cm)				
Initial	218.67±9.64	215.03±5.95	216.23±4.08	226.06±12.12
Final	216.79±8.90	217.47±4.25	218.33±5.34	224.66±12.26
Gain / loss	1.88	-2.44	-2.10	1.40
Body length (cm)				
Initial	162.33±8.21	156.17±1.58	154.67±5.19	161.50±4.25
Final	163.17±8.30	157.00±1.83	159.00±4.79	162.50±4.18
Gain / loss	-0.84	-0.83	-4.33	-1.00

Table 3. Milk and fat yield of experimental Jaffrabadi buffaloes

Groups	T1	T2	T3	T4
Total whole milk (kg)	1170.10±80.6	1448.80±122.7	1118.77±102.5	1282.79±66.4
Average daily milk yield (kg)	6.43±0.44	7.96±0.67	6.15±0.56	7.05±0.36
Total fat yield (kg)	73.42±5.07	95.42±8.18	78.31±7.29	91.84±8.85
Average daily fat % in milk	6.26^{c}±0.15	6.58^{bc}±0.08	7.04^{ab}±0.20	7.12^{a}±0.16

Means in a column with different superscripts differ significantly (P<0.05).

Table 4. Digestion coefficients of experimental rations supplemented with varying levels of bypass fat

Groups	DMD	CPD	EED	CFD	NFED	OMD
T1	53.68±6.08	72.57±1.43	70.42±1.35	61.33±2.20	50.77±8.74	55.98±5.56
T2	55.55±4.64	73.35±1.59	73.46±2.27	56.19±3.65	59.10±5.24	58.60±4.03
T3	53.49±5.58	73.27±3.31	71.64±3.04	52.07±3.30	58.38±7.41	55.73±5.17
T4	51.21±6.69	68.82±3.76	70.59±1.90	51.65±9.43	52.78±4.99	52.64±6.91
S.Em.±	5.79	2.72	2.22	5.42	6.70	5.51
C.D. at 5 %	NS	NS	NS	NS	NS	NS
C.V. %	18.77	6.55	5.39	17	21.02	17.14

but milk fat percentage was significant (P<0.05) and increased linearly with graded levels of bypass fat supplementation. Kim *et al.* (1993) reported no beneficial effect of feeding of bypass fat in in increasing the milk production. Research findings of these workers are in line with the observation in the present study.

Mean daily DMI (kg), per cent DMI and DMI (g) / metabolic BW were given in Table 4. Dry matter intake (kg/day), per cent DMI and DMI/kg$W^{0.75}$ remained non significant during the entire experimental period and was unaffected by levels of bypass fat supplementation.

At higher levels of bypass fat supplementation, lactating buffaloes did not consume more DM, but on acclimatization to the fat supplementation, they consumed required DM which was apparent from overall mean DMI, per cent DMI and DMI/kg$w^{0.75}$ during the entire experimental period. Ranjan *et al.* (2012) offered by pass fat supplements to lactating Murrah buffaloes and found no significant effect on dry matter intake. In the present experiment, lactating Jaffrabadi buffaloes received 0 (T1), 10 g (T2), 20 g (T3) and 30 g (T4) per day per kg of milk production. Though overall DMI and per cent DMI were non significant, T2 group animals had 3.07 % and 2.25 % more total DMI and per cent DMI, respectively, over control group of animals. Animals in T3 and T4 groups was having lower DMI per day and per cent DMI over control group. Overall results indicated that at 10 g supplementation per kg of milk per day did not affect the DMI intake per day, per cent DMI and DMI/kg$W^{0.75}$. However 20 and 30 g supplements / day / kg of milk production appeared to lower, though nonsignificantly, the DMI/day, per cent DMI and per kg metabolic body weight.

Mean daily water intake (l/day), mean water intake kg/ metabolic body weight (l/day), mean water intake kg/100kg body weight and water intake l/kg DMI are given in Table 4. Daily water intake was slightly on higher side in bypass fat supplementation group. Water intake (l/kg $W^{0.75}$ and l/ 100 kg B.W.) were unaffected by bypass fat supplementation. Mean water intake / kg DMI being nonsignificant, in the present experiment. Water intake per kg DMI was in conformity as suggested by Thomas and Sastry (1999) for Indian buffaloes.

Table 5. Balances of N, P, and Ca (g/day/animal) in lactating Jaffrabadi buffaloes

Groups	Nitrogen	Calcium	Phosphorus
T1	100.41±12.76	9.48±9.33	14.19±1.91
T2	104.63±11.20	38.76±9.95	19.18±2.96
T3	78.38±14.87	3.46±11.65	11.33±2.21
T4	107.77±8.05	8.32±7.93	12.48±3.02
S.Em.±	11.98	9.80	2.57
CD at 5 %	NS	NS	NS
CV %	21.22	113.18	31.17

Digestibilities of the rations for DM, OM, CP, EE, CF and NFE are given in Table 5. From the perusal of the data, it is evident that digestibilities of experimental rations were not affected significantly by addition of supplemental fat. Apparently the digestion coefficients were higher in T2 group of lactating buffaloes that were offered bypass fat @ 10 g/kg milk production. Sirohi *et al*. (2010) reported that inclusion of bypass fat did not affect the digestibility of nutrients. Supplementation of bypass fat had significant effect in increasing the digestibility of EE (Thakur and Shelke 2010). However in the present experiment, EE digestibility, though apparently higher in supplement groups than control group of buffaloes, was unaffected.

The data pertaining to N, Ca and P intake, voided in feces, urine, milk and balances are given in Table 6. Nitrogen, phosphorus and calcium balances were non significant among different treatment groups. Mean balances N, P and Ca were positive in all the treatment

Table 6. Plane of nutrition of experimental lactating Jaffrabadi buffaloes

Groups	B wt. (kg)	MB wt. (kg)	DMI (kg)	DCP		TDN		DE intake (M.cal)	ME intake (M. cal)	DMI		Nutrient intake/ unit MBwt			PE ratio
				% in ration	Intake kg/d	% in ration	Intake kg/d			kg/100 kg Bwt	g/MB wt	DCP (g)	DE (k.cal)	ME (k.cal)	
T1	577.21	117.31	17.54	7.26	1.18	53.83	9.44	41.66	34.41	3.46	161.51	10.12	355.13	291.02	1:35.09
T2	572.27	116.87	18.08	7.34	1.31	56.03	10.13	44.71	36.63	3.40	167.41	11.23	382.56	313.43	1:34.07
T3	586.37	119.01	16.87	7.33	1.20	54.19	9.14	40.30	33.05	3.49	166.69	10.14	338.63	277.71	1:33.40
T4	584.50	118.65	16.90	6.88	1.18	51.26	8.66	38.23	31.31	3.38	160.45	9.98	322.21	263.84	1:33.29
ICAR (1985)	580.00	118.18	17.34	5.58	0.968	53.92	9.315	41.27	33.81	2.99	146.78	8.19	349.21	286.09	1:42.64

groups. Balances of N, P and Ca reflect the period of seven days during metabolic trial. During this period, all the animals retained nitrogen and phosphorus in positive manner. The quantitative balances of nitrogen are in agreement with Kaur *et al*. (2009) in Murrah buffaloes on different experimental diets. From the perusal of the data on balances it is evident that all the experimental buffaloes retained the nutrients at all levels of bypass fat inclusion in the diets.

Plane of nutrition: Plane of nutrition of experimental lactating Jaffrabadi buffaloes is given Table 6. Average DMI of the experimental animal was taken into consideration for arriving at different nutrients intake for ICAR feeding standards. DCP% and DCP intakes in the ration in all the experimental rations were higher than ICAR recommended levels, while TDN% and TDN intake were at par with ICAR (1998) recommended feeding levels. High DCP % and intake may be due to differences in calculated values and trial values in commercial concentrate mixture. DE and ME intakes (day/unit metabolic body weight) were comparable to ICAR feeding standards, However DCP intake was higher than ICAR feeding levels. P:E ratio was narrower compared to ICAR recommended ratio which may be due to higher DCP intake per kg metabolic body weight.

Overall results indicated that supplementing daily rations in lactating Jaffrabadi buffaloes with varying levels of bypass fat have positive but non significant effect on nutrients utilization in different treatment groups. Plane of nutrition of the experimental animals was at par with ICAR (1998) feeding levels.

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