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Effect of Additional Energy Supplement on the Productive Performance of Lactating Murrah Buffaloes

Danveer Singh Yadav[1], G.P. Lakhani[1], R.P.S. Baghel[1], B. Roy[1], A. Mishra[1], S. Nanavati[1], R. Choudhary[1], J. Shakkarpude[1]

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ABSTRACT

Background: Energy is one of the most important nutritional factors that limits the production of dairy animals. It has been observed that the productivity of dairy animals is adversely affected because of lack of providing sufficient ration in early lactation stage which results into weight loss, anemia and various reproductive and metabolic disorders. Maximizing energy intake by increasing the energy density of the diet is a logical feeding strategy for early lactating buffaloes.

Methods: Considering the need of energy in high yielding lactating animals especially in their early stage of lactation, the experiment was planned to investigate the effect of additional energy supplement (5% additional concentrate, soybean oil @ 100 ml/animal/day, bypass fat @ 100 g/animal/day and roasted soybean @ 100 g/animal/day) on productive performance of 30 apparently healthy lactating Murrah buffaloes for a period of 90 days post-partum.

Result: Maximum per cent increase in the milk yield was noted in buffaloes of T3 group. The average fat percent in milk has increased significantly ($p<0.05$) throughout the study period in all the groups. There was no significant difference in the overall average protein, lactose, SNF and total solids percent were observed among the groups.

Key words: Additional energy, High yielding, Lactating murrah buffaloes, Productive performance.

INTRODUCTION

India is the motherland for the superior milch breeds of buffalo's contributing 57.3% of world's population, having 109.85 millions in India (Livestock Census, 2019). These buffaloes share 49% of the India's total milk production (BAHS, 2019). Hence, the contribution of buffaloes in the milk production of the country is significantly higher. Most of the animals in developing countries including India suffer shortage of feed resources and are fed on agriculture by-products and low-quality crop residues, which have got inherent low nutritive value and digestibility responsible for low productivity of dairy animals. Energy is one of the most important nutritional factors that limit production in dairy buffaloes. It has been realised that the high producing dairy animals in early lactation remain in negative energy balance for first 8 to 12 weeks because of lack of sufficient dry matter intake and higher milk yield. As a result, their energy intake is not sufficient to meet the energy requirements for maintenance and milk production (Pantoja *et al*., 1996). The energy intake of high yielding buffaloes during initial lactation phase is almost lower than half of the energy required for production purposes. During early lactation buffaloes are unable to consume enough energy from the feed to meet their energy demand for lactation. Thus, the body reserves are mobilized, leading to the negative energy balance which adversely affects their peak milk yield and overall lactation yield. The additional energy in the diet of lactating animals has been found to affect the efficiency of animals as an output of a combination of caloric and non-caloric effects. Studies conducted in dairy animals indicated that use of fat as tallow, whole flaxseed, calcium salts of fatty acids (Sultana *et al*., 2008), soybean oil (Shelke and Thakur, 2011), sunflower oil (Dai *et al*., 2011) and mustard oil (Kathirvelan and Tyagi, 2009) in the ration of early lactating dairy animals increased their milk production and reproductive performances and also changed the fatty acids profile of milk (Parihar *et al*., 2018).

Keeping in view the above facts and considering the need of energy in high lactating animals especially in their early stage of lactation, the experiment was planned to investigate the effect of additional energy supplement on the productive performance of lactating Murrah buffaloes for a period of 90 days pos-partum. The additional energy was supplemented in the form of concentrate ration, soybean oil, by pass fat and roasted soybean. Productive performance parameters like milk yield, peak milk yield,

[1]Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Jabalpur-482 001, Madhya Pradesh, India.

Corresponding Author: Rashmi Choudhary, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Mhow-453 446, Madhya Pradesh, India. Email: rashmichoudhary967@gmail.com

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lactation milk yield, persistency of milk production and milk components were recorded.

MATERIALS AND METHODS

The present experiment was conducted at Livestock Farm Complex, Adhartal, College of Veterinary Science and Animal Husbandry, NDVSU, Jabalpur (M.P.) Thirty lactating Murrah buffaloes were selected on the basis of similarity in the body weight (450 kg), parity (second stage of lactation), age (5-6 years), milk yield and free from any anatomical, physiological and infectious disorders and were randomly distributed into five groups each containing six animals. The experiment was conducted as per the guidelines of Institutional Animal Ethics Committee (IAEC). All the animals were maintained under intensive system of farming. Basal diet was formulated using maize, cotton seed cake, mustard seed cake, wheat bran, rice polish, arharchuni along with mineral mixture and salt, as per ICAR (2013) feeding standards. All supplementation was started from 15th day post-partum and was continued up to 3 months post-partum. The composition of basal ration is given in Table 1.

The experimental period was for one year *i.e*., from July 2018 to end of June 2019.The grouping of the animals was based on the dietary treatments and is described in the Table 2.

Production performance parameters to be studied includes

Milk yield

Daily milk yield (kg) of the animals was measured in the morning and evening usually at a fixed time.

Peak milk yield

The peak milk yield of the animals was recorded from their daily milk record.

Lactation yield

The lactation yield of the animals was recorded from their milk yield during 305 days.

Persistency of milk production

Persistency is defined as the milk yield at one test expressed as a percentage of milk yield at an earlier test, adjusted to a 30-day interval between tests. Therefore, if two tests are exactly 30 days apart persistency can be simply calculated as follows using the formula given by Sastry and Thomas (2005).

$$\text{Persistency \%} = \frac{\text{Milk kg at later test}}{\text{Milk kg at earlier test}} \times 100$$

Milk components

The milk components including fat, protein and solid not fat (SNF) were analyzed after 21 days of calving to 305 days postpartum at fortnightly intervals. The representative milk samples from individual buffaloes of different groups were collected in plastic sample bottles during the study period. The milk samples were analyzed for various parameters using lacto scan (Netco, Pvt. Ltd.).

RESULTS AND DISCUSSION

Daily milk yield (MY)

The average daily milk yield (L) in lactating Murrah buffaloes offered different dietary treatments at monthly intervals after post-partum to 305 days lactation is presented in Table 3. Statistically, there was no significant difference in the average daily milk yield (L) in lactating Murrah buffaloes among the groups. Highest increase in average daily MY was seen in T3 group of buffaloes. Regarding increase in milk yield of animals due to intake of additional energy through use of bypass fat as a supplement in buffaloes have been supported by Barley and Baghel (2009). The improvement in MY associated with supplemental fat can largely be attributed to an improvement in energy balance. The highest average per cent increase in daily MY was 17.5 in the present study than 7.27 and 7.30 reported by Alzahal *et al*. (2008) and Gowda *et al*. (2013), respectively which further indicates that pre and post-partum feeding was more effective in eliciting the higher milk production response than feeding alone in early lactation.

In the present study, gradual decrease in average daily MY from 5th month onwards was due to increase in the lactation length. Critical perusal of the data clearly revealed that the overall average daily MY significantly varied among the groups and was higher in buffaloes of T3 group followed by T4 and T5 group and was lowest in T2 group.

Peak milk yield and persistency of lactation

The peak milk yield in lactating Murrah buffaloes of different treatment groups is presented in Table 4. In the present study, percent increase in average daily milk yield in T3 group as compared to T2, T4 and T5 groups were 5.91, 3.59 and 4.41 respectively and was attributed to better utilization of nutrients, more availability of energy and improved reproductive performances. Whereas, less MY in T1 group as compared to T2, T3, T4 and T5 groups was mainly because of non-availability of fat supplements in their ration resulting in to reduced energy intake in comparison to body requirements. Higher peak milk yield (L) in T3 group followed by T5, T4, T2 and T1 groups

Table 1: Composition of basal ration used in the experiment.

Ingredients	Parts (%)
Yellow maize	38.00
Cotton seed cake	13.00
Mustard cake	20.00
Wheat bran	9.00
Rice polish	8.00
Arhar chuni	9.00
Mineral mixture	2.00
Common salt	1.00
Total	100

Table 2: Experimental design.

Groups	Animals	Treatment
T1	6	Basal diet (Control)
T2	6	Basal diet+5% additional concentrate feeding
T3	6	Basal diet+Soybean oil supplementation @ 100 ml/animal/day
T4	6	Basal diet+By pass fat energy @ 100 g/animal/day
T5	6	Basal diet+Roasted Soybean supplementation @ 100 g/animal/day

Table 3: Daily milk yield (lit.) in lactating murrah buffaloes in different treatment groups.

Trts / Months	T1	T2	T3	T4	T5
1	8.84±0.24	9.12±0.24	8.86±0.08	8.52±0.44	8.64±0.37
2	9.25±0.29	9.84±0.33	10.11±0.34	9.48±0.36	9.78±0.39
3	8.82±0.38	9.27±0.41	9.74±0.38	9.16±0.35	9.36±0.39
4	8.01±0.39	8.72±0.38	9.26±0.32	8.86±0.29	8.95±0.33
5	7.76±0.24	8.17±0.25	8.74±0.57	8.53±0.34	8.51±0.34
6	6.71±0.23	7.61±0.40	8.09±0.76	8.14±0.22	7.99±0.36
7	5.77±0.10	6.85±0.10	7.34±0.33	7.58±0.32	7.22±0.39
8	4.39±0.27	6.18±0.15	6.61±0.41	6.62±0.26	6.33±0.13
9	3.44±0.15	5.46±0.25	5.76±0.28	5.75±0.24	5.47±0.36
10	3.37±0.08	4.71±0.30	4.96±0.28	4.74±0.36	4.63±0.43
Average	6.64±0.10	7.59±0.15	7.95±0.20	7.74±0.20	7.69±0.29
Increase in daily milk yield in comparison to T1	-	0.95	1.31	1.10	1.05
Increase in daily milk yield (%)	-	14.30	19.72	16.56	15.81

Table 4: Effect of different treatments on peak milk yield and day to attend peak milk yield in lactating Murrah buffaloes.

Treatments	T1	T2	T3	T4	T5
Peak milk yield (lits.)	10.92±0.21	11.17±0.24	11.83±0.17	11.42±0.24	11.33±0.30
Increase in milk yield in comparison to T1	-	0.25	0.91	0.5	0.41
Increase in milk yield (%) in comparison to T1	-	2.29	8.33	4.58	3.75
Days to attain peak milk yield	61.33±7.98	54.00±2.42	47.33±4.76	51.83±3.52	49.33±6.21
Decrease in days to attain milk yield	-	7.33	14.00	9.50	12.00
Decrease in days (%) to attain milk yield	-	11.95	22.83	15.49	19.57

corroborate with the findings of Tyagi *et al*. (2010). The findings may be attributed to the increased energy density of the ration due to fat supplementation resulting in to higher MY and lower milk fat per cent in comparison to T1 group. The peak milk yield (days) was attained earlier in T3 group followed by T5, T4, T2 and T1 groups of buffaloes, respectively. No significant difference was observed among the groups but clearly there was reduction in days to attain the milk yield in different groups in comparison to control. The per cent decrease in days to attain peak milk yield in T2, T3, T4 and T5 groups as compared to T1 was 11.95, 22.83, 15.49 and 19.57, respectively.

The persistency of lactation in lactating Murrah buffaloes of different treatment groups is presented in Table 5. The persistency of lactation (%) was found higher in T4 group of buffaloes followed by T3, T5, T2 and T1 groups, respectively. No significant difference was observed among the groups. In comparison to control group T1, the per cent increase in persistency of lactation in T2, T3, T4 and T5 groups were 7.73, 8.53, 8.94 and 8.05, respectively. Persistency of lactation was numerically higher in group T4 as compared to T1, T2, T3 and T5 groups. The persistency of lactation was monitored for 305 days of lactation after cessation of fat supplementation to buffaloes and it was observed that bypass fat supplementation in T4 group of buffaloes not only increased the MY but the effects persisted even after the supplement was withdrawn which may be due to better dry matter intake and improved reproductive performances.

Lactation yield

The average lactation yield in lactating Murrah buffaloes under different treatment groups is presented in Table 6. The lactation yield (L/lactation/animal) based on full lactation length of 305 days was significantly ($p<0.05$) higher in T3 group followed by T4, T5, T2 and T1 group, respectively. Significant difference was observed between T1 and T3 group but no significant difference was observed between

T2 and T3 groups, T4 and T3 groups and T5 and T3 groups. In comparison to T1, increase in milk yield in T2, T3, T4 and T5 groups was 287.4, 392.83, 330.25 and 315.84 litres respectively. While the percent increase in lactation yield in T2, T3, T4 and T5 groups as compared to T1 group of buffaloes was 14.44, 19.73, 16.59 and 15.87 respectively.

Table 5: Effect of additional energy on persistency of lactation (%) in lactating Murrah buffaloes.

Trts / Months	T1	T2	T3	T4	T5
2	94.53	94.22	96.35	96.60	95.74
3	92.26	94.07	95.07	96.75	95.61
4	92.18	93.66	94.36	96.27	95.03
5	86.57	93.00	92.53	95.41	93.96
6	85.97	90.20	90.72	93.11	90.30
7	76.13	90.11	90.08	87.32	87.76
8	74.34	89.70	87.10	86.86	86.40
9	68.88	78.34	78.86	75.45	77.92
10	48.00	51.09	55.08	55.35	53.94
Persistency of lactation (%)	79.87	86.04	86.68	87.01	86.30
Increase in comparison to T1		6.17	6.81	7.14	6.43
Increase (%) in comparison to T1	-	7.73	8.53	8.94	8.05

Table 6: Effect of different treatments on lactation yield (lit./lactation/animal) in lactating Murrah buffaloes.

Treatments	T1	T2	T3	T4	T5
Lactation yield	$1990.67^{b}\pm33.42$	$2278.07^{a}\pm49.96$	$2383.50^{a}\pm65.78$	$2320.92^{a}\pm64.63$	$2306.51^{a}\pm94.01$
Increase in comparison to T1	-	287.4	392.83	330.25	315.84
Increase in comparison to T1 (%)	-	14.44	19.73	16.59	15.87

Mean bearing different superscript (a and b) within row differ significantly ($p<0.05$).

Table 7: Fortnightly average fat percent in milk of lactating Murrah buffaloes in different treatment groups.

Trts / Fortnights	T1	T2	T3	T4	T5
Initial	6.74±0.15	6.98±0.36	7.04±0.31	6.74±0.33	6.65±0.35
1st	6.04±0.11	6.37±0.38	6.74±0.34	6.05±0.32	6.46±0.36
2nd	6.05±0.16	6.51±0.28	6.83±0.38	6.16±0.30	6.54±0.44
3rd	6.24±0.22	6.44±0.26	6.78±0.40	6.42±0.38	6.64±0.39
4th	6.50±0.18	6.50±0.20	7.07±0.39	6.71±0.41	7.02±0.38
5th	6.53±0.16	6.52±0.20	7.38±0.36	6.93±0.41	7.27±0.37
6th	6.72±0.21	6.58±0.19	7.64±0.35	7.1±0.40	7.40±0.38
7th	6.79±0.21	7.06±0.24	7.83±0.32	7.26±0.37	7.61±0.45
8th	7.02±0.28	7.13±0.23	8.02±0.28	7.45±0.37	7.74±0.46
9th	7.12±0.30	7.45±0.21	8.19±0.26	7.71±0.34	8.03±0.44
10th	7.16±0.27	7.78±0.180	8.36±0.24	7.92±0.34	8.23±0.40
11th	7.32±0.31	8.00±0.16	8.55±0.25	8.17±0.35	8.49±0.39
12th	$7.52^{b}\pm0.34$	8.23±0.16	8.82±0.20	8.47±0.34	8.66±0.38
13th	$7.60^{b}\pm0.37$	$8.37^{ab}\pm0.16$	$8.95^{a}\pm0.19$	$8.70^{a}\pm0.34$	$8.76^{a}\pm0.38$
14th	$7.85^{b}\pm0.38$	$8.43^{ab}\pm0.17$	$9.20^{a}\pm0.18$	$9.02^{a}\pm0.30$	$8.98^{a}\pm0.36$
15th	$8.10^{c}\pm0.47$	$8.48^{bc}\pm0.16$	$9.47^{a}\pm0.17$	$9.30^{ab}\pm0.25$	$9.15^{ab}\pm0.37$
16th	$8.17^{c}\pm0.46$	$8.47^{bc}\pm0.11$	$9.47^{a}\pm0.14$	$9.30^{ab}\pm0.26$	$9.22^{ab}\pm0.39$
17th	$8.28^{c}\pm0.44$	$8.53^{bc}\pm0.16$	$9.55^{a}\pm0.13$	$9.35^{ab}\pm0.24$	$9.27^{ab}\pm0.37$
18th	$8.29^{c}\pm0.45$	$8.51^{bc}\pm0.17$	$9.53^{a}\pm0.11$	$9.34^{ab}\pm0.22$	$9.28^{ab}\pm0.38$
Average	$7.15^{c}\pm0.18$	$7.48^{bc}\pm0.3$	$8.18^{a}\pm0.24$	$7.79^{abc}\pm0.27$	$7.96^{ab}\pm0.24$
Increase in comparison to T1		0.33	1.03	0.64	0.81
Change in fat (%)	-	4.62	14.41	8.95	11.33

Mean bearing different superscript (a, b and c) within row differ significantly ($p<0.05$).

Table 8: Fortnightly average protein percent in milk of lactating murrah buffaloes in different treatment groups.

Trts / Fortnights	T1	T2	T3	T4	T5
Initial	3.63±0.06	3.68±0.04	3.63±0.05	3.58±0.04	3.55±0.07
1st	3.48±0.05	3.56±0.03	3.57±0.04	3.48±0.03	3.5±0.04
2nd	3.60±0.07	3.53±0.03	3.53±0.04	3.51±0.06	3.48±0.06
3rd	3.65±0.06	3.53±0.06	3.52±0.05	3.53±0.07	3.53±0.05
4th	3.72±0.08	3.56±0.09	3.53±0.06	3.59±0.07	3.58±0.04
5th	3.72±0.09	3.58±0.08	3.55±0.04	3.60±0.05	3.58±0.04
6th	3.80±0.08	3.61±0.07	3.59±0.03	3.61±0.04	3.75±0.08
7th	3.87±0.08	3.68±0.10	3.64±0.04	3.62±0.04	3.78±0.09
8th	3.88±0.07	3.73±0.1	3.67±0.04	3.65±0.03	3.80±0.09
9th	3.98±0.07	3.80±0.10	3.74±0.05	3.77±0.05	3.81±0.08
10th	3.88±0.11	3.82±0.10	3.78±0.05	3.8±0.06	3.84±0.08
11th	3.90±0.11	3.88±0.11	3.80±0.06	3.82±0.05	3.85±0.08
12th	3.95±0.07	3.90±0.11	3.82±0.07	3.85±0.06	3.87±0.08
13th	4.01±0.07	4.03±0.11	3.94±0.07	3.93±0.06	3.95±0.08
14th	4.02±0.07	4.06±0.10	3.97±0.08	3.98±0.07	4.00±0.08
15th	4.03±0.07	4.09±0.10	4.00±0.05	4.03±0.06	4.02±0.07
16th	4.04±0.07	4.11±0.09	4.01±0.05	4.09±0.05	4.03±0.07
17th	4.05±0.07	4.12±0.07	4.02±0.05	4.10±0.04	4.07±0.07
18th	4.06±0.08	4.20±0.08	4.03±0.06	4.12±0.05	4.08±0.06
Average	3.86±0.04	3.81±0.06	3.75±0.05	3.77±0.04	3.79±0.05
Decrease in comparison to T1	-	0.02	0.11	0.09	0.07
Decrease in protein (%)	-	1.30	2.85	2.33	1.81

Table 9: Fortnightly average solid not fat (SNF) percent in milk of lactating murrah buffaloes in different treatment groups.

Trts / Fortnights	T1	T2	T3	T4	T5
1st	9.47±0.10	9.58±0.11	9.54±0.13	9.04±0.08	9.16±0.07
2nd	9.27±0.07	9.38±0.10	9.40±0.10	8.98±0.08	9.09±0.05
3rd	9.50±0.12	9.37±0.13	9.35±0.09	9.15±0.09	9.30±0.11
4th	9.45±0.16	9.26±0.18	9.24±0.08	9.20±0.13	9.24±0.11
5th	9.53±0.23	9.25±0.19	8.95±0.42	9.43±0.11	9.45±0.09
6th	9.65±0.15	9.38±0.19	9.08±0.31	9.42±0.06	9.47±0.09
7th	9.72±0.13	9.57±0.21	9.18±0.23	9.45±0.07	9.45±0.12
8th	9.75±0.12	9.63±0.17	9.32±0.17	9.50±0.06	9.46±0.12
9th	9.80±0.13	9.76±0.13	9.50±0.11	9.58±0.07	9.60±0.16
10th	9.87±0.14	9.83±0.11	9.53±0.10	9.62±0.05	9.63±0.15
11th	9.91±0.13	9.88±0.11	9.55±0.10	9.67±0.06	9.70±0.17
12th	9.95±0.14	9.90±0.12	9.70±0.11	9.72±0.07	9.80±0.19
13th	9.95±0.15	9.92±0.12	9.73±0.10	9.85±0.06	9.88±0.20
14th	10.03±0.17	9.95±0.10	9.78±0.11	9.85±0.06	9.90±0.19
15th	9.99±0.15	9.95±0.10	9.83±0.11	9.88±0.05	9.97±0.17
16th	10.15±0.18	10.00±0.10	9.95±0.11	9.98±0.06	10.00±0.16
17th	10.14±0.17	10.05±0.11	9.97±0.11	10.03±0.05	10.17±0.18
18th	10.20±0.17	10.07±0.10	9.95±0.07	10.07±0.06	10.17±0.19
Average	9.83±0.10	9.71±0.11	9.53±0.11	9.58±0.04	9.63±0.11
Decrease in comparison to T1	-	0.12	0.30	0.25	0.20
Decrease in SNF (%)	-	-1.22	-3.05	-2.54	-2.03

Thus, the maximum increase in per cent milk yield was in T3 group followed by T4, T5 and T2 groups.

Milk components

Milk fat

The average fat per cent in milk of lactating Murrah buffaloes under different treatment groups is presented in Table 7. In this study, increase in fat per cent in milk in all the groups may be attributed to the availability of more fatty acids for absorption in intestine and these fatty acids might have been directly incorporated in to milk fat after absorption from intestine, leading to increase in milk fat, which is in confirmation with the findings of Shelke *et al*. (2012). The fat percentage in milk varied significantly among the groups and the values were higher in T3 group followed by T5, T4, T2 and T1 groups.

The fat percentage in milk varied significantly among the groups and the values were higher in T3 group (8.1±0.24) followed by T5 (7.89±0.49), T4 (7.71±0.27), T2 (7.44±0.20) and T1 (7.1±0.18) groups.

Milk protein

The average protein per cent in milk of lactating Murrah buffaloes under different treatment groups is presented in Table 8. In comparison to control (T1) in energy supplemented groups (T2, T3, T4 and T5) there was reduction in the milk protein content. Thus, in comparison to T1 group, per cent reduction in milk protein was 1.30, 2.85, 2.33 and 1.81 in T2, T3, T4 and T5 groups respectively, although these differences were non-significant. The non-significant increase in protein per cent in milk is in confirmation with the findings of Sharma*etal* (2016).

Milk solid not fat

The average SNF per cent in milk of lactating Murrah buffaloes allotted different dietary treatments at fortnight intervals after 21 days post-partum to 305 days lactation length is presented in Table 9. There was no significant difference in the overall average SNF percent among the groups; however the numerical values were higher in T1 group (9.83±0.10) followed by T2, T5, T4 and T3 groups, respectively. In comparison to control there was 1.22, 3.05, 2.54 and 2.03 percent reduction in SNF content of milk in T2, T3, T4 and T5 groups of buffaloes, respectively. The non-significant findings about SNF per cent in milk is in accordance with the findings of Suksombat and Chullanandana (2008).

CONCLUSION

The study was conducted to see the effects of additional energy supplementation on the productive performance of lactating Murrah buffaloes. Animals of the group-1 (T1) received only basal diet as per ICAR (2013) requirements. Whereas group-2 (T2), 3 (T3), 4 (T4) and 5 (T5) were supplemented with 5% additional concentrate (T2) or 100 ml soybean oil (T3) or 100 g bypass fat (T4) or 100 g roasted soybean (T5) per animal/day. Other than feed, all the animals were maintained under same managemental conditions. Supplementation of energy over and above the ICAR recommendation in buffaloes either through 5 per cent additional concentrate feeding or use of 100 ml of soybean oil or 100 g each of bypass fat or roasted soybean daily increased the milk yield and non-significant results of SNF, protein, lactose and total solids per cent in milk was found, which might be due to less dose of supplementation of oil in the ration.

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Conflict of interest

All authors declare that they have no conflict of interest.

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