

Original Research Article

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Economics of Milk Production in Lactating Murrah Buffaloes Supplemented with Mustard Oil

Aayush Yadav*, G.P. Lakhani, Biswajit Roy, Bhavna Aharwal,
Sudipta Ghosh and R.P.S. Baghel

Department of Livestock Production and Management, College of Veterinary Science and
Animal Husbandry, NDVSU, Jabalpur, M.P., India

*Corresponding author

ABSTRACT

The present study was conducted at Livestock farm, Adhartal, College of Veterinary Science & A.H., N.D.V.S.U., Jabalpur (M.P.). A total of 12 advance pregnant Murrah buffaloes of identical parity and similar previous lactation yield were selected 21 days pre-partum and randomly assigned to two groups of six animals each; CON as control with basal diet and MO as mustard oil supplementation @ 200 ml/animal/day upto 90 days post-partum to study the effect on economics of milk production in lactating Murrah buffaloes. The daily milk yield was recorded individually twice at 6 A.M. and 4 P.M. and the milk fat per cent was studied using ultrasonic auto milk analyser. Results revealed reduced feed cost (Rs.) per kg 6% FCM yield in MO (19.03) than CON (20.25) and highest return of Rs. 270.82 per animal per day in MO. The net return in comparison to CON was Rs. 45.94 in MO which suggests that supplementation of MO is economically feasible. The additional benefits are due to significant ($p < 0.05$) improvement in average daily milk yield by 8.10 per cent and milk fat content by 9.14 per cent in MO as compared to CON. The 6% FCM yield were significantly ($p < 0.05$) higher in MO followed by CON. In conclusion, MO provided more economic returns to the dairy farm.

Keywords

Murrah, Mustard oil,
Economics, Milk
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Introduction

Nutrition plays crucial role in growth, reproduction and production of animals. Out of total production cost, 60 per cent is accounted for feed and fodders. Therefore, in today's economy, it becomes imperative to get maximum out of the feed fed (Thomas and Sastry, 2012). As parturition approaches, a progressive decrease in dry matter intake (30%) in the last three weeks of gestation and about 90 per cent during last five to seven

days occurs before calving (Ingvarsen and Andersen, 2000). After calving, most of energy gets diverted for colostrum and milk synthesis as a result of which animal goes into negative energy balance (NEB) (Walsh *et al.*, 2007) for first 8 to 12 weeks. Therefore to prevent NEB, cereal grains and fats play a valuable role as alternate sources of energy in the ration of dairy animals. To counter affect the demerits of higher levels of concentrate feeding as acidosis and decline in concentration of milk fat; supplementing fat in

the diet has become a standard practice to fulfil the energy requirements of dairy cows. Supplementation of fat might increase the cost of feeding but net return per animal may also increase due to increase in milk yields and milk fat apart from its positive effect on reproduction and health of animal (Mane *et al.*, 2017). The cost of feeding per litre milk production is a significant factor in governing the economic viability of livestock sector which must be reduced by adopting new measures in the ration formulation. This leads to search for sources that are also easily available and economically feasible. In this context, dietary fat as whole flaxseed (Cavalieri *et al.*, 2005), mustard oil (Kathirvelan and Tyagi, 2009), soybean oil (Thakur and Shelke, 2010) and sunflower oil (Dai *et al.*, 2011) has been used for long in many developing countries for high producing dairy animals. Among these oils, mustard oil is cheaper source of fat supplements and therefore, in view of the above facts, the present investigation was conducted to assess the economics of milk production in lactating Murrah buffaloes supplemented with mustard oil.

Materials and Methods

Proposed work

The proposed work was conducted on twelve advance pregnant Murrah buffaloes for a period of six months at Livestock Farm, Adhartal, College of Veterinary Science & A.H., Nanaji Deshmukh Veterinary Science University, Jabalpur (M.P.). The study was conducted during 21 days pre-partum to 90 days post-partum after the adaptation period of 10 days. The climate of the region is light tropical, sub humid with a seasonal variation in temperature ranging from 6.6 to 41.9°C and an average annual rainfall of 1,415 mm. The animals were selected on the basis of similarity in body weight, age, parity (1st to

3rd) and previous lactation yield. The animals were randomly assigned into two groups as control (CON) and mustard oil (MO), based on feeding of different feed substances (Table 1).

Feeding regime

Experimental animals were stall fed and maintained in semi-intensive system of housing. All The experimental animals were fed total mixed ration according to their body weight and production as per ICAR (2013). The chaffed green fodder (berseem / sorghum / maize), and wheat straw were offered *ad libitum* and concentrate consisting of 18 per cent crude protein and 70 per cent total digestible nutrients was offered at a scale of 1 kg per 2.0 kg milk production along with maintenance ration as per routine practices at the farm. Measured quantity of mustard oil (200 ml) was mixed daily in concentrate of supplemented group (MO) at the time of feeding. Half of the total required quantity of feed was offered daily at morning 5.30 am and rest amount offered in the afternoon 3.00 pm. The water was kept available to animals round the clock.

Parameters studied were

Feed intake and dry matter (%)

Daily intake of concentrate, straw and green fodder was recorded for individual animals. Weighed quantities of concentrate, straw and green fodder were offered to animals and the leftover was collected next day in the morning and weighed. The leftover was subtracted from the initial feed supplied to know the actual amount of feed consumed by the animal. The representative samples of concentrate mixture and roughage were taken in moisture cup and kept in hot air oven at 100±2°C for 24 hrs and dry matter was calculated as follows:

$$\text{Dry matter (\%)} = \frac{\text{Dry weight of sample (g)}}{\text{Fresh weight of sample (g)}} \times 100$$

Milkfat (%)

The representative milk samples of individual animals were collected from the milking bucket after complete milking of the individual animal and analysed for milk fat percentage at fortnightly intervals throughout the experimental period using Lacto Plus (Ultrasonic auto milk analyzer, Netco Pvt. Ltd.).

Milk yield and fat corrected milk (FCM) yield

Animals were hand milked twice a day for the first five days and ninety days after calving i.e., at 6 am and 4 pm for recording of colostrum and milk yield individually. Milk obtained from two times milking was combined together to get the actual milk yield of the buffaloes for that day. The milk yield was recorded at fortnightly intervals throughout the experimental period. For the conversion of whole milk into 6 per cent FCM yield, the equation derived by Rice (1970) was used. The FCM yield was calculated at fortnightly intervals during 90 days lactation period.

$$6 \text{ per cent FCM yield (kg)} = \frac{(0.4 \times \text{MY (kg)} + 15 \times \text{Fat (kg)})}{1.3}$$

Economics of milk production

The economics of milk production was calculated on the basis of 6 percent FCM yield.

Statistical analysis

Data were analyzed using ANOVA, described by Snedecor and Cochran (1994) and the

means showing significant differences in the ANOVA table were compared using the Duncan Multiple Range Test (Steel and Toorie, 1980).

Results and Discussion

Mustard oil is extracted from the seeds of *Brassica juncea*, *B. nigra* and *B. hirta* belonging to family Brassicaceae and order Brassicales. It has 12 per cent of saturated fat, 60 per cent of monounsaturated and 21 per cent of polyunsaturated fat. The major unsaturated fatty acids (%) in mustard oil are the polyunsaturates; alpha-linolenic acid (3) and linoleic acid (15) and the monounsaturates; oleic acid (12) and erucic acid (42). It also contains the saturated fatty acids (%); stearic acid (1.12), myristic acid (1.39) and palmitic acid (3.75). The characteristic pungent flavour of mustard oil is due to allyl isothiocyanate (Anonymous, 2018). Mustard oil have been known as the cheaper and most abundant potential fat source which can increase flexibility of diet and makes possibility for cheaper animal production.

Dry matter intake (DMI; Kg/animal/day)

The detail performance of the lactating Murrah buffaloes is presented in table 2. The overall average daily DMI was 19.60±0.44 and 19.41±0.48 in CON and MO, respectively and was numerically higher in CON. There was no significant difference in the average DMI between the groups. The percent improvement in DMI from calving to 3 months in CON and MO was 26.96 and 17.10, respectively whereas; in comparison to CON, per cent decrease in MO was 0.96. Continuous increase in the DMI was observed in lactating Murrah buffaloes throughout the study period.

The non-significant findings are in agreement with the findings of Sarwar *et al.*, (2004);

AlZahal *et al.*, (2008); Huang *et al.*, (2008); Mele *et al.*, (2008); Suksombat and Chullanandana (2008); Sultana *et al.*, (2008); Ye *et al.*, (2009); Sirohi *et al.*, (2010); Tyagi *et al.*, (2010); Dai *et al.*, (2011); Khalil *et al.*, (2012); Mudgal *et al.*, (2012); Shelke *et al.*, (2012); Altenhofer *et al.*, (2014); Khare *et al.*, (2014); Kirovski *et al.*, (2015) and Sharma *et al.*, (2016). Numerically, MO experienced lowest DMI which is supported by the findings of Chouinard *et al.*, (1997); Shingfield *et al.*, (2006); Ben-Salem and Bouraoui (2008) and Kathirvelan and Tyagi (2009). The animals in NEB consume more DMI because of craving for more nutrients to support higher milk production. This was not seen in the present study as animals were not high yielders and the required energy for supporting milk production was met through the diet. This may be a possible hypothesis for no significant changes in DMI. Also, short feeding period of 12 weeks or small amount of oil supplementation may be another reason. Further findings reveal that pungent flavour of mustard oil may be a reason for numerically lowest DMI in MO.

Daily milk yield (MY; lit)

The detail performance of the lactating Murrah buffaloes is presented in table 2. The overall average daily MY (lit.) was found to be significantly ($p < 0.05$) higher in MO (8.54 ± 0.06) than CON (7.90 ± 0.06), respectively. The overall average daily MY varied significantly between the groups and the per cent increase in daily MY from calving to 3 months period in CON and MO was 22.00 and 27.69, respectively; however MO showed 8.10 per cent increase in daily MY as compared to CON. The fortnightly average daily MY increased up to 4th fortnight and thereafter decreased gradually.

Similar findings of increase in milk yield by fat supplements were reported by McNamara

et al., (2003); Barley and Baghel (2009); Kathirvelan and Tyagi (2009); Tyagi *et al.*, (2010); Dai *et al.*, (2011); Khalil *et al.*, (2012); Shelke *et al.*, (2012); Gowda *et al.*, (2013); Madan *et al.*, (2013); Vahora *et al.*, (2013); Otto *et al.*, (2016); Sharma *et al.*, (2016) and Singh *et al.*, (2016). The gradual decrease in fortnight average daily MY from 5th fortnight onwards was in agreement with the findings of Veira *et al.*, (2001); Altenhofer *et al.*, (2014) and Rodrigues (2017).

Milk production is generally increased by the inclusion of fat in basal ration probably due to improvement in the efficiency of energy utilization. The highest average per cent increase in daily MY was 8.10 in this 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. The increase in average daily milk yield in MO is believed to be due to improved reproductive performances; whereas less MY in CON is credited to the non-availability of fat supplements in the ration.

Milk fat (%)

The detail performance of the lactating Murrah buffaloes is presented in table 2. The overall average fat per cent varied significantly ($p < 0.05$) between the groups and the values were higher in MO (7.52 ± 0.01) followed by CON (6.89 ± 0.01). The average fat per cent in milk has increased throughout the study period in both the groups. The per cent increase in milk fat from calving to 3 months period in CON and MO was 16.32 and 5.48; however milk fat per cent was significantly higher in MO by 9.14 per cent in comparison to CON. Further, results reveal higher fat yield (kg) in MO (0.64) followed by CON (0.54).

Table.1 Experimental diet were fed as follows

S. No.	Groups	Number of animals	Treatments
1.	CON	6	Basal diet
2.	MO	6	Basal diet + Mustard oil supplementation @ 200 ml per animal per day

Table.2 Fortnightly average daily dry matter intake (DMI; kg/animal/day), daily milk yield (lit.), milk fat (%) and 6 per cent FCM yield (Kg) in lactating Murrah buffaloes (Mean ± SE) in different treatment groups

Fort.	DMI		Daily Milk Yield		Milk fat		FCM yield	
	CON	MO	CON	MO	CON	MO	CON	MO
1	16.80±0.71	17.77±1.38	6.23±0.17	6.50±0.16	6.19±0.02	7.30±0.01	6.95±0.18	8.07±0.20
2	18.07±0.57	18.48±1.19	8.10±0.10	8.50±0.12	6.70±0.04	7.45±0.01	9.49±0.11	10.70±0.16
3	20.32±1.25	19.10±0.98	8.51±0.11	9.20±0.08	6.96±0.01	7.50±0.01	10.23±0.15	11.64±0.10
4	20.37±1.26	20.04±0.96	8.81±0.13	9.64±0.08	7.10±0.01	7.55±0.04	10.73±0.16	12.24±0.10
5	20.90±0.99	20.25±1.42	8.20±0.13	9.10±0.12	7.19±0.01	7.62±0.05	10.08±0.15	11.64±0.16
6	21.33±0.78	20.81±1.22	7.60±0.12	8.30±0.05	7.20±0.01	7.70±0.02	9.34±0.14	10.69±0.07
Avg.	19.60±0.44	19.41±0.48	7.90^a±0.06	8.54^b±0.06	6.89^a±0.01	7.52^b±0.01	9.47^a±0.08	10.84^b±0.08

^{a and b} Mean with different superscript differ significantly within rows (p<0.05)

Table.3 Economics of mustard oil supplementation on milk production in lactating Murrah buffaloes

Attributes	CON	MO
Amt. (kg) of concentrate/animal/day	6.88	6.90
Amt. (kg) of dry roughage/animal/day	10.80	9.28
Amt. (kg) of green roughage/animal/day	19.50	19.53
Cost (Rs.) of concentrate/animal/day	116.41	116.75
Cost (Rs.) of dry roughage/animal/day	36.39	31.27
Cost (Rs.) of green roughage/animal/day	39.00	39.06
Cost (Rs.) of mustard oil/animal/day @ Rs. 95.3/lit.	-	19.06
Total feed cost (Rs.)/animal/day	191.80	206.14
Average 6 per cent FCM yield (kg)/animal/day	9.47	10.84
Return (Rs.) from 6 per cent FCM yield produced/animal/day @ Rs. 44/lit	416.68	476.96
Cost of feed (Rs.)/kg 6 per cent FCM yield	20.25	19.03
Return (Rs.)/animal/day	224.88	270.82

Cost of ingredients: Concentrate- Rs.16.92/kg; Dry roughage- Rs.3.37/kg; Green roughage- Rs.2.00/kg; Mustard oil- Rs.19.06/200 ml; Milk – Rs.44.00/lit.

The present findings are in orthodox with the findings of Mele *et al.*, (2008); Barley and Baghel (2009); Shelke *et al.*, (2012); Madan *et al.*, (2013); Vahora *et al.*, (2013); Kirovski

et al., (2015); Moncada-Lainez and Liang-Chou (2016); Otto *et al.*, (2016); Sharma *et al.*, (2016) and Thul *et al.*, (2017). In the current study, increase in fat per cent in milk

in MO may be attributed to the availability of more fatty acids for absorption in intestine and these fatty acids are directly incorporated in milk fat after absorption from intestine, leading to increase in milk fat, which is in confirmation with the findings of Shelke *et al.*, (2012).

Fat corrected milk yield (FCM; kg)

The detail performance of the lactating Murrah buffaloes is presented in table 2. The overall average 6 per cent FCM yield (kg) varied significantly between the groups and the values were statistically higher in MO (10.84±0.08) followed by CON (9.47±0.08). The per cent increase in FCM yield from calving to 3 months period in CON and MO was 34.39 and 32.47; however MO showed 14.47 per cent increase in FCM yield as compared to CON. The fortnightly average 6 per cent FCM yield (kg) increased up to 4th fortnight and thereafter decreased gradually.

The findings are consistent with the findings of Sultana *et al.*, (2008) in Holstein cows supplemented with calcium salts of soybean oil and linseed oil fatty acids @ 1 per cent (DMB); Vahora *et al.*, (2013) in buffaloes supplemented with bypass fat @ 20 g/kg milk yield and Sharma *et al.*, (2016) in Murrah buffaloes supplemented with prilled fat @ 100 and 150 g/d during pre and post-partum period, respectively. The increase in 6 per cent FCM yield is credited to the higher average daily MY and milk fat per cent in the supplemented group over control group.

Economics of milk production

The effect of feeding of mustard oil on average cost of milk production for experimental period of three months is presented in table 3. On an average, the total feed cost (Rs.) per animal per day during the experimental period in CON and MO was

191.80 and 206.14, respectively. The average 6 per cent FCM yield (kg) in CON and MO was 9.47 and 10.84, respectively. The total average cost (Rs.) of feed per kg 6 per cent FCM yield was calculated as 20.25 and 19.03 for CON and MO, respectively. Reduction in feed cost (Rs.) per kg 6 per cent FCM yield in comparison to CON was 1.22 in MO. The per cent reduction in feed cost per kg 6 per cent FCM yield in MO was 6.02 in comparison to CON. Based on the cost of feed, return (Rs.) per animal per day was calculated as 224.88 and 270.82 in CON and MO, respectively. The per cent return per animal per day in MO was 20.43 in comparison to CON. The net return (Rs.) per animal per day in MO was 45.94 in comparison to CON.

Similar findings have shown to give additional profit of Rs.34.5/- per buffalo per day (Naik *et al.*, 2009); 36/- per buffalo per day (Parnerkar *et al.*, 2011); 46.91/- per buffalo per day (Shelke and Thakur, 2011); 11.60/- per cow per day (Gowda *et al.*, 2013); 15.53/- per buffalo per day (Vahora *et al.*, 2013); 23.70/- per animal per day (Amrutkar *et al.*, 2014); 11.05/- per animal per day (Grewal *et al.*, 2014); 50/- per cow per day (Singh *et al.*, 2014); 94.46/- per cow per day (Yadav *et al.*, 2015); 62.07/- per cow per day (Mane *et al.*, 2017) and 127.49/- per cow per day (Parihar *et al.*, 2018).

The present findings may be attributed to the supplementation of mustard oil in the ration which increased 6 per cent FCM yield, suggesting that supplementation is economically feasible.

The present findings indicate that MO significantly ($p < 0.05$) improved average daily milk yield, milk fat per cent and 6 per cent FCM yield as compared to CON. Besides improvement in production performances, supplementation of MO has reduced feed cost per kg 6 per cent FCM yield which resulted in

higher returns based on feed cost per animal per day in MO followed by CON, suggesting that this technology is economically feasible and can be used for efficient milk production.

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