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Effects of Manipulation of Forage and Concentrate in Diets of Murrah Buffalo on Production and Reproduction

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ABSTRACT

A study of six month duration was conducted to evaluate the effect of dietary management on production and reproduction performance in lactating Murrah buffalo. Eighteen lactating Murrah buffaloes were assigned to three dietary treatment groups with six animals in each group based on parity. Control group (T_1) was fed wheat straw, green fodder and concentrate mixture based diet in the ratio of 30:35:35 as per ICAR (2013) standards. Crude protein and total digestible nutrients contributed by green fodder of control group ration was replaced with concentrate mixture at 30% and 40% level in group T_2 and T_3, respectively in an iso-nitrogenous and iso-caloric manner. Dry matter intake, milk yield, 6% fat corrected milk yield, solid-not-fat and total solids were reported to be significantly ($P<0.05$) higher in groups T_2 and T_3 as compared to control (T_1), but milk fat (%) and milk protein (%) remained unaffected among different groups. Peak milk yield was similar in T_2 and T_3 however, significantly higher ($P<0.05$) compared to T_1. Although, the treatment groups T_2 and T_3 took significantly more number of days to attain peak milk yield but, the persistency period of peak milk yield were significantly ($P<0.05$) greater in T_2 and T_3 as compared to control. Efficiency of conversion of feed to milk was significantly ($P<0.05$) improved in T_2 and T_3 treatment groups as compared to control. Compared to the control animals, number of days taken to post-partum estrous and number of services per conception was lesser in groups T_2 and T_3. Total costs of feeding per kg milk production were lower in groups T_2 and T_3 groups than control (T_1). It was inferred that 30% replacement of crude protein and total digestible nutrients of green fodder with concentrate mixture increased the feed conversion efficiency of Murrah buffaloes thereby, improving their production and reproduction performance resulting in more economical milk production.

Key words: Concentrate, Feed conversion efficiency, Green fodder, Murrah Buffalo, Milk yield and quality

INTRODUCTION

India is an agrarian country with livestock as a major source of livelihood. The total number of buffaloes in the country as per 2019 census is 109.85 million that contributes around 20.50% of the total livestock population (20th Livestock census, 2019). The buffalo forms the backbone of India's dairy industry and is rightly considered as India's milking machine (Balain, 1999). It alone contributes approximately 12.8% of the total world milk production (FAOSTAT, 2007). India has the privilege of having the best breeds of buffaloes, of which Murrah is the most popular because of its superiority on commercial grounds (Garg *et al.,* 2004). The buffalo alone contributes about 56% of total milk production in India (Das *et al.,* 2008). Low milk yield, poor reproductive performance (seasonal breeding behaviour, anestrous, and longer calving interval) and low growth rate have been reported in buffaloes (Sahoo *et al.,* 2004). Irregular and inadequate availability of quality feedstuffs and their utilization are the main causes of the poor performance of buffaloes (Wynn *et al.,* 2009). Feeding is the foundation of livestock system and accounts for more than 70% of the total cost of milk production. It directly or indirectly affects the entire livestock sector, including animal productivity, health and welfare and the environment (Makkar, 2016). In most developing countries including India, agricultural by-products and crop residues are chief feed source for livestock that are characterized by low energy, nitrogen and high fibre contents (Owen and Jayasuriya, 1989). Nutrient utilization from high fibrous diets can be improved by supplementation of concentrates (Das, 2008), specific energy protein (Mehra *et al.,* 1999; Das *et al.,* 2012) or micro-nutrient supplement (Sahoo *et al.,* 2004; Ankita *et al.,* 2016). Another, alternative approach is to optimize the use of

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green fodder (Das *et al.,* 1999a,b). However, availability of quality green fodder is also limited and erratic. Dairy farmers sometimes try to solve this problem by increasing the inclusion of concentrate into the diets (Gabbi *et al.,* 2013). However, excessive concentrate feeding is also harmful. Thus, maintaining proper roughage: concentrate ratio is of paramount importance (Sterk *et al.,* 2011). Although, there are some reports on the ration formulation for high yielding cows that have shown positive relationships between increased ratios of dietary concentrate: roughage and milk yield, work done on buffaloes is comparatively scanty. Considering the above facts, the present study was planned' to investigate the effect of dietary management on production and reproduction performance in lactating Murrah buffalo under loose housing system.

MATERIALS AND METHODS

The present research was carried out at the Buffalo farm of Department of Livestock Production Management, College of Veterinary Sciences, LUVAS, Hisar after prior approval from the11th meeting of Institutional Animal Ethics Committee held on dated February 6th, 2018.

Eighteen lactating Murrah buffaloes of 1st to 2nd lactation with average body weight of 478.16 ± 17.44 kg were selected. Based on parity, the buffaloes were assigned to three dietary treatment groups (T_1, T_2 and T_3) each having six animals following completely randomized design. T_1 served as control group and were fed diets containing wheat straw, green fodder and concentrate mixture at 30: 35: 35 (on DM basis) to meet the nutrients requirements as per ICAR (2013) standards. For the animals of group T_2, 30% crude protein (CP) and total digestible nutrient (TDN) of green fodder of T_1 were replaced with concentrate mixture while for those of group T_3, 40% CP and TDN of green fodder of T_1 were replaced with concentrate mixture. The concentrate mixture was formulated using 25 parts maize, 15 parts barley, 20 parts groundnut cake, 8 parts soybean meal, 29 parts wheat bran, 2 parts mineral mixture and 1 part common salt. The cost of wheat straw, berseem fodder, green maize and concentrate mixture was ₹ 1.98, 1.50, 1.50 and 21.43 per kg, respectively. The study continued from 10 days postpartum to 6 months of lactation.

All the animals were kept under loose housing system with east-west direction of shed. Covered area of the shed had asbestos roofing with Patera grass (*Typha angustata*) insulation and floors made up of paved brick and concrete. Inside the shed, animals were fed in concrete manger with partition for individual feeding. The buffaloes were dewormed and disinfested against ecto- and endo-parasites before start of the experiment. Routine protection against hemorrhagic septicemia and foot and mouth disease was done by immunization with vaccines. 10 days adjustment period was given to the buffaloes for acclimatization to new house and feeding regimen prior to start of the experiment. The buffaloes were fed a ration containing concentrate mixture and berseem or maize as green fodder and wheat straw as dry fodder. Roughages

Table 1.Chemical composition (%DM basis) of concentrate mixture and roughages*

Attributes	Concentrate mixture	Wheat straw	Berseem	Green Maize
Dry matter (DM %)	92.02	94.43	23.52	25.02
	on %DM basis			
Crude protein	21.20	2.45	17.76	10.45
Organic matter	89.38	90.73	91.06	89.63
Ether extract	3.40	2.87	3.12	4.31
Nitrogen free extract	54.75	48.62	52.64	48.47
Total ash	10.62	9.27	8.94	10.37

*Each value is mean of three observations.

(green and dry) were offered individually between 10:00-12:00 AM, while daily allowance of concentrate mixture was offered at the time of milking in equal quantity in the morning and evening. All three dietary treatments were iso-nitrogenous and iso-caloric. Concrete rectangular waterer with potable water supply round the clock was provided in loafing area.

Chemical composition of concentrate mixture, dry fodder and green fodders (Table 1) was analyzed by the methods proposed by AOAC (2005). Body weight of individual animal was recorded for two consecutive days to measure the average body weight and body weight gain at monthly interval. A weighed quantity of feed and fodder was offered for two consecutive days at monthly interval to determine average daily dry matter intake (DMI). Data regarding daily milk yield, peak milk yield, number of days taken to attain peak milk yield, persistency of peak milk yield, days taken to first post-partum estrous and number of services per conception were assessed from the farm record. Composition of milk was estimated with automatic milk analyzer (MRC Lab Milk Analyzer, India Model: MIA-S-30, S/N: 9166) at weekly interval. 6% fat corrected milk (FCM) (kg) was calculated by the method

Table 2. Productive and reproductive performance and economics of feeding under different dietary treatments

Attributes	Treatments		
	T_1	T_2	T_3
Initial body weight (kg)	473.33±19.05	478.83±22.96	482.33±10.30
Average daily dry matter intake (kg/day)	15.43^b±0.34	16.76^a±0.39	17.16^a±0.19
Average daily dry matter intake (%BW)	3.08^b±0.04	3.30^a±0.06	3.32^a±0.03
Production performance			
Milk Yield (kg/day)	9.68^b±0.53	12.21^a±0.94	12.69^a±0.88
6% FCM yield (kg/day)	11.30^b±0.65	14.19^a±1.06	14.79^a±1.17
Milk fat, %	7.53±0.08	7.49±0.13	7.47±0.19
Milk protein, %	3.11±0.10	3.17±0.10	3.19±0.06
Solid-not-fat, %	8.78^b±0.03	8.96^a±0.04	9.01^a±0.05
Total solid,%	16.31^b±0.06	16.45^a±0.07	16.49^a±0.06
Peak milk yield (kg)	12.40^b±0.83	15.17^a±1.16	15.35^a±1.03
Days taken to attain peak milk yield	46.67^b±1.84	56.67^a±2.94	62.33^a±2.91
Persistency of peak milk yield (days)	56.00^b±2.56	67.67^a±1.48	68.83^a±5.24
Feed conversion ratio (FCR)	1.59^a±0.05	1.37^b±0.08	1.35^b±0.04
FCR on 6% FCM	1.37^a±0.05	1.18^b±0.05	1.16^b±0.06
Reproductive performance			
Days taken to post-partum estrous	61.25±7.76	59.60±1.96	57.67±4.34
Number of services/conception	1.25±0.25	1.25±0.25	1.00±0.00
Economics of feeding			
Total cost of feeding (₹)	193751.34	221302.98	227393.52
Average feeding cost (₹/day/per animal)	179.40	204.91	210.55
Feed cost/kg milk yield (₹)	18.53	16.78	16.59
Feed cost per kg 6 % FCM (₹)	15.88	14.42	14.17
Net profit per kg milk yield (₹)	-	1.75	1.94
Net profit per kg 6%FCM yield (₹)	-	1.46	1.71

of Rice (1970) using the formula, 6% FCM (kg) = 0.308 × Total milk + 11.54 × Total fat. Feed conversion efficiency and economics of feeding under different dietary regimen was calculated.

Statistical Analysis

Data obtained was subjected to statistical analysis as per Snedecor and Cochran (1994) using completely randomized design (CRD). All the data were subjected to ANOVA using the General Linear Models procedure of SPSS-23 software (SPSS, 2019). The mean differences among different treatments were separated by Duncan's multiple range tests. A level of $P<0.05$ was used as the criterion for statistical significance (Duncan, 1955).

RESULTS AND DISCUSSION

Average DMI (as kg/day or %BW) during the experimental period was significantly ($P<0.05$) higher in groups T_2 and T_3 than the control group. It has also been reported earlier by Ghosh *et al.* (2018) and Machado *et al.* (2014) that increasing the dietary dry matter share of concentrate by lowering roughage proportion improved DMI in dairy cows due to the fact that diet rich in forage limits the DMI (Das *et al.,* 1999a). Also, overall average milk yield in groups T_2 and T_3 was found to be higher ($P<0.05$) as compared to control, probably due to comparatively higher DMI in groups T_2 and T_3. Increase in milk yield with increasing dietary proportion of concentrates has also been reported earlier by Argov-Argaman *et al.* (2014) and Machado *et al.* (2014). Changing the dietary proportion of concentrate and green roughage showed no considerable effects on milk fat and protein content in the current study. This is to be noted that even though we had increased the proportion of concentrates in the two treatment groups the proportion of concentrates never exceeded 50%. Milk fat depression is recorded when diets contain very high amount of concentrates (Zebeli *et al.,* 2008). On the other hand, whilst diet is of low energy density, increasing the proportion of concentrate is conducive to production of ruminal propionate which promotes partition of energy towards synthesis of milk fat (Randby, 1996). In this experiment, 6% FCM yield (kg) was significantly higher in groups T_2 (14.19) and T_3 (14.79) as compared to control (11.30). Research conducted earlier (Beyero *et al.,* 2015; Ghosh *et al.,* 2018) reported no improvement in 6% FCM yield by changing the level of concentrate and forages in ration of dairy cows. The discrepancy in response might be due to difference in dietary composition and proportion of roughages or concentrates. It is to be noted that the performance of buffaloes in groups T_2 and T_3 were at par. Thus replacement of crude protein and total digestible nutrients of roughage with that of concentrate at level of more than 30% may not be necessary and a diet containing wheat straw, green fodder and concentrate at 30:25:45 should be optimum for early lactating Murrah buffaloes. Milk fat and protein content were similar among the groups, however, SNF content was higher ($P<0.05$) in group T_3. The results corroborate well with those of Gaafar *et al.* (2009), who reported higher SNF percentage as a result of partial replacement of green fodder with concentrate mixture than the control treatment group.

Replacing the dietary nutrients provided by green fodder with that of concentrate mixture at 30% and 40% showed significant effect on the peak milk yield of buffaloes (12.40, 15.17 and 15.35 kg per day in T_1, T_2 and T_3, respectively). In addition, days taken to attain peak milk yield were significantly ($P<0.05$) greater in T_2 and T_3 as compared to control group T_1. Persistency period of peak milk yield was significantly ($P<0.05$) greater in T_2 and T_3 than the T_1 (56.00). Feed conversion ratio (kg DMI/kg milk or per kg FCM) was significantly ($P<0.05$) improved in groups T_2 and T_3 in comparison to T_1. Similarly, Observations were also made by other research workers (Tessmann *et al.,* 1991; Broderick, 2003). Buffaloes in treatment group T_2 and T_3 showed the signs of first post-partum estrous earlier as compared to the control. Average number of services per conception was similar among the groups.

Although the total cost of the feeding of buffaloes during the experimental period as well as feeding cost per animal per day was higher in groupsT_2 and T_3 than T_1. Cost of per kg milk production was lower in groups T_2 and T_3 as compared to group T_1.

Net profit increased due to replacement of green with concentrates.

CONCLUSION

It was concluded that replacement of 30 percent of the protein and total digestible nutrients contributed by green fodder with that of concentrate mixture in the ration of lactating Murrah buffaloes, would increase the income of dairy farmers owing to more milk and 6% FCM yield. Further replacement demonstrated no additional benefits in terms of milk production and reproductive performance of lactating Murrah buffalo.

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