Original Article

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AQUATIC FERN *Azolla* AFFECTING MILK PRODUCTION IN BUFFALOES

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ABSTRACT

A feeding trial was conducted to assess the effect of incorporating dried green aquatic fern *Azolla* (*Azolla microphylla*) in the diet of lactating Murrah buffaloes. Ten multiparous Murrah buffaloes with an average body weight of 499.34±20.71 kg, parity of 2.4±0.31, average milk yield of 11.29±0.51 kg and average days in milk 30.40±3.86 were distributed randomly into two equal groups. One of the groups served as control and fed concentrate mixture prepared by Wheat bran, Maize grain, Mustard cake, Cotton seed cake, Groundnut cake, mineral mixture, and salt, while in treatment group 10% of the dried *Azolla* was incorporated in the concentrate mixture to make both the concentrate mixtures iso-nitrogenous and iso-caloric. Milk quantity was recorded and milk components including protein, fat, lactose, solids not fat and total solids were assessed at the day before starting experimental feeding and followed by a weekly interval for four week.

After 28 days of experimental feeding no significant (P>0.05) effect was apparent on total milk production, but fall in production of fat corrected milk was 23.54% in the control group as compared to only 8.24% in the Treatment group, which indicated the superiority of *Azolla* based concentrate mixture over control concentrate mixture. No significant (P>0.05) variation was also observed in the quality of milk produced including milk protein, fat, lactose, solids not fat and total solids between the milk of buffaloes fed with two different concentrate mixtures. Results indicated that feeding of concentrate mixture consisting of 10% dried *Azolla* helped to maintain the production of fat corrected milk in early lactating Murrah buffaloes without affecting the intake of nutrients.

Keywords: *Bubalus bubalis*, buffaloes, feed intake, *Azolla*, milk production, milk quality

INTRODUCTION

Continuously increasing demand for animal products due to the human population explosion warranted research for better utilizing the available nutrients from feed items. Due to lack of availability of nutritious feed, livestock mainly

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fed with crop residues as their main feed resource (Singh *et al*., 2013), which are not only nutritionally poor i.e. low in crude protein but also high in crude fiber, leading to poor digestibility of otherwise available nutrients. Forage production for rearing livestock is being neglected day by day which creates a serious gap of critical nutrients; hence productivity of dairy animals gets compromised. Under the circumstances of limited nutritious feeds availability for ruminants, *Azolla* may serve as an alternative feed supplement that could be grown with low labor cost, utilizing minimally available land and could be able to supply quality nutrients whole of the year. *Azolla* is a short, branched, roots bearing free-floating aquatic macrophyte containing about 28% crude protein on a dry weight basis and has the potential to be used as a protein supplement in ruminants (Ahirwar and Leela, 2012). *Azolla* grows well in ponds, ditches, swamps, wetlands of warm temperate and tropical countries throughout the world and it is even capable of growing in lakes and rivers where the water is not turbulent (Lumpkin and Plucknett, 1982). It has been used as a beneficial fodder supplement by various researchers because of ease of cultivation, high productivity and good nutritive value (Singh and Subudhi, 1978; Prabina and Kumar, 2010).

The present study was therefore conducted to explore the possibility of using *Azolla* as a supplement in iso-nitrogenous and iso-caloric concentrate mixture to assess its impact on qualitative and quantitative production of milk in an early stage of lactation in Murrah buffaloes.

MATERIALS AND METHODS

Location of the study

The experiment was undertaken on Murrah buffaloes maintained at Animal Farm Section of ICAR-Central Institute for Research on Buffaloes, Hisar, Haryana, India, during March, when humidity varied from 13 to 98% and ambient temperature from 13.7 to 30.5°C. The farm is located 212 meters above sea level.

Experimental animals, management, and study design

Before starting the experiment proper approval for animal experimentation was obtained from the Institutional Animal Ethics Committee (IAEC). Ten Murrah buffaloes during their early stage of lactation were selected from an existing herd of Murrah buffaloes and divided randomly into two groups of five buffaloes each based on their body weight (499.34±20.71 kg), parity (2.4±0.31), average milk production (11.29±0.51 kg) and average days in milk (DIM, 30.40±3.86). All buffaloes were maintained under iso-managerial, individual and intensive feeding systems with housing in a well-ventilated concrete floor shed.

Feeding of buffaloes

Buffaloes of both the groups were fed as per standard nutrient requirements (ICAR, 2013) individually, using concentrate mixture, green berseem, and *ad-libitum* wheat straw. Concentrate mixture fed to buffaloes of Control group had 20% Wheat bran, 35% Maize grain, 10% Mustard cake, 20% Cottonseed cake, 12% Groundnut cake, 2% mineral mixture and 1% salt, while in Treatment group 10% of the dried *Azolla* was incorporated in the concentrate mixture to keep both the concentrate mixtures iso-nitrogenous and iso-caloric. The composition of concentrate mixture of the treatment group had 10% Wheat bran, 37% Maize grain, 10% Mustard cake, 20% Cottonseed cake, 10% Groundnut cake, 10% dried green

Azolla, 2% mineral mixture and 1% salt.

Analysis of feed and fodder

Feeds and fodder samples were analysed for proximate principles (AOAC, 2000), neutral detergent fiber (NDF) and acid detergent fiber (ADF) as per the standard method (Goering and Van Soest, 1970).

Milk recording, sampling, and analysis

Hand milking of buffaloes was followed twice at 05.00 and 16.00 h. daily. Milk produced from each buffalo was recorded for the period of study every week, using the electronic weighing machine. Milk sample from each buffalo was collected and pooled in proportion to the milk yield of individual buffalo for analyzing the chemical composition of milk. Milk samples were taken immediately before analyses and poured several times from vessel to vessel to distribute the fat content uniformly. Representative samples of milk were analyzed for chemical composition (protein, lactose, fat, and total solids) using a pre-calibrated ultrasonic milk analyzer (LACTOSCAN LA, 8900 Zagora BULGARIA). Solids-not-fat (SNF) content was calculated by subtracting fat content with total solids. Production of fat-corrected milk (FCM) in kg/d was calculated with consideration of 6% fat content.

Statistical analysis

The experimental unit considered for the statistical analysis was an individual buffalo. Data generated in the experiment were analyzed statistically using the SPSS (2011) computer package (version 20) with a t-test.

RESULTS AND DISCUSSIONS

Nutritive value of feeds

Nutritive value analysed for different proximate components and fiber fractionation has been presented in Table 1.

The designed concentrate mixtures had very close crude protein content i.e. 14.94% and 14.81%, respectively in control and treatment groups. Likewise was the contents of nitrogen-free extracts i.e. 49.90% and 49.24%, respectively in control and treatment groups, hence both these concentrate mixtures were almost iso-nitrogenous as well as iso-caloric (Table 1) nutritionally. Berseem and wheat straw used in the experiment had 22.10% and 4.76% of crude protein and 35.52% and 44.93% nitrogen-free extract, respectively.

Intake

Average dry matter intake in buffaloes remained comparable between two groups with 3.10 and 3.07 kg dry matter intake per 100 kg of body weights, respectively for Control and Treatment groups. Inclusion of *Azolla* in the ration could not evoke any effect on dry matter intake of various animals (Chatterjee *et al*., 2013; Sharma, 2013; Roy *et al*., 2016). Similarly, in the ration of crossbred cows, dry matter intake remained unaffected due to the inclusion of green *Azolla* (Chandewar, 2017). Further, it was observed that the intake of crude protein also remained comparable between both the groups with 24.89 and 24.63 g per kg of metabolic body weights, respectively for Control and Treatment groups. Similar results were obtained by Regar (2016) due to the inclusion of *Azolla* in the ration of crossbred cows.

Quantitative and qualitative traits of milk

Total milk production

Average milk production (kg/d) from buffaloes of two groups at weekly intervals is presented in Figure 1. No significant difference was observed in total milk production data between the two groups at weekly intervals. The overall mean value of 5 weeks in the Treatment group (12.58 kg/d) was also statistically comparable (P>0.05) with the Control group (12.82 kg/d) values. However, Rawat *et al*. (2015) reported improvement in milk production during a three-month feeding trial using green *Azolla* 1:1 ratio with concentrate mixture in the ration of crossbred dairy cows. Significant improvement in milk production was, however, reported by Lavania *et al*. (2019) during a three-month feeding trial with an additional 1.5 to 2 kg green *Azolla* in the treatment group of mid lactating Kankrej cows. Singh *et al*. (2017) also reported improvement in milk yield due to feeding of wet *Azolla* (additional 2 kg) in the treatment group in three months feeding trial. As compared to the Control group additional feeding of *Azolla* (1.5 kg wet) daily resulted in improvement in milk yield in buffaloes (Meena *et al*., 2017). Additional supplementation of *Azolla* in the Treatment group may be a reason for getting significant improvement over the Control group in these studies. On the other hand, in the present experiment, the effect due to supplementation of *Azolla* was not visible because both the groups were fed with iso-nitrogenous and iso-caloric ration.

Milk protein content

Average milk protein percentage at different intervals in the Treatment and Control groups has been presented in Figure 2. There was no significant (P>0.05) difference observed on the milk protein content of two groups at different weekly intervals. The addition of 2 kg fresh *Azolla* in the ration of crossbred dairy cattle did not report result in any improvement in milk protein percentage (Chatterjee *et al*., 2013).

Milk fat content

The fat percentage in buffalo milk of two groups during the four weeks study has been presented in Figure 3. The fat percentage in the milk of the Control group was more at day 0 itself i.e. 8.77 vs 6.88 and hence the values of FCM also were high (Figure 4) at the start of the study, but since then the values were comparable throughout the study. Gowda *et al*. (2015) reported that the addition of 2 kg green *Azolla* in the ration of dairy cattle did not improve milk fat percentage. On the contrary, in their three-month feeding trial fed an additional 1.5 to 2 kg green *Azolla* in the Treatment group of mid lactating Kankrej cows, Lavania *et al*. (2019) reported 18% improvement in milk fat yield.

Fat-corrected milk (FCM) production

The average weekly FCM production of both groups has been presented in Figure 4. At different points of observations, FCM production remained comparable between two groups, though the values at day 0 itself were high in the Control group (21.54 kg) as compared to the Treatment group (18.21 kg). When we compare a fall in production of FCM during four weeks period i.e. day 28 vs. day 0 value, it showed a drastic change between two groups i.e. fall was 23.54% in the Control group as compared to only 8.24% in the Treatment group, which indicated the superiority of the *Azolla* based concentrate mixture over control concentrate mixture. An improvement of 12.5% in the production of fat corrected milk was also reported in crossbred cattle due to feeding

Table 1. Chemical composition (% on dry matter basis) of feeds and fodder provided to the lactating Murrah buffaloes.

Ingredients	Concentrate mixture control	Concentrate mixture treatment	Green berseem	Wheat straw
Organic matter	91.20	90.20	88.46	86.63
Crude protein	14.94	14.81	22.10	4.76
Ether extract	8.17	7.53	3.05	1.08
Crude fiber	18.19	18.62	27.79	35.86
Nitrogen free extract	49.90	49.24	35.52	44.93
Neutral detergent fiber	32.45	30.65	51.72	68.37
Acid etergent fiber	23.43	19.94	38.23	49.68
Hemi Cellulose	9.02	10.71	13.49	18.71
Total Ash	8.80	9.80	11.54	13.37

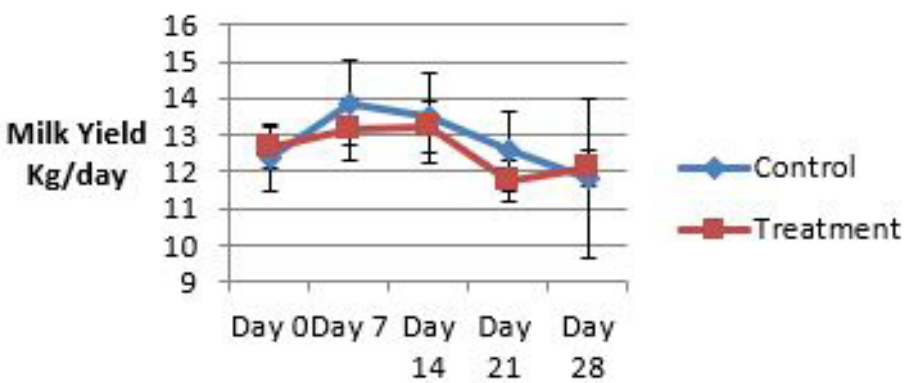

Figure 1. Milk production (kg/day) in Murrah buffaloes affected by *Azolla* feeding.

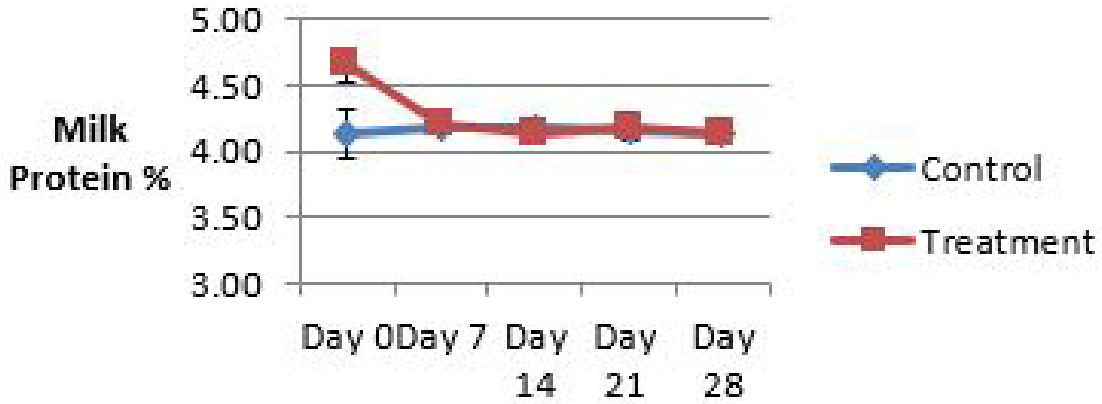

Figure 2. Milk protein (%) in Murrah buffaloes affected by *Azolla* feeding.

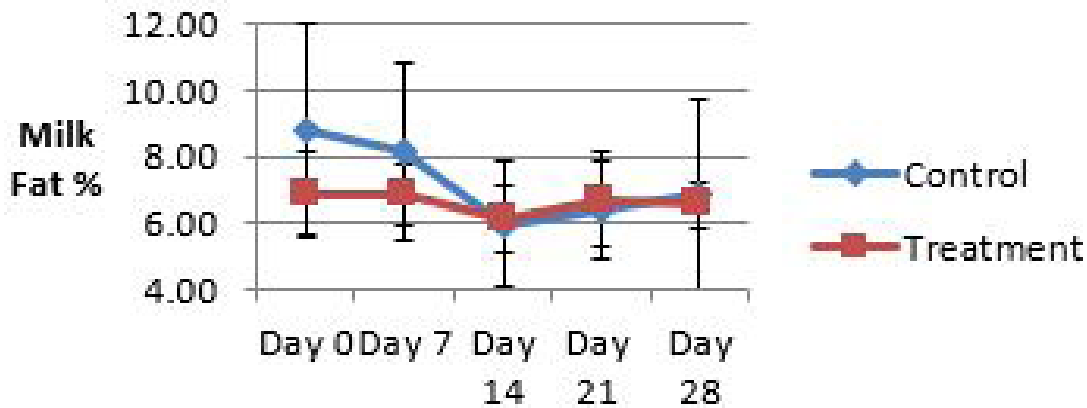

Figure 3. Milk fat (%) in Murrah buffaloes affected by *Azolla* feeding.

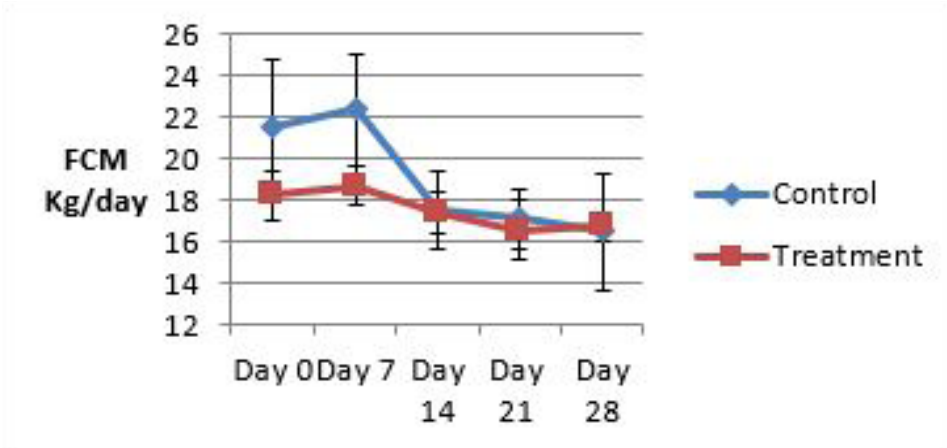

Figure 4. Fat corrected milk (FCM) production in Murrah buffaloes affected by *Azolla* feeding.

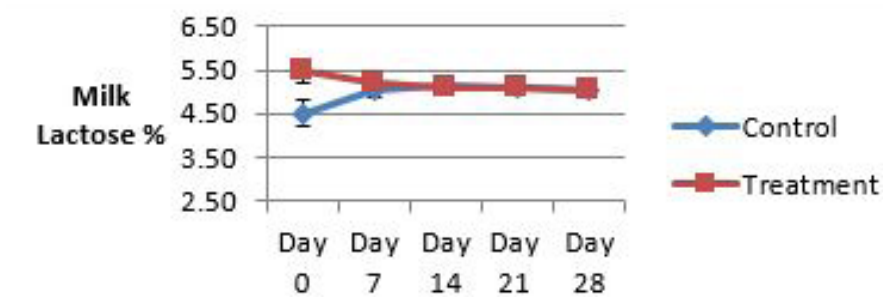

Figure 5.: Milk lactose (%) in Murrah buffaloes affected by *Azolla* feeding.

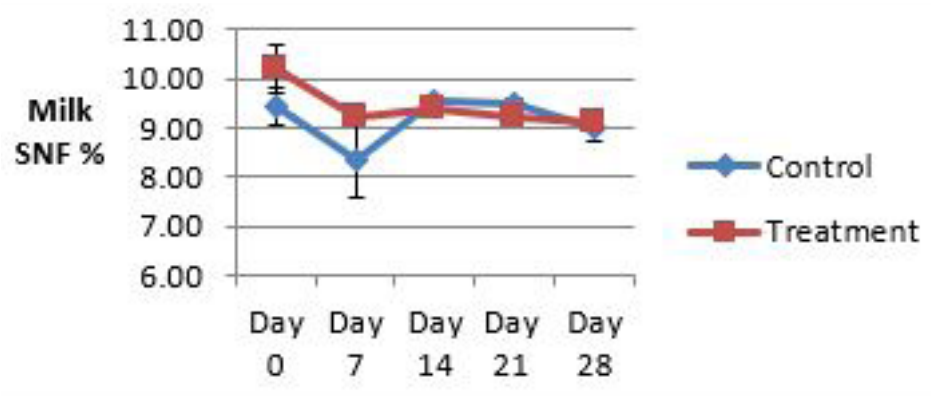

Figure 6. Milk solids not fat (SNF %) in Murrah buffaloes affected by *Azolla* feeding.

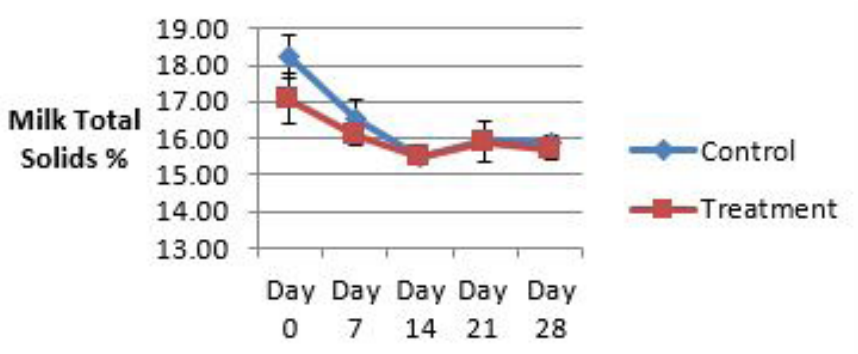

Figure 7. Milk total solids (TS %) in Murrah buffaloes affected by *Azolla* feeding.

of 2 kg wet *Azolla* in addition to control feeding (Annual Report, NDRI, 2012 to 2013) during a six weeks study, without significantly affecting the composition of milk.

Milk lactose content

Average milk lactose at different intervals in treatment as well as in Control groups has been presented in Figure 5. There was no significant (P>0.05) effect of treatment on milk lactose content. In agreement with the present findings, Kumar *et al*. (2016) also did not report any influence on milk lactose due to the replacement of concentrate mixture with dried *Azolla* in the ration of Barbari does.

Milk solids-not-fat (SNF) content

Milk-solids-not-fat (SNF) at different intervals in the two groups has been presented in Figure 6. The mean value of the Treatment group was comparable (P>0.05) to the Control group at different points of observation. The results are in agreement with the findings of Gowda *et al*. (2015) who did not report any improvement in SNF percentage due to the addition of 2 kg green *Azolla* in the ration of dairy cattle. Similar results have also been obtained by Chatterjee *et al*. (2013); Lavania *et al*. (2019).

Milk total solids (TS) content

An average value of TS in two groups during 4 weeks of lactation period is presented in Figure 7. The values of TS remained comparable (P>0.05) throughout the observation period between the two groups. Further, these results are in agreement with the findings of Chatterjee *et al*. (2013).

CONCLUSION

Feeding trial conducted to study the effect of incorporating the *Azolla* in the diet of lactating Murrah buffaloes. Based on present findings, it may be concluded that feeding of concentrate mixture included 10% dried *Azolla* helped to maintain the production of fat corrected milk in early lactating Murrah buffaloes without affecting the intake of nutrients and quantity of milk produced including protein, fat, lactose, solids-not-fat and total solids of milk.

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