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Finding the impact of WB 02 straw based diet on milk composition of Murrah Buffaloes

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Abstract
Background: Buffalo milk constitutes major part of milk production in India. It is preferred for due to the presence of more nutrients. Further, most of the buffaloes reared in India belong to small and marginal farmers and most of the feed is given as roughage. WB 02 is a wheat crop variety produced by ICAR-IIWBR, Karnal, Haryana whose grain contains higher amount of zinc and iron. The present experiment compares the effect of replacing conventional straw with the WB 02 straw.
Methods: Twelve Murrah buffaloes were used in this experiment, and they were split into two groups, Control (T0) and Treatment (T_1) according to their body weight, parity, and past milk production. Based on the ICAR (2013) guideline, feeding was sustained for a duration of 90 days. The concentrate combination, oat fodder, and wheat straw were fed to both groups in the following proportions: 50:15:35 (based on dry matter). Nevertheless, biofortified wheat variety straw was used in the treatment group and regular wheat straw was used in the control group.
Results: When the weekly composition of milk in both groups was evaluated, non-significant differences (p>0.05) were seen. According to the study, providing Murrah buffaloes with WB 02 straw had no effect on the composition of their milk as compared to feeding them a regular diet based on straw.

Keywords: WB 02, Murrah buffaloes, milk, wheat straw

1. Introduction
India has 109.85 million buffaloes with overall milk production of 221.06 million tonnes. In India, buffaloes are given more preference than cattle as the former can be maintained on feed and fodders having low nutritional values, provide higher milk fat yield (more than 8%), and thus better feed conversion efficiency, which ultimately results in a higher economic return (Balhara *et al*., 2017) [1].
ICAR-IIWBR, Karnal, Haryana, developed a biofortified wheat variety that was released in 2017 by the Government of India. This variety, known as WB-02, is a pure line cultivar with a rich content of zinc and iron in the grains, i.e., 42.0 and 40.0 ppm, respectively (Yadava *et al*., 2018) [14]. A higher zinc level and improved dry matter digestibility *in vitro* were the outcomes of this biofortification. Zinc and iron concentrations in grains and straw rice increase whenever foliar application is done (Paramesh *et al*., 2020) [8]. Increased availability of zinc to dairy animals via zinc-enriched fodder might help meet the requirement (Capstaff and Miller, 2018) [2]. Cow milk usually contains 3-5 mg Zn/l, predominantly associated with casein (Goff and Stabel, 1990) [5]. Additionally, Trávníček *et al*. (2004) [12] reported that there is a correlative dependency between the Zn content and the level of milk proteins in raw cow milk (r_{xy} = 0.30). Keeping the above facts in mind, the present study was conducted to study the effect of feeding a biofortified wheat (WB-02) straw-based diet on the milk composition of lactating Murrah buffaloes (Bubalus bubalis).

Materials and Methods
Twelve recently calved Murrah buffaloes, sourced from the Livestock Research Center, ICAR-NDRI, Karnal, were divided into two groups based on body weight, production capacity, and lactation stage. The experiment adhered to Institutional Animal Ethics Committee

(IAEC) guidelines under CPCSEA regulations. Before the feeding trial, all animals were dewormed. They were housed in well-ventilated tie-stalls with separate feeding arrangements. Both groups received a total mixed ration (TMR) in a 50:15:35 ratio (Wheat Straw: Green Fodder: Concentrate) based on dry matter (DM), following ICAR (2013) specifications. The control group was given conventional wheat straw, while the treatment group received WB 02 straw. Daily logs of feed and leftovers were maintained throughout the trial. At 10:00 a.m., precisely measured TMR, comprising wheat straw, concentrate mixture, and chaffed green fodder, was provided. Buffaloes had unrestricted access to poTable drinking water. The frequency of milk sampling was weekly, during the morning (0500 hours) and evening (1800 hours) milking. Determination of milk composition was done by collecting about 100 ml milk sample from individual animal of each milking at weekly interval in a properly cleaned milk sample bottle. The milk constituents such as fat, protein, lactose and SNF were analysed by Lacto Scan- automatic milk analyser. Statistical analysis was carried out using IBM SPSS (26.0) and ANOVA feature was used to compare the means at different intervals.

Results and Discussion

Milk fat (%)

The price of milk in India is heavily influenced by the amount of fat in the milk. Additionally, for the production of value-added dairy products, milk containing a higher fat content is tremendously demanded, prompting the livestock rearing community to strive for milk with an improved fat level. The data on milk fat percentage, recorded on a weekly basis, are presented in Table 1. These values were in the range of 5.42±0.13% to 6.62±0.36% and 5.53±0.37 to 6.58±0.51% for the control (T_0) group and the treatment (T_1) group, respectively. It was observed that both groups were statistically at par with each other (p>0.05).

Limited literature is available for comparative study with respect to the effect of feed biofortified with zinc and iron on milk fat content. Nevertheless, Sobhanirad *et al*. (2010) [11] observed no significant improvement in cattle milk fat percentage following zinc supplementation. Furthermore, Weiss *et al*. (2010) [13], in their study of supplementing organic iron to cattle, failed to report any effect on milk fat content.

Table 1: Milk fat (%) of experimental Murrah buffaloes

Week	Control (T_0)	Treatment (T_1)	P-Value
1	5.42±0.13	5.53±0.37	0.777
2	5.52±0.13	5.91±0.25	0.194
3	5.63±0.13	6.12±0.34	0.204
4	5.70±0.38	6.12±0.30	0.405
5	6.22±0.46	6.58±0.51	0.613
6	6.11±0.20	6.58±0.43	0.356
7	6.00±0.18	6.57±0.43	0.249
8	6.06±0.26	6.42±0.33	0.404
9	6.62±0.36	6.42±0.49	0.747
10	6.19±0.47	6.39±0.37	0.741
11	6.40±0.23	6.47±0.44	0.903
12	6.50±0.25	6.51±0.46	0.985
Overall Mean ± SE	6.03±0.09	6.30±0.11	

Milk SNF (%)

Weekly records of milk SNF% for both groups are presented in Table 2. In the control (T_0) group, the mean values ranged from 9.04±0.12%, while in the treatment (T_1) group, they ranged from 9.38±0.18 to 10.24±0.26%. These differences in milk SNF content between both groups were found to be non-significant (p>0.05).

Existing studies, such as the work of Sobhanirad *et al*. (2010) [11], reported no discernible effect on milk SNF levels following zinc supplementation in cattle. Similar results were also observed by Shafi *et al*. (2020) [9], where zinc supplementation in goats failed to impact the milk SNF content. Moreover, there is a noTable absence of available studies demonstrating the effect of zinc and iron biofortified feed on milk SNF in comparison with the findings of the current study.

Table 2: Milk SNF (%) of experimental Murrah buffaloes

Week	Control (T_0)	Treatment (T_1)	P-Value
1	10.13±0.18	10.24±0.26	0.734
2	10.02±0.16	10.17±0.23	0.608
3	9.89±0.13	10.09±0.2	0.428
4	9.61±0.21	9.90±0.23	0.376
5	9.77±0.29	10.03±0.17	0.458
6	9.55±0.16	9.76±0.11	0.321
7	9.33±0.10	9.48±0.06	0.241
8	9.04±0.12	9.38±0.18	0.139
9	9.38±0.17	9.66±0.15	0.247
10	9.47±0.18	9.75±0.16	0.271
11	9.36±0.13	9.53±0.13	0.397
12	9.26±0.15	9.46±0.15	0.370
Overall Mean ± SE	9.57±0.06	9.79±0.06	

Milk protein (%)

The data in Table 3 represents the mean values of milk protein percentage measured weekly. These values were in the range of 3.62±0.04% to 4.03±0.08% and 3.75±0.07% to 4.09±0.09% for the control (T_0) group and the treatment (T_1) group, respectively. It was observed that there was no statistically significant difference between the two groups with respect to milk protein level (p>0.05).

These results were consistent with the studies conducted by Sobhanirad *et al*. (2010) [11], where they reported no profound effect on milk protein following zinc supplementation in cattle. Similarly, Shafi *et al*. (2020) [9] also documented no significant effect on milk protein content when goats were provided with supplemental zinc. In contrast, Singh *et al*. (2021) [10] observed an improvement in milk protein level upon zinc supplementation in Murrah buffaloes. Further, in an experiment conducted by Weiss *et al*. (2010) [13], organic iron supplementation in cattle failed to improve protein content in milk.

Table 3: Milk lactose (%) of experimental Murrah buffaloes

Week	Control (T_0)	Treatment (T_1)	P-Value
1	5.26±0.09	5.33±0.14	0.685
2	5.20±0.08	5.29±0.13	0.559
3	5.14±0.07	5.25±0.11	0.405
4	4.97±0.12	5.16±0.13	0.301
5	5.02±0.16	5.24±0.09	0.269
6	4.94±0.09	5.09±0.06	0.201
7	4.85±0.06	4.93±0.03	0.243
8	4.69±0.07	4.88±0.10	0.142
9	4.89±0.10	5.01±0.09	0.372
10	4.94±0.10	5.12±0.08	0.179
11	4.88±0.07	4.97±0.06	0.348
12	4.82±0.08	4.93±0.07	0.330
Overall Mean ± SE	4.96±0.03	5.10±0.03	

Milk lactose (%)

Table 4 presents data on milk lactose content, measured at a weekly interval. For the control (T_0) group, values spread from 4.69±0.7% to 5.26±0.9%, with an average of 4.96 + 0.03%; while for the treatment (T_1) group, data range from 4.88±0.10 to 5.33±0.14, with an average of 5.10±0.03%. Both experimental groups showed no significant difference between them with respect to milk lactose level (p>0.05).

In a few studies conducted on cattle where they were fed a ration supplemented with zinc, the differences in milk lactose content were non-significant (p>0.05). (Sobhanirad *et al*., 2010) [11]. Shafi *et al*. (2020) [9], in their study on goat milk, also found similar results. Moreover, there is not any published report available for the comparison that demonstrates feed biofortified with iron and zinc having an influence on milk lactose content.

Table 4: Milk protein (%) of experimental Murrah buffaloes

Week	Control (T_0)	Treatment (T_1)	P-Value
1	4.03±0.08	4.09±0.09	0.640
2	3.99±0.07	4.06±0.08	0.496
3	3.94±0.06	4.03±0.07	0.361
4	3.74±0.08	3.97±0.08	0.254
5	3.89±0.11	3.99±0.06	0.423
6	3.81±0.06	3.89±0.04	0.298
7	3.73±0.04	3.78±0.02	0.233
8	3.62±0.04	3.75±0.07	0.145
9	3.73±0.06	3.85±0.05	0.158
10	3.76±0.07	3.89±0.06	0.187
11	3.72±0.05	3.80±0.05	0.292
12	3.68±0.06	3.77±0.06	0.287
Week	Control (T_0)	Treatment (T_1)	

Conclusion

In conclusion, the study focused on the impact of feeding biofortified wheat straw-based diets on the milk composition of lactating Murrah buffaloes. The introduction of WB-02 straw did not significantly alter the milk fat, solid not fat (SNF), protein, or lactose content when compared to the conventional straw. The study contributes valuable insights into the limited existing literature on the influence of zinc and iron biofortified feed on milk composition in buffaloes. Further research is warranted to explore potential correlations between biofortified feed and milk composition in different livestock species, thereby advancing our understanding of nutritional strategies for improved dairy production.

Authorship Contribution Statement

Davender Singh Kalwani carried out the experiment. Yash Parsana prepared the manuscript draft. Arun Kumar Misra designed the experiment and edited the draft.

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