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Effect of feeding wet Distillers grains with soluble on milk production and its composition in lactating Murrah buffaloes

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Abstract
In the present experiment, the effect of supplementing WDGS replacing cotton seed cake (CSC) on milk production and its composition in lactating Murrah buffaloes have been studied. Twenty-four lactating graded Murrah buffaloes were selected and divided into three groups of eight each on the basis of milk yield and body weight following completely randomized design. The buffaloes in control group (T_0) were fed on cotton seed cake as a concentrate source with wheat straw as per requirement. In the treatment group (T_1) and T_2 the cotton seed cake as concentrate mixture was replaced by 50% and 100% wet distiller's grains with soluble (WDGS). Buffaloes were kept under stall fed system with uniform management condition by housing them in well ventilated sheds. The duration of experimental feeding was 270 days. Total dry matter intake, milk production and milk composition were recorded during experimental feeding. There was no statistically ($P>0.05$) significant change in the total dry matter intake of buffaloes of all groups. There was significant increase in the average milk yield of buffaloes fed with 50% (T_1) and 100% (T_2) WDGS as a concentrate mixture in comparison to control (T_0) group. However, the supplementation of WDGS did not have any significant effect on overall milk composition in graded Murrah buffaloes. Supplementation of WDGS also improve the net returns per liter in treatment (T_2) group, in which 100% cottonseed cakes was replaced by wet distiller's grains with soluble. From the present study, it is concluded that the supplementation of WDGS in diet increased average milk yield without affecting milk composition and dry matter intake in lactating Murrah buffaloes.
Highlight: A significant increase in the average milk yield was observed in buffaloes fed with 50% and 100% WDGS as a concentrate mixture. Supplementation of WDGS also improve the net returns per liter in WDGS fed buffaloes in which 100% cottonseed cakes was replaced by wet distiller's grains with soluble.

Keywords: Dry matter intake, lactating Murrah buffaloes, milk production, milk composition, wet distillers' grains with soluble (WDGS)

Introduction
The contribution of livestock and allied sectors in agriculture sector has increased to 29.8% and share about 5.1% to gross domestic products (CSO, 2020). As per the 20th Livestock Census (2019) [1] total population of Indian buffaloes is 109.8 million, ranking first with 56.7% of total world buffalo population. Milk production from buffalo is increasing much faster than cow. It contributes 13% of the total world milk production. Indigenous animals' production is many folds lower than the global average. At present, the country faces a net deficit of 35.6% green fodder, 10.95% dry crop residues and 44% concentrate feed ingredients (IGFRI, (2013) [12] High feed costs around the world have caused animal nutritionists to search for lower cost alternative feed ingredients to minimize the cost of animal food and dairy production costs.
Distiller's grains are considered to be highly palatable; it is observed that dry matter intake is increased when distiller's grains are included in dairy cow diets (Schroer, *et al.*, (2014) [16]. It is an excellent, lower cost alternative feed ingredient that continues to be produced in large quantities by ethanol industry; from the grain after fermentation of starch (Youssef *et al.*, 2013) [24]. It was observed that feeding 30% DDGS supplemented diets resulted in increased milk production as compared to cows fed traditional feeds (Sihag *et al.*, (2018) [18]. Distillers grains with soluble have been reported to be a good source of rumen undegradable protein (RUP) and energy for ruminants and may be included up to approximately one third of the diet for lactating dairy cows (Schingoethe *et al.*, (2009) [17].

The positive effect of feeding DDGS have been reported by some earlier workers on growth and feed conversion efficiency (Engel *et al.*, (2014) [7]

Scientific studies regarding the effect of inclusion of WDGS in ration replacing cotton seed cake Murrah buffaloes is limited. Therefore, the present investigation was carried out to study the effect of feeding WDGS on milk production and its composition on lactating Murrah buffaloes.

Materials and Methods

The present research work was carried out in the Department of Livestock Production Management, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Mhow (M.P., India). Standard sanitary practices were followed for the entire experimental period and the animals were closely examined for any kind of health issues or sickness for the entire study period. The experimental buffaloes were dewormed with Fenbendazole @ 7.5 mg / kg BW and properly vaccinated before the start of the experimental trial.

Twenty four lactating graded Murrah buffaloes were selected and divided into three groups of eight each on the basis of milk yield and body weight following completely randomized design. The buffaloes in control group (T_0) were fed on cotton seed cake as a concentrate source with wheat straw as per requirement using ICAR (2013) [11]. In the treatment group (T_1) and T_2 the cotton seed cake as concentrate mixture was replaced by 50% and 100% wet distiller's grains with soluble (WDGS). Buffaloes were kept under stall fed system with uniform management condition by housing them in well ventilated sheds. The duration of experimental feeding was 270 days.

Chemical composition of the diet fed to the animals is presented in Table 1. The milking was performed twice daily at 5 AM and 4 PM and milk yield (MY) was recorded daily at each milking using an electronic digital balance. During experimental period, daily feed offered and residue leftover was recorded to determine voluntary feed intake at fortnightly intervals. All feed samples were analysed for proximate composition as per the standard procedures and fibre fractions (AOAC, (2005) [3].

Milk fat, protein, solid not fat (SNF), lactose and total solid were analyzed by Electronic Lactoscan (Milk Analyser, ISO: 9001). For the analysis, thoroughly mix milk sample was taken in the bottle and transferred in a clean receptacle provided with lactoscan. Economics of feeding was calculated by considering expenditure on feeds and WDGS and return from the sale of milk.

Data pertaining to feed intake, milk yield and milk composition were subjected one-way ANOVA using statistical package for social sciences (SPSS) version 21.0. Differences between the means were tested by using Duncan's multiple range test and significance level was set at $p<0.05$ (Snedecor and Cochran, (1994) [20].

Table 1: Chemical (% DM basis) composition of feed ingredients fed to experimental buffaloes

Particulars (%)	Cottonseed cake	Gram straw	Wheat straw	WDGS
Dry matter (DM)	91.34	86.90	87.97	34.82
Crude protein (CP)	17.6	8.4	10.8	36.68
Ether extract (EE)	11.56	2.81	3.34	9.08
Crude fibre (CF)	30.45	34.85	36.85	6.21
Total ash (TA)	4.88	11.45	10.15	6.86
Nitrogen Free Extract (NFE)	35.51	42.49	38.86	40.98
Acid insoluble ash (AIA)	0.089	6.7	5.3	1.89

Results and Discussion

Effect of dietary inclusion of WDGS on voluntary feed intake and milk yield of Murrah buffaloes

From the present study, it is revealed that the supplementation of wet distiller's grains with soluble (WDGS) has no any adverse effect on overall voluntary dry matter intake in graded Murrah buffaloes Table 2. Similarly, Gaillard *et al.* (2017) [8] reported that supplementation of DDGS in soybean-canola mixture diet have no any significant effect on voluntary dry matter intake. In corroboration with present study, Huang *et al.* (2020) [10] investigated the effect of palm kernel cake, cassava residue and dried distiller grain with soluble, on the dry matter intake of water buffaloes and concluded that the supplementation of DDGS did not affect the dry matter intake in water buffaloes. While, Pandey *et al.* (2021) [15] reported that the Average DMI was observed in cross bred heifers that received 40% soya DOC in concentrate was significantly ($p< 0.05$) higher than cross bred heifers those fed different concentrates

The daily milk yield over the lactation was found to be statistically maximum (6.02±0.03 lit) in buffaloes of T_2 group reared on 100% WDGS than buffaloes of T_1 group fed on 50% cottonseed cake with 50% WDGS (5.79±0.02 lit) and it was lowest (5.56±0.031 lit) in control (T_0) group, which indicates that feeding WDGS to lactating buffaloes is a better option. Moreover, it is also evident from Table 2 that there was an increase of 3.97% and 7.64% in milk yield in T_1 and T_2 groups, respectively, which indicates that there is an increasing trend in milk production percentage when cottonseed cake was replaced by WDGS in both the groups of lactating graded Murrah buffaloes. It might be due to higher proportion of rumen degradable protein of WDGS and energy (Schingoethe *et al.*, (2009) [17]. Similar to our results, Sihag *et al.* (2018) [18] reported that the experimental cattle fed 50% DDGS substituting GNC as protein source, yielded approximately 1.39 kg/d more milk ($p<0.05$) than cows fed diets containing no distiller's grains. Kleinschmit *et al.* (2006) [13] also reported that majority of the soybean meal in a protein-deficient dairy rations, when replaced with DDGS, significantly increased the milk yield. Soliman *et al.* (2013) [19] showed significant increase milk yield of lactating crossbred Friesian cows for the 20% DDGS containing rations. Increased milk production has also been reported in some studies with lactating cows (Chibisa *et al.* (2012) [5], Benchaar *et al.* (2013) [4] Tangendjaja *et al.* (2013) [21], Thanh and Suksombat, (2015) [22]. Therefore, the farmers may be suggested to offer WDGS supplemented feed to lactating buffaloes as there has been numerical increase in milk production in dairy buffaloes fed DDGS as compared to the buffaloes of control group.

Table 2: Effect of dietary Inclusion of WDGS on overall dry matter intake and milk Yield of Murrah buffaloes

Particulars	T_0	T_1	T_2	p-value
Average DMI (kg/d)	13.41±0.23	12.87±0.32	12.98±0.20	0.060
Fortnightly average daily milk yield (kg/d)				
1st	7.71^{a}±0.06	8.08^{b}±0.02	8.29^{c}±0.05	0.010
2nd	7.33^{a}±0.07	7.51^{a}±0.07	8.40^{b}±0.10	0.010
3rd	7.21^{a}±0.07	7.17^{a}±0.07	8.10^{b}±0.12	0.010
4th	7.75^{a}±0.13	7.12^{a}±0.03	8.00^{b}±0.05	0.010
5th	7.33^{ab}±0.08	7.13^{a}±0.05	7.52^{b}±0.12	0.020
6th	7.07^{a}±0.03	7.24^{b}±0.03	7.42^{c}±0.07	0.010
7th	6.75^{a}±0.03	7.13^{b}±0.04	7.27^{b}±0.07	0.020
8th	6.76^{a}±0.02	6.93^{b}±0.06	7.05^{b}±0.07	0.004
9th	6.65^{a}±0.04	6.83^{a}±0.05	7.05^{b}±0.11	0.004
10th	6.37^{a}±0.05	6.34^{a}±0.02	6.89^{b}±0.08	0.010
11th	5.70±0.05	5.61±0.07	5.87±0.14	0.154
12th	4.72^{a}±0.06	5.07^{b}±0.12	5.36^{b}±0.13	0.002
13th	4.06^{a}±0.03	4.46^{b}±0.06	4.41^{b}±0.05	0.002
14th	3.79^{a}±0.06	4.39^{b}±0.13	4.31^{b}±0.04	0.002
15th	3.54^{a}±0.07	3.88^{b}±0.09	3.82^{b}±0.06	0.010
16th	3.38^{a}±0.06	3.73^{b}±0.08	3.75^{b}±0.05	0.001
17th	2.90^{a}±0.08	3.49^{b}±0.10	3.29^{b}±0.09	0.001
18th	1.09^{a}±0.27	2.09^{b}±0.24	1.52^{ab}±0.30	0.040
Overall Average	5.56^{a}±0.03	5.79^{b}±0.02	6.02^{c}±0.03	0.001
% increase	-	3.97	7.64	-

Means with different superscripts within the column differ significantly at $p<0.05$.

Table 3: Effect of dietary inclusion of WDGS on milk composition of Murrah buffaloes

Particulars	T_0	T_1	T_2	p-value
0 day				
Fat	8.71±0.52	7.55±0.33	7.88±0.31	0.13
Protein	3.41±0.14	3.66±0.14	3.76±0.09	0.15
Lactose	5.08±0.19	5.14±0.20	5.01±0.21	0.91
SNF	8.97±0.23	9.19±0.18	9.22±0.17	0.62
Total solids	17.69±0.44	16.82±0.40	17.10±0.21	0.25
90 Days				
Fat	8.87±0.26	8.80±0.25	8.92±0.38	0.97
Protein	3.49±0.51	3.85±0.10	3.90±0.08	0.58
Lactose	5.18±0.18	5.14±0.14	5.03±0.23	0.84
SNF	9.01±0.19	9.17±0.17	8.95±0.16	0.64
Total solids	17.88±0.33	17.98±0.30	17.86±0.39	0.97
180 days				
Fat	9.42±0.26	8.79±0.19	8.96±0.41	0.34
Protein	3.76±0.13	3.95±0.07	3.83±0.07	0.40
Lactose	5.10±0.12	5.21±0.05	5.28±0.10	0.43
SNF	9.17±0.19	9.38±0.14	9.36±0.21	0.67
Total solids	18.59±0.35	18.18±0.14	18.33±0.58	0.76
270 Days				
Fat	9.29±0.21	8.50±0.19	8.73±0.28	0.065
Protein	3.91±0.06	3.84±0.11	3.90±0.07	0.801
Lactose	5.24±0.08	5.26±0.08	5.30±0.11	0.884
SNF	9.39±0.11	9.49±0.14	9.32±0.19	0.716
Total solids	18.68±0.30	17.99±0.28	18.05±0.44	0.320

Effect of dietary inclusion of WDGS on milk composition of Murrah buffaoes: From the results, it may be deduced that the milk composition (Milk Fat, Milk Protein, Lactose, SNF, Total Solid) has not affected by WDGS supplementation in Murrah buffaloes Table 4. Present results are synchronized with that of Sihag *et al.* (2018) [18], who reported that the milk fat and total solids contents are not affected by 50% replacement of groundnut cake with DDGS in concentrate mixture of cattle, however, crude protein contents of milk were not influenced even at 100% substitution. In the present study, no differences in milk fat yield and concentration were found, which rejects the general perception that feeding DDGS results in milk fat depression (Kleinschmit *et al.* (2006) [13]. The lactose concentration of milk usually shows only little variation in healthy cows, and it is rarely influenced by the feeding. It has been also confirmed by present study, in which milk lactose concentration was unaffected by feeding WDGS based diets.

Economics of Milk Production

Knowing the cost of production is an important aspect for a viable dairy farm business. Estimating the cost per liter of milk is a way to help farmers to become more aware of their overall costs, not just their cash flow

Table 4: Comparative economics of experimental groups

S. No.	Components	Expenditure incurred (Rs)		
		T_0	T_1	T_2
1.	Fodder	56.28	54.00	54.48
2	Concentrate	120.90	86.85	58.35
3	Total feed cost (1+2)	176.88	140.85	112.83
4	Labour	33.33	33.33	33.33
5	Veterinary medicine cost	13.32	13.32	13.32
6	Miscellaneous	10.52	10.52	10.52
7	Total variable cost (3+4+5+6)	234.05	198.02	169.98
8	Depreciation on fixed capital	13.69	13.69	13.69
9	Interest on fixed capital	14.42	14.42	14.42
10	Total fixed cost (8+9)	28.11	28.11	28.11
11	Gross cost (7+10)	262.16	226.13	198.09
12	Milk yield (L /D/A)	5.56	5.79	6.02
13	Sale price of milk (Rs/L)	60.00	60.00	60.00
14	Returns from milk (12*13)	333.60	347.40	361.20
15	Cost per litre (11/12)	47.15	45.27	32.90
16	By product value	9.13	9.13	9.13
17	Gross return (14+16)	342.73	356.53	370.33
18	Net return (17-11)	80.57	130.4	172.24
19	Net return per liter (18/12)	14.49	22.52	28.61

The economics of milk production is mostly governed by two major factors - one, is total feed cost and another is average milk yield per day per buffalo. The expenditure incurred on

total feed cost was found to be Rs. 176.88, 140.85 and 112.83 in T_0, T_1 and T_2 groups, respectively. This indicates that the cost incurred on feed was found to be significantly higher in control group as compared to treatment groups. In the line of similar trial, Tangendjaja (2013) [21] recorded reduction in cost of feed by 4% of daily diet for every inclusion of 10% corn DDGS in the dairy cow's diet.

The same result was obtained by Pandey *et al.* (2021) [15] in crossbred heifers when soy DOC was replaced with RDDGS. In present study, the expenditure incurred on feed in experimental group reflects in the difference in total variable costs between the groups. The total variable costs were determined as Rs. 234.05, 198.02 and 169.98 in T_0, T_1 and T_2 groups Table 4. The impact of variable cost in turn affects the gross cost of production, this resulted in higher gross cost (Rs. 262.16) in control (T_0) and comparatively lower cost in subsequent treatment T_1 (Rs. 226.13) and T_2 (Rs. 198.09) groups.

Another factor that influences the economy of production is average milk yield of individual buffaloes. The average milk yield and returns from milk were found to be 5.56, 5.79 and 6.02 liters and Rs. 333.60, 347.40 and 361.20 per day per buffalo, while gross returns were found to be Rs. 342.73, 356.53 and 370.33 in T_0, T_1 and T_2 groups, respectively. Net return per day per buffalo was found to be Rs. 80.57, 130.4 and 172.24, respectively, whereas, net return per liter of milk has been calculated as Rs.14.49, 22.52 and 28.6 Table 3. These results revealed that there were significant differences in all three groups indicative of the facts that supplementation of cottonseed cake is costly from milk production point of view as compared to replacement of cottonseed cake by WDGS either 50% or 100%. The same findings were reported by Thanh and Suksombat (2015) [22], Kumawat *et al.* (2016) [14] and Sehag *et al.* (2018) [18].

Conclusion

From the results it can be deduced that the WDGS supplementation improves milk yield by 3.97 and 7.64% in treatment groups T_1 and T_2. However, it has no effect on composition of milk in Murrah buffaloes. Moreover, it also improves the cost-benefit ratio and in turn increases the profitability of dairy enterprise.

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Conflict of Interest: None

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