

Effect of Feeding Wet Distillers Grains with Solubles (WDGS) on Milk Yield and Composition in Crossbred Cows

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Abstract

To arrive at the optimum level of Wet Distillers Grains with Solubles (WDGS) in dairy cow diets, a 120-day lactation trial, using hybrid napier (APBN-1) green fodder and paddy straw as roughage and concentrate mixture (T1, control) or WDGS @ 15 (T2), 25 (T3) and 35 % (T4) of DM requirement using 24 Jersey x Sahiwal crossbred dairy cows @ 6 cows per treatment allotted at random to one of the four treatments. The chemical composition of the WDGS for DM, CP, CF, EE, NFE, TA, Ca and P was 28.22, 36.72, 7.16, 8.74, 42.12, 5.25, 0.32 and 0.67 per cent. There was no significant difference in DMI (kg/d) and body weight change among the groups. CP and EE intakes were significantly ($P < 0.05$) increased with the increase in the level of WDGS inclusion from 0 to 35%. Inclusion of WDGS from 0 (T1) to 35% (T4) of DM requirement increased ($P > 0.05$) milk yield (4.74 to 5.8 kg/d), 4% FCM (5.39 to 7.04), % fat (4.99 to 5.52), fat yield (0.23 to 0.31 kg/d), protein yield (0.17 to 0.20 kg/d). Feed cost per kg FCM has decreased ($P > 0.05$) from Rs.23.95 (T1) to Rs.19.76 (T4). Mean MUN (mg/dl) lower ($P < 0.01$) in T2 (17.67), when compared to other treatments. Based on the results of the study it was concluded that WDGS can be included up to 35% of DM requirement for profitable milk production in crossbred dairy cattle rations.

Keywords: Crossbred Dairy Cows, Milk Composition, Milk Yield, Nutrient Intake, WDGS

Introduction

The dairy industry plays an important role in the economy of our country as well as providing a safe and wholesome protein supply for consumers. India accounts for only about 2.4% of the world's geographical area and 4% of its water resources, but has to support about 17% of the world's human population and 15% of the livestock (Khatkar *et al.*, 2016). There is a net deficit of 61.1% green fodder, 21.9% dry fodder and 64% concentrate feeds (Datta, 2013). Finding cheaper and nutrient dense feeds is essential in any sector of animal agriculture, but in the past few years, this has become increasingly important for the dairy industry. A lot of research has been conducted in the past on unconventional feeds and agro-industrial by-products as alternative resource of feeds for livestock. One such example is distiller's grain or brewer's grain with good nutritive potential.

The increased ethanol production from maize has resulted in increased availability of wet distillers grains with solubles (WDGS). WDGS is the main by-product of brewing industry, representing approximately 85 per cent of total by-products generated. One ton of grains produce 430kg of brewer's grain (Rendell, 2004). Wet distiller's grain can be conveniently used by the livestock owners in close proximity to the plant producing them, since they contain large amounts of water (75-80%) and transporting can be expensive. Hence, an attempt was made in the present study to see the effect of inclusion of WDGS in the diets on the performance of cattle.

Materials and Methods

The investigation was carried out for a period of 120 days using Jersey x Sahiwal crossbred cows at Livestock Farm Complex, College of Veterinary Science, Tirupati, to arrive at the optimum level of WDGS inclusion in lactating dairy cow diet. Twenty-four lactating Jersey x Sahiwal crossbred cows (336.87 ± 9.96 kg) in late lactation (183.92 ± 2.38 days) with average milk yield of 5.55 ± 0.35 kg/d, were divided into four groups of 6 cows each and randomly allotted to one of the dietary treatments. The cows were housed in a pucca shed with the provision for individual feeding and watering. Stall feeding was practiced throughout the experimental period. The four dietary treatments used in the feeding trial were formulated using Hybrid Napier (APBN-1) green fodder and paddy straw as roughages and concentrate mixture (T1, control) or WDGS @ 15 % (T2), 25% (T3) and 35 % (T4) of DM requirement. The experimental diets were fed depending upon the body weight and level of production of animals as per ICAR (2013) recommendations. WDGS was procured from a local supplier once in a week. Concentrate mixture was prepared by using 40 parts maize, 35.5 parts DORB, 21.5 parts soybean meal, 1 part urea and 2 parts mineral mixture. The daily requirement of concentrate mixture and WDGS were divided into two halves and offered in the morning and evening at the time of milking. Feed offered and orts of the concentrate and roughage left behind by each animal was monitored daily and averaged per week. Representative samples of feed offered and feed left over of individual animal were collected, dried and stored for further analysis.

Body weights of animals was recorded at the beginning and at the end of the experiment early in the morning before offering feed and water for three consecutive days and the average of three consecutive days was taken as the body weight. Cows were completely milked twice daily at 4.00 AM and 4.00 PM to record the daily milk yield. Daily milk production was averaged per week. Representative samples from milk of individual cows in control and treatment groups were collected at weekly intervals for four consecutive milkings throughout the experiment and were analysed for fat, protein, lactose and solids not fat (SNF) by using Milkoscan minor type 78110. Milk urea nitrogen (MUN) was estimated at fortnight intervals. 1 ml of milk sample was taken, added with 9 ml of 5% TCA solution and centrifuged at 2000 rpm for 5 minutes to separate upper fat layer and the milk serum was transferred to a separate vial for MUN estimation by Rahmatullah and Boyde (1980) method.

Feed samples (concentrate mixture, WDGS, paddy straw and APBN) and orts were analysed for proximate constituents (AOAC, 2005) and cell wall constituents (Van Soest *et al.*, 1991). For mineral estimation, feed (0.5g) were digested in microwave sample digester (CEM Mars X-press) using 15 ml nitric acid. Digested samples were diluted with double glass distilled water and filtered through No. 1 Whatman filter paper. Calcium in feeds and faeces was estimated using atomic absorption spectrophotometer (Perkin Elmer, Avanta- PM-A-6287). Phosphorus was analyzed by AOAC (2005) procedure.

Statistical Analysis

The data of the trail was subjected to statistical analysis through software (version 23.0; SPSS, 2015) by applying

one-way analysis of variance through generalized linear model and the treatment means were ranked using Duncan's multiple range test with a significance at $P < 0.05$ (Duncan, 1955). All the statistical procedures were done as per Snedecor and Cochran (1994).

Results and Discussion

The chemical composition, fibre fractions and mineral composition of the concentrate mixture, WDGS, APBN and paddy straw used for lactation trial is given in Table 1. The per cent proximate composition and fibre fractions viz., DM, OM, CP, EE, CF, NFE, TA, NDF, ADF, hemicellulose, cellulose and lignin values for WDGS were 28.22, 94.75, 36.72, 8.74, 7.16, 42.12, 5.25, 44.69, 21.25, 24.27, 16.10 and 3.69, respectively. Per cent CP (36.72% on DMB) of WDGS in the present study is slightly higher than the values reported by Westendorf *et al.* (2014), Durga *et al.* (2018) and Naveena *et al.* (2020), who reported CP values of 33.60, 32.06 and 32.00, respectively. The differences in chemical composition of WDGS may be attributed to the nature of grain used for beer making, differences in the manufacturing process and differences in the analytical techniques employed.

Table 1: Chemical composition (%) of WDGS, concentrate mixture, APBN and paddy straw (on DM basis)

	WDGS	Concentrate mixture	APBN	Paddy straw
Dry matter	28.22	91.55	24.77	90.7
Organic matter	94.75	89.65	89.29	85.59
Crude protein	36.72	21.83	7.31	4.44
Ether extract	8.74	1.64	2.35	1.34
Crude fibre	7.16	11.56	32.38	35.17
Total ash	5.25	10.39	10.7	14.41
Nitrogen free extract	42.12	54.6	47.25	44.63
Neutral Detergent Fibre	44.69	33.28	66.82	78.84
Acid Detergent Fibre	21.25	19.31	44.23	52.39
Hemicellulose	24.27	13.94	22.59	26.44
Cellulose	16.1	11.07	31.39	39.64
Lignin	3.69	5.54	7.31	5.4
Acid Detergent Insoluble Ash	1.46	2.7	5.53	7.38
Calcium	0.32	0.99	1.54	0.28
Phosphorus	0.67	0.43	0.59	0.11

Body Weight

The initial and final body weight (kg) and body weight change (g/d) of animals are presented in Table 2. The body weight change of animals among the treatments was not significantly different. Body weight gain (g/day) of 61.11, 62.50, 90.27 and 43.05, respectively was observed in T1, T2, T3 and T4 groups, respectively. This is in agreement with the results of Senthilkumar (2009) and Vitthal (2012) who reported no significant differences in live weight of milch cows and buffaloes fed different levels of wet brewer's grain in the diets. While Bohn *et al.* (2016) found increased body weight of cows supplemented with wet brewers grains compared to control animals supplemented with molasses low moisture protein blocks.

Table 2: Effect of inclusion of WDGS at different levels on body weights (kg) in lactating crossbred cows

Treatment	Initial weight (kg) ^{NS}	Final weight (kg) ^{NS}	Body weight gain (g/day) ^{NS}
T1	336.17 ± 22.64	343.50 ± 23.23	61.11 ± 9.78
T2	331.5 ± 20.71	332.50 ± 20.55	62.50 ± 12.5
T3	339.83 ± 15.08	355.83 ± 19.41	90.27 ± 11.26
T4	340.00 ± 25.39	345.17 ± 27.30	43.05 ± 16.16

^{NS} Values in the column do not differ significantly

Nutrient Intake

The data on nutrient intake is given in Table 3. The total DM intake of cows ranged between 8.27 to 8.98 kg per day across treatments and the differences were not significant. Similar findings were reported by Augustine (2008) and Piccolo *et al.* (2016), who reported non-significant differences in DMI in cattle fed diets containing WDGS. CP intake (kg/d) increased ($P < 0.05$) with the level of WDGS at 35% inclusion (1.53) compared to other groups. EE intake has significantly ($P < 0.05$) increased from 0.19 to 0.36 (kg/d) with the level of WDGS inclusion from 0 to 35% in T1 to T4. Piccolo *et al.* (2016) and Faccenda *et al.* (2017) also reported increased CP intake with the inclusion of wet brewers grain in the diets of cows. This increase in CP intake was due to the higher level of CP of WDGS.

Table 3: Effect of inclusion of WDGS at different levels on dry matter intake in lactating crossbred cows

Parameter	T1	T2	T3	T4
DMI from APBN (kg/d)	1.95 ± 0.15	2.14 ± 0.18	2.15 ± 0.09	2.15 ± 0.19
DMI from Paddy straw (kg/d)	3.08 ± 0.03	3.06 ± 0.07	3.00 ± 0.09	2.93 ± 0.09
DMI from concentrate (kg/d)**	3.94 ± 0.29 ^a	1.83 ± 0.14 ^b	0.79 ± 0.04 ^c	0
DMI from WDGS (kg/d)**	0	1.36 ± 0.29 ^c	2.20 ± 0.21 ^b	3.37 ± 0.69 ^a
Total DMI (kg/d)	8.98 ± 0.47	8.39 ± 0.45	8.27 ± 0.22	8.45 ± 0.50
DMI as % of B.Wt.	2.68 ± 0.16	2.56 ± 0.20	2.40 ± 0.09	2.53 ± 0.20
CP Intake (kg/d)*	1.14 ± 0.08 ^b	1.19 ± 0.09 ^b	1.27 ± 0.05 ^{ab}	1.53 ± 0.12 ^a
EE intake (kg/d)*	0.19 ± 0.01 ^c	0.25 ± 0.01 ^{bc}	0.29 ± 0.01 ^b	0.36 ± 0.03 ^a

^{ab} Values in row bearing different superscripts differ significantly* ($P < 0.05$), ** ($P < 0.01$)

Milk Yield and Composition

The average daily milk yield (kg/d) and 4% FCM (kg/d) of T4 fed group were higher ($P > 0.05$) (5.8 and 7.04, respectively) than in other groups (Table 4). Anderson *et al.* (2006), Senthil Murugan *et al.* (2015) and Changan *et al.* (2019) reported increased milk yield and FCM with the inclusion of WDGS @ 20 and 30 per cent of DM, respectively in dairy diets. However non-significant differences in milk yield and FCM were reported by different studies with the inclusion of WDGS or DDGS in dairy ration (Kelzer *et al.*, 2009 and Senthilkumar, 2017). Percent milk fat and fat yield (kg/d) among different treatments differed non-significantly with increased values in T4, 5.52 and 0.31 for per cent milk fat and fat yield, respectively. Increase in milk fat yield was also reported by Belibasakis and Tsirgogianni (1996) and Anderson *et al.* (2006) in wet brewers grain fed dairy cattle.

Per cent milk protein, lactose and SNF contents did not differ significantly among groups, but non-significant ($P > 0.05$) increase in yield (kg/d) of milk protein (0.20), lactose (0.26) and SNF (0.51) were seen in 35% WDGS fed cows. Most of the works with WDGS in dairy cattle also indicated it had no effect on milk protein, lactose and SNF contents (Ramirez- Ramirez *et al.*, 2011 and Senthil Murugan *et al.*, 2015). However, Anderson *et al.* (2006) and Gehman and Kononoff, (2010) found increased milk protein yield in wet brewers grain fed groups. The increase ($P > 0.05$) in FCM yield and yield of milk components in 35% WDGS group in lactation trail might be attributed to the increased intake of CP and EE with the increase in the level of WDGS and increased digestibility of EE and fibre.

DMI per kg FCM (1.88 kg to 1.35 kg) and feed cost per kg FCM (Rs.23.95 to Rs. 19.76) were decreased with the level of WDGS inclusion from 0 to 35% of DM requirement, indicating 17.49% decrease in the feed cost per kg FCM at 35% level of inclusion when compared to control, but the differences were not significant. Geetha *et al.* (2017) found lowered cost of milk production by 22% and 30% by the incorporation of brewery waste at 40 per cent and 80 per cent level in concentrate mixture (DM basis) in early lactating cows, compared to control group. Similarly lowered ($P < 0.01$) cost of milk production was noticed in cows fed diets containing commercial concentrate mixture replaced with WDGS at 20% of concentrate DM (Changan *et al.*, 2019) and in cows fed WBG at 15 and 30% of diet compared to control (West *et al.*, 1994). The decrease in DM intake per kg FCM in the present study might be due to increased yield of 4% FCM and increased energy supply because of greater intake of EE with the increase of WDGS in the diet. Decreased feed cost per kg FCM may be attributed to the increased FCM yield and lower cost of feed in WDGS supplemented groups.

Table 4: Effect of inclusion of WDGS at different levels on milk production and milk quality of crossbred cows

Parameter ^{+NS}	T1	T2	T3	T4
Daily milk yield (kg)	4.74 ± 0.77	4.78 ± 0.99	4.75 ± 0.35	5.80 ± 0.90
4% FCM	5.39 ± 0.80	5.18 ± 0.97	5.69 ± 0.45	7.04 ± 1.00
Milk composition				
Fat %	4.99 ± 0.26	4.71 ± 0.15	5.31 ± 0.17	5.52 ± 0.32
Fat yield (kg/d)	0.23 ± 0.03	0.22 ± 0.04	0.25 ± 0.02	0.31 ± 0.04
Protein %	3.57 ± 0.16	3.58 ± 0.08	3.67 ± 0.16	3.59 ± 0.09
Protein yield (kg/d)	0.17 ± 0.02	0.17 ± 0.03	0.17 ± 0.02	0.20 ± 0.03
Lactose %	4.43 ± 0.05	4.37 ± 0.04	4.45 ± 0.10	4.38 ± 0.15
Lactose yield (kg/d)	0.21 ± 0.04	0.21 ± 0.05	0.21 ± 0.02	0.26 ± 0.04
SNF %	8.82 ± 0.13	8.77 ± 0.06	8.88 ± 0.18	8.83 ± 0.13
SNF yield (kg/d)	0.42 ± 0.07	0.41 ± 0.08	0.42 ± 0.04	0.51 ± 0.08
DMI per kg FCM	1.88 ± 0.28	1.88 ± 0.25	1.54 ± 0.11	1.35 ± 0.21
Feed cost/ kg FCM	23.95 ± 3.42	23.78 ± 2.88	19.86 ± 1.32	19.76 ± 3.25

^{NS} Values in a row do not differ significantly for all the parameters

The results of the present study on milk urea nitrogen (MUN) levels (Table 5) showed significant increase ($P < 0.01$) in the mean MUN (mg/dl) from starting of the experiment (15.70) towards the end of the experiment (21.09) and the values were higher than the normal range of 8-12 mg/dl (Kohn, 2007). Mean MUN (mg/dl) was significantly ($P < 0.01$) higher in the animals fed diets with 35% of WDGS. The results on MUN levels are in consistent with results of Anderson *et al.* (2006), Kelzer *et al.* (2009), Ramirez- Ramirez *et al.* (2011), who reported increased MUN levels with the addition of WDGS in lactating dairy cow diets.

Table 5: Effect of inclusion of WDGS at different levels on MUN of lactating crossbred cows

Fortnight	T1	T2	T3	T4	Mean ^{**}
0	15.13 ± 1.88	15.75 ± 0.59	15.83 ± 0.91	16.10 ± 1.3	15.70 ± 0.60 ^D
1	18.65 ± 0.92	16.61 ± 0.27	18.40 ± 1.32	18.74 ± 1.57	18.10 ± 0.56 ^C
2*	18.85 ± 0.75 ^{ab}	16.39 ± 0.43 ^b	18.49 ± 1.20 ^{ab}	20.35 ± 0.98 ^a	18.52 ± 0.51 ^{BC}
3	20.33 ± 0.45	18.10 ± 0.47	18.63 ± 0.74	19.26 ± 0.95	19.08 ± 0.36 ^{AB}
4	19.21 ± 1.08	18.61 ± 1.06	18.89 ± 1.49	20.10 ± 1.39	19.20 ± 0.60 ^{AB}
5	18.02 ± 1.17	17.72 ± 1.01	18.63 ± 1.58	19.37 ± 1.65	18.44 ± 0.66 ^{BC}
6	19.22 ± 2.18	18.04 ± 0.96	20.30 ± 1.84	21.55 ± 1.32	19.78 ± 0.81 ^{AB}
7	20.17 ± 2.13	18.17 ± 1.76	21.14 ± 1.86	22.31 ± 1.81	20.45 ± 0.94 ^{AB}
8	20.97 ± 1.21	19.66 ± 1.10	20.93 ± 1.16	22.81 ± 1.06	21.09 ± 0.58 ^A
Mean ^{**}	18.95 ± 0.46 ^a	17.67 ± 0.30 ^b	19.03 ± 0.44 ^a	20.07 ± 0.45 ^a	

abc Values in a row, ABCD Values in a column not sharing common superscripts differ significantly * ($P < 0.05$), ** ($P < 0.01$)

Conclusion

Based on the results obtained in the present study it can be concluded that wet distillers grains with solubles (WDGS) can be included up to 35% of DM requirement with no adverse effect on DMI, milk yield and composition of the crossbred cows for economical production.

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Conflict of Interests

There is no conflict of interest.

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