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RESEARCH PAPER

Effect of Dietary Supplementation of Wet Brewer's Grains on Lactation Performance of Jersey Cross Breed Cows

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ABSTRACT

The present study was carried out to determine the effect of feeding different levels of wet brewers grains (WBG) on lactation performance of Jersey cross bred cows. Lactation and feeding wet brewer's grain feed trail was conducted in sixty lactating cross bred Jersey cow for 120 days and effect of milk production and milk composition and economics were studied. Sixty cows were randomly selected for three treatment groups with four replicates and five cows each. The nutrient requirements calculated were according to Indian Council Agriculture Research (1998) and experimental feeds were formulated dietary inclusion Brewer's grain 0 % (T1 Control group) 10 % (T2) and 20% (T3) ration dry matter replacing the cow feed experimental diet were fed with the cow feed twice daily, morning and afternoon before milking. Required green fodder was fed four times a day to avoid wastage of feed. Data on milk yield of individual animal was recorded daily throughout the experimental period. Milk samples were collected at fortnightly intervals and were analyzed for total solids, fat and solid not fat (SNF). The result showed that there was highly significant ($p< 0.01$) increase on milk yield (kg per day) when brewers grain was included in the cattle ration at 20 per cent DM replacing cattle feed dry matter quantity proportionately compared to other rations (T1 and T3). Non-significant ($P < 0.01$) changes were recorded in milk fat (%), solid not fat (%) and total solids (%) of milk between treatment groups. The efficiencies of Milk yield (milk yield/DMI) were significantly ($p < 0.05$) differed compare to control group and T2 group compared to T3 The income over feed cost (₹/animal/day) was significantly more for T3 group.

HIGHLIGHTS

- Brewers' grains are an excellent source of high-quality by pass protein, rumen non-degradable protein (RUP), fiber and energy. It is a cheaper alternative source of feed livestock feed.
- Wet brewers' grain 20 per cent added in lactating cross bred Jersey cows ration by replacing cattle feed to increase milk yield, improve efficiency of milk production and income over feed cost.

Keywords: Jersey cross breed cow, Milk composition, Milk production, Wet brewers' grain

India is home to a huge livestock population, which are crucial in enhancing socio-economic conditions of the rural people. According to the 20th Livestock Census in 2019, the total number of livestock population in the country is 536.76 million. India's livestock sector is one of the largest in the world, accounting for 11 % of the world's livestock. Dairying is the largest agricultural sector, accounting for 5% of the national economy and directly employing more than 8 million farmers. India is the number one producer of milk accounting for 23% of world milk production with an annual growth rate of approximately 6.2%. The production per animal is severely limited by the lack and high price of high-quality feed. Feed is one of the most important representative factors

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of production cost in dairy farming. Feed cost is a significant expenditure item, accounting for over 60 - 70 % of total production cost.

In India, one of the main reasons for low dairy cow productivity is the lack of quality and quantity of animal feed in the country, particularly during dry season. Due to the rising prices of concentrate feed material and the increasing demand for milk and dairy products, the need for alternative feed material has become very important in the dairy sector. The growth in livestock and human population, as well as the decline in agricultural area, has resulted in an acute shortage of feeds and fodder for livestock, which is exacerbated by natural calamities like as droughts and floods.

In India, most of the livestock farmers are marginal and small farmers whose agricultural land is not sufficient for their needs. Feed costs are high compared to milk production. Due to the increasing demand and high prices, dairy farmers are looking for alternative feed materials for sustainable development of dairy production. Locally available non-conventional agricultural by-products are increasingly used as animal feed and it has become imperative for dairy farmers to seek alternative cheaper and more nutritious feed sources to meet nutritional needs and improve animal performance (Westendorf *et al*. 2014).

A wide variety of agro-industrial by-products with significant nutritional value are available in large quantities. Brewers' grains are a representative example of such unrealized potential. The brewing industry produces large amounts of by-products and waste (Thomas *et al*. 2016). Wet brewer's grains are the most abundant byproduct of a brewery. The use of agricultural waste as feed for dairy animal lowers feed costs and enables the reuse of organic material in animal husbandry, which minimizes waste accumulation and environmental pollution. Brewers' grains are an excellent source of high-quality by pass protein, rumen non-degradable protein (RUP), fiber and energy. It is a cheaper alternative source of feed livestock feed (Davis *et al*. 1983). Wet brewers' grains are easily digested by dairy cows with minimal or no nutritional deficiencies as long as the spent grains are treated and fed as concentrate substitutes. Two potential benefits of using wet brewer's grains as a source of protein for ruminant feed are as follows: first one is it possess a source of slowly degradable protein, which bypasses the rumen to a large extent second, when combined with urea, it gives rumen microbes enough nitrogen (N) for optimal growth while reducing the amount of N lost to the rumen as ammonia (Westendorf *et al*. 2014)

Wet brewers grain feeding is becoming increasingly popular due to its low cost. Based on limited information, wet brewers' grains appear to be nutritionally equivalent to or better than dried grains. However, the maximum amount that can be fed to lactating cows has not been established.

The present study was conducted with major objective to study the effect of wet brewers grain feeding on milk production and milk composition of lactating jersey cross breed cows and also to calculate the of wet brewers grain feeding.

MATERIALS AND METHODS

Experimental Location

The present study was conducted at Department of Veterinary and Animal Sciences, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.

Nutritional properties of Wet brewers grain (WBG)

Wet brewer's Grain (WBG) is a byproduct of the brewing industry. It is an excellent source of high-quality protein, energy and fiber. They have a low content of dry matter (20-28%), an important source of protein, the crude protein content varies between 25-32% and high digestible nutrient (TDN) content due to the digestibility of available fiber. The high fiber content of WBG is related to the elimination of starch and sugars from barley grains during the malting process, leaving behind mostly the structural cell wall carbohydrates of hemicellulose and cellulose cell walls (Murdock *et al*. 1991). WBG is an important source of ruminal "bypass" (undegradable ingested protein – UIP). Brewers' Grain has a proteolytic rating of 0.49, while soybean meal has a proteolytic rating of 0.35. The energy value of WBG is approximately 71-75% of the total digestible nutrients, which is comparable to that of corn grains. The total energy value of spent grains is a combination of energy from highly digestible

fiber and crude fat, which accounts for 7-10% of the total product (Johnson *et al*. 1987).

WBG contains 70-75% water and quickly spoils due to the growth of bacteria, yeast, and fungi. Removing starch and rapidly fermentable sugars during soaking reduces the risk of acidosis. Brewer's grains can be used as a fiber extender in a balanced feeding program. Brewer's grains are an excellent source of phosphorus and selenium, providing additional nutrition by improving palatability. Brewer's grains have a low potassium content and require special care when formulating feeds (Khidzir *et al*. 2010). However, the low content of this mineral makes Brewer's grains particularly attractive in potassium-rich feeds, where overall potassium can be reduced to more acceptable levels. The flavour of brewer's grains decreases with storage time. Maximum recommended storage period depends on temperature and climate: 2-5 days in warm climates, 5-7 days in cold climates.

Experimental Animals and Design

Lactation and feeding wet brewers grain feed trail was conducted in sixty Jersey cross bred cows recorded milk yield average 7-8 litres in the previous lactation. Cows were randomly divided into three treatment groups (T1, T2 and T3) and each group consist of ten cows. The experimental cows were similar age, body weight, previous milk yield and stage of lactation. All the experimental cows are had free access to clean, wholesome drinking water and maintained at intensive system of management.

Experimental Ration

Wet brewer's grain purchased from local market and stored for daily use. The concentrated feed purchased and daily used for experimental animals. The green fodder (hybrid grass) cultivated in farmers field and utilised for feeding of animals. Dry matter (DM), crude protein (CP), crude fat (CF), total ash content and calcium and phosphorus were analysed according to AOAC methods (2012), Acid detergent fiber (ADF), neutral detergent fiber (NDF), lignin and silica were determined by the method of Goering and Van Soest *et al*. (1991) and for soluble nitrogen Wohlt *et al*. (1993). The dry matter and nutrient composition of Wet Brewers Grain presented in Table 1.

Table 1: Dry matter and Nutrient composition of Wet Brewers Grain

Sl. No.	Composition	Wet Brewers Grain
1	Dry matter, %	24.65 ± 4.79
2	Crude Protein, % of DM	27.82 ± 5.36
3	Soluble Protein, % of CP	12.95 ± 5.24
4	Crude Fat, % of DM	9.34 ± 2.58
5	Acid Detergent Fiber, % of DM	24.3 ± 7.56
6	Neutral Detergent Fiber, % of DM	49.72 ± 8.65
7	Lignin, % of DM	4.39 ± 0.68
8	Total Ash, % of DM	4.92 ± 0.36
9	Calcium, % of DM	0.31 ± 0.16
10	Phosphorus, % of DM	0.67 ± 0.19

The experimental rations were formulated according to Indian Council Agriculture Research (1998) based on the average body weight of 350-400 Kg, milk yield 7-8 per day with 4.0 - 4.5 % milk fat content. The nutrient requirements calculated were 5.26 kg TDN, 0.590 kg of DCP, 35.6 gm. of calcium, 27 gm. of phosphorus and 10.5 kg of dry matter. The experimental ration were formulated dietary inclusion wet brewers' grain 0 % (T1 Control group) 20 % (T2) and 30% (T3) ration dry matter replacing the cattle ration. After two weeks of preliminary adoption period, WBG were fed three experimental diets T1, T2 and T3 and continued 120 days feeding trial.

Green fodder (Bajra Napier grass) was fed in four divided lots in every day to ensure minimum wastage. Dry fodder paddy straw was fed daily in one time. The concentrate feed and wet brewer's grains were fed in equal quantity twice daily, in the morning and in the afternoon before milking. The balance concentrate feed, wet brewers' grains, Bajra Napier grass (Hybrid Napier grass) left behind by each animal was collected and weighed separately every day to calculate the actual dry matter intake. The wet brewer's grain was sampled three times weekly and composited by 120 days study periods.

Milk production and Milk composition

Milk production was recorded daily both in the morning and evening for throughout the experimental period. Milk samples were collected daily from each animal during morning and evening were pooled individually and the representative milk samples of individual animal were analysed

fat, solid not fat and total solids by using milk analyser.

Economics

The calculation of economics are based on dairy enterprises that consist of the following elements: Total feed cost, Cost of wet brewer's grain, Average daily milk yield, Income from milk production and income over feed cost.

STATISTICAL ANALYSIS

The data collected on various parameters during this experiment was statistically analysed by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Nutrient composition of Experimental ration

Feed and fodder requirement and nutrient composition of experimental rations of lactating cross breed Jersey cows are shown in Table 2. The experimental animal allowed to take equal quantity of hybrid Napier grass, paddy straw. The experimental rations T1, T2 and T3 crude protein content were formulated at 12.90, 13.72 and 13.89 per cent, respectively. The concentrate feed which was analysed and found 19.80 % crude protein on DMB.

The WBG used in this study was analysed for its crude protein content and found 20.30 % on DM. Since the ration crude protein content were differ very little, no protein source materials were added to adjust the crude protein content. The calculated Total Digestible Nutrients (TDN) content in the experimental rations were 49.78 per cent (T1), 49.89 per cent (T2) and 49.87 per cent (T3). The DM Intake (kg) in the experimental rations T1, T2 and T3 were 11.67, 11.70, and 11.72, respectively

Effect of feeding wet brewer's grain on Milk production and Milk composition

The effect of feeding of wet brewer's grain for lactating cross breed cow on milk production, fat percent, and solid not fat and total solids are shown in Table 3. In this study, the experimental group results revealed that there was highly significant ($p< 0.01$) increase on milk yield (lit per day) when WBG was included in the lactating cross bred jersey cow ration at 20 per cent proportionately increased milk yield compared to other rations. The increase in milk yield was not evidenced in when WBG was included at 30 per cent DM of total ration and similar to control group.

In this study, milk fat percentage was not altered by dietary treatment, percentages were within normal ranges, and diets did not depress milk fat. The efficiencies of milk yield (milk yield/DMI) were significantly ($p < 0.05$) differed compare to control group, although the milk yield was significantly less in T_3 (30 % DM) group compared to T_2 (20 % DM).

The present study indicated that feeding of wet brewer's grain 20 % for lactating cross breed cow significantly increased milk production compared to other experimental groups. The increase in milk

Table 2: Feed and fodder requirement and nutrient composition of experimental rations of lactating cross breed Jersey cows

	Ration Mixture (Kg/Day/Cow)		
	Control (T1)	Ration (T2) (20% DM WBG)	Ration (T3) (30% DM WBG)
Green Grass (Kg)	28.0	28.0	28.0
Bajra Napier CO(BN)5			
Paddy straw (kg)	5.0	5.0	5.0
Concentrate feed (Kg)	6.0	3.5	2.0
Wet Brewers Grains (Kg)	0.0	10.0	16.0
Nutritive Value			
DM Intake (Kg)	11.67	11.70	11.72
TDN (%)	49.78	49.89	49.87
Crude protein (%)	12.90	13.72	13.89

Table 3: The effect of feeding of wet brewer's grain on dry matter intake, milk production, fat percent, and solid not fat, total solids content of milk and milk production efficiency in lactating cross breed Jersey cows

	Dry Matter Intake (Kg)	Milk Production (Lt)	Milk Fat (%)	Solid Not Fat (%)	Total Solids (%)	Milk Production Efficiency (MY/DMI)
Over All Mean ±SE	12.073 ± 0.009	8.029 ± 0.017	4.493 ± 0.033	7.714 ± 0.055	11.659 ± 0.160	0.666 ± 0.003
15 days	11.634^{a}	7.768^{a}	4.341^{a}	7.405^{ab}	10.709^{a}	0.669^{bc}
30 days	12.169^{b}	7.844^{ab}	4.318^{a}	7.250^{a}	10.537^{a}	0.645^{a}
45 days	12.169^{b}	7.960^{bc}	4.593^{ab}	7.639^{abc}	11.551^{ab}	0.655^{ab}
60 days	12.142^{b}	8.258^{f}	4.489^{a}	7.746^{c}	11.583^{ab}	0.680^{c}
75 days	12.131^{b}	8.106^{cd}	4.459^{a}	7.918^{c}	12.249^{b}	0.669^{bc}
90 days	12.117^{b}	8.102^{cd}	4.823^{b}	7.779^{c}	11.877^{ab}	0.670^{bc}
105 days	12.125^{b}	8.059^{cd}	4.527^{a}	8.061^{c}	12.606^{b}	0.665^{abc}
120 days	12.101^{b}	8.133^{de}	4.393^{a}	7.918^{c}	12.164^{b}	0.672^{bc}
Treatment						
T1 Control	12.355^{a}	7.818^{a}	4.589^{a}	7.695^{a}	11.666^{a}	0.635^{a}
T2 (20% DM WBG)	12.382^{a}	8.432^{b}	4.442^{a}	7.775^{a}	11.830^{a}	0.680^{b}
T3 (30% DM WBG)	11.484^{b}	7.835^{a}	4.447^{a}	7.674^{a}	11.483^{a}	0.681^{b}

Mean values bearing the same superscript in different rows for a factor did not differ significantly (p<0.05).

yield might be due to WBG have a larger degradable fraction of protein, that protein is converted into microbial cell protein which is digested and absorbed in the duodenum. However, WBG supplies protein to the duodenum in a different manner and is therefore thought to provide sufficient amounts of amino acids for milk production (Davis *et al.* 1983).

West *et al*. (1994) reported there were no differences (P = 0.37) in milk production who replaced forage in the diet up to 30% DM and 26% DM respectively. However, when Polan *et al*. (1985) tested three different levels of WBG inclusion (13.0 %, 20.6% and 29.0% DM) and compared them to the basal diet, the cows fed WBG produced more milk. But Imaizumi *et al.* (2015) conducted a trail on lactation cows fed experimental ration with 10% and 20% of WBG, but there was no difference in milk production and milk composition.

A significant increase in amounts of milk yield and percent of milk protein and solids not fat when they fed on different levels of dried brewers' grains (2.4, 4.8, 7.2) kg in experimental diets as compared to the control group and also, they did not find any significant effect on milk composition at 15% dried brewers' grains in dairy cow rations. (Chioua *et al*. 1998). The use of feeding wet brewer's grain for lactating cows has produced positive results because it increases milk production and fat contents without affecting dry matter intake (Valentine and Wickes, 2003).

But contrary to present observation there was no difference in dry matter intake, milk yield, and milk composition of cows fed WBG at 15 and 30% of the dietary DM when WBG replaced soybean meal and barley in diets based on alfalfa hay and corn silage (Murdock *et al.* 1991). Lactating cows fed diets containing 21.5% DBG and 23.5% WBG resulted in no change in feed intake, milk yield, and milk composition of cows (Hoffman *et al*. 1988). Feeding wet brewers' grain at 15% of the dietary dry matter to dairy cows had no influence on feed intake, fat corrected milk yield, milk composition and feed consumption (Dhiman *et al*. 2003).

Economics of feeding wet brewer's grain

The effect of feeding of wet brewer's grain feed costs, income from milk and income over feed cost for lactating cross bred Jersey cow is presented in Table 4. The feed cost per Kg of dry matter for T1 (control) comparatively more than T2 and T3. However, based on the study report the income over feed cost was significantly (P<0.05) more compared to other experimental rations. The milk income from cow per day was significantly more in T_2 (20 % DM) group. In this study report that income over feed cost was significantly high in T_2 (20 % DM) group compared to T3 and T1.

Table 4: Economics of feeding different levels of wet brewer's grain in diet of lactating cross breed Jersey cows

Parameter	T1 Control	T2 (20% DM WBG)	T3 (30% DMWBG)
Feed Cost ₹/Kg of dry matter	16.78	17.89	18.65
Feed Cost ₹/day/ animal	201.75[a]	166.49[b]	138.36[c]
Income from milk Rs/ day/cow	234.21[a]	272.80[b]	238.21[a]
Income Over Feed Cost	32.46[a]	106.31[c]	99.85[b]

Mean values bearing the same superscript in different columns did not differ significantly (p<0.05).

CONCLUSION

Wet brewers' grain could be included in lactating cross bred Jersey cows ration by replacing cattle feed (concentrate) at 20 per cent dry matter of ration with increased milk yield, improved efficiency of milk production and income over feed cost. It is signified that production of the dairy cows had improved resulting in more earning to the farmer. WBG is used in animal nutrition, especially in ruminants and due to its high fiber content. The low cost of this feed also has an impact on the economics of production. Fresh brewer's grains left on the ground outside the brewery spoil quickly and can become an environmental nuisance, including water pollution. Using brewers' grains as animal feed alleviates the environmental impact of the brewing process. In this study we conclude that WBG used as an alternative to feed source for dairy cattle ration.

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