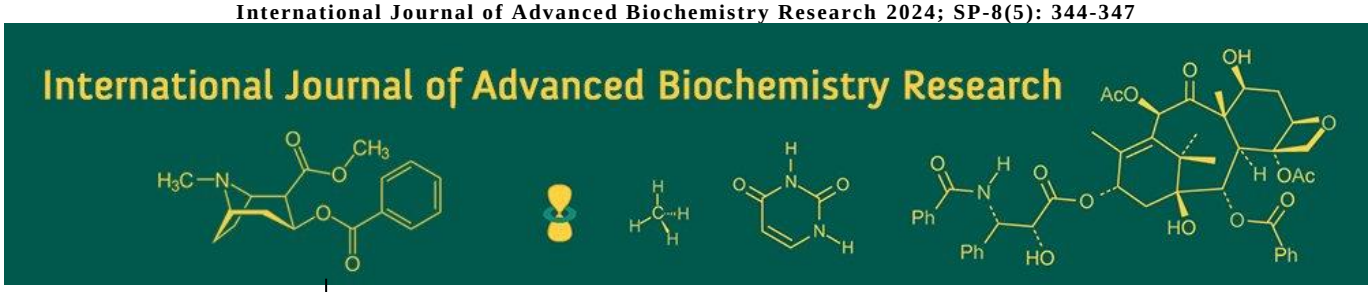

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Lactation performance of dairy buffaloes fed with wet brewer's grain

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Abstract
A study was conducted to find out the feeding value of brewer's grain on milk production and economics of dairy buffaloes (*Bubalus bubalis)* at farmer's field in Tiruppur district of Tamil Nadu. India. Wet brewers' grain (WBG) is low cost used in animal nutrition and due to its high fiber content, especially in cattle and buffaloes. The experiment was carried out under completely randomized block design. Sixty lactating non-descript buffalo were randomly selected for three treatment groups with four replicates and five buffaloes each. The nutrient requirements calculated were according to Indian Council Agriculture Research (1998) and experimental feeds were formulated dietary inclusion Brewer's grain 0% (T_1 Control group) 10% (T_2) and 20% (T_3) ration dry matter replacing the buffalo feed experimental diet were fed with the buffalo feed twice daily, in the morning and in the 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 buffalo ration at 20 percent DM replacing cattle feed dry matter quantity proportionately compared to other rations (T_1 and T_3). 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 T_2 group compared to T_3 The income over feed cost (Rs/animal/day) was significantly more for T_3 group.

Keywords: Buffalo, fat%, milk yield, solid not fat, economics, wet brewers' grain

Introduction
Livestock is an essential part of India's agricultural economy and plays a vital role in the livelihood and food security of the country's rural population. The country's livestock population accounts for 11% of the world's livestock farming population, making it one of the biggest in the world. Globally, India ranks first both in production as well as consumption of milk. The buffalo account for nearly 50% of Indian milk production, while cow and goat account for the remaining 50%. The buffalo population in India accounts for 56% of the global buffalo population. Buffaloes are considered to be one of the most resilient species of ungulates in the world. They can withstand all climatic conditions and infectious diseases. They have a very high survival rate and feed on low quality inputs. This makes them a preferred and sustainable choice for many poor farmers.
Buffaloes play an important role in the production of milk, meat, draught power, and manure. They are found all over the country because of their high milk production potential, their ability to adapt to different environmental conditions, and their feed conversion efficiency. Composition of milk is economically important to milk producers, important to dairy industries for producing better quality products and nutritionally important to milk consumers for their health.
The growth of livestock and human population, as well as the decrease in agricultural area, there is an acute shortage of feed and fodder for livestock. This shortage is further compounded by natural disasters such as drought and floods. The majority of buffalo farmers are marginal or small farmers, and the availability of agricultural land is not enough to meet their needs. To ensure the sustainability of the dairy farming, the locally available, non-conventional agro-industrial products are being used as buffalo feed.

As a result, it has become essential for dairy producers to find cheaper and more nutritious alternative feed sources to improve animal performance. In the brewing industry, generates large amounts of by-products and wastes. Brewer's grains are produced most abundant in brewing by-product. Brewer's grains are, an excellent source of high-quality bypass protein, ruminal un degradable protein (RUP), fiber and energy content. It is a cheaper alternative compared to higher-cost feed grains.

The use of agribusiness waste for ruminant feed provides a reduction in feed cost and allows for the reuse of organic material in animal production, thus preventing waste accumulation and environmental pollution (Brochier and Carvalho, 2009) [2]. Wet Brewer's grains possess two potential advantages as a protein source for ruminants: firstly, it constitutes a source of slowly degradable protein, which bypasses the rumen to a large extent and secondly its combination with urea provides rumen microbes with sufficient nitrogen (N) for their optimum growth while minimizing N losses absorbed as ammonia from the rumen. Interest in feeding wet brewer's grains has increased because of comparatively less cost. It appears from limited data that wet brewers' grains are equal to or possibly superior in nutritional value to dried grains. However, the maximum amount that can be fed to lactating buffalo has not been established. In this context, the objective of this study was to determine the optimal level of dietary inclusion of wet brewer's grain for lactating buffaloes.

Materials and Methods

Experimental Location and Environmental conditions

The study was conducted in Tiruppur district of Tamil Nadu in dairy buffaloes ((*Bubalus bubalis)* under farmer field condition. Tiruppur is located at 11°062 273 N 77°202 233 E / 11.1075°N 77.3398°E Geographical area of Tiruppur district is 5186.34 square kilometres. Tiruppur district lies on the western part of Tamil Nadu bordering the Western Ghats and hence the district enjoys a moderate climate. The climate in Tiruppur is hot semi-arid with the mean maximum and minimum temperatures varying between 35 and 22 °C (95.0 and 71.6 °F).

Wet brewers' grain (WBG)

Wet brewer's grains (WBG), is one of the by-products of the brewing industry and is an excellent source of high quality protein. Its energy and fiber content is 21-33% dry matter. It is suitable as a supplement for ruminant's diets due to its high fiber content. WBG has a total energy value of about 71-75% of total digestible nutrients which is similar to corn grains. Total energy value of spent grain is a combination of highly digestible fiber energy and crude fat which makes up 7-10% of total product. WBG contains 70-75% water and breaks down quickly due to the presence of microorganisms such as bacteria, yeasts, and fungi. The palatability of the brewer's grains decreases with the amount of time they are stored. The maximum recommended storage time depends on the temperature and climate. In warm weather, the recommended storage time is 2-5 days. In cold weather, the storage time is 5-7 days.

Experimental Animals

The study was carried out in farmer field using completely randomized block design. Sixty dairy buffaloes selected for three treatment groups with four replicates of five buffaloes each. The buffalo selected for experiment average milk yield was 6-8 litres in the previous lactation. The experimental animals were similar age, body weight, parity, previous milk yield and stage of lactation. All the selected experimental buffaloes had free access to clean, wholesome drinking water. Green fodder was fed in 3 divided lots every day to ensure minimum wastage. 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 and Bajra Napier grass CO (CN) 5 left behind by each animal was collected and weighed separately every day to calculate the actual dry matter intake.

Experimental Ration

Wet brewer's grain purchased from nearby market and kept for everyday usage. The concentrated feed that was bought is used daily for the experimental animals. The green fodder Bajra Napier CO5 grass, cultivated in farmers' fields and used to feed animals. Dry matter, crude protein, crude fat, ash content, calcium, and phosphorus were tested using AOAC methods as described by Murdock *et al*. (1981) [9]. Acid detergent fiber, neutral detergent fiber, lignin, and silica were analyzed following Goering and Van Soest's method (1970), while soluble nitrogen was determined by Wohlt *et al*. (1993) [12]. Table 1 shows the dry matter and nutrient content of Wet Brewers Grain.

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

S. 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 diets were formulated based on the guidelines from the Indian Council of Agriculture Research (1998) for buffalo weighing 400-450 Kg, producing 6-8 liters of milk per day, and with a milk fat content of 4.0 - 4.5%. The nutrient needs were determined as 5.26 kg of TDN, 0.590 kg of DCP, 35.6 gm of calcium, 27 gm of phosphorus, and 10.5 kg of dry matter. The study diet was made with different levels of wet brewers' grain: 0% in T_1 (Control group), 20% in T_2, and 30% in T_3, replacing part of the buffalo ration dry matter. Following a two-week initial

adoption phase, the WBG were given three different experimental diets (T_1, T_2, and T_3) and the feeding trial lasted for twelve weeks.

Green fodder Bajra Napier hybrid grass CO (BN)5 was fed in 3 divided lots 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 hybrid grass CO (BN)5 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 three months study periods.

Milk production was recorded daily both in the morning and evening for throughout the experimental period. Milk samples were collected at from morning and evening milking once in every week throughout the experimental period and were analysed fat, solid not fat and total solids by using milk analyser. The calculation of economics is 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. The data collected on various parameters during this experiment was statistically analysed under completely randomized design.

Results

Nutrient composition of Experimental ration

Feed and fodder requirement and nutrient composition of experimental rations of dairy buffaloes are shown in Table 2. The experimental animal allowed to take equal quantity of Bajra Napier hybrid grass CO (BN) 5, paddy straw. The experimental rations T_1, T_2 and T_3 crude protein content were formulated at 12.90, 13.72 and 13.89 percent, 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 very little, no protein source were added to adjust the crude protein content. The calculated Total Digestible Nutrients (TDN) content in the experimental rations were 49.78 percent (T_1), 49.89 percent (T_2) and 49.87 percent (T_3). The DM Intake (kg) in the experimental rations T_1, T_2 and T_3 were 11.67, 11.70, and 11.72, respectively.

Table 2: Feed and fodder requirement and nutrient composition of experimental rations of dairy buffaloes

	Ration Mixture (Kg/Day/Cow)		
	Control (T_1)	**Ration (T_2) (20% DM WBG)**	**Ration (T_3) (30% DM WBG)**
Green Grass (Kg) Bajra Napier CO(BN)5	28.0	28.0	28.0
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			
Dry Matter Intake (Kg)	11.67	11.70	11.72
TDN (%)	49.78	49.89	49.87
Crude protein (%)	12.90	13.72	13.89

Milk Yield and Milk composition in Buffalo

The effect of feeding of wet brewer's grain for lactating buffalo on milk production, fat percent, and solid not fat and total solids is presented in Table 2. 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 buffalo ration at 20 percent proportionately increased milk yield compared to other rations. The increase in milk yield was not evidenced in when WBG was included at 30 percent DM of total ration and similar to control group.

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

	Dry Matter Intake (Kg)	Milk Yield (Lt)	Milk Fat (%)	Solid Not Fat (%)	Total Solids (%)	Milk Production Efficiency (MY/DMI)
Experimental Group						
T1 Control	12.43^{a}±0.018	7.818^{a}±0.064	6.589^{a}±0.046	8.635^{a}±0.026	14.384^{a}±0.069	0.635^{a}±0.083
T2 (20% BG)	12.59^{b}±0.012	8.532^{b}±0.089	6.842^{b}±0.083	8.975^{b}±0.043	14.936^{b}±0.052	0.695^{b}±0.078
T3 (30%WBG)	12.52^{a}±0.017	7.835^{a}±0.092	6.447^{a}±0.072	8.624^{a}±0.039	14.323^{a}±0.094	0.641^{a}±0.069

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

Economics of feeding wet brewer's grain

The effect of feeding wet brewer's grain feed costs, income from milk and income over feed cost for lactating buffalo is presented in Table 3. The feed cost per Kg of dry matter for T_3 (30 percent DM) comparatively more. 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 percent) group.

Table 4: Economics of wet brewer's grain feeding of dairy buffaloes

Parameter	T_1	T_2	T_3
Feed Cost Rs/Kg of dry matter	16.78	17.89	18.65
Feed Cost Rs/day/animal	211.75^{a}	195.49^{b}	147.36^{c}
Income from milk Rs/day/cow	234.21^{a}	261.80^{b}	238.21^{a}
Income Over Feed Cost	22.26^{a}	56.31^{b}	90.85^{c}

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

Discussion

The increase in milk production could be a result of WBG containing a higher percentage of protein that can be broken down, transformed into microbial cell protein, and then digested in the duodenum. Nevertheless, WBG supplies protein to the duodenum in a different manner, yet it still appears to provide enough amino acids for milk production (Murdock *et al*., 1981) [9].

West *et al*. (1994) [11] reported there were no differences in milk production who replaced forage in the diet up to 30% DM and 26% DM respectively. However, when Polan *et al*. (1985) [10] 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. Meanwhile, Chioua *et al.* (1998) [4] observed significant reduction in milk production of dairy cows fed with diets containing wet brewer's grain. 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 percent DM) group compared to T_2 (20 percent DM).

Valentine and Wickes (2003) [13] found 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 comparison to control group and also, they did not find any significant effect on milk composition at 15% dried brewers' grains in dairy cow's rations.

Conclusion

Wet brewers' grain could be included in dairy buffalo ration by replacing concentrate feed at 20 percent dry matter of ration with increased milk yield, improved efficiency of milk production and income over feed cost. The increased milk production of dairy buffaloes led to increased earnings for the farmer. The affordable price of this feed also affects the economics of production. Brewer's grains that are freshly discarded on the ground outside the brewery can deteriorate rapidly and lead to environmental problems such as water contamination.

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