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(RESEARCH ARTICLE)

Supplementation of brewer's yeast slurry improves the performance of dairy cattle

Wijerathna Jayantha [1], Lansakara Priyanwada [1], Abeysinghe Chandana [1] and Prathapasinghe Gamika [2,*]

[1] *Department of Plantation Management, Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura, Gonawila, 60170, Sri Lanka..*

[2] *Department of Livestock and Avian Sciences, Faculty of Livestock, Fisheries and Nutrition, Wayamba University of Sri Lanka, Makandura, Gonawila, 60170, Sri Lanka.*

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Abstract

Brewer's yeast slurry is the by-product of the beer processing industry which includes live cells of *Saccharomyces cerevisiae*. It is rich in high-quality protein, vitamins and minerals essential for the growth and well-being of animals. Moreover, *Saccharomyces cerevisiae* improves the growth of beneficial microflora in the rumen of ruminant animals. Sri Lanka is importing a large amount of milk and milk products to fulfill the demand of consumers. Lack of high-quality feed is one of the major concerns which hinders the dairy production in the country. Therefore, the purpose of this study was to investigate the effects of supplementing brewer's yeast slurry on the performance of dairy cattle in large scale production. In this study, 120 lactating cows were selected and divided into two groups as control and treatment considering their production, breed, and stage of lactation. The complete study period was 77 days. In the first period, the treatment group was fed with brewer's yeast slurry for 32 days. In the second period, which included 26 days both treatment and control groups were not fed brewer's yeast slurry. In the third period, the treatment group was fed brewer's yeast slurry for 19 days. Milk samples were collected daily and milk weight, fat content and density were measured. According to the results, milk production was significantly higher in the treatment group. Furthermore, supplementation of brewer's yeast slurry has improved the total solids and fat content of the milk.

Keywords: Brewer's yeast slurry; Dairy cattle; Milk yield; Milk fat; Total solids

1. Introduction

Although milk production in Sri Lanka has been growing over the years, at present the production fulfills only 40% of the national demand. This has resulted in importing large amounts of milk and milk products into the country. The total importation cost for dairy products for the year 2017 was around 266 million USD. Therefore, the dairy sub-sector has the most priority for the development among the other sub-sectors in Sri Lanka [1]. The shortage of steadily supply of feed is one of the major constraints which hinders the development of the dairy industry in Sri Lanka. Furthermore, in intensive dairy production, feed cost accounts for the second-highest cost next to the labor cost which is strongly influenced by the high price of compounded feed [2]. The total dairy production in Sri Lanka is largely contributed by the smallholder farmers in rural areas and with few large scale milk producers. Smallholder farmers mainly depend on the forages available in natural grazing lands, roadsides, riversides and paddy fields. This leads to fluctuations in quantity and quality of the feed especially during the dry season [3].

The use of antibiotics and various growth promoters as feed additives in animal feeding has become a growing concern worldwide. Supplementation of yeast (*Saccharomyces cerevisiae*) culture for dairy cows has been practiced over decades in the dairy industry. Many studies have reported its advantages such as improvement of the nutritional value of low-quality forages, regulation of ruminal pH, stimulation of cellulolytic bacteria in the rumen and increase fiber digestion. Besides, feeding of yeast culture helps in alleviating heat stress in dairy animals [4]. Moreover, it increases the dry

* Corresponding author

E-mail address: gamika@gmail.com

matter intake, feed efficiency, milk yield, milk component yield and overall performance of dairy cattle [5]. Feeding of brewer's yeast in liquid form has increased the feed intake of dairy animals as it increases the palatability. It is similar to soybean meal as a protein supplement which will increase the total protein content in the diet. The direct addition of brewer's yeast slurry into animal feed avoids the huge cost associated with drying [6].

Usage of brewer's yeast slurry which is a byproduct of the beer industry as an animal feed supplement decreases its potential adverse effects to the environment. Its beneficial effects in the animal body would increase the overall production in dairy cattle both in commercial and small scale dairy production. Besides, its high protein content would replace the concentrate feeding and reduce the cost involved in the use of protein supplements such as soybean meal. Overall feeding of brewer's yeast slurry could increase milk production in the country which will in turn avoid the protein malnutrition at a low cost. Therefore, this study was carried out in a large scale dairy farm to investigate the effectiveness of supplementation of brewer's yeast slurry to dairy cows on their performance.

2. Material and methods

2.1. Location

This study was carried out at the Andigama farm, a government farm under the National Livestock Development Board (NLDB), Sri Lanka.

2.2. Brewer's yeast slurry

Brewer's yeast slurry was obtained from the Lion Brewery Ceylon PLC, Biyagama, Sri Lanka and transported to the farm and stored in stainless steel storing tanks.

2.3. Animals and experimental design

The farm is a coconut-cattle integrated farm where the cattle are reared under the semi-intensive management system. Dairy cows were allowed for grazing on improved pasture lands day and night. Grazing was controlled with an electric fencing system. Clean, potable water was provided *ad-libitum*.

In this study, 120 cows were selected regarding their breed, stage of lactation and average milk production for the experiment and they were grouped into two as control and treatment. All the animals selected for the study had not been fed brewer's yeast slurry previously. The whole study period was divided into three parts. In the first period, the treatment group was fed brewer's yeast slurry for 33 days. In the second period which was extended for 26 days, both treatment and control groups were not fed brewer's yeast slurry. In the third period, the treatment group was fed brewer's yeast slurry for 19 days. The brewer's yeast slurry was fed at a rate of 2kg/ day/ head for the treatment group. It was mixed with general cattle feed and fed to the cows during milking at milking parlor twice a day.

2.4. Milk testing

Milk was collected in separate chilling tanks from treatment and control groups. Samples were taken from chilling tanks using milk sampler. Milk yield was measured on a weight basis using a weighing machine (Avery Weigh-Tronix Saltner Brecknell B140-50). Milk Fat content was measured according to the Gerber method as described by Kleyn *et al*. (2001) [7]. The specific gravity of milk was measured using the Lacto densimeter (DIC131, India). The total solid content (TS%) of the milk was calculated using specific gravity and fat. The Average milk yield (AMY) and the average fat corrected milk yield (AFCMY) were calculated.

2.5. Statistical analysis

Data were analyzed by performing two sample t-test in Minitab 16.1.0 software package [8]. Statistical significance was declared at $P < 0.05$.

3. Results

3.1. Milk yield

The average milk yield of the treatment group and the control group was not significantly different in the first period of the experiment (Table 1). However, in the second and third periods, the average milk yield and the average fat corrected milk yield were significantly higher (p<0.05) in the treatment group compared to the control group (Table 2 and 3, Figure 1 and 2).

Table 1 Average milk yield, Average fat corrected milk yield, Fat% and Total solids% of treatment and control groups in the first period.

Variable	Treatment	Control
AMY (kg/cow/day)	4.31±0.36[a]	4.34±0.41[a]
AFCMY (kg/cow/day)	5.02±0.43[a]	4.61±0.41[b]
Fat%	5.09±0.26[a]	4.54±0.21[b]
TS%	13.81±0.28[a]	12.82±0.27[b]

Values are Means ± SD. Means within the same row with different superscripts are significantly different at P<0.05.

Table 2 Average milk yield, Average fat corrected milk yield, Fat% and Total solids% of treatment and control groups in the second period.

Variable	Treatment	Control
AMY (kg/cow/day)	4.69±0.98[a]	4.08±0.13[b]
AFCMY (kg/cow/day)	5.40±1.14 [a]	4.39±0.24 [b]
Fat%	5.01±0.24 [a]	4.64±0.22 [b]
TS%	13.26±2.73[a]	12.97±0.31[a]

Values are Means ± SD. Means within the same row with different superscripts are significantly different at P<0.05.

Table 3 Average milk yield, Average fat corrected milk yield, Fat% and Total solids% of treatment and control groups in the third period**.**

Variable	Treatment	Control
AMY (kg/cow/day)	5.86±0.21[b]	5.60±0.25[a]
AFCMY (kg/cow/day)	6.56±0.26 [a]	5.86±0.43 [b]
Fat%	4.81±0.19 [a]	4.41±0.31 [b]
TS%	13.51±0.31[a]	12.59±0.40[b]

Values are Means ± SD. Means within the same row with different superscripts are significantly different at P<0.05.

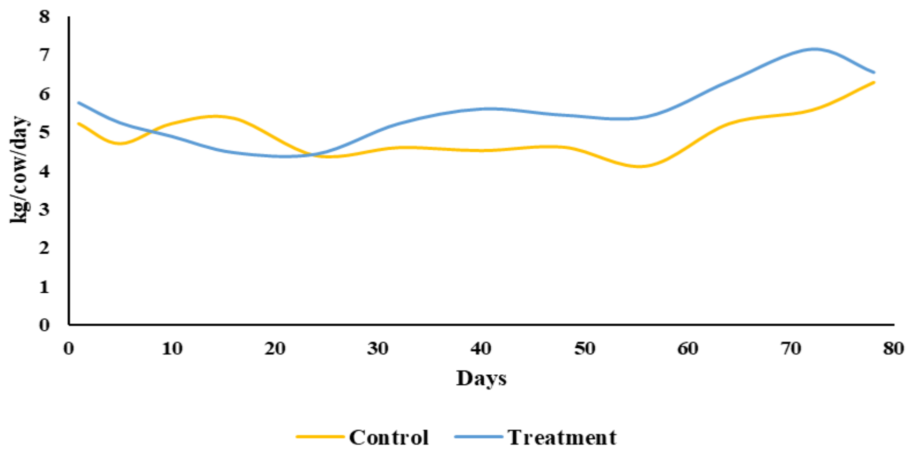

Figure 1 Change of average fat corrected milk yield of treatment and control groups

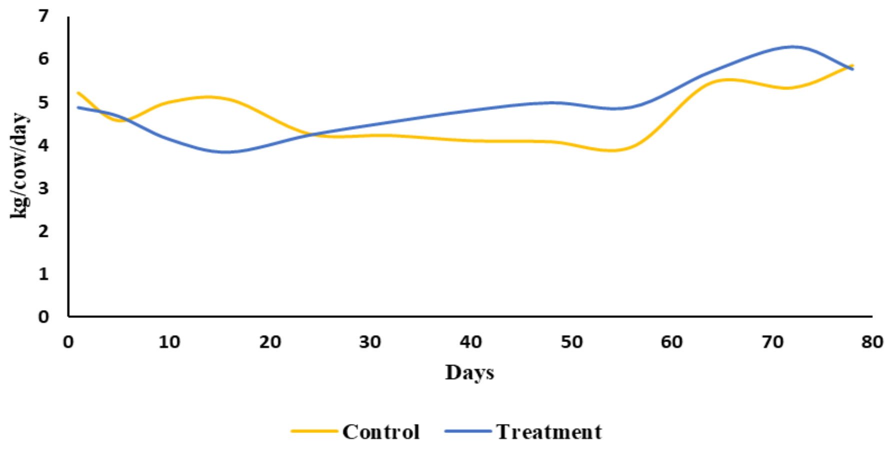

Figure 2 Change of average milk yield of treatment and control groups

3.2. Milk fat

Results show that the milk fat content of the treatment group is significantly higher ($p<0.05$) than the control group during the study period (Table 3, 2 and 3 and Figure 3).

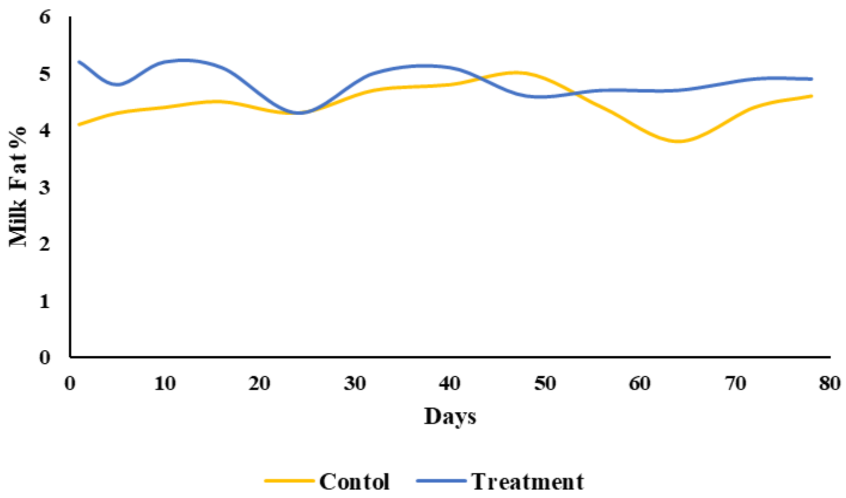

Figure 3 Change of milk fat content of treatment and control groups

3.3. Total solids

According to the results of the study, the total solids content of milk in the first and third periods is higher ($p<0.05$) in the treatment group compared to the control group (Table 1, 3 and Figure 4). However, it is not significantly different between the treatment and control in the second period (Table 2 and Figure 4).

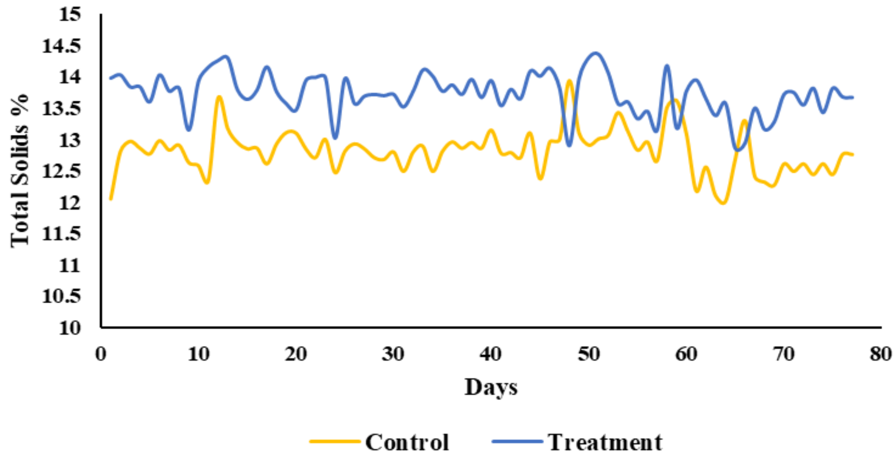

Figure 4 Change of total solids % of control and treatment groups

4. Discussion

4.1. Milk yield

Supplementation of live yeast during the hot weather season improves the dry matter intake and milk production due to the development of the rumen environment of dairy cattle [9]. Steckley *et al*. (1979) [6] investigated the effect of brewer's yeast slurry as a protein supplement compared to soybean meal. Results suggested that brewer's yeast fed group has higher milk production, high rumen acetic acid production, high digestion coefficients, and lower blood urea nitrogen contents. According to a recent study, supplementation of yeast culture improved the milk yield without affecting dry matter intake and body weight of dairy cattle. However, slightly greater body condition scores were observed in yeast culture fed animals [5]. A similar study was conducted by Alshaikh *et al*. (2002) [10] with multiparous cows at post-peak of lactation where dietary yeast supplementation increased the water consumption, average daily milk yield and 4% fat corrected milk without changing the dry matter intake. These results suggest that high milk yield and good body condition are due to the beneficial effects of yeast supplementation.

Yeast supplementation facilitates the growth and activity of beneficial bacteria in the rumen and improves the digestibility of the feed. Live yeast culture promotes the growth of cellulolytic [11, 12], amylolytic, and lactate metabolizing microorganisms [4]. Improved fiber digestion enhances the production of short chain fatty acids including acetate, propionate, and butyrate in the rumen [11].

The results of the study conducted by Yalcin *et al*. (2011) [12] suggest that supplementation of live yeast does not adversely affect the metabolic health of cows. It did not significantly change the concentration of plasma metabolites including total protein, urea nitrogen, glucose, cholesterol, and triglycerides.

The composition of the brewer's yeast slurry changes with storage conditions particularly temperature and length of storage. Dry matter and true protein contents decline with time and the effect is greater at high temperatures. Moreover, the number of live cells reduces with storage [13].

4.2. Milk fat

Earlier studies have reported that supplementation of yeast increased milk fat in cows in early lactation [5, 14]. Fatty acid composition in the milk could be modified to a greater extent by changing the diet to provide healthy fatty acids for the consumers. According to a study conducted by Yalcin *et al*. (2011) [12], live yeast supplementation improved the concentration of 18:3 (n-3) fatty acid and decreased the concentration of short chain fatty acids in the milk. A study was carried out in Kenya to assess the effect of supplementing liquid brewer's yeast on the physicochemical quality of milk in smallholder dairy farms. Results reported that the butterfat content of liquid brewer's yeast supplemented group is higher than the control group supplemented with a commercial dairy meal. High butterfat content is due to the improved fiber degradation and digestibility of the diet which results in greater acetic acid production in the rumen [15]. The neutral detergent fiber content in the diet influences on increasing milk fat content. For instance, milk fat and protein contents were significantly higher when yeast is supplemented with a diet containing 21% of neutral detergent fiber (NDF) compared to 17% NDF [14].

4.3. Total solids

Yeast supplementation increased the protein [6] and lactose contents [15] of milk. Kalmus *et al*. (2009) [14] reported that yeast supplementation increases milk protein content in early lactating cows. Improved fermentation and digestibility enhance ammonia uptake by the proteolytic bacteria in the rumen leading to high microbial protein synthesis [10]. Moreover, Alaru *et al*. (2019) [15] suggested that liquid brewer's yeast increases the milk protein content by improving the nutritional value of the poor quality forages and enhances the growth of lactate consuming bacteria in the rumen resulting low lactate accumulation in the rumen. Besides, yeast supplementation has increased the levels of methionine, phenylalanine, tyrosine, tryptophan and taurine contents in milk [12].

5. Conclusion

Brewer's yeast slurry which is a readily available by-product in the beer industry can effectively use as a supplement in the feeding of dairy cattle. Its beneficial effects increase the production of dairy cattle with more fat and total solids in milk. Furthermore, supplementation of brewer's yeast slurry to dairy cattle avoids its potential adverse effects on the environment and eliminates the cost associated with drying. However, the present study was carried out to investigate the effect of supplementing brewer's yeast slurry to dairy cattle in large scale production under an integrated farm setting. Therefore, future studies with a small number of animals would be needed to assure its usage as a feed supplement for dairy cattle in Sri Lanka.

Compliance with ethical standards

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Disclosure of conflict of interest

All the authors, Jayantha Wijerathna, Priyanwada Lansakara, Chandana Abeysinghe, and Gamika Prathapasinghe declare that there is no conflict of interest.

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