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Effects of live yeast on the rumen fermentation parameters and milk performance of Simmental dairy cows during the hot season

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Abstract: The effects of dietary supplementation with live yeast culture (LY) on the milk performance and rumen fermentation parameters of Simmental cows in the middle of lactation were examined under hot season conditions in 2019. The 28 cows, which were divided into two experimental groups of 14, were fed a controlled diet, with or without the addition of 5 g of LY per cow daily. The mean dry matter intake (DMI) and yield of milk in the LY group were greater by 0.25 kg/day and 0.42 kg/day, respectively, than for the control group. The yields of milk components and 4% fat corrected milk were also significantly greater in the LY group than in the control group, but LY supplementation did not significantly alter milk composition percentages. The acetate concentration in the rumen tended to be higher in cows fed LY but the ruminal pH, NH_3-N, propionate and butyrate levels, and acetate/propionate ratio were similar in the two groups. It can be concluded that LY supplementation of the diet of Simmental dairy cows during the hot season improved milk production and ruminal fermentation performance to a limited degree.

Key words: Live yeast, milk yield, rumen parameters, hot season

1. Introduction

Physiological stress caused by overheating is a major limiting factor in the performance of dairy cattle and therefore imposes substantial financial losses. The temperature–humidity index (THI) is used worldwide to estimate the degree of heat stress experienced by dairy cows. THI values of <68 are suitable for the performance and welfare of dairy cattle. However, mild heat stress can be expected at THI values between 68 and 74, which generally leads to reduced dry matter intake (DMI) and milk production in dairy cows. Furthermore, THI values of ≥75 cause very severe heat stress and dramatic decreases in production performance [1]. The principal negative effect of high THI values is a decrease in rumination time, which leads to a fall in the DMI [2]. Reduced DMI may be accompanied by reduced saliva production and thus decreased rumen pH and disturbed ruminal function in heat stressed cows [3], followed by a decline in milk performance [2]. Therefore, the optimization of the ruminal function of heat stressed cows is paramount for the achievement of peak lactational performance [4].

Live yeast (LY) strains, including *Saccharomyces cerevisiae*, have been widely adopted in dairy cow nutrition to alter the microbial environment of the rumen for the purpose of improving both milk output and the yields of its components [5]. Some experiments with live animals and also in laboratories have shown that dietary supplementation with *S. cerevisiae* stimulates the growth of fibrolytic bacteria in the rumen, which in turn increases the rate of fiber digestion and microbial protein production. By increasing the number of lactate-metabolizing bacteria in the rumen, supplementation with *S. cerevisiae* also prevents the accumulation of lactate, and the rumen pH was increased [6]. Some researchers have suggested that LY supplementation may be most beneficial to heat-stressed dairy cows, rather than under normal circumstances [2,7]. However, the supplementation of the diet of dairy cattle with cultures of *S. cerevisiae* has produced varying results. Schingoethe et al. [8] reported that improved feed efficiency may be due to stimulation of the appetite of heat-stressed cows or the improved digestibility of feed supplemented with LY. In addition, Moallem et al. [2] reported that multiparous Holstein cows (average 114 DIM) fed LY under heat stress (mean THI values at 06:00 hours and 16:00 hours of 69.4 and 79.3, respectively) had both a higher DMI and greater milk yield by 1.5 kg/day (4.1%) than the control cows. In a similar study, Gandra et al. [9] reported that LY administration

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during the middle of the lactation period improved the feed intake, milk production, and milk fat content and reduced the rectal temperature (RT) and respiration rate (RR) of cows that experienced a high mean THI value of 77.8. However, in some studies, the same positive responses were not demonstrated following supplementation with LY (*S. cerevisiae*). For example, Schingoethe et al. [8] reported no practical effect of LY on the DMI, milk yield, and milk composition of Holstein cows in mid-lactation during summer, but there was improved feed efficiency. Other studies reported no meaningful effects of LY on DMI [10], milk yield [11], and milk composition [12] when THI values were above 68. These mixed results for LY use were put into context by Ghazanfer et al. [13], who stated that the response of dairy cattle to yeast consumption is highly dependent on factors that include environmental conditions; lactation stage; diet composition, including forage to concentrate ratio; and strain and dose of yeast.

Consequently, the use of LY (*S. cerevisiae*) as a dietary supplement to ameliorate the negative effects of stress caused by heat is still an open question and more definitive research is needed. In addition, no data are available for LY use as a supplement for heat-stressed Simmental cows dedicated to milk production. Therefore, the aim of this investigation has been to determine whether the use of LY supplementation is reflected in improvements in both the milk performance and ruminal performance indicators of Simmental cows in the middle of their lactation period during the hot season in northern Turkey.

2. Materials and methods

2.1. Animals, feeds, and experimental protocol

The protocol for this study was accepted by the Animal Care Committee of Ondokuz Mayıs University (approval date and number: 2019/E.16505). The experiment was done on a dairy farm in Atakum, Samsun Province, Turkey, over a period of 70 days (June 20, 2019 to August 30, 2019) in the typically hot summer period (mean ± SD temperature and relative humidity: 24 ± 1.38 °C and 71.78 ± 5.06%, respectively); the 70-day period comprised a 10-day period of adaptation, followed by a 60-day period of treatment. The 28 cows were allocated randomly to either the experimental or control group, with 14 cows in each group, after taking into account their average milk production during the pretreatment period (10 days), days in milk (DIM), parity status, and body weight (BW). Collectively, the 28 cows had the following characteristics: body weight, mean ± SD: 634.23 ± 30.92 kg; days in milk, 144 ± 33; pretreatment milk yield, 25.13 ± 1.96 kg milk/day; and parities, 2.8 ± 0.9. The cows in the two groups were penned separately. In the pens, they had uninhibited access to fresh water for drinking purposes. In addition, no supplementary cooling was provided to the cows.

The diet of the 28 animals was specially formulated according to the Nutrient Requirements of Dairy Cattle (NRC) [14]. The diet was provided as a total mixed ration, abbreviated as TMR (Table 1). Before the scheduled feeding times, the TMR was prepared by sequentially adding the forages and the concentrates into the mixer. The cows, which were milked at 06:00 and 18:00 hours every day, were supplied sufficient feed after milking to ensure that approximately 5% remained uneaten. The treatments were applied as follows: 1) Control group: basic diet (Table 1); and 2) LY group (*S. cerevisiae,* BRT Feed Additives Manufacturing Company, Samsun, Turkey): basic diet complemented with 5 g of LY (equivalent to 10^8 cfu/day), as per the instructions provided by the manufacturer. The LY dose was blended with 100 g per cow per day of wheat bran. The control group also received the same amount of wheat bran. The bran, with or without LY for the LY and control groups, respectively, was sprinkled on the TMR at the morning feeding of each day.

2.2. Sampling, measurement, and analyses

The DMI of each group was determined daily by subtracting the amount of unconsumed feedstuff from the amount of feedstuff offered. The individual DMI for each cow was calculated by dividing the DMI of the group by 14, the number of cows in the group. Milk production for each cow was measured daily by the automatic milking system at each milking throughout the experiment. The weekly averages of daily milk yields were used for statistical analysis. Biweekly, milk samples were collected from each cow at consecutive morning and evening milkings. By the NRC formula [14], milk yield was adjusted to the yield of 4% fat-corrected milk (FCM).

The RT and RR of all cows were measured at 07:00, 14:00, and 21:00 hours on day 7 of each week from July to August of the experiment. The RT was recorded to the closest 0.1 °C with a veterinary thermometer. The RR was measured by counting the inspiratory movements of the cow's flank in a 15-s period and multiplying that number by 4. The BW was estimated on the first and last days of the experiment. The equation used for estimating it was as follows: Estimated BW (kg) = girth of heart^2 (m) × length of body (m) × 90 [7]. The body condition score (BCS) was determined at the beginning and end of the study by two experienced veterinarians who used a rating scale of 1 to 5, with 1 = thin and 5 = obese [15]. The temperature and relative humidity data for the study came from a weather station close to the farm in Atakum, Samsun, Turkey. The THI was calculated according to the methodology of an equation from the National Research Council [16]: THI = (1.80 × temperature + 32) – [(0.55 – 0.0055 × relative humidity) × (1.80 × temperature – 26.8)].

TMR samples were taken once every 7 days and stored at –20 °C before chemical analysis. All the samples were

Table 1. Ingredients and chemical composition of formulated TMR (DM basis, %).

Ingredient	Amount, % of DM
Corn silage[1]	33.5
Alfalfa hay[2]	15.2
Corn grain	9.7
Barley grain	7.5
Soybean meal	6.6
Sunflower meal	8.5
Dried distiller's grain	7.6
Wheat bran	7.4
Calcium salts of fatty acids	1.7
Salt	0.28
Sodium bicarbonate	0.72
Magnesium oxide	0.28
Calcium carbonate	0.55
Vitamins and minerals[3]	0.39
Chemical composition	
NEL, Mcal per kg of DM[4]	1.6
CP, %	15.8
Starch[5], %	22.7
ADF, %	19.2
NDF, %	33.7
Forage NDF, %	20.6

[1]Corn silage: 33.8% DM, 6.8% CP, 44.8% NDF, 23.1% ADF.
[2]Alfalfa hay: 89.0% DM, 19.6% CP, 36.6% NDF, 29.8% ADF.
[3]Contained (per kg of DM) 1,500,000 IU of vitamin A, 300,000 IU of vitamin D3, 3000 IU of vitamin E, 1200 mg of niacin, 50 mg of biotin, 20,000 mg of choline chloride, 3000 mg of Mn, 2500 mg of Zn, 2500 mg of Fe, 1500 mg of Cu, 200 mg of I, and 150 mg of Co.
[4]Calculated using NRC [14] recommendations.
[5]Calculated on the basis of feed charts.

dehydrated at 55 °C in an oven for 48 h to estimate the DMI. The dry matter (DM) and crude protein (CP) contents of the separate forages and TMR were estimated based on the procedures of the AOAC [17]. The neutral detergent fiber (NDF) (with alpha-amylase and sodium sulfite) and acid detergent fiber (ADF) contents were also determined [18]. An ANKOM 2000 fiber analyzer (ANKOM Technology, Macedon, NY, USA) was used to extract and filter the NDF and ADF. On day 70 of the study, approximately 50 mL of rumen liquid was collected with an orarumen tube from each of the 28 cows 4 h after feeding. The pH of each sample was immediately measured with an electronic pH meter (GLP 22, Crison Instruments, Barcelona, Spain) and

Table 2. Temperature–humidity index (THI) values during the live yeast supplementation experiment on Simmental dairy cows.

Item	
THI 68 to 74, % of time	83.87
THI ≥75, % of time	16.13
THI mean	72.64
THI maximum	75.80
THI minimum	67.80

the ruminal liquid was then filtered through cheesecloth of four layers in thickness. Two to three drops of toluene were mixed with one 10-mL portion of the filtered rumen liquid for volatile fatty acid (VFA) analysis. The second 10-mL portion had 0.2 mL of 50% H_2SO_4 added and mixed before NH_3-N analysis. The two mixtures were centrifuged at 10,000 × *g* for 10 min. The supernatant was collected and stored at –20 °C prior to analysis for ruminal VFA and NH_3-N contents. The acetate, butyrate, and propionate contents and the NH_3-N content were then determined according to Filipek et al. [19] and the AOAC [17], respectively. Within 3 h of the completion of milking, the chilled milk samples were analyzed individually for milk fat, protein, and lactose content by Milktest (Hasvet, Turkey).

2.3 Statistical analysis

All data were subjected to analysis of variance (one-way ANOVA) by employing the general linear model procedure of SPSS 21.0 [20]. The group means, which are given in Tables 3, 4, and 5 as mean ± standard error, were considered significantly different at the level of $P < 0.05$.

3. Results

The THI values during the period of this experiment ranged from 67.80 to 75.80, with a mean of 72.64. Values ranging from 68 to 74 and values of ≥75 were observed for 83.87% and 16.13% of the trial period, respectively (Figure; Table 2). The mean RT, RR, BW gain, and BSC values of the LY group were not significantly different from those of the control group ($P > 0.05$). (Table 3). The mean DMI of the LY group was 0.25 kg/day (1.4%) higher than for the control group (Table 4). Feed efficiency was quite similar between the groups (Table 4). However, both the DMI and feed efficiency were not evaluated statistically because the data were collected per pen. As also shown in Table 4, LY supplementation numerically increased the average daily milk yield by 0.42 kg per day. In addition, the 4% FCM yield was significantly increased (2.44%) by LY supplementation (23.49 kg/day and 22.93 kg/day for the LY and control groups, respectively) ($P < 0.01$).

Table 3. Mean rectal temperature and respiration rate of two groups of lactating Simmental cows (control and live yeast-supplemented) under summer conditions.

Item	Treatment		SEM	P
	Control	LY		
Rectal temperature, °C				
07:00 hours	38.52	38.56	0.016	0.19
14:00 hours	39.17	39.15	0.027	0.70
21:00 hours	38.76	38.80	0.012	0.16
Respiration rate, breaths/min				
07:00 hours	40.28	40.14	0.415	0.86
14:00 hours	53.57	53.35	0.550	0.85
21:00 hours	45.64	45.78	0.307	0.82

LY: Live yeast culture.

However, the milk composition characteristics of the LY supplementation group were not significantly different from the control group. Unlike the milk composition, the yields of milk fat ($P < 0.01$), protein ($P < 0.01$), and lactose ($P < 0.05$) were significantly different between the LY supplementation and control groups. In addition, Table 5 shows that the ruminal pH, NH_3-N, propionate, and butyrate levels and the acetate/propionate ratio of the LY and control groups did not differ significantly ($P > 0.05$); however, the acetate level had a tendency to be higher in the LY-supplemented group.

Table 4. Lactational performance of Simmental dairy cows in control and live yeast treatments.

Item	Treatment		SEM	P
	Control	LY		
Group DMI[1], kg/day	17.79	18.04	0.105	N/A
Yield, kg/cow/day				
Milk	23.14	23.56	0.113	0.06
4% FCM[2]	22.93	23.49	0.113	0.01
Milk fat	0.91	0.93	0.004	0.003
Milk protein	0.75	0.77	0.003	0.01
Milk lactose	1.01	1.03	0.005	0.04
Milk composition, %				
Fat	3.94	3.98	0.019	0.29
Protein	3.27	3.29	0.007	0.17
Lactose	4.40	4.41	0.012	0.89
Feed efficiency[3]	1.32	1.33	0.113	N/A
BW gain, kg/cow/day	0.15	0.14	0.005	0.59
BSC, units/cow	2.98	2.92	0.031	0.40

LY: Live yeast culture, DMI: dry matter intake, FCM: fat corrected milk, BW: body weight, BSC: body condition score, N/A: not applicable.
[1]: DMI was not evaluated statistically because cows were fed by group in the experiment.
[2]: 4% FCM = (0.40 + 15 × % fat / 100) × milk (kg) [14].
[3]: Feed efficiency = milk yield/DMI (not evaluated statistically because cows were fed by group in the experiment).

4. Discussion

In the current study, the mean THI value of 72.64 (Table 2) was above the accepted minimum value (68) for the onset of heat stress [3]. This mean value suggests that the Simmental cows were mildly heat-stressed for the duration of the current experiment. Despite the heat stress, supplementation with LY did not affect the RT and RR values at any time. Similar results for effect of LY supplementation on RR and RT values have been reported [21,22]. In contrast, Huber et al. [23] reported that dietary supplementation with a yeast culture decreased the RT and RR in heat-stressed dairy cows. However, they did not clarify the mechanism.

In this study, no differences were detected for BW gain and BSC between treatments. These results accord with those of Tristant and Moran [24], who found no effect of LY use on BSC in early and mid-lactation. Similarly, Zhu et al. [7] stated that BW gain and BSC were not influenced by yeast addition to the diet in the mid-lactation period. However, Zhu et al. [10] reported that the mean BSC of dairy cows fed 120 g/day of live yeast was higher than for both the control and 240 g/day LY group due to improved net energy balance during heat stress. The finding of no differences in BW gain and BSC between treatments during heat stress in the present study may be attributable to either sufficient nutrient supply or no catabolism of body tissues [21].

Overall, the summaries of metaanalytical and literature studies show inconsistencies in the DMI response to LY use in lactating dairy cows, as follows. Different studies reported that the DMI response to LY supplementation was dependent upon the lactation stage [25], DMI of cows [26] and acidotic diet [27]. In the current study, LY supplementation in mid-lactation cows raised the DMI by 0.25 kg per cow per day. Similarly, Desnoyers et al. [28] reported that yeast use raised the DMI by 0.44 g/kg of BW, or 0.275 kg/day for 625 kg BW. A positive response to feed intake with LY supplementation early in lactation, associated with an improvement in the digestibility of the feedstuff, has also been noted [29]. In contrast, some researchers [8,10] reported a decrease

Table 5. Ruminal volatile fatty acid, pH, and ammonia-N levels of Simmental dairy cows in control and live yeast treatments on day 60.

Item	Treatment		SEM	P
	Control	LY		
pH	6.37	6.42	0.022	0.33
Acetate, mmol/L	61.77	63.52	0.476	0.06
Propionate, mmol/L	21.49	22.45	0.560	0.40
Butyrate, mmol/L	10.08	10.32	0.367	0.75
Acetate/propionate	2.91	2.88	0.074	0.83
NH_3-N, mg/dL	14.69	14.38	0.166	0.37

LY: Live yeast.

in DMI for LY supplementation in mid-lactation cows during summer. On the other hand, recent studies have reported unchanged DMI for LY use in dairy cows in both early and late lactation [21,30]. In the current study, a DMI increase with LY supplementation was expected because the cows were in the mid-lactation stage, but no meaningful difference was detected.

Although there was not a significant difference between the milk yields in the LY and control groups in this study, the mean milk yield was 0.42 kg/day higher with LY supplementation. Moallem et al. [2] reported a higher milk yield (1.5 kg/day) from 10^{10} cfu of LY per 4 kg of DM consumed in comparison with the control. In addition, some authors [9,10,12] reported increases in milk production by cows fed LY that ranged from 0.7 to 3.06 kg/day. Also, Desnoyers et al. [28], in a metaanalysis on *S. cerevisiae* supplementation, reported a higher milk yield (0.78 kg/day) for a 650-kg cow-equivalent. Several authors suggested that a milk yield increase is usually linked to an increased DMI and/or VFA concentration [9,10,12,28]. In this study, supplementation with LY tended to increase milk production compared with the control diet, but not as much as reported by the above mentioned authors. Because the calculated metabolizable energies of the LY and control diets were similar in this study, and the DMI was numerically increased by the dietary LY, it is likely that the tendency to increased milk production resulted from a slight increase in the NDF digestibility of the diet. Bitencourt et al. [31] reported that dietary NDF digestibility increased by 11.3% with the use of 10^{10} cfu/day of LY and milk yield increased by 0.9 kg/day, which supports the proposition in the previous sentence. However, Ferreira et al. [32] reported no significant difference in milk yield in lactating dairy cows due to yeast use. Moreover, the addition of 60 g yeast/day to the diet of Holstein dairy cows for 84 days in mid-lactation during a period of heat stress did not enhance milk production or affect its components [8]. Another study [30] also detected no effects of a high LY dose (6×10^8 cfu/cow/day) on milk yield compared with a low dose of LY (5.7×10^7 cfu/cow/day). A number of factors may explain the contradictory responses of dairy cows to yeast supplementation, including experimental conditions, feeding management, diet composition, stage of lactation

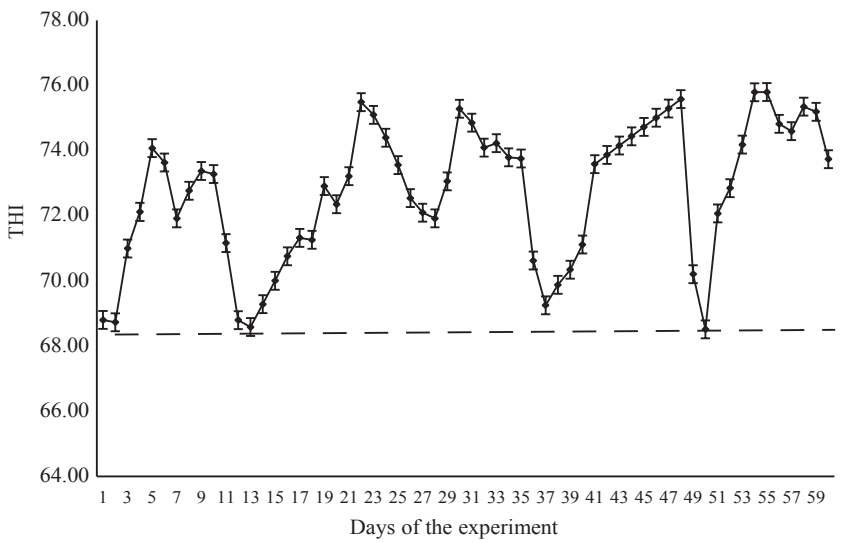

Figure. Temperature-humidity index (THI) during a dietary yeast supplementation experiment on Simmental dairy cows at the weather station close to the farm in Atakum, Samsun Province, Turkey.

(early, mid, late), type and level of stress, and varying doses and types of yeast [30].

Although the milk yield improved, milk composition did not change in this study. Kumprechtova et al. [33] also stated that milk composition was not altered by LY administration. Likewise, from their metaanalysis, Desnoyers et al. [28] reported that yeast use had no effect on milk composition. In addition, the finding of this study regarding milk fat percentage matches the finding of Moallem et al. [2], who also stated that the fat content of milk appears to be unchanged by the administration of LY to lactating cows. As suggested by various authors, the lack of response to LY was most likely due to sufficient fiber in the diet to maintain milk fat synthesis [6,34]. Some studies reported that the percentage of protein in milk was not affected by LY administration [2,21]; these results are supported by those of the present study. This result was probably due to the ineffectiveness of LY in stimulating additional microbial protein production by ruminal microbes [35]. In the current study, LY use did not change the milk lactose content, probably because it did not contribute to more efficient metabolizable energy use, as reported by Erasmus et al. [26]. This result from the current study matched those of Schingoethe et al. [8] and Gandra et al. [9], who found no significant difference in the percentage of lactose in milk from dairy cattle fed LY. In contrast, Moallem et al. [2] found that cattle with yeast added to their diet had more lactose than the control group. In the current study, greater milk fat, protein, and lactose yields might be the result of a slight, nonsignificant increase in milk yield, which supports the results of Zhu et al. [10] and Moallem at al. [2].

In the present study, the average daily yield of 4% FCM was greater by 0.56 kg/day in the LY group. This result reflects that of Salvati et al. [12], who also reported an increase in the 4% FCM yield in response to dietary supplementation with LY. There was a much greater improvement in the 4% FCM yield (2 kg/day) when the diet of milking dairy cows was supplemented with LY during a period of heat stress [2]. Also, the enhancement of the feed efficiency of dairy cows in response to yeast supplementation improved milk production at similar DMI [2] or similar milk yield at reduced DMI [8]. As opposed to the results of this study, Zhu et al. [10] reported that yeast use enhanced feed efficiency, which resulted in increased milk yield in the LY-supplemented cows.

In this study, the ruminal pH of both groups remained above 6.0, with LY addition to the diet having no effect on ruminal pH. The use of sodium bicarbonate (~130 g/day) and magnesium oxide (~50 g/day) as dietary buffers and the level of dietary NDF (Table 1) was likely sufficient to balance the rumen environment (Table 1). Nevertheless, a higher ruminal pH was expected with LY use due to the population growth and activity of lactic acid-using bacteria. The absence of an effect may be a consequence of the introduction of LY into the environment of rumen fibrolytic bacteria not being reflected in a change in the rumen pH [36]. This finding from the present study is consistent with those of Zhu et al. [7] and Salvati et al. [12] in that there was no difference in the pH of the rumen between the control and LY groups. However, the results of these studies contradict the findings of other research. For example, Moallem et al. [2] reported a higher pH value due to the higher level of activity of ruminal lactate consumers when LY was fed to cows. Moreover, Desnoyers et al. [28] reported an increase of 0.03 in the ruminal pH of animals with yeast added to their diet. These contradictory experimental results could be associated with the dairy cow breed, diet composition, and/or experimental conditions, including THI values.

In the present study, the tendency for a higher acetate level in cows fed LY is in agreement with results of some previous studies [33,37]. Although ruminal pH was unchanged in both groups in the current study, this situation may have been the result of higher fiber digestibility resulting from the higher level of activity of fibrolytic bacteria [38]. Similar to the findings of this study, Bal and Göksu [39] reported that propionate amount was not affected by LY supplementation for both 50% and 70% concentrates. Moreover, the results of the current study complement the results of Salvati et al. [12], who reported that the acetate/propionate ratio was unchanged by LY supplementation. The addition of LY to the diet would be expected to increase the acetate/propionate ratio via the increased activity level of fibrolytic microorganisms [40]. However, a decrease in the ratio of acetate to propionate in the rumen accompanying LY use has been reported [26,29,41], probably as a consequence of the stimulation of bacteria that can metabolize lactate to propionate. Also, contradictory results were reported by Jiang et al. [30] and Kung et al. [42] when mid-lactation cows were fed a mixture of 41.7% alfalfa, 7.60% wet brewers grain, and 50.7% concentrate or 35% alfalfa, 15% corn silage, and 50% concentrate, respectively, as substrate, with LY. These authors measured no effect of LY on acetate, propionate, and butyrate levels. These contradictory results may be related to the time of sampling, feeding regime, diet composition, and DMI.

In the current experiment, LY supplementation did not induce better utilization of NH_3-N. This result is in line with those of Biricik and Yavuz [43], Nursoy and Baytok [44], and Zhu et al. [7], who reported no effect on the NH_3-N level in the rumen after the addition of dietary yeast. However, a lower ruminal NH_3-N concentration

in response to yeast input due to reduced proteolytic rumen bacteria activity was reported by Chaucheyras-Durand et al. [40], as well as the increased use of NH_3-N in protein synthesis by microbes [29]. However, the available evidence suggests that neither of these effects occurred in the current study.

In this study, the supplementation of the diet of Simmental cows with LY had no effect on RR, RT, BW gain, and BCS values during the hot season. Moreover, LY supplementation significantly improved the 4% FCM and the yields of milk components. However, given the mixed results reported from the numerous studies on the relationship between LY and both milk output and composition, it would be useful to investigate in detail the causative relationships between ruminal microbiota and milk production parameters in response to live yeast supplementation. It can be concluded that LY supplementation of the diet of Simmental dairy cows during the hot season improved milk production and ruminal fermentation performance to a limited degree.

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