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Effects of yeast culture addition (*Saccharomyces cerevisiae)* to Anatolian water buffalo diets on milk composition and somatic cell count

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Summary

This study was carried out to determine the effect of *Saccharomyces cerevisiae* (SC) addition to dry matter intake, milk yield, milk composition and somatic cell count in Anatolian water buffalo diets (AWB). The SC-treated groups (n = 5 buffalo cow/group) received 30.0 g of SC per buffalo cow per day. Compared to the control group, the SC-treated group consumed more total dry matter ($P<0.05$; 14.27 vs. 13.50 kg/day) and produced more milk/day ($P<0.01$; 7.13 vs. 6.22 kg/day). Dietary yeast inclusion significantly increased alfalfa dry matter intake during a 28-day lactation period ($P<0.01$; 10.41 vs. 9.81 kg/day) compared with the control diet. Yeast application significantly reduced the somatic cell count (SCC) in milk ($P<0.05$; 3.33 and 1.08 SCC ($\log_{10}$/mL) for control and SC-treated groups, respectively). The fat (58.40 and 59.00 g/kg), non-fat solids (120.00 and 122.80 g/kg), protein (46.40 and 46.26. g/kg) and lactose components of milk (37.72 and 38.90 g/kg) were similar for both groups. The response of the AWB to supplemental yeast addition improved forage intake and daily milk production but did not affect milk composition. In conclusion; it has been thought that farmers with AWB can benefit from the use of yeast cultures in early lactation diets.

Key words: yeast, Anatolian water buffalo, dry matter intake, milk composition, somatic cell count

Introduction

The number of buffalo cows in the world has decreased rapidly over the past three decades (Georgoudis et al., 1998). Most of world buffalo cows live in Asia, Egypt, Southern and south-eastern Europe. Buffalo cows play an important role in the rural economy of developing countries. For example; it is suitable for cream making industry because of the high milk fat component and sausage making industry because of meat quality (Soysal et al., 2005). Anatolian water buffalo (AWB) are suitable farm animals for farmers living in a region with swamps and streams. They are suitable dual-purpose animals for meat and milk and are often used by smaller farmers. Pastures are usually the primary source of nutrients for AWB. Anatolian water buffalo are given supplemental feed during milking. Yeast cultures create suitable conditions for cellulolytic degradability and lactate usage by stimulating the development and activity of ruminal bacteria (Yoon and Stern, 1995, 1996; Newbold et al., 1996; Callaway and Martin, 1997; Beharka and Nagaraja, 1998; Miller-Webster et al., 2002; Lila et al., 2004). Rose (1987) has suggested that yeasts reduce oxygen in the rumen. Yeast cells in the rumen use available oxygen on the surface of freshly ingested feed to maintain metabolic activity. In ad-

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dition, *Saccharomyces cerevisiae* competes with other starch-utilizing bacteria for the fermentation of starch (Lynch and Martin, 2002), which leads to the prevention of lactate accumulation in the rumen (Chaucheyras et al., 1995). Chaucheyras et al. (1995) have also reported that *S. cerevisiae* provides growth factors, such as organic acids or vitamins. The use of yeast fermentation products in ruminants has been a common practice for the last 20 years. However, the effects of SC supplementation on dairy cow performance have been inconsistent (Moallem et al., 2009). In some reports, yeast culture increases the dry matter intake of dairy cows (Williams et al., 1991; Erasmus et al., 1992; Wohlt et al., 1998; Dann et al., 2000; Moallem et al., 2009), whereas other studies were unable to determine the effect on the intake (Kung et al., 1997; Soder and Holden, 1999; Schingoethe et al., 2004). Similarly, the effects of SC on the milk yield are variable. Previous studies have reported that SC supplementation improved milk yield. Piva et al. (1993) observed that yeast significantly increased the milk yield. Kung et al. (1997) showed that diets supplemented with 10.0 or 20.0 g of the yeast-enzyme preparation significantly increased the milk yield and 3.50 % FCM in the Holstein cows. Wohlt et al. (1998) reported that correlation of yeast-enzyme preparation with dry matter intake and milk yield was of interest in Holstein steers. Moallem et al. (2009) reported that live yeast culture in Holstein steers has increased dry matter intake and milk yield did not affect the milk composition. Yalcın et al. (2011) reported that yeast culture supplementation (50 g of the RumiSacc) significantly increased milk yield and milk composition. In contrast no differences were found in milk yield and milk composition in other studies (Putnam et al., 1997; Soder and Holden, 1999; Schingoethe et al., 2004). The determination of the somatic cell count (SCC) is used worldwide in dairy practice to describe the hygienic control of the milk (Urech et al., 1999; Wellnitz et al., 2009; Ma et al., 2000). Milk processors strive for reduced SCC because somatic cells cause a disagreeable taste, reduce cheese yield, and decrease the shelf life of milk. Low somatic cell count is important, and some dairy factories pay a premium price for milk with low SCC (Revilla et al., 2007). Although numerous studies evaluated use of yeast fermentation products, few research data are available on the evaluation of its use in AWB. The objective of this study was to investigate the effect of SC addition on performance, the milk yield and milk composition and somatic cell count in AWB diets.

Materials and methods

This research was conducted at Karaoglan Village located of Mustafakemalpasa in May. 2 years old lactating buffalo cows whose live body weight and milk yield were approximately accordant were selected (Table 1). Ten buffalo cows were randomly divided into two groups (five animals each), with 21 days of adaptation period and 7 days of the experimental period comprised the sampling period. *Saccharomyces cerevisiae* was used as dry yeast in this experiment. The certified composition of SC contained dry matter 95 %, protein 12 %, fat 3 %, fiber 6.5 and ash 5.0 %.

Experimental rations were as follows: control (concentrate feed mixture - CFM) and treated (control ration plus 30 g yeast/2.1x10^{10} CFU/g/d). The CFM consisted of 40 % barley, 27 % wheat, 31 % sunflower meal, 1 % marble powder, 0.75 % salt and 0.25 % vitamin + mineral mix (Table 2). The offered feeds were assessed to cover the maintenance and production requirements for each animal NRC (2001) recommendations for dairy cattle. The experimental diet consisted of CFM : alfalfa (1:3 dry matter bases). The CFM for each buffalo cow was offered individually once daily at 6.30 a.m, while alfalfa was offered twice daily at 6:30 a.m and 7:30 p.m. The buffalo cows had *ad libitum* access to water and pasture. The quantity of SC added to diet was determined after reviewing multiple references from Kung et al. (1997) and Wohlt et al. (1998). Dry

Table 1. Basic information on the examined buffaloes

Groups	Number of buffaloes	Body weight (kg)	Days in milk	Milk production (kg/d)
Control (0 g/d SC)	5	560.00	15	4.86
Treated (30.00 g/d SC)	5	541.60	10	4.72

Table 2. Chemical composition of concentrate feed mixture (CFM) and alfalfa (g/kg) DM

Chemical (g/kg) DM composition	CFM	Alfa	Pasture
DM[1]	900.9	884	209
OM	716.3	788	871
CP	184.6	160.0	104
EE	13.8	15	16
ADF	100.1	285.0	646
NDF	567.2	310.0	761
CA	62.6	96.0	129
Starch	288.8	-	-
M.E. Kcal/kg	2876.0	1910	

[1]DM, dry matter; OM, organic materials; CP, crude protein; EE, Ether extract ; ADF, acid detergent-fibre; NDF, neutral detergent fibre; CA, crude ash
[2]Obtained by calculation (NRC 2001)

matter intake was measured at the end of sample collection period by weighing the offered diet and refusals from the previous day. Pasture consumption was not determined because of free pasture. The animals were milked twice daily at 6:30 a.m and 7:30 p.m. Milk yield was measured daily. Milk samples were collected at the end of sample collection period. The milk from each cow was individually sampled at the delivery site of the firms in the morning. All the samples were stored at 5±1 °C before analysis or shipment.

The fat-corrected milk yield (4 %) was calculated according to Kumlu (1999).The content of dry matter, organic matters, crude protein, crude fat and ash in the diets were analyzed by methods AOAC (1990). Neutral detergent fiber (NDF) and acid detergent fibers (ADF) values were determined using methods outlined by Robertson and Van Soest (1981). The metabolizable energy value of feeds was calculated from chemical analyses of feed based on the computer software of the National Research Council (NRC) (NRC, 2001).Solids-not-fat content (SNF), fat, protein and lactose components of milk were analyzed using a Milcosan FT - 120 devices. The somatic cell values were determined using a Delaval Database Kit. The means of each parameter measured in the milk yield, milk composition and DM intake were tested by analysis of variance using the Minitab Statistical Package Minitab (1998) and means were compared using t-test model described by Cochran and Cox (1957):

$$Yijk = \mu + Ti + Pj + Eijk$$

Yijk=observation, μ = population mean, Ti = treatment (i = 1 or 2), Pj = animals (j = 1, 2, 3, ……9 or 10) and Eijk = residual error.

Results and discussion

In this study, body weight was not affected significantly by yeast supplementation. However the mobilization of body reserves was decreased in the treated and untreated groups (Table 3). As known the dairy cow mobilizes energy from body tissue to support energy requirements from milk production during early lactation (NRC, 2001). In this study, alfalfa DM consumption in the SC-treated group was higher than in the control group (5.76 % ($P<0.05$); table 3), which was consistent with the findings of Erasmus et al. (1992) that showed an increase dry matter intake with the addition of yeast (1.4 kg/day). Wohlt et al. (1998) also observed that yeast supplementation increased DMI (5.04 %). Moallem et al. (2009) observed that dry matter intake was affected by yeast culture supplementation. Similarly Desnoyers et al. (2009) reported that yeast supplementation increased DMI 0.275 kg/d for BW of 625 kg. The observed increase in alfalfa DM consumption correlates with the increase in pH and cellulolytic activity due to the stabilization of the ruminal environment by yeast application (Miller-Webster et al., 2002). Yeast added to the rations provides stimulatory actors to rumen cellulolytic bacteria as reported by Williams et al., 1991; Erasmus et al., 1992; Harrison et al. (1998). However, other studies have not observed any effects of yeast supplementation on DM intake (Kung et al., 1997; Soder and Holden, 1999; Schingoethe et al., 2004). The observed response variance may be related to several factors, such as forage type, forage-to-concentrate ratio, feeding strategy, animal differences, the lactation length tested, the amount of yeast culture added, the source of the yeast culture product and seasonal effects (Williams et al., 1991; Piva et al., 1993; Kung et al., 1997; Lesmeister et al., 2004).

As shown in Table 3, daily milk yields for the control and yeast groups were 4.86 and 4.72 kg/day, respectively, before experiment. Yeast improved (P<0.01) milk yield by 0.91 kg/d (7.13 vs. 6.22 kg/d for yeast and control group, respectively) after experiment. Desnoyers et al. (2009) concluded that the addition of yeast improved milk yield by 0.75 kg/d. Yield of 4.0 % FCM was increased (P<0.01) by 19.79 % with yeast supplementation (9.90 vs. 7.94 kg/d for yeast and control, respectively; Table 3). Significant increases in milk production associated with yeast supplementation have previously been reported in dairy cows (Piva et al., 1993; Kung et al., 1997; Wohlt et al., 1998; Wohlt et al., 1998; Abdel-Khalek, 2003; El-Ashry et al., 2003; Moallem et al., 2009; Yalcin et al., 2011). Milk response to feeding yeast culture usually ranges between 1 and 2 kg/d (Robinson and Garrett, 1999). Kellems et al. (1990) reported that microbial additives such as yeast cultures had the greatest positive effect on cows in early lactation, increasing milk yield compared to control cows. Williams et al. (1991) found that yeast cultures had the greatest effect when diets contained 60 % concentrate and 40 % forage. Campanile et al. (2008) concluded that *Saccharomyces cerevisiae* supplementation increased organic matter digestibility thus allowing higher energy availability for milk yield. Investigations have shown positive responses to yeast culture supplementation. However, some studies have reported inconsistent results regarding the influences of yeast culture supplementation, partially due to confounding effects of ration composition, the level of yeast culture inclusion, and the source of yeast culture product (Putnam et al., 1997; Soder and Holden, 1999; Schingoethe et al., 2004; Lesmeister et al., 2004).

Ramírez et al. (2007) have reported that the addition of yeast does not significantly increase the milk yield in water buffalo but induces a difference of 0.57 kg milk/animal/day between the treated and untreated groups. This effect may be attributed to using water buffalo with 84 days of lactation (late period).

Decreasing of milk components (fat, protein, lactose, SNF) in treated and untreated groups during experimental period can be milk yield dependent. In

Table 3. Effects of SC on the body weight, DM intake, milk yield, milk composition and somatic cell counts

	Control (0 g/d)	Treated (30.00 g/d)	S.E.M[5]	P-value
Body weight (kg)	530.00	534.00	11.91	NS
Concentrate DM I[1] (kg/day)	3.68	3.86	0.12	NS
Alfalfa hay DM I (kg/day)	9.81	10.41	0.10	*
Milk yield (kg/day)	6.22	7.13	0.09	**
4 % FCM (kg/day)[2]	7.94	9.90	0.46	*
SNF (g/kg)[3]	120.00	122.80	1.77	NS
Fat (g/kg)	58.40	59.00	2.53	NS
Protein (g/kg)	46.40	46.26	0.60	NS
Lactose (g kg)	37.72	38.90	0.94	NS
SCC (log10/mL)[4]	3.33	1.08	4.91	*

[1]DMI, dry matter intake; [2]4 % FCM, 4% fat-corrected milk; [3]SNF, solids-not-fat; [4]SCC, Somatic cell count
SEM, Standart error mean, NS, not significant; *P-value<0.05. ** P-value<0.01.

this study, milk composition was not affected significantly by yeast supplementation (Table 3). However, milk fat content was higher when yeast was added to the diet (59.00 vs. 58.40 g/kg for yeast vs. control, respectively). The improvement of fat component was also reported in other researches (Piva et al., 1993; Adams et al., 1995; Wohlt et al., 1998; Abdel-Khalek, 2003; El-Ashry et al., 2003; Ondarza et al., 2010; Yalçın et al., 2011). In this study, yeast supplementation did not affected the protein, lactose and SNF content of buffalo cow milk and this result complies with the other studies (Schingoethe et al., 2004; Soder and Holden, 1999; Desnoyers et al., 2009; Moallem et al., 2009; Helal and Abdel Rahman, 2010) who reported that differences in SNF and protein contents of cow's milk fed ration supplemented with yeast were not significant. Conversely, El-Ashry et al. (2003) and Abdel-Khalek, (2003) showed that milk protein contents were significantly ($P<0.05$) affected by yeast supplementation. Similarly Ondarza et al. (2010) reported that greater protein component was observed in the yeast group compared to the control group. The increase in milk protein content by probiotics supplementation may be due to stimulation of rumen microbes that cause alteration of the microbial protein synthesis and increased protein yield in the milk (Dawson, 1993). In the current study, somatic cell count measurements in AWB were significantly reduced due to yeast culture supplementation ($P<0.05$). The SCC percent was 1.08 and 3.33 $\log_{10}$/mL for the yeast-treated and control groups, respectively. This result is similar to that of Zongyun et al. (2007) showing that after addition of SC to the daily ration, cows somatic cell counts decreased significantly ($P<0.01$). But the precise modes of action involved are not yet clear and need further investigation.

Conclusion

Based on these results, farmers with Anatolian water buffalo can benefit from the use of yeast cultures in early lactation diets, which may improve efficiency and provide economic advantages. Further investigation is required to elucidate the effects of yeast on water buffalo performance.

Utjecaji dodatka kulture kvasaca (Saccharomyces cerevisiae) u obroke anatolijskih vodenih bivolica na sastav mlijeka i broj somatskih stanica

Sažetak

Istraživanje je provedeno kako bi se utvrdio utjecaj dodatka *Saccharomyces cerevisiae* (SC) na unos suhe tvari obroka, količinu i sastav mlijeka te broj somatskih stanica u mlijeku anatolijskih vodenih bivolica (AWB). Pokusna skupina SC (n = 5 krava/skupini) dobila je 30,0 g SC po kravi na dan. U usporedbi s kontrolnom skupinom, SC- skupina konzumirala je više ukupne suhe tvari (P<0,05; 14,27 : 13,50 kg/dan), i proizvela veću dnevnu količinu mlijeka (P<0,01; 7,13 : 6,22 kg/dan). Uključivanje konzumnog kvasca u obrok značajno je povećalo unos suhe tvari lucerne tijekom 28-dnevnog razdoblja laktacije (P<0,01; 10,41 : 9,81 kg/dan) u usporedbi s kontrolnom skupinom. Primjena kvasca značajno je smanjila broj somatskih stanica (SCC) u mlijeku (P<0,05; kontrolna 3,33 : pokusna SC 1,08 SCC ($\log_{10}$/mL). Količine masti (58,40 i 59,00 g/kg), bezmasne suhe tvari (120,00 i 122,80 g/kg), proteina (46,40 i 46,26 g/kg) i laktoze (37,72 i 38,90 g/kg) bile su slične za obje skupine. Odgovor AWB na dopunu obroka kvascem bilo je povećanje unosa krme i dnevne proizvodnje mlijeka, ali nije utjecalo na sastav mlijeka. Stoga, proizvođači mlijeka koji drže AWB mogu imati koristi od korištenja kulture kvasaca SC u obrocima tijekom rane laktacije.

Ključne riječi: kvasac, anatolijske vodene bivolice, unos suhe tvari, sastav mlijeka, broj somatskih stanica

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