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The Effect of *Saccharomyces cerevisiae* on Milk Yield, Milk Compositions and Body Condition Score Raised Organically in Dairy Cows

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Abstract: The objective of this study was to evaluate the effect of *Saccharomyces cerevisiae* (SC) on milk yield, milk compositions and the body condition score raised organically in dairy cattle. For this aim, 120 lactating Holstein Friesian dairy cows were randomly divided into group control (n = 60) and treatment (n = 60) in a private organic dairy farming in the Kelkit District of the Gumushane Province in Turkey. The diet of group treatment each cow was supplementation with 6 g SC per day. The experimental was started after 30 days of calving and lasted 45 days after. The average daily milk yield production ($p<0.01$) was higher in the SC group (34.6±0.31 vs. 31.8±0.44 kg day^{-1} in the treated and control group, respectively). The effect of SC on some milk compositions as non-fat solids (%), milk fat (%), protein (%) and lactose were statistically non-significant. Body condition score in the treated group (2.74±0.016) was higher than control group (2.58±0.017) ($p<0.01$). It was concluded that milk yield capacities in organic dairy cattle farming in case that the similar results are confirmed with additional studies can be substantially increased.

Key words: *Saccharomyces cerevisiae*, milk yield, milk compositions, organic milk, body condition score

INTRODUCTION

Microbial feed additives such as *Saccharomyces cerevisiae* (SC) have positive effects on rumen fermentation and also improve the milk and beef yield performance of animals (Bruno *et al*., 2009). For this reasons, microbial feed additives have been used for a long time for diet of the ruminants (Masek *et al*., 2008; Bruno *et al*., 2009). Especially, feed additives such as hormone and antibiotic have negative effects on human and animal health and they were forbidden to be used as a growth factor in many countries particularly in the EU countries. So, this has resulted in an increased interest in feed additives such as SC and many studies have been conducted on the use of these feed additives.

It has been reported that supplementation with *S. cerevisiae* in the ruminant diet may improve feed intake (Poppy *et al*., 2012), milk production (Nocek *et al*., 2011), daily weight gain (Salama *et al*., 2002), digestion of nutrients (Miller-Webster *et al*., 2002), number of anaerobic, cellulolytic bacteria (Newbold *et al*., 1995), ruminal pH value (Bach *et al*., 2007) and changed the concentration of rumen volatile fatty acids (Arcos-Garcia *et al*., 2000). In addition, there have been also other studies (Dann *et al*., 2000; Kalmus *et al*., 2009; Al-Ibrahim *et al*., 2010; Promkot *et al*., 2013) that the addition of *Saccharomyces cerevisiae* had no effect on milk production and milk compositions in dairy cows. There was no consistency among result of the experimental in which supplementation with SC in dairy cow. This situation may resulted from different dose use in the experimental, stage of lactation and animal age, composition feed and feeding strategy. It has been stated that *S. cerevisiae* is more effective in the diets in which nutrient content is inefficient or in the diets including much energy with concentrate feed (Masek *et al*., 2008).

There have been many studies that effect of SC on health, yield and product quality of the cattle raised in conventional conditions. All the same, there has not been experimental about the effects of SC on milk production raised organically in dairy cows. The consumer who prevents from the negative effects of feed additives as antibiotic and hormone on human and animal health have trend for organic animal products in which the use of these additives is forbidden. Among the organic animal products to which the demand increased milk and milk products are the primaries. In this study, it was aimed to test the effect of SC that is a microbial feed additive on milk yield, milk compositions and body condition score raised organically cow.

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Table 1: Ingredient and nutrient composition of treatment and control groups diets

	Treated					Control				
Ingredients	DFI	DM (%)	CP (%)	Fat (%)	ADF (%)	DFI	DM (%)	CP (%)	Fat (%)	ADF (%)
Alfalfa hay	10.0	88.0	11.0	1.7	30.0	9.5	88.0	11.0	1.7	30.0
Vetch hay	1.0	88.0	9.0	1.6	33.0	1.0	88.0	9.0	1.6	33.0
Corn silage	15.5	27.0	2.1	0.9	6.3	14.7	27.0	2.1	0.9	6.3
Organic con.	11.5	88.0	18.4	2.8	9.1	10.9	88.0	18.4	2.8	9.1
Conv. con.	1.7	88.0	35.2	6.8	5.4	1.6	88.0	35.2	6.8	5.4
Total (kg)	39.7	64.2	16.6	3.0	21.4	37.7	64.2	16.6	3.0	21.4

DFI = Daily Feed Intake; DM = Dry Matter; CP = Crude Protein; ADF = Acid Detergent Fib

MATERIALS AND METHODS

The trial was conducted from October 13, 2012 to November 28, 2012 in a private dairy cattle farming (Dogan Organ Urunler Inc.) in Kelkit District in Gumushane Province that is located in the North of Turkey. From this organic dairy farming, 120 Holstein Friesian cows that calving in the same year and same season were taken for experimental.

The study was conducted with 120 lactating Holstein Friesian dairy cows randomly divided into group control (n = 60) and treated (n = 60). In the treated group each cow received 6 g day^{-1} SC (6.2×10^{9}) with roughage diet. The 6 g of SC is the recommended dosage according to Sim®NutriMa instructions. The experimental was started after 30 days of calving and lasted 45 days after. During the study, practices of the organic dairy cattle rearing are based on combination of general principles and detailed rules of organic milk production as indicated in the organic farming law printed Turkish Republic official gazette. According to regulations for organic dairy cattle rearing in Turkey, the ration of cows can contain 60% of roughage and 40% of concentrate. The ingredient and nutrient composition treatment and control group were given in Table 1.

The study was conducted farming, Holstein Friesian cows were milked twice a day. After milking, daily milk yield was recorded by a computer system that can recognize each cow by using transponders carried by each cow. In addition, individual milk samples were taken from in both the control and treatment group with two days of interval to determine the components of fat free dry matter, protein (%), fat (%) and lactose. The taken milk samples were analyzed in the same day with the existent milk analysis device (MAYSCAN). During the experimental, Body Condition Score (BCS) were recorded bi weekly by trained personnel using a 5 point scale (1: thin and 5: fat) as described by Edmonson *et al.* (1989).

The effect of SC to on milk yield milk composition and body condition score were analyzed according to following mathematical model in SPSS computer statistics program (SPSS, 2010).

$$Y_{ijk} = \mu + a_i + b_j + e_{ijk}$$

Where:

Y_{ijk} = Dependent variable
μ = Overall mean
a_i = The effect of feeding group (1: control, 2: treated)
b_j = The effect of parity (j = 1, 2 and 3^{+})
e_{ijk} = Residual

For the comparison of the significant averages, t-test was used (SPSS).

RESULTS AND DISCUSSION

The most important characteristic of ruminant animals such as sheep, goat and cattle are that they disintegrate the components as cellulose and lignin that monograstic animals cannot digest via the activity of mono-organisms living in the rumen and they transform them into beef and milk. In addition, some important problems such as methane gas occurrence in the ruminal digestion, the decrease in digestion of nutrients and nitrogen loss can appear. As the proportion of roughage increases these problems become clearer. According to the regulations for organic dairy cattle rearing in Turkey, the ration of the cows contains 60% of roughage and 40% of concentrate. So, there is a need for use of much healthier and much safer feed additives with the aim of overcoming the problems originating from the ration with roughage feed in the organic dairy cattle farming. In this study, the use of SC was researched in the direction of this purpose.

The results of milk analyses are summarized in Table 2. The average daily milk yields of the control and treated groups were 31.8±0.44 and 34.6±0.31 kg, respectively. Milk production was 2.8 kg day^{-1} higher in treated than control group and this difference was significant ($p<0.01$).

There has been no study that reported SC was added to the rations of organically raised in dairy cattle. In consistent with the results it has been reported in many studies conducted in conventional conditions (Nocek *et al.*, 2003; Nocek and Kautz, 2006; Phondba *et al.*, 2009; Al-Ibrahim *et al.*, 2010;

Table 2: Effects of SC on milk yield, milk composition and body condition score

Production traits	Control ($X \pm S_X$)	Treated ($X \pm S_X$)	p-values
Milk yield (kg day^{-1})	31.8±0.440	34.6±0.310	**
Peak milk yield	39.5±0.440	38.8±0.350	NS
Non-fat solids (%)	8.54±0.120	8.54±0.070	NS
Fat (%)	3.77±0.120	3.98±0.100	NS
Protein (%)	3.12±0.040	3.13±0.020	NS
Lactose	4.35±0.070	4.33±0.040	NS
Body condition score	2.58±0.017	2.74±0.016	**

**($p<0.01$); NS: Non-Significant

Ramsing *et al*., 2009; Bruno *et al*., 2009; Nocek *et al*., 2011) SC addition to the ration increased milk yield. This finding can be said to have been resulted from the increase of disintegration and digestibility of the nutrients as a result of the increase in the number of anaerobe and cellulolytic bacteria in rumen and that the addition of SC to the ration increased the use of dry matter. In contrast, other researchers found no improvement on milk yield in dairy cows (Dann *et al*., 2000; Kalmus *et al*., 2009; Promkot *et al*., 2013; Szucs *et al*., 2013).

In the organic dairy farmings, milk yield was lower 1.6 and 32.6% than conventional dairy farming due to using less concentrated feed and the energy and protein inefficiency in roughages that were used at a high proportion (Kristensen and Kristensen, 1998; Rosati and Aumaitre, 2004). Turkey has an important potential in organic dairy farming, however, the desired and targeted success has not been achieved yet because of the low milk yield in farming and high costs of feeds. The obtained increase of 8.6% (2.8 kg) daily milk yield in this study should be perceived as a quite significant result. In the event of obtaining similar results through the additional studies to conduct, important developments can be achieved in dairy farming by means of increasing milk yield in dairy cattle raising farming.

The peak milk yield was 39.5±0.44 and 38.8±0.35 kg in control and treated group, respectively. The difference of approximately 0.7% kg that was evaluated as in benefit of the control group was non-significant (Table 2). Promkot *et al*. (2013) has reported that the group in which SC was added to the ration reached to the pick point quicker compared to the control group (1.6 day) and this group had a higher rate of milk yield (2.3 kg).

In dairy cattle farming, all components and quality of nutrients are as important as the milk yield. In this study, the effect of SC on milk and composition was given Table 2. SC supplementation did not affect non-fat solids (%) (8.54±0.12 vs. 8.54±0.07 in the SC and control groups, respectively).

One of the important factors effecting the price in the milk market is milk fat. Milk fat contributes to reaching the desired quality in milk and milk products and to the creation of composition and aroma. Although, treated group was higher than control, the treatment was associated with no effects of milk fat (%) (control 3.77%, treated 3.98%). This result according with results of study by Nocek *et al*. (2011) and Pronkot *et al*. (2013) who had been reported that the effect of *S. cerevisiae* on milk fat (%) was non-significant. However, there was other study that *S. cerevisia* supplementation increases milk fat (%) (Kalmus *et al*., 2009).

The second important nutrient of milk is protein component. The main proteins included in milk are alpha casein, beta casein and alpha lacto albumin and beta lacto-globulin. These are existent only in milk and compose >90% of the total milk proteins. The milk protein (%) was higher in treated group (3.13±0.02) compared with the control group (3.12±0.04) but this difference was non-significant. Ramsing *et al*. (2009) and Promkot *et al*. (2013) obtained similar results. There were other studies reported that SC effect on milk proteins is important (Nocek *et al*., 2003; Nocek and Kautz, 2006). An explanation for the higher milk protein (%) content could be the well-known impact SC on rumen fermentation and nutrient digestibility which enhances ammonia uptake and improves microbial protein production (Kalmus *et al*., 2009).

Lactose that is a milk sugar is intrinsic to milk and is the most intensive carbohydrate included in milk. The lactose values in control and treated group were 4.35±0.07 and 4.33±0.04, respectively and there were no difference between two groups.

Periodically accurate determination and following of Body Condition Scores (BCS) allow for the observation of body energy reserves that are closely related with health, reproduction and milk yield and the appropriate management of the drove. The conditions of the cows can substantially change depending on the body store fats. Indirectly, estimation of these store fats help to increase the effectiveness of milk production. In this study, the supplementation of diet with SC significantly ($p<0.01$) effect of body condition score (2.58±0.017 vs. 2.74±0.016 in the control and treated group, respectively). The result obtained from this study is in consist with the results of the study conducted by Wohlt *et al*. (1991) and Diler (2011) that the SC addition to the ration was significant. However, in some studies (Nocek and Kautz, 2006; Kalmus *et al*., 2009; Al-Ibrahim *et al*., 2010) it was stated that feed additive did not affect body condition score. Nearly 6-8 weeks after calving, the highest rate of milk yield was achieved. During this period, the nutrients that will meet the high rate of milk yield are not met with the daily ration. So, the cows consume some of their own body reserves and a decrease in the body condition score. As a result of this negative energy

statement appears. Serious condition loss increases sensitivity against the diseases in the cows, reproductive performance and milk yield performance is negatively affected. In this study, SC addition to the ration in the 30th day following the birth by means of increasing appetite in cows and supporting the nutrient consumption provided them to be in a much better condition compared with the control group.

CONCLUSION

No research has available about the effects of SC on milk production raised organically in dairy cows. In this study, SC addition to the rations of organically raised in dairy cattle optimized rumen conditions for the micro-organisms and increased feed intake. So, the daily milk yield increased at a rate of 8.6% and substantially improved the condition score. Milk composition was no affected by SC. Turkey has an important potential in dairy farming, however, the desired and targeted success has not been achieved because of the low milk yield in farming and high costs of feeds. In this study, the increase of daily milk of 2.8 kg for each cow has been evaluated as a good result. In the event of confirming the similar results via the additional studies as a result of increasing milk yield in organic dairy farming enterprises, important successes will be achieved and the economic and ecological losses due to the methane gas will be minimized.

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