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Effects of Live Yeast Culture (*Saccharomyces cerevisiae*) on Milk Production and Blood Lipid Levels of Jersey Cows in Early Lactation

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Abstract: Effects of live yeast culture (*Saccharomyces cerevisiae* 1026) as a feed additive, on milk production and blood lipids contents of 10 Jersey cows in early lactation were determined in 21 days. Twenty Jersey cows, which have had their second delivery were allocated equally to one or the other treatments: control vs experimental. From 45-66th days in milk, 10 g day^{-1} of *Saccharomyces cerevisiae* (1×10^{8} cfu g^{-1}) dissolved in 200 mL of water were administrated to cows. Daily milk yields were recorded individually and blood samples were obtained weekly for each experimental cow. The diet supplemented with *Saccharomyces cerevisiae* (Yea-Sacc 1026/Alltech) implied an extension at the peak lactation period and a statistically significant increase of serum cholesterol and LDL ($p<0.05$) contents of early lactation Jersey cows.

Key words: Blood lipids, Jersey, *Saccharomyces cerevisiae*, lactation, milk yield, cholesterol

INTRODUCTION

Yeast is already in widespread use as a feed additive. Fermentated yeast and yeast cultures have been fed to dairy cattle for >60 years with varied responses (Schingoethe *et al*., 2004). In some studies, yeast cultures improved Dry Matter Intake (DMI) (Williams *et al*., 1991; Wohlt *et al*., 1991; Dann *et al*., 2000) and milk production (Arambel and Kent, 1990; Piva *et al*., 1993; Wang *et al*., 2001), whereas other studies (Erdman and Sharma, 1989; Arambel and Kent, 1990; Soder and Holden, 1999) found no response to yeast cultures.

Saccharomyces cerevisiae feed additives have been used as an alternative to antimicrobial feed additives for over 10 years (Lynch and Martin, 2002) but reported effects are controversial. Some researchers indicated the benefits associated with *S. cerevisiae* as increased DMI (Carro *et al*., 1992), increased fiber digestion (Williams *et al*., 1991) and increased milk production in dairy cattle (Harris and Webb, 1990; Wang *et al*., 2001). *In vitro* experiments have also reported that in some cases, *S. cerevisiae* culture favorably altered the total ruminal microorganism fermentation and stimulated lactate uptake and cellulose digestion by pure cultures of predominant ruminal bacteria (Nisbet and Martin, 1991; Martin and Nisbet, 1992; Callaway and Martin, 1997). In this scheme, removal of oxygen from the rumen environment by *S. cerevisiae* may play a prominent role in increasing bacterial viability (Wallace, 1994). Even though the effects of *S. cerevisiae* are not always consistent (Wohlt *et al*., 1991), few models have been proposed regarding the stimulatory effects of yeast culture on ruminal fermentation (Dawson, 1990; Lyons *et al*., 1993; Wang *et al*., 2001).

Several studies have suggested that *S. cerevisiae* cultures moderate the ruminal pH by increasing lactate utilization in ruminal lactate-utilizing bacteria (Nisbet and Martin, 1991; Martin and Nisbet, 1992; Koul *et al*., 1998) and also the yeast culture provides soluble growth factors (i.e., organic acids, B vitamins and amino acids) that stimulate growth of ruminal bacteria which utilize lactate and digest cellulose (Wiedmeier *et al*., 1987; Newbold *et al*., 1995; Callaway and Martin, 1997).

Supplementing diets with *S. cerevisiae* was shown to increase total Volatile Fatty Acids (VFA) and propionic acid production, besides higher propionate concentration and decreased acetate to propionate ratio were determined in some experiments (Dawson *et al*., 1990; Nisbet and Martin, 1991; Wohlt *et al*., 1991; Sullivan and Martin, 1999). Higher VFA, especially propionic acid are important in terms of enhanced lactose production, milk volume and overall energy balance (Miller-Webster *et al*., 2002).

On the other hand, many researchers stated that *S. cerevisiae* supplementation had no direct effects on prepartum or postpartum dry matter intake or milk yield and composition (Erdman and Sharma, 1989; Swartz *et al*.,

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1994; Kung *et al*., 1997; Soder and Holden, 1999). Furthermore, yeast additive did have no or very little effect on ruminal pH according to some researchers (Erasmus *et al*., 1992; Lynch and Martin, 2002). Erasmus *et al*. (1992) suggested that supplementation of *S. cerevisiae* tended to increase microbial protein synthesis in dairy cows and significantly altered the amino acid profile of the duodenal digesta.

The purpose of this study is to demonstrate the effects of *S. cerevisiae* (Yea-Sacc 1026/Alltech) on milk production, serum total cholesterol, triglycerides, High Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL) in Jersey cows in early lactation.

MATERIALS AND METHODS

This study was carried out in the Karaköy Farm of General Directorate of Agricultural Enterprises (TIGEM), Samsun, Turkey.

Twenty Jersey cows which have had their second delivery were used in this study. Ages, lactation number, lactation period of all the cows used in this study were similar and same housing and feeding conditions were valid for all of them. The cows were fed with a ration consisting of 10 kg of concentrate mixture (commercial feed for dairy cattle), 2 kg of triticale hay and 15 kg of maize silage totally per day, per cow. They were divided randomly to 2 groups, forming a study group and a control group. Starting from the 45th day of the lactation period, 10 g day^{-1} of *S. cerevisiae* (Yea-Sacc/Alltech Co.) were administrated to cows for 21 days in 200 mL of water. Water with yeast was fed by opening the mouth of each cow and pouring the water to the oesophagus, hence securing an intake of 10 g day^{-1} of yeast for each cow. *S. cerevisiae* was a live culture consisting 1×10^{8} cfu g^{-1} (EU Ref. No. CBS493.94). Milks were collected twice a day by automatic milking machine (WESTFALIA) and total milk yields for each animal were recorded daily through days 38-79 postpartum, thus having the milk yields also before and after the yeast ingestion.

Blood were collected via vena jugularis on the 45, 52, 59, 66 and 73th days postpartum. Obtained bloods were centrifuged and sera were seperated into sterilised tubes. Total cholesterol, triglycerides, HDL and LDL were measured using an autoanalyser (Tokyo Boeki) with Spinreakt commercial kits. Results were confirmed by spectrophotometry (Humalyzer) using Humman commercial kits, with results expressed in mg dL^{-1}.

The serum biochemical values and milk yield values analysed in the study did not show a normal distribution, therefore Friedman test was used to evaluate the weekly changes of serum biochemical values and milk yields of both experimental and control groups (John, 1971).

RESULTS AND DISCUSSION

Weekly changes at serum cholesterol, triglyceride, HDL and LDL values of the experimental and control groups are shown in Table 1. Changes for the biochemical values of the control group for the entire 5 weeks period was determined insignificant ($p>0.05$). Yet, weekly changes in the cholesterol and LDL values of the experimental group was determined significant ($p<0.05$), where no statistically important variances was calculated at HDL and triglyceride values ($p>0.05$).

Standart errors and average values of milk yield changes according to weeks are shown in Table 2. Milk yield changes according to weeks of the control group was determined statistically insignificant, where it was statistically significant for the experimental group ($p<0.05$). Average daily milk yield at the 37th day of lactation (before treatment) for the experimental group, was 16.05 kg but it was 15.63 kg at the week after the experiment was ended (after treatment). The effects of *Saccharomyces cerevisia* on milk yield are shown in Fig. 1. Since the experiment started at the peak period of lactation, it was observed that this peak period extended with the effect of *Saccharomyces cerevisia.* Weekly changes of the milk yield at both study and control groups indicates that the insignificant variation at the control group was at a statistically significant level at the studygroup.

This study was designed to investigate the effects of yeast cultures on the milk yields, serum cholesterol and triglyceride values of lactating Jersey cows. There are controversial reports on the effect of *S. cerevisiae* on milk yield of dairy cows. On one hand, Swartz *et al*. (1994), performed a 14 weeks study with 366 lactating Holstein cows in the first 120 days of lactation from seven farms to evaluate supplementation of two *S. cerevisiae* yeast cultures containing about 10^{8} cfu g^{-1} viable yeast cells on milk production and composition and reported that milk production, milk fat and protein percentage, milk fat and protein production were not affected by either yeast treatment.

There were no significant interactions of farm by treatment, stage of lactation by treatment, lactation number by treatment or week by treatment. No differences in performance were significant for early lactation cows that calved during the trial and daily DMI measured on 39 cows at one location did not differ among treatments. Yeast supplementation was not beneficial for any production parameters under the nutritional management programs of these seven dairy farms.

Similarly, Erdman and Sharma (1989), Arambel and Kent (1990), Soder and Holden (1999) and Kung *et al*.

Table 1: Average value and standart errors of serum cholesterol, triglyceride, LDL and HDL levels of the experiment and control groups

Groups	Cholesterol	Triglyceride	LDL	HDL
Experiment				
Week 1	113.4±34.7	46.2±39.5	55.9±23.60	36.5±8.9
Week 2	113.1±35.5	39.8±24.9	64.4±29.30	37.0±8.30
Week 3	162.1±44.1	57.4±31.5	101.7±32.0	46.1±16.9
Week 4	124.5±48.1	42.1±29.2	77.9±43.10	37.8±18.7
Week 5	131.7±40.4	39.3±19.3	80.4±27.40	41.1±14.6
χ^2	9.78*	3.052	13.367*	2.29
Control				
Week 1	120.1±41.8	49,6±33.3	73.2±38.3	35.1±13.5
Week 2	102.8±37.5	32.9±25.9	59.1±32.1	35.0±12.7
Week 3	127.1±43.2	62.7±30.9	76.7±35.1	42,1±11.8
Week 4	122.8±44.1	48.1±37.4	72.5±35.0	42,5±11.6
Week 5	123.7±62.0	48.4±34.1	77.4±41.8	39.6±20.1
χ^2	1.88	6.707	3.357	3.18

*p<0.05

Table 2: Milk yield averages and standart errors for the control and experiment groups

Groups	Experiment	Control
Before treatment	16.05±3.0	11.72±2.7
Treatment week 1	16.63±3.3	11.61±2.5
Treatment week 2	16.41±3.5	11.92±3.1
Treatment week 3	15.78±3.7	11.90±2.8
After treatment	15.63±3.6	12.15±2.8
χ^2	13.44*	3.56

*p<0.05

(1997), found no response in milk yield to yeast cultures. Seasonal and climate factors nearby feed ration, concentrate level in ration may play a role at these results.

On the other hand, many studies suggest that yeast cultures improved DMI (Williams *et al*., 1991; Wohlt *et al*., 1991) and milk production (Williams *et al*., 1991; Wohlt *et al*., 1991; Erasmus *et al*., 1992; Huber, 1998). Lynch and Martin (2002), observed that *S. cerevisiae* culture and *S. cerevisiae* live cell feed supplements had little effect on milk production, ruminal fluid pH and total VFA concentrations in early lactation cows.

Wohlt *et al*. (1991), found that *S. cerevisiae* supplementation stimulated DMI and milk production in Holstein cows fed a combination of corn silage, grain and hay. These results tend to support the findings which revealed an extension of the peak period of lactation at the experiment group, where no variation was determined at the control group and this observation indicates the effect of *S. cerevisiae* supplementation on milk yield and the extension of the plateau period.

Several studies demonstrated that *S. cerevisiae* feed additives increased the production of acetate, propionate and total VFA in dairy cows (Nisbet and Martin, 1991; Piva *et al*., 1993; Miller-Webster *et al*., 2002) and a decrease in the acetate:propionate ratio was observed due to the greater increase in the propionate production relative to acetate (Nisbet and Martin, 1991). The higher

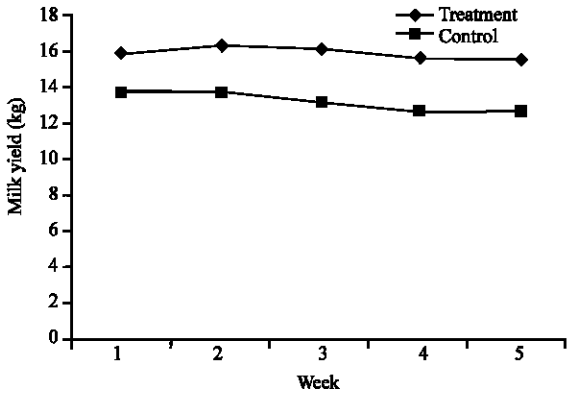

Fig. 1: Effect of Saccharomyces cerevisiae (Yea-Sacc 1026/Alltech) on milk yields of the groups

propionic acid production that resulted from feeding *S. cerevisiae* would be expected to have a positive effect on milk volume. Propionate is used by the cow to produce glucose and can be in short supply during prenatal period and lactation.

Since glucose is needed to produce energy, less fat might be mobilized and this condition might be advantageous in preventing postpartum metabolic diseases, especially ketosis.

Iwanska *et al*. (1999) evaluated the effects of yeast culture (*S. cerevisiae* 1026) in 30 early-lactation Black and White Lowland cows and reported that there were no significant differences in the glucose level, mineral contents and enzyme activities of the blood serum. Similarly Banadaky *et al*. (2003), investigated the effects of *S. cerevisiae* in early lactation Holstein dairy cows and no differences were demonstrated in the concentration of glucose, calcium, phosphorus, sodium, cholesterol, triglycerids, urea nitrogen and total protein in plasma of all cows receiving different diets.

The results regarding HDL and triglyceride levels are in accordance with these two studies, as no differences in serum HDL and triglyceride levels were recorded with feeding *S. cerevisiae*. But different from the studies performed before, in the study, cholesterol and LDL levels for the 5 weeks after the 45th day of lactation presented a statistically significant difference.

CONCLUSION

S. cerevisiae (Yea-Sacc 1026/Alltech) used as a feed additive implied an extension of the peak lactation period during the experiment. Weekly changes of the milk yield of both control and study groups indicates a statistically significant variation at the experimental group, where no

significant difference was determined at the control group. This situation may suggest that *S. cerevisiae* prolongs the peak period of lactation at Jersey cows. *S. cerevisiae* (Yea-Sacc 1026/Alltech) also increased serum cholesterol and LDL contents of early lactation Jersey cows but did not modify serum HDL or triglyceride levels. During early lactation, cows often are in negative energy and nitrogen balance and this study demonstrates the *S. cerevisiae* supplementations are to be the right attempts in improving the milk yield.

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