EFFECTS OF YEAST (*SACCHAROMYCES CEREVISIAE*) FEED SUPPLEMENT ON MILK PRODUCTION AND ITS COMPOSITION IN TUNISIAN HOLSTEIN FRIESIAN COWS

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A 105-day feed trial was conducted to evaluate the effect of probiotic feed supplement containing *Saccharomyces cerevisiae* on milk yield and its composition in Holstein Friesian cows. The trial was conducted in the region of Sidi Bouzid in the west of Tunisia. Effects of *Saccharomyces cerevisiae* have been investigated on eight Holstein Friesian cows randomly divided into two groups of four animals on the basis of age, body weight, average milk yield, and lactation number. The first group was supplemented with 2.5 g/cow/day of probiotic yeast *Saccharomyces cerevisiae* (2.5 10^{10} CFU/day) and the second group (control) was without the yeast. The study showed that supplementation with 2.5 g of yeast *Saccharomyces cerevisiae* per cow per day or 2.5 10^{10} CFU/day tended ($P < 0.06$) to increase milk production by 1.1 kg/cow. By cons, there was a significant increase of fat ($P < 0.01$; 52.8 and 46.9 g/cow/day) and protein ($P < 0.05$; 41.7 and 38.7 g/cow/day) content both for treated and control group, respectively. It is concluded that supplementation of *Saccharomyces cerevisiae* at 2.5 10^{10} CFU/day in the diet of dairy cows may have positive influence on milk fat and protein yield (g/cow/day).

dairy cow; feed concentrates; probiotics; milk yield; composition

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INTRODUCTION

The proper management strategies for dairy cattle are designed to prepare the cow for lactation and to minimize the incidence of metabolic diseases in the time of calving. To ensure a high milk production, numerous problems associated with the dry period have to be coped with. In order to overcome these problems it is recommended to use some feed additives which are a group of feed ingredients that can cause a desired animal response in a non-nutrient role such as rumen pH shift, growth, or metabolic modifier. Currently there has been a great interest in the use of probiotics for the livestock industry. Probiotic foods are a group of functional foods with growing market shares and a large commercial interest (Arvanitoyannis et al., 2005). Probiotics, with regard to animal applications, were defined as live microbial feed supplements beneficially improving the intestinal microbial balance in host animal (Ibrahim et al., 2010). Moreover, they have been approved to provide many benefits to the host animal and animal products. They are used as animal feed to improve the animal health and to improve food safety (Song et al., 2012). Among probiotics, *Saccharomyces cerevisiae* can optimize rumen function by enhancing food components and consequently improve the milk production performance while ensuring digestive comfort and health of the animal. The objective of this test is to determine the effect of the use of *Saccharomyces cerevisiae* on production of milk and its composition.

MATERIAL AND METHODS

Animals and experimental design

The trial was carried out in the governorate of Sidi Bouzid. Eight Holstein cows in their mid-lactation were randomly divided into two groups (yeast and control) per 4 cows, according to age (3.88 ± 0.83 years), body weight (775 ± 116.5 kg), average milk yield (14.5 ± 0.7 kg), and lactation number (2.4 ± 0.5). The experiment lasted for three and half months with 15 days of adaptation. Cows of both groups were fed the same ration. Each cow in the first, probiotic group was additionally supplemented with powdered yeast *Saccharomyces cerevisiae* at the dose of

Table 1. Chemical composition and nutritive value of diets

	Concentrate	Wheat bran	Oat hay	Grass
DM (%)	90.9	89.1	92.0	44.0
OM (% DM)	93.0	89.0	92.7	93.0
Ash (% DM)	7.0	11.0	7.9	7.0
CP (% DM)	16.2	8.7	4.9	9.6
FM (% DM)	3.0	1.7	1.8	2.5
CF (% DM)	6.5	7.0	35.6	11.3
ADF (% DM)	7.1	7.7	39.2	12.4
UFL (/kg DM)	1.0	0.9	0.4	0.3

DM = dry matter, OM = organic matter, CP = crude protein, FM = fat matter, CF = crude fibre, ADF = acid detergent fiber, UFL = milk fodder unit.

2.5 g/cow/day (2.5 10^{10} CFU). Ration was composed of oat hay (7 kg dry matter (DM)/cow/day) and fresh grass (1.5 kg DM/cow/day). The average milk yields of each group before trial were 14.8 ± 0.3 kg and 14.2 ± 1 kg for yeast and control group, respectively.

Measurements

Animals were milked twice daily, at 06:30 and 16:30. Individual milk yield was recorded weekly during the whole experimental period and individual milk samples (20 ml) were taken and kept at 4°C for analysis.

Laboratory analysis

Milk fat, protein, lactose, solids-not-fat (SNF), milk pH, milk density were analyzed using milkanalyzer (*MilkoScan;* FOSS, Hillerod, Denmark).

Chemical composition of various feed sources was determined in the animal nutrition laboratory at the Regional Center of Agricultural Research in Sidi Bouzid (Table 1). Nutritive values of experimental aliments were determined following the method described by Sauvant (1981). Samples of diets were dried in a forced-air oven at 105°C for 24 h to determine DM. Dried samples were ground through a 1-mm screen and then used to determine ash content (450°C for 8 h) and crude fibre (CF) content by the method of Weende (AOAC, 1984). Fat matter was determined by Randhall method (AOAC, 1984). Crude protein (CP) was determined by Kjeldahl method (AOAC, 1984).

Statistical analysis

The results of the effects of the diets on the measured parameters were subjected to Analysis of Variance with the GLM procedure of SAS (Statistical Analysis System, 2000) and compared by *t*-test. The statistical model was:

$Y_{ij} = \mu + R_i + e_{ij}$

where:

μ = overall mean

R_i = fixed effect of diet (i = 1, 2)

e_{ij} = residual error term

RESULTS

Chemical composition of foods

The chemical composition of foods is shown in Table 1. Oat hay exhibited a low CP content (4.9%) and low energy value (0.4 milk fodder unit (UFL) kg^{-1} DM). For grass, the CP content was 9.6% and it was not less than the level at which it could be considered deficient (Norton, 1994), but its energy value of about 0.3 UFL kg^{-1} DM was low. Feed concentrate showed 16.2% CP and 1 UFL kg^{-1} DM. The result for wheat bran was 8.7% CP and 0.9 UFL kg^{-1} DM.

Milk production and composition

The results showed that supplementation with yeast *Saccharomyces cerevisiae* at 2.5 g/cow/day tended ($P < 0.06$) to increase milk production by 1.1 kg per cow. But no changes were noted for milk composition. The differences between the measured parameters of the two groups were 3.65% fat, 2.94% protein, 4.5% lactose, and 4.6% SNF in favour of the yeast supplemented group. There was a significant ($P < 0.01$) increase of fat production (by 53 against 47 g/cow) and a significant ($P < 0.05$) increase of protein content (by 41.7 against 38.7 g/cow) for yeast against control group respectively (Table 2). These two parameters are interesting in determining cheese production efficiency.

Table 2. Effect of *Saccharomyces cerevisiae* yeast supplement on milk production and composition

	Group		MSE	*Pr.* > *F*
	yeast	control		
Milk yield (kg/day)	14.4 ± 0.34	13.3 ± 0.37	0.670	0.06
Fat (%)	3.37 ± 0.07	3.59 ± 0.08	0.300	0.20
Protein (%)	2.94 ± 0.01	2.94 ± 0.01	0.005	0.90
Milk density	28.62 ± 0.10	28.59 ± 0.11	0.0001	0.80
Solids-not-fat (SNF) (%)	4.65 ± 0.02	4.62 ± 0.02	0.0001	0.50
Ash (%)	7.81 ± 0.05	7.85 ± 0.06	0.160	0.60
Lactose (%)	4.54 ± 0.01	4.55 ± 0.01	0.010	0.60
Milk pH	4.67 ± 0.06	4.63 ± 0.07	0.240	0.70
Fat yield (g/cow/day)	53^{a} ± 1.50	47^{b} ± 1.60	1.300	0.01
Protein yield (g/cow/day)	41.7^{a} ± 0.97	38.7^{b} ± 1.06	0.600	0.04

MSE = mean standard error

$^{a, b}$mean values with different letters in the same row are significantly different

DISCUSSION

Milk production increased by 7% in cows supplemented with probiotic yeast which is in agreement with other authors who reported a relatively low responses ranging from 3 to 9% (Robinson 1997; Dann et al., 2000). Contrarily, results of other studies by Williams et al. (1991), Wohlt et al. (1991), Putnam et al. (1997), and Wohlt et al. (1998) suggest the milk production increase may attain 12% and even more. The analysis of the results obtained in tests incorporating probiotic yeast in dairy ruminants shows a great variability in the responses relating to the quantity and quality of milk (Swartz et al., 1994; Soder, Holden, 1999; Wang et al., 2001). A significant increase in milk production, ranging 0.7–2.4 kg per day, was reported by Piva et al. (1993) and Robinson, Garrett (1999). Other authors reported only a trend towards improved milk production because the effect was not significant ($P < 0.10$) (Erasmus et al., 1992; Dann et al., 2000). Other tests negate the effect of yeast on the milk production (Erasmus et al., 2005). A meta-analysis using the results of 29 114 references accumulating a lot of cows in production, confirms a significant average effect of 4% on the amount of milk (Ali-Haimoud Lekal et al., 1999). Finally, another study using literature results (22 published studies) involving more than 9000 dairy cows showed that the yeast could be responsible for an increase in milk production ranging from 2 to 30%, with an average of 7.3% (Dawson, 2000). Moreover, the response to probiotics described in various studies is often very different due to the variability associated with diets, types and doses of yeast used, and the animals tested (Williams et al., 1991), as well as with the stage of lactation or physiological condition of the animals. Indeed, milk production is greater in early than in late lactation (Majdoub-Mathlouthi et al., 2009). Yeasts are active agents which have a beneficial effect on ruminal fermentation. These metabolites stimulate bacterial growth and particularly the cellulolytic bacteria of the rumen. This positive impact on bacterial growth is reflected favourably in the production of protein and milk fat. Our results show that cows supplemented with yeast of *Saccharomyces cerevisiae* culture tended ($P < 0.06$) to produce more milk than controls (14.4 vs 13.3 kg/day). In addition, probiotics increase the assimilation of nutrients by the digestive intake of vitamin B1 (thiamine), which promotes the colonization of plant tissues by rumen microbes and further enhances the digestibility of the diet (Erasmus et al., 1992). As for the chemical composition of milk, fat content and protein content are not altered by the addition of yeast. Several tests indicate that the increase in milk production induced by dietary supplementation with *Saccharomyces cerevisiae* is not always associated with a change in milk fat and milk protein (Wohlt et al., 1991; Soder, Holden, 1999). In addition, our test is partially in agreement with the work of Ali-Haimoud Lekal et al. (1999) which shows an increase in the fat content while the protein is not altered. For lactating goat, a significant effect of yeast on the fat content was reported (El-Ghani, 2004; Stella et al., 2007), whereas the protein level was not changed. We can deduce that in some field trials, if the response of dairy cows to an intake of probiotic yeast is not significantly positive, it is probably because the conditions to allow the yeast to express its potential are not met. Moreover, the response of animals seems to be dependent on the physiological status of the lactating animal (Williams, Newbold, 1990) and the nature of the diet (Dawson, 1989). The contribu-

tion of probiotic yeasts of the genus *Saccharomyces cerevisiae* induced a significant ($P < 0.01$) increase in the production of fat with 53 vs 47 g per cow for yeast and control group respectively, and a significant ($P < 0.05$) increase of milk protein amount with 41.7 vs 38.7 g per cow for yeast and control group respectively, due to a higher milk production.

CONCLUSION

Our results confirm the importance of incorporating the probiotic yeast *Saccharomyces cerevisiae* in the diet of dairy cows to improve milk production and composition. And it seems necessary to explore the mechanisms of action of the *Saccharomyces cerevisiae* metabolic activities and intra-ruminal lipid and nitrogen metabolism of dairy cows.

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