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Influence of Live Yeast Culture on Milk Production, Composition and Some Blood Metabolites of Ossimi Ewes During the Milking Period

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ABSTRACT

A feeding trial was conducted to evaluate the influence of live yeast culture (*Saccharomyces cerevisiae*) on milk production, composition, and some blood metabolites of Ossimi ewes during the milking period. The control group (G1) was fed a concentrate mixture (CFM) and hay (H) and grazed twice daily, while the second group (G2) and third group (G3) were fed the same diet supplemented with 3 or 6 g of live yeast culture (Yea Sacc1026), respectively. The treated groups had significantly higher values ($p<0.05$) for fat corrected milk (FCM) (740, 605, 571 g/day, for G3, G2 and G1 vs, respectively), while the values for milk yield, fat yield and lactose yield were higher ($p<0.05$) only in G3 compared with G1. Milk yield values were constantly higher in G3 than in G1 while the values for the G3 were more variable during milking. Milk composition was not significantly affected by yeast supplementation with the exception of urea values which were significantly ($p<0.05$) lower in G3. Yeast administration influenced β-Hydroxy-Butyrate (BHB) values, which were significantly ($p<0.05$) higher in the treated groups; and non-esterified fatty acids (NEFA) values, which were significantly ($p<0.05$) higher only in the G3 compared with the G1. Other blood metabolites values were not influenced by the treatments. It was concluded that supplementation with live yeast culture, under the conditions of this experiment, had a significant effect on the performance and metabolism of Ossimi ewes during the milking period. Based on more constant results, it is recommend including live yeast culture (Yea Sacc1026) at 6 g/animal/day as appropriate level for field conditions.

Key words: Live yeast culture, Ossimi ewes, milk production and composition, some blood metabolites

INTRODUCTION

Sheep milk is uniquely different from cow or goat milk. Sheep milk has about twice the fat of cow milk and 40% more protein than cow milk. In the last twenty years, some probiotics, such as *Aspergillus* or *A. niger* (Pioneer, 1989), yeast culture (*Saccharomyces cerevisiae)* (Wallace, 1994) and some microbial growth promoters e.g., thiamine, niacin (Shields, 1981) were used as feed additives in order to improve rumen conditions and cellulose digestion in the rumen and milk yield of dairy cows. Inactive dry yeast is only used to improve the yield and composition of milk in sheep and also as a source of protein and vitamins of B-complex, when added to rations (Dilanyan *et al*., 1977; Peppler, 1979). Products containing *Saccharomyces cerevisiae* vary widely in efficiency, primarily because of differences in strain and the viability of yeast cells. Numerous models have been designed to explain the effects of yeast in the rumen. Data indicate that supplementation of yeast in the ruminant diet may improve feed intake (Williams *et al*., 1991; Robinson and Garrett, 1999), milk production (Wang *et al*., 2001; El-Ghani, 2004), weight gain (Salama *et al*., 2002), digestion (Jouany *et al*., 1998; Wohlt *et al*., 1991), numbers of anaerobic and cellulolytic bacteria

(Newbold *et al.*, 1995), ruminal pH value (Doreau and Jouany, 1998; Jouany *et al.*, 1998) and alter the patterns of volatile fatty acids (Arcos-Garcia *et al.*, 2000) or even supply the animal with unknown growth factors (Girard and Dawson, 1995). Nevertheless, the results of these studies have been variable and strongly influenced by ration composition (Dawson, 1992; Newbold, 1996). The influence of yeast supplementation on grazing animals has mainly been investigated in grazing steers (Olson *et al.*, 1994a, b; Arakaki *et al.*, 2000). Much less is known about the effects of yeast supplementation on grazing dairy ewes, nevertheless *in vitro* trials (El-Hassan *et al.*, 1994) and trials on grazing steers may give justification for more investigation. A feeding trial was conducted to evaluate the influence of live yeast culture (*Saccharomyces cerevisiae*) on milk production, composition, and some blood metabolites of Ossimi ewes during the milking period.

MATERIALS AND METHODS

The live yeast culture supplements: (*Saccharomyces cerevisiae*) (Yea Sacc 1026; Alltech, Inc., Nicholasville, Kentucky, USA).

Feeding and management: The present study was carried out at the Experimental farm of Animal Production Department, Faculty of Agriculture, South Valley University, Qena during the period from February to July 2010. A feeding trial was conducted to evaluate the influence of live yeast culture (*Saccharomyces cerevisiae*) on milk production, composition and blood metabolites of Ossimi ewes during the milking period. Sixty Ossimi ewes (aged 3-3.5 years, average body weight 48.3±3.13 kg) were used in the lactation trial from the 42th to the182th day of lactation, which is the usual period of milking in the region. All ewes were in second lactation. The sheep were divided into three groups on the 42th day of lactation after peak to carry out the experiment. The sixty Ossimi ewes at peak of lactation (42 day) were divided into three groups (20 animals/each): Control group(G1): received only 100% of NRC (2001) nutrient allowances of dairy sheep without live yeast culture for 6 weeks after parturition, G2: received 100% of NRC nutrient allowances of dairy sheep (2001) with 3 g/day/sheep of live yeast culture for 6 weeks after parturition and G3: received 100% of NRC nutrient allowances of dairy sheep (2001) with 6 g/day/sheep of live yeast culture for 6 weeks after parturition.

Animals were kept in open yards belonging to Animal Production Experimental Farm, Faculty of Agriculture, South Valley University. During the experimental period the animals received 1 kg/ewe/day of concentrate mixture, 0.3 kg/ewe/day rice straw and were allowed to graze (mixed grass pasture and alfalfa hay) from 7.00 am and 3.00 pm. Animals were fed (at 7.00 am and 5.00 pm) ration consisted of a concentrate mixture according to their live body weight and level of milk production. Beside the concentrate mixture, animals were fed mixed grass pasture (natural pasture, cereal stubble, crop residue, vegetable by-products) and alfalfa hay. Water was available all day and minerals were supplied in salt licking blocks. Animals were adopted the double daily milking at 6.00 am. and 5.00 pm. The daily control ration consisted of concentrate mixture: 36.5% yellow maize, 16% wheat bran, 16% sunflower meal, 8% soybean meal, 20% barley meal, 2% calcium carbonate and 1% sodium chloride and 0.5% mineral and vitamins additives. The rations were fed to ewes as Total Mixed Rations, based on NRC (2001). The Total Mixed Rations was comprised of 65% forage and 35% of a concentrate mix to formulate diets to meet NRC (2001). Approximate and analysis of the concentrate mixture, mixed grass pasture and alfalfa hay is provided in Table 1 and 2 according to AOAC (1995). Body weight of animals was recorded at the beginning and at the end of the experiment.

Table 1: Formulation of the concentrate mixture diet

Ingredients	Concentrate mixture (%)
Soybean meal	8.0
Yellow maize	36.5
sunflower meal	16.0
Barley meal	20.0
Wheat bran	16.0
Calcium carbonate	2.0
Sodium chloride	1.0
Vitamin-mineral mixture	0.5
Total	100.0

Table 2: Composition and chemical analysis of experimental basal diet of rations

Chemical composition(%):	Concentrate mixture	Mixed grass pasture	Alfalfa hay
Dry matter	88	21	89
Ash	7.5	8.1	7.2
Crude fat	3.0	3.8	2.3
Crude protein	17.3	11.2	15.9
Crude fibre	9.7	33.5	33.2
Neutral detergent Fibre	16.9	59.5	52.3
Acid detergent fibre	7.1	36.4	38.6
Calcium	0.66	0.38	1.28
Phosphorus	0.78	0.30	0.29
Magnesium	0.24	0.14	0.30
Sodium	0.23	0.19	0.12
Sulphur	0.05	0.15	0.24
Potassium	0.81	1.68	1.9
Chloride	0.08	0.57	0.37
Zinc (mg kg^{-1})	96	28 22	22
Manganese (mg kg^{-1})	75	89 66	66

Samples collection and measurement:

Feed samples: Samples of the concentrate, hay and pasture were collected throughout the experimental period for chemical composition analyses. The samples were ground and analyses were made according to the AOAC (1999). Neutral Detergent Fibre (NDF) and Acid Detergent Fibre (ADF) were determined by detergent procedure of Robertson and Van Soest (1981) and Van Soest *et al.* (1991), with alpha amylase (SIGMA-ALDRICH, Inc., USA) being added during NDF extraction. Sodium sulphite was not added. Feed samples were dried to ashed at 600°C/6 h. Then after Calcium, Sodium, Potassium, Chloride, Magnesium, Sulfur, Zinc and Manganese concentrations were measured by using PV9100 atomic absorption spectrophotometer and they were analyzed for Phosphorus by using Varian DMS 1005 UV Visible Spectrophotometer (AOAC, 1990).

Milk and blood samples: Individual milk samples, consisted of proportional volumes of morning and evening milk, were collected in order to evaluate milk composition (5 mL kg^{-1} of produced milk). A composed milk sample of each ewe was analyzed weekly. Fat percentage was determined by the standard Gerber method according to the British Standards Institution (1962). Protein percentage of milk was evaluated by Micro Kjeldahl technique (AOAC, 1999). Total Solids (TS) percentage of milk was determined gravimetrically using the method by Oser (1965). Solid Not Fat (SNF) was calculated by the difference (T.S%-fat%). Milk yield was corrected to 7% fat

(Raafat and Saleh, 1962), 7% FCM=0.265×milk yield (kg) +10.5 × fat yield (kg). The urea values were determined by an enzymatic colorimetric method using commercial kits of reagents (Patton and Crouch, 1977). Somatic Cell Counts (SCC) was determined with by the fluorescent method (DeLaval Cell Coun-ter, Tumba, Sweden). pH : It was determined by using a pH meter combined with a glass electrode (Model SS-3, Beckman, Fullerton, CA, USA).

Blood samples were collected on the 42th, 112th and 182th day of lactation by puncture of the jugular vein, with the addition of heparin as an anticoagulant, prior to morning feeding. Blood was allowed to coagulate at room temperature. The blood plasma was separated by centrifugation and stored at -20°C for a maximum of 60 days until assayed. Obtained blood serum were subjected to determine blood plasma constitunits as described by Wiebe and Bernert (1984), Kaplan and Szalbo (1983) and Trinder (1969).

Statistical analysis of the data: Data were statistically analyzed according to the General Linear Model (GLM) by using SAS (1998) and the differences among means were detected by Duncan`s Multiple Range Test (Duncan, 1955).

RESULTS

The values for milk yield and composition are presented in Table 3. Supplementation with live yeast culture only significantly ($p<0.05$) increased the total milk yield during the experimental period in G3 although G2 also had a higher value, but non-significantly, milk yield than the control group. Values for FCM were higher in the treated groups and the differences were significant ($p<0.05$) than in G1 (control). Fat yield and lactose yield significantly ($p<0.05$) increased only in G3 compared to G1. The chemical composition of the milk was not influenced by the treatments with the exception of milk urea nitrogen which was significantly ($p<0.05$) lower in the G3, the differences were significant. Values of milk yield and chemical composition did not differ from the respective values recorded in other animals in the herd (not included in the experiment) kept on the experimental farm. The values of blood biochemistry are summarized in Table 4. Values for **β**-Hydroxy-Butyrate (BHB) were significantly ($p<0.05$) higher in the treated groups than in the G1

Table 3: Means ±SE for milk yield and composition of Ossimi ewes as affected by yeast supplementation in the ration

Composition of milk	G1 0 g of live yeast culture per day	G2 3 g of live yeast culture per day	G3 6 g of live yeast culture per day
NO	20	20	20
Milk yield (g/day)	527±55b	564±53ab	670±76a
Fat (%)	7.8±0.3	7.7±0.3	8.0±0.1
Protein (%)	5.8±0.47	5.7±0.35	5.7±0.51
Lactose (%)	4.4±0.1	4.4±0.2	4.3±0.2
Total solids (%)	19.0±0.8	18.8±0.5	19.5±0.8
Non-fat solids (%)	11.2±0.4	11.0±0.3	11.1±0.6
FCM7(g/day)*	571.62±63b	605.48±73a	740.35±81a
Fat yield (g/day)	73±8b	76±8b	85±15a
Protein yield (g/day)	54±5	56±6	60±8
Lactose yield (g/day)	38±5b	43±3ab	47±8a
SCC ($x10^3$ mL^{-1})	405±169	380±75	490±15.2
Urea N (mg/100 mL^{-1})	27.4±2.46a	27.16±1.95a	25.01±2.55b
pH	6.76±0.44 a	6.72±0.36 a	6.74±0.43

Means in the same row followed by different letters are significantly different ($p<0.05$). * FCM7% = Fat corrected milk (7% milk fat)

Table 4: Means±SE for blood plasma constituents of sheep groups fed on different levels of live yeast culture

Biochemical indicators	G1 0 g of live yeast culture per day	G2 3 g of live yeast culture per day	G3 6 g of live yeast culture per day
No	20	20	20
NEFA (mmol L^{-1})*	0.30±0.10b	0.37±0.20ab	0.38±0.12a
BHB (mmol L^{-1})**	0.51±0.08b	0.61±0.14a	0.60±0.12a
Urea (mmol L^{-1})	7.40±1.39	7.31±0.86	6.94±1.17
Triglycerides (mmol L^{-1})	0.25±0.06	0.24±0.06	0.28±0.07
Cholesterol (mmol L^{-1})	1.92±0.23	1.91±0.25	1.96±0.16
VLDL (%)	6.3±4.1	6.1±4.0	7.7±4.0
HDL (%)	44.5±12.1	46.6±8.7	48.5±8.8
LDL (%)	49.1±12.6	47.2±7.9	43.7±10.0
AST (μkat L^{-1})	2.55±1.01	2.78±1.30	2.45±0.95
ALT (μkat L^{-1})	0.31±0.15	0.23±0.12	0.26±0.13
GGT (μkat L^{-1})	0.82±0.07	1.07±0.20	0.93±0.33
ALP (μkat L^{-1})	3.82±0.98	3.75±1.43	3.28±1.30

Means in the same row followed by different letters are significantly different ($p<0.05$). *β-hydroxy-butyrate = BHB . **Non-esterified fatty acids = NEFA

and Non-Esterified Fatty Acids (NEFA) values were significantly ($p<0.05$) higher in G3 than in the G1. All other values concerning blood components were not significantly different among other groups.

DISCUSSION

In this study, the live yeast culture included the ewes' diet showed a positive effect on milk yield during lactation. This has also been reported in dairy cows (Wohlt *et al*., 1991; Robinson and Garrett, 1999; Wang *et al*., 2001), also the same trend in dairy goats was observed by (Reklewska *et al*., 2000; El-Ghani, 2004; Stella *et al*., 2007). In contrast, other authors found no improvement of milk yield in dairy cows (Arambel and Kent, 1990; Swartz *et al*., 1994; Soder and Holden, 1999), dairy goats (Hadjipanayiotou *et al*., 1997; Giger-Reverdin *et al*., 1996) or in dairy ewes (Hadjipanayiotou *et al*., 1997). These results reflect that the effects of live yeast culture.

Administrations were strongly influenced by diet composition. Although many authors stated that live yeast cultures are most efficient when animals are fed diets poor in nutrient supply (Plata *et al*., 1994; Jouany *et al*., 1998) or high concentrate diets overloaded with energy (Williams *et al*., 1991; Zelenak *et al*., 1994), in some cases it is difficult to find a correlation between diet composition and the results of yeast supplementation. The animals in the present were fed relatively high levels of concentrate (1 kg/animal/day) which could lead to improved buffering capacity in the rumen. the results were also dose-dependent because 3 g of live yeast cultures per day was not efficient enough to maintain a constantly higher milk yield than in the control group. Similar results were obtained by El-Ghani (2004) with 3 and 6 g of live yeast cultures per day fed to dairy goats. Due to the higher amount of total solids in sheep milk, compared to cows and goats, it is expected that the supplementation of yeast may be more efficient in changing milk composition. However, the milk fat content was not significantly higher in the treated groups than in the control group, which is in agreement with Piva *et al*. (1993) who stated that the common result of yeast supplementation to dairy cows is only a slight (nonsignificant) increase in the milk fat content. Hadjipanayiotou *et al*. (1997) and Stella *et al*. (2007) also reported no increase in milk fat content

in dairy goats. In Damascus dairy ewes Hadjipanayiotou *et al.* (1997) found no influence of live yeast administration on milk composition, although in their study the yeast was steam-pelleted with no report on cell viability. On the contrary, Giger-Reverdin *et al.* (1996), El-Ghani (2004) and Masek *et al.* (2008) found increased milk fat values in dairy goats and ewes. Milk protein and lactose values did not differ between the treatments, which was also noticed by the majority of authors (Stella *et al.*, 2007; Giger-Reverdin *et al.*, 1996). Milk urea values were significantly ($p>0.05$) lower in the group fed 6 g per day. Harrison *et al.* (1988) reported a much lower concentration of rumen ammonia N after yeast supplementation, which is in agreement with the results of Erasmus *et al.* (1992), who found that the mean concentration of rumen ammonia decreased by 10% after live yeast culture supplementation. Erasmus *et al.* (1992) explained these reduced concentrations of ammonia in the rumen as the result of increased incorporation of ammonia into microbial protein stimulated microbial activity which could explain lower blood and milk urea values the present experiment. Results significantly subsequent showed ($p<0.05$) higher non-esterified fatty acids (NEFA) and β-Hydroxy-Butyrate (BHB) values were presently recorded in the treated groups, which is in agreement with Giger-Reverdin *et al.* (1996) and Quigley *et al.* (1992). Increase in Non-Esterified Fatty Acids (NEFA) values could be explained by increased mobilisation of fat tissue caused by live yeast supplementation, which was also noted in dairy goats (Giger-Reverdin *et al.*, 1996). According to Quigley *et al.* (1992), the increased ruminal butyrate was at least partially responsible for increased BHB values. Triglycerides and cholesterol values tended to be higher in the treated groups, which was also noted by Pysera and Opalka (2001). The same authors also found, in contrast to our results. All metabolites values were within the normal reference range for lactating dairy ewes (Dubreuil *et al.*, 2005; Roubies *et al.*, 2006; Yokus and Cakir, 2006; Masek *et al.*, 2007). Literature dealing with yeast supplementation in grazing animals is scarce and to our knowledge, involves mainly steers. Various authors found an increased number of protozoa increased the live body weight gain (Arakaki *et al.*, 2000; Combellas *et al.*, 2002) and increased degradation and digestibility (Olson *et al.*, 1994a, b). Dawson (1992), Wallace and Newbold (1992) and Newbold *et al.* (1995), showed that the micro-population plays a key role in the mode of action of yeast in the rumen El-Hassan *et al.* (1994) dound that the Yea Sacc1026 stimulated the total bacterial number in a rumen-simulating fermentor when the basal diet was grass and increased, the number of cellulolytic bacteria. Subsequent increased the degradalility and digestion then fore the better performance and best daily weight gain. I concluded that the supplementation of live yeast culture (Yea Sacc1026) had a significant beneficial effect on the milk yield of Ossimi sheep, fed pasture and concentrate mixture during the milking period. The significant results were probably a result of the interactions between yeast culture supplementation and diet composition. Since the influence was dose-dependent, we could recommend 6 g per day for inclusion in dairy sheep diets. Additional studies under different feeding conditions and in earlier stages of lactation should clarify the influence of live yeast supplementation in the diets of Ossimi ewes and define the dietary situations in which it may be beneficial.

It could be concluded that the supplementation of live yeast culture (Yea Sacc 1026) had a significant beneficial effect on the milk yield of Ossimi sheep, fed pasture and concentrate mixture during the milking period. The significant results were probably a result of the interactions between yeast culture supplementation and diet composition. Since the influence was dose-dependent, 6 g per day for inclusion in dairy sheep diets, is recommended. Additional studies under different feeding conditions and in earlier stages of lactation should clarify the influence of live yeast supplementation in the diets of Ossimi ewes and define the dietary situations in which it may be beneficial.

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