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Effect of Feeding Yeast Culture on Productive and Reproductive Performance of Dairy Cows

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ABSTRACT

A 105- day feed trial was conducted to evaluate the effect of supplementation of yeast culture on body condition score, body weight changes, dry matter intake, milk production and its composition and reproductive performance in lactating crossbred cows. Twelve multiparous crossbred cows were divided in to two groups (n=6); control group received ration composing of forages and concentrate (60:40). The experimental group received the same diet supplemented with 10 g of yeast (*Saccharomyces Cerevisiae*) per cow per day. The study showed that supplementation with yeast *Saccharomyces cerevisiae* tended ($P<0.06$) to increase milk production, 4% fat corrected milk (FCM), energy corrected milk (ECM), solid corrected milk (SCM) and milk energy (ME). There was a significant increase of fat ($P<0.01$) and protein ($P<0.05$) content also. However, dry matter intake (DMI), body weight and body condition score (BCS) were similar among the groups. Feed efficiency in terms of milk yield/DMI (kg/kg), ECM/DMI (kg/kg) and SCM/DMI (kg/kg) was similar among treatments. Supplementation of yeast culture did not show any effect on duration required for commencement of cyclicity and conception rate. In conclusion, yeast seems to have positive effect on milk production and its fat and protein composition in lactating cows.

Key words: Dairy cows, Milk production, Milk components, Reproductive performance, Yeast

INTRODUCTION

Based on a growing concern over the use of antibiotics and other growth promoters in the animal feed industry, interest in the effects of microbial feed additives on animal performance has increased. Probiotics 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 food safety. Among probiotics, *Saccharomyces cerevisiae* can optimize rumen function by enhancing food components and consequently improve the milk production performance while ensuring digestive efficiency and health of the animal. Yeast (*Saccharomyces cerevisiae*) addition has been reported to increase nutritional value of poor quality forages and high grain diets (Newbold *et al.,* 1996). Beauchemin *et al.* (2003) reported that yeast addition improved the development of rumen lactate-consuming bacteria; prevent accumulation of lactate and rumen pH drop. Yeast is also observed to stimulate cellulolytic bacteria in the rumen, increase fibre digestion and flow of microbial protein from the rumen (Jouany and Morgavi, 2007). Moreover, yeast was reported to improve feed intake and milk yield in dairy cows in several earlier studies (Wohlt *et al.,*1991; Erasmus *et al.,* 1992). The objective of this study was to determine the effect of the use of *Saccharomyces cerevisiae* on milk production, its composition and reproductive performance of dairy cows.

MATERIALS AND METHODS

The study was conducted in SKUAST-K dairy herd, at Mountain Livestock Research Institute (MLRI),

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Manasbal Safapora in Bandipora distirct of J&K. The experiment was carried out between January and April, the period which is characterized by high cold stress in this area. Twelve crossbred cows in their mid-lactation were randomly divided into two groups (yeast and control) of 6 cows each, according to age, body weight, average milk yield, and lactation number. The experiment lasted for 105 days with 15 days of adaptation. Cows of both groups were fed the same ration. However, each cow in the treatment group was additionally supplemented with powdered yeast *Saccharomyces cerevisiae.* Ten grams of the yeast were hand-mixed with a small amount of concentrate and were fed daily to each cow of the experimental group. The cows were housed in separate rows on the farm and had free access to water. Ration was composed of paddy straw, corn silage and concentrate feed. Proportion of forages and concentrate in the ration was 60:40 on dry matter basis. Concentrate was composed of different ingredients (Table 1).

The DMI was recorded daily. The body weight (BW) of each cow was measured fortnightly and body condition score (BCS) was assigned monthly to evaluate the effects of diet on energy status of each cow. Milk production was recorded daily for 105 days and individual milk samples (20 ml) were taken fortnightly and kept at 4°C for analysis of fat, CP, lactose, SNF and total solids.

All reproductive events were recorded, particularly the date of the first observed estrous postpartum and inseminations. Cows were observed regularly for a minimum of 30 min twice daily for signs of estrus. For this purpose they were observed for any obvious swelling of or any mucus discharge from vulva as well as other behavioral symptoms i.e., bellowing, restlessness, mounting other cows or standing still when mounted by other cows. The other important fertility measures included days open, conception rate at first service and number of services required per conception.

Total milk yield was converted to 4% fat corrected milk (FCM), energy corrected milk (ECM), solid corrected milk (SCM), milk energy (ME) yield as per NRC (1989). Milk fat, protein, lactose, solids-not-fat (SNF), and total solids were analyzed using milk analyzer (MilkoScan).

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 were compared by *t*-test.

RESULTS AND DISCUSSION

Supplementation with yeast had no significant effect on BCS and body weight over the study period (Table 2), which corroborates with Robinson (1997) and Nocek and Kautzt (2006). Piret *et al.* (2009) also reported a non-significant effect on BCS by feeding yeast culture to early lactating cows. Some researchers found a significant improvement in body condition and body

Table 1. Composition of concentrate mixture

S.No.	Ingridients (% dm basis)	Control (c)	Treatment (t)
1	Maize	25	25
2	Cotton seed cake	13	13
3	Mustard oil cake	23	23
4	Dorb	12	12
5	Wheat bran	15	15
6	Rice bran	5	5
7	Molasses	4	4
8	Mm	2	2
9	Salt	1	1
10	Yeast culture	-	10 grams/head/day
	Total	**100**	**100**

Table 2. Effect of supplementation of diet with yeast on body weight, body condition score and DMI of lactating crossbred cows

Parameter	Control (C)	Treatment (T)
Initial body weight (kg)	252.7±8.12	248.5±9.32
Final body weight (kg)	293.8±8.41	285.0±10.15
Mean body weight (kg)	273.3±5.11	266.8±4.54
Body weight change (kg/fortnight)	5.9±0.11	5.2±0.21
Body condition score	3.21±0.04	3.13±0.02
DMI (kg/day)	8.58±0.15	8.72±0.09
DMI (kg/100Kg BW)	3.14±0.03	3.27±0.01
DMI (g/Kg $W^{0.75}$)	127.54	132.07

weight after adding yeast to the diet of the cow peripartum (Dann *et al.,* 2000; Ayad *et al.,* 2013).

DMI was similar among treatment groups (Table 2), which is in agreement with previous research findings (Rossow *et al.,* 2017; Ramsing *et al.,* 2009) that reported a similar DMI in dairy cattle fed control or yeast product supplemented diet. However, Soder and Holden (1999) reported that supplementation of yeast culture during the first 42 days of lactation increased DMI of lactating Jersey cows.

The results indicated that supplementation with yeast *Saccharomyces cerevisiae* at 10 g/cow/day tended ($P < 0.06$) to increase milk production by about 0.9 kg per cow (Table 3). This is in agreement with other studies reporting increased milk production at the tune of 12% and more (Williams *et al.,*1991; Wohlt *et al.,*1991; Putnam *et al.,*1997; Wohlt *et al.,*1998). Some studies (Robinson, 1997; Dann *et al.,* 2000) reported relatively lower responses ranging from 3 to 9%. Studies on incorporation of probiotic yeast in dairy

Table 3. Effect of supplementation of diet with yeast on milk production and its composition in lactating cross bred cows

Particular	Control (C)	Treatment (T)
Milk yield (kg//animal/day)	9.64^{a}±0.11	10.51^{b}±0.13
4% FCM (kg/day/ animal)	10.39^{a}±0.12	11.99^{b}±0.11
ECM (kg/day/ animal)	9.89^{a}±0.13	11.83^{b}±0.12
SCM (kg/day/ animal)	12.17^{a}±0.11	13.42^{b}±0.13
ME (Mcal.)	9.13±0.20	10.06±0.18
Milk composition (%)		
Fat (%)	4.52^{a}±0.03	4.94^{b}±0.02
Fat yield (kg/day)	0.44^{a}±0.01	0.52^{b}±0.01
Protein(%)	3.27^{a}±0.02	3.61^{b}±0.03
Protein yield (kg/day)	0.32^{a}±0.01	0.38^{b}±0.01
Lactose (%)	4.1±0.03	4.53±0.02
Lactose yield (kg/day)	0.40±0.01	0.48±0.02
SNF (%)	9.59±0.04	9.03±0.03
SNF yield (kg/day)	0.92±0.01	0.95±0.01
Total solids (%)	14.11±0.18	13.97±0.13
Total solids yield (kg/day)	1.36±0.02	1.47±0.01

Observations with different superscripts (a and b) differ significantly (P<0.05) between the groups ruminants report great variability in the responses relating to the quantity and quality of milk (Swartz *et al.,* 1994; Soder and 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 and Garrett (1999), whereas no significant effect was reported by other researchers (Erasmus *et al.,* 1992; Dann *et al.,* 2000). Response to probiotics is often very different between studies that could be attributed to the variability related to diets, types and doses of yeast used, and the animals tested (Williams *et al.,* 1991).

Our results show that supplemented cows produced more 4% FCM, ECM and SCM (kg/day/animal) than controls. This relative increase in milk production is not due to overconsumption of dry matter, but could be linked to the complementation of *Saccharomyces cerevisiae* in the food, as reported by Newbold *et al.* (1998). Indeed, all cows in our trial had consumed the similar amount of food (ingested equalized). It is rather associated with better recovery of the nutrients, facilitated by the probiotic through interaction with the microbial flora. Probiotics stabilize rumen pH by competing with bacteria that produce lactate (Beauchemin *et al.,* 2003), providing nutrients and promoting the growth of favourable bacteria by destroying the lactate (Vandehaar *et al.,* 1999). This may results in increase in number of cellulolytic flora resulting in the enhanced degradation of plant fibers, and therefore, the digestibility of the diet (Newbold *et al.* 1998). Furthermore, probiotics enhance the intestinal absorption of nutrients like vitamin B_1 (thiamin), which promotes the colonization of plants by the rumen bacteria, and further improves the digestibility of the ration (Erasmus *et al.,* 1992). The recovery of nitrogen is also permitted by uptake of ammonia by probiotics, which are themselves then digested (Jouany and, Morgavi 2007; Newbold *et al.,* 1996).

As for the chemical composition of milk (Table 3), fat and protein content were enhanced by the addition of yeast. However, SNF, lactose and total solids content were not affected by treatment. The increase in milk production induced by dietary supplementation with *Saccharomyces cerevisiae*, is not always associated with changes in protein and fat content of milk (Vandehaar *et al.,* 1999). Nevertheless, an increase of fat content in the milk of cows fed the probiotic yeast was reported by Piva *et al.* (1993) and Putnam *et al.* (1997). 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. According to the literature, improvement of fat content of milk of dairy cows supplemented with yeast was associated with a positive effect of the stimulation of cellulolytic bacteria,

Table 4. Effect of supplementation of diet with yeast on feed efficiency and reproductive performance in lactating cross bred cows

Particular	Control (C)	Treatment (T)
Feed Efficiency		
(FCM/DMI, kg/kg)	1.21[a]±0.01	1.38[b]±0.01
(MY/DMI, kg/kg)	1.12±0.02	1.21±0.01
SCM/DMI	1.42±0.01	1.54±0.02
ECM/DMI	1.15±0.02	1.36±0.01
Reproductive performance		
Commencement of cyclicity (days open)	84.32±2.21	77.50±3.10
Days open (days)	171.6±5.25	133.5±4.64
AI/Conception	1.66±0.14	2.00±0.11
Conception rate	66.6	50.0

Observations with different superscripts (a and b) differ significantly (P<0.05) between the groups and a preferred shift of fermentation to acetic acid production, especially for diets rich in concentrate (Piva *et al.,* 1993). An explanation for the higher milk protein content in the experimental group could be the well-known impact of yeast on rumen fermentation and nutrient digestibility which enhances ammonia uptake and improves microbial protein production (Erasmus *et al.,* 1992, Miller *et al.,* 2002), However, a lack of response in milk fat in many studies (Swartz *et al.,* 1994; Soder and Holden, 1999) could be indicative that the stimulation of fibre-digesting ruminal bacteria was insufficient to cause an increase milk fat synthesis in those experiments.

The data regarding efficiency of production are presented in Table 4. The milk yield/DMI (kg/kg), ECM/DMI (kg/kg) and SCM/DMI (kg/kg) were similar among different treatments (P≥0.05). However, the average FCM/DMI (kg/kg) was significantly (P≤0.05) higher in treatment group, indicating that efficiency was improved by supplementing yeast culture in the respective group. Moallem *et al.* (2009) also found that the efficiency of dry matter use to produce 4% fat-corrected milk was 3.7% greater in the yeast supplemented group compared with the control group.

The reproductive parameters recorded in the study are listed in table 4. The duration required for commencement of cyclicity was similar in both the groups. The service period was shorter by 38.1 days in treatment group than control (P>0.05) indicating that lesser time was required by the animals of treatment group for conception. The feeding of yeast may alter fermentation pattern in lactating animals and may be responsible for stimulating the hypothalamus, pituitary gonadal axis resulting in improved reproductive efficiency following feeding of yeast culture. The number of artificial inseminations required per conception was slightly higher in treatment group which might be due to inexperienced inseminator or wrong timing of insemination. The conception rate also was similar in both the groups. Previous studies with direct-fed microbials (Francisco *et al.,* 2002), also showed no effect on reproductive function. Stein *et al.* (2006) reported that there was no treatment, parity, or interaction on days to first postpartum ovulation or on estrous behavior at 45 and 90 d postpartum by feeding *Propionibacteria* to dairy cows. However, a large field study with a greater number of cows and herds is needed to determine the influence of yeast culture supplementation on reproductive performance.

CONCLUSIONS

Incorporation of the yeast culture in the diet of dairy cows improved milk production and composition, but did not influence dry matter intake and feed efficiency.

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