Comparative Evaluation of *Saccharomyces cerevisiae* and *Saccharomyces siccum* as a Feed Supplement on Production Performance of Crossbred Cows

A. Ramanathan and K. Venkata Narasimham

**Abstract**--- A feeding trial was conducted in eight cows to compare the effect of supplementing commercial yeast species *Saccharomyces cerevisiae* and *Saccharomyces siccum* on milk yield and its composition. Cows were randomly assigned to one of the two treatment groups consisting four animals each. Commercial yeast granules were added at the rate of 25 g/cow/day to the concentrate feed in the afternoon for a period of one month. Daily milk yields were recorded and milk samples were analysed for its composition from five days before supplementation until five days after withdrawing the supplementation. A significant increase (p<0.05) in milk yield, mean milk fat, protein and total solids content was observed in both the treatment groups during supplementation of yeast when compared to the pre supplementation value. Both the treatments showed positive effect on milk yield, fat, protein and total solids content of milk. The positive effect of *Saccharomyces cerevisiae* was noted even after withdrawal of supplementation indicating the colonization and establishment of the yeast in the rumen environment. Whereas the milk yield and other positive effects of *Saccharomyces siccum* was seen only during the period of supplementation and after withdrawal of yeast supplementation all the parameters returned to pre supplementation value, thus the effect of *Saccharomyces siccum* is only temporary. It is concluded that supplementation *Saccharomyces cerevisiae* to cows in early lactation have more beneficial effect in terms of higher yield and total solids in milk than *Saccharomyces siccum*.

**I. INTRODUCTION**

Dairying in India is primarily the crop livestock integrated farming system wherein arable land is mainly used for food and cash crops thus there is little chance of having land available for fodder production. For getting high milk production from crossbred cows at economic rate, it is essential to enhance the nutrient utilization from available feed resources. Several feed supplements and additives like minerals and vitamin supplements, antibiotics, buffers and probiotics have been used to improve the milk yield and its composition. Microbial feed additives are preferred over chemicals because of the current trend of consumers for choosing natural and organic alternatives. Chemical feed additives may also disturb the rumen microbial ecosystem and leave their residue in milk. The increasing concern regarding the use of antibiotics has led to even greater interest in probiotics as feed additives. Hence probiotic feed additives like yeast, bacteria and fungi have attracted increasing attention during recent years. Yeast cells are known to be a rich source of vitamins, enzymes and some unidentified cofactors that are helpful in increasing microbial activity in the rumen (Dawson *et al.*, 1990). However, reports on effect yeast supplementation milk yield and its composition are inconsistent. Significant increase in dry matter intake milk yield and fat and protein content of milk were reported by many workers (Williams *et al.*, 1991; Erasmus *et al.*, 1992; Piva *et al.*, 1993; Robinson and Garrett, 1999; Dann *et al.*, 2000) while others observed no significant change in these parameters (Blauwiekel *et al.*, 1995; Putnam *et al.*, 1997; Soder and Holden, 1999 and Cooke *et al.*, 2007). The response to yeast supplementation vary depending on dosage and type of microorganism, composition of basal diet, and feed management practices (Newbold *et al.*, 1995); according to species and strain, number of live cells, and...
microorganisms’ growth medium (Erasmus et al., 1992) forage to concentrate ratio, type of forage fed, yeast dose, feeding strategy and stage of lactation (Yalcin et al., 2011). Commercially available yeast products vary according to species and strain, number of live cells and microorganisms’ growth medium (Erasmus et al., 1992). Therefore, the effect of supplementation of locally available commercial yeasts under prevailing feeding system on milk yield and its composition needs to be tested. Hence, the present study was carried out to find out the effect of feeding two commercially available yeast species Saccharomyces cerevisiae and Saccharomyces siccum on milk yield and milk composition of crossbred cows on predominantly roughage based diet with napier-bajra green fodder and sorghum straw.

II. MATERIALS AND METHODS

A feeding trial was conducted in eight crossbred cows that were in early to mid lactation at University Dairy Farm, Gandhigram Rural Institute to find out the effect of yeast supplementation effect on milk yield and composition. The cows were randomly divided into two groups of four animals each. All the cows were maintained under identical conditions of environment to minimize environmental influence on composition and yield. Commercially available S. cerevisiae and S. siccum were used as supplement in group I and II respectively. The respective yeast was added to the concentrate portion of the feed just prior to feeding in the afternoon for a period of one month. Milk yield of each cow was recorded daily both in the morning and evening from five days before supplementation until five days after withdrawing the supplementation. Daily milk samples were analysed for percentage of milk fat, solids-not-fat (SNF) and protein. Statistical analysis of various milk parameters was performed by two way analysis of variance (ANOVA) using the software SPSS (Statistical Package for Social Science) version 10.

III. RESULTS AND DISCUSSION

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Yeast</th>
<th>Before supplementation</th>
<th>During supplementation</th>
<th>After supplementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk Yield</td>
<td>S. cerevisiae</td>
<td>6.14 ± 0.65</td>
<td>6.60 ± 0.78</td>
<td>6.54 ± 0.73</td>
</tr>
<tr>
<td></td>
<td>S. siccum</td>
<td>6.02 ± 0.52</td>
<td>6.30 ± 0.58</td>
<td>5.84 ± 0.74</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>S. cerevisiae</td>
<td>3.39 ± 0.21</td>
<td>3.55 ± 0.49</td>
<td>3.60 ± 0.60</td>
</tr>
<tr>
<td></td>
<td>S. siccum</td>
<td>3.39 ± 0.21</td>
<td>3.60 ± 0.64</td>
<td>3.40 ± 0.58</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>S. cerevisiae</td>
<td>3.77 ± 0.39</td>
<td>6.57 ± 0.84</td>
<td>5.70 ± 0.83</td>
</tr>
<tr>
<td></td>
<td>S. siccum</td>
<td>3.77 ± 0.31</td>
<td>7.13 ± 0.77</td>
<td>5.43 ± 0.85</td>
</tr>
<tr>
<td>SNF (%)</td>
<td>S. cerevisiae</td>
<td>9.07 ± 0.38</td>
<td>9.12 ± 0.24</td>
<td>9.11 ± 0.15</td>
</tr>
<tr>
<td></td>
<td>S. siccum</td>
<td>9.07 ± 0.38</td>
<td>8.99 ± 0.22</td>
<td>8.97 ± 0.15</td>
</tr>
<tr>
<td>Total solids</td>
<td>S. cerevisiae</td>
<td>12.44 ± 0.47</td>
<td>12.74 ± 0.60</td>
<td>12.77 ± 0.74</td>
</tr>
<tr>
<td></td>
<td>S. siccum</td>
<td>12.37 ± 0.77</td>
<td>12.58 ± 0.77</td>
<td>12.44 ± 0.65</td>
</tr>
</tbody>
</table>

* Means bearing different superscripts within a row differ significantly

- **Milk Yield**

A significant increase in daily milk yield was observed in cows of both the groups. Similar increase in milk yield was observed by Wohlt et al. (1991), Robinson and Garret (1999) and Wang et al. (2001) in cows fed with Saccharomyces cerevisiae. Putnam et al., (1997) found that milk yield of dairy cows was increased with addition of yeast but only when protein content was deficient in the diet. This would corroborate the observation that yeasts increase the flow of microbial protein to the small intestine but that this extra protein would only be beneficial in situations where protein is deficient in the diet. In most of the studies, increased milk yield is associated with increased dry matter intake. Chiquette (1995) reported a 6 percent increase in milk efficiency (kg milk/kg dry matter intake) when 20 dairy cows received either 3 g/head/day of A. oryzae + fermentation extract or a mixture (10 g/head/day) of A. oryzae and S. cerevisiae. The increase in milk yield could be attributed to increase in nutrient availability due improved cellulose digestion and dry matter intake (Erasmus et al., 1992, Williams et al., 1991, and Wohlt et al., 1998). Cellulose represents approximately 30 percent of the dietary dry matter for most dairy cows. It is degraded in the rumen by a specific bacterial population because the animal host does not possess the enzymes required to breakdown cellulose. Yeasts were shown to stimulate cellulolytic populations in the rumen and increase their enzymatic activity. The
increase in cellulolytic population is believed to be the result of yeast scavenging ruminal O\textsubscript{2} which is detrimental to those populations (Chaucheyras-Durand and Fonty, 2001 and Mosoni et al., 2007). Yeasts are also reported to release vitamins and other growth factors (organic acids, B-vitamins and amino acids) which are essential for the growth of cellulolytic bacteria. This increased fibre digestibility has been the explanation for the increased dry matter intake and increase in milk production often observed with yeast supplementation.

- **Percent milk fat**

A significant increase in milk fat content was observed on analysis of milk samples during supplementation of *Saccharomyces cerevisiae* as well as *Saccharomyces siccum*. This is in agreement with the results of Wang et al. (2001) who also observed a significant increase in milk fat content in cows in early lactation during supplementation of yeast culture. On the contrary, according to Piva et al. (1993) a common result of yeast supplementation is only a slight (non significant) increase in milk fat content. Several other authors even found no influence of yeast on milk fat content (Arambel and Kent, 1990 and Eramus et al., 2005). These results could be explained by differences in diet composition, because fat percentage is normally positively correlated with the concentration of NDF in the diet. The positive effect of yeast supplementation on milk fat content could be attributed to enhanced ruminal acetic acid production (Chaucheyras et al., 1995) as result of greater fiber digestibility due to increased activity of fibrolytic microorganisms (Wiedmeier et al., 1987 and Wohlt et al., 1998). The significant increase in milk fat content in the present study could be attributed to roughage based diet in which the animals are maintained.

The increase in milk fat content persisted for five days after cessation of supplementation in the *Saccharomyces cerevisiae* group whereas the fat content started decreasing immediately after withdrawal of yeast supplementation in *Saccharomyces siccum* group and returned to pre supplementation values within 3 days. This could be attributed to difference in the ability of the two species to thrive in the rumen environment.

- **Total solids**

The mean total solids content of the milk samples from cows of both group I and II was significantly higher than those values observed before supplementation of yeast. On further analysis, it was observed that the increase in total solids content of the milk was primarily due to an increase in protein and fat content of milk. Konyves et al. (2006) also observed a significant ($P<0.05$) increase in milk protein percentage and increase in total solids in Holstein-Friesian cows in early lactation fed with 5 g of *Saccharomyces cerevisiae* per day. The increase in total solid content of the milk persisted for more than three days in *Saccharomyces cerevisiae* group than in *Saccharomyces siccum* group. This shows the ability of *Saccharomyces cerevisiae* to thrive in the environment of fore stomachs of cattle and to colonize it. The sudden drop in total solid content of milk after withdrawal of supplementation indicates that *Saccharomyces siccum* is unable to colonize the rumen because of low pH.

- **Solids not fat**

No significant change was observed in solids not fat content of the milk samples obtained before, during and after supplementation of *Saccharomyces cerevisiae* as well as *Saccharomyces siccum*.

- **Milk Protein**

A significant ($p<0.05$) increase in the mean protein content milk samples were observed during supplementation of *Saccharomyces cerevisiae* as well as *Saccharomyces siccum* After withdrawal of *Saccharomyces cerevisiae* the protein content of milk started decreasing but remained significantly higher ($p<0.05$) when compared to pre treatment values in both the groups. When yeasts are fed to ruminants, fermentation of feed is directed towards bacterial cell production instead of volatile fatty acids. Yeasts are also reported to release vitamins and other growth factors (organic acids, B-vitamins and amino acids) which are essential for the growth of rumen bacteria. The utilization of ammonia for protein synthesis was also higher in cows fed with yeast than in controls Dolezal and Trinacty (2005). Microbial growth could be stimulated by dietary yeast (Harrison et al., 1988; Newbold et al., 1995), which in turn could increase the flow of protein into
the duodenum (Erasmus et al., 1992). Dietary yeast may promote microbial population growth in the rumen by increasing the pH (Nisbet and Martin, 1991; Chaucheyras et al., 1995; Marden et al., 2008). This increases the availability of microbial protein in the ruminant’s small intestine. This could be the reason for significant increase in milk protein content observed in the present study.

REFERENCES


