EFFECT OF LIVE YEAST (*Saccharomyces cerevisiae*) FEEDING ON MILK COMPOSITION AND GROSS PROFIT MARGIN OF CROSSBRED DAIRY CATTLE AT KHUMALTAR, NEPAL

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ABSTRACT

This study was carried out to assess the effect of live yeast *Saccharomyces cerevisiae* (Nutriferm™) inclusion in feed and its effects on milk composition and gross profit-margin from crossbred dairy cattle at Khumaltar, condition. An Experiment was carried out at National Cattle Research Program station of Nepal Agriculture Research Council (NARC), Khumaltar, Lalitpur of Nepal for 28 days from 19 March 2015 to 15 April 2015. Twenty crossbred cattle were selected randomly and divided into five treatment groups with each group having four cows arranged in Complete Randomized Design (CRD). Five type of ration was composed to experimental animals; T_1: 0.5kg/MT, T_2: 1 kg/MT, T_3: 1.5 kg/MT, T_4: 2 kg/MT and T_5 as control. Milk samples were collected during milking and Lactoscan auto analyzer was used to measure fat, solid not fat (SNF), lactose, protein along with the volume for four weeks' experimental period. Data was analyzed using Split plot ANOVA method. Mean fat percentage between treatments was found non-significant but there was significant difference ($P<0.05$) in mean fat percentage across different time periodS in day 1st and 28th day being statistically significant. In this experiment, changes SNF, protein, and lactose in milk were found to be non-significant. Gross profit-margin of the milk production was done with the market price of raw milk and it was found to be significant ($P<0.05$) for 1st and 28th days of experiment. Supplementation of live yeast *Saccharomyces cerevisiae* (Nutriferm™) @ 2 kg/ 1000 kg feed with standard feeding diet enhanced the milk production, improved fat content in milk and generate profit margin.

Keywords: *crossbred cattle, saccharomyces cerevisiae feeding, fat, lactose, SNF*

INTRODUCTION

Livestock enterprises like milk, meat, eggs, hatchery, feed and hides are commercialized and organized. They collectively contribute 11.5 % of national GDP (CBS, 2012), and 25.68% of the agricultural GDP (MoAD, 2014). From traditional characterized by large number of animals with low level of productivity (TLDP, 2002), commercial dairy farms with upgraded breeds and improved management is noticeable changes in the dairy sector Milk production from cattle and buffalo is one of the important sub sectors in Nepalese economy. The total milk production is around 2,168,434 MT per year with dairy cattle and buffalo contributing around 795,530 and 1,372,905 MT of milk respectively (MoALD, 2018/19). Out of the total annual milk production of 2,168,434 MT, dairy cattle contribution is 36.68% while the cattle population is 16.9 % higher than buffalo (MoALD, 2018/19). Dairy industry contributes a big share on livestock sector but growth of milk production over last decade has been insignificant i.e. only 2.6 % per year (Pradhan *et al.,* 2003). Milk and milk products are a major source of animal protein in the Nepalese diet. Many foreign returned youths have taken up dairy farming but for various reasons discontinued or barely hanging on. Among the many factors, improved feed conversion ratio (FCR) and market access for premium price remains the most important.

With the purpose of enhancing milk production, scientists over the last couple of decades have been attempting to manipulate the microbial activities in ruminants. Though various synthetic supplements, chemical feed additives are considered as common means to enhance milk production, they have limited roles. The mode of action of these additives varies according to the ruminal fermentation patterns. Some other feed additives, antibiotics and ionophores have antimicrobial activities which enable them to eliminate specific harmful organisms present in the rumen but strong regulations are making their uses illegal. The use of feed additives likes antibiotics are not safe stimulants due to the possibility of various chemicals entering the human food chain (Chiquette, 1995). Antimicrobial Resistance Monitoring (ARM) initiated globally is also adopted by Nepal and it has strict say on non-inclusion of antibiotics in feed for growth promotion. Thus, attention is drawn towards natural products and many researchers have shown beneficial results with the inclusion of live yeast cultures in ration of lactating dairy cattle. The low manufacturing costs associated with the production of yeast cultures have enhanced their use and in contrast to chemical feed additives, yeast cultures stimulate and enhance multiplication of cellulolytic bacteria in rumen, which has resulted alternative use of yeast as a natural, safe and cost-effective feed additive (Newbold et al., 1992). Yeast has been utilized successfully for many years in animal feed industries. In feed industry; antimicrobials, natural products and yeast are used as probiotics and growth promoters (Muihead, 1992). Due to fungal origin, yeast and its derivatives have resistant property to anti-bacterial agents (Auclair, 2000). Live yeast (*Saccharomyces cerevisiae)* culture is a fermented feed additive product used in cattle feed (Linn & Raeth-Knight, 2006). Live yeast extract improves the feed efficiency and milk yield as it is a source of naturally occurring B-vitamins and disaccharides enzymes which enhance digestion of fiber, protein, fats and minerals (Buts et al., 1994). Specifically, live Yeast extract (*Saccharomyces cerevisiae)* has capability to competitively inhibit pathogenic bacteria and to promote growth of beneficial bacteria (Gedek, 1989). Therefore, this study was conducted to find out the impact of live yeast (*Saccharomyces cerevisiae*) on milk composition and gross profit margin of crossbred cattle.

MATERIALS AND METHODS

Research design

The experiment was conducted by using Complete Randomized Design (CRD). A total of 20 crossbred cattle were randomly allocated in five different treatments with four replications where each cattle represented as an experimental unit. Efforts were made to group cattle with similar parity and age into a treatment group. The five different dietary treatment groups, T_1, T_2, T_3, T_4 and T_5 were as following.

Experimental diet

Treatments	Experimental diet
T_1	Concentrates enriched with live yeast (*S. cerevisiae)* @ 0.5kg/MT of feed and rice straw and green oat
T_2	Concentrates feed enriched with live yeast (*S. cerevisiae)* @ 1 kg/MT of feed and rice straw and green oat
T_3	Concentrates feed enriched with live yeast (*S. cerevisiae)* @ 1.5 kg/MT of feed and rice straw and green oat
T_4	Concentrates feed enriched with live yeast (*S. cerevisiae)* @ 2 kg/MT of feed and rice straw and green oat.
T_5 (Control)	Normal concentrates feed and normal rice straw and green oat.

Preparation of the experimental feed

The feed used in this experiment were purchased from Proboitech Industry Pvt. Ltd., Parsa Nepal with the formulation as shown in Table 1. Live yeast supplement *S. cerevisiae*in the trade name Nutriferm™ was obtained from Ab Mauri India Private Limited, No. 2/15 Ganapathy Colony, Teynampet, Chennai-600018, Tamil Nadu, India. The commercial feed was fortified with the treatment in mentioned doses prior to feeding.

Table 1. Composition of concentrate mixture

Ingredients	Percentage
Maize	20
Soybean Meal	5
De-oiled Rice Bran	50
De-oiled Mustard oil cake	15
Molasses	7
Vitamin and mineral premix	3
Total	100

Nutrients analysis

The proximate constituent analysis of the concentrate mixture such as moisture, total ash, organic matter, crude protein, crude fiber, ether extract, calcium and phosphorous were analyzed at Animal Nutrition Laboratory of Probiotech Industry Pvt. Ltd., Parsa Province 2 of Nepal using the methods described in AOAC (1997). The results of lab analysis is given in Table 2

Table 2. Nutrient content of concentrate mixture

S.N.	Parameters	T_1	T_2	T_3	T_4	T_5
1	Moisture (%)	9.62	10.52	10.23	10.97	10.09
2	Total Ash (%)	9.38	9.37	9.42	9.42	9.47
3	Organic Matter (%)	2.44	2.43	2.38	2.53	2.55
4	Fat content (%)	2.43	2.52	2.5	2.49	2.58
5	Crude Fiber (%)	6.01	6.04	6.31	6.37	6.21
6	Crude Protein (%)	21.95	22.25	21.13	21.3	22.13
7	Calcium (%)	0.62	0.62	0.7	0.65	0.71
8	Phosphorous (%)	0.66	0.69	0.69	0.69	0.67

Sample collection for analysis

Total data of 28 days of milk yield was collected. The daily milk yield (liter) was recorded directly in farm of National Cattle Research Program Khumaltar, Lalitpur. Daily 50 ml of milk sample was collected from each animal and that milk sample was analyzed for milk fat, SNF, protein and lactose.

Composition of milk

Daily milk sample for 28 days were taken and examined for composition of milk (Fat, SNF, lactose and protein) by Lactoscan Autoanaliser at Animal Breeding Division of Nepal Agriculture Research Council Khumaltar Lalitpur. The chemical composition of milk was estimated using Lactoscan ("milkanalyzer", MILKOTRONIC LTD, Bulgaria Europe) (www.

milkotronic.com). The lactoscan estimated Fat, Solid Nots Fat, Protein, Water, Density and Conductivity percentage having following measuring range as shown in Table 3.

Table 3. Measuring range of Lactoscan 'milkanalyzer' for various components of milk under different treatments for the period of four weeks of time period.

Parameter	Range
Fat	0. 01– 25% (45%)>
Solids-non-fat (SNF)	3% – 15%
Density	1015 – 1040 kg/m^3
Protein	2% – 7%
Lactose	0.01% – 6%
Milk sample temperature	1°C – 40 °C
Solids	0.4% – 1.5%
P^H	0 – 14
Conductivity	3 – 14 [mS/cm]

Daily feed intake

The daily feed was given to the cattle according to the thumb rule of ruminant nutrition. Every cattle were fed 1 kg of concentrate mixture for 3 liter milk production. Extra 400 gm. of feed was provided for each extra liter milk production above 3 liter. Every week, amount of feed was changed according to this thumb rule.

Profit margin analysis

Total variable cost for each treatment was calculated taking into account the feed cost, while keeping other cost constant. The cost of feed including transportation was NRs. 32 for normal, 32.50 for 0.5 kg/MT live yeast supplemented feed, 33 for 1 kg/ MT live yeast supplemented feed, 33.5 for 1.5 kg/MT live yeast supplemented feed and 34 for 2 kg/MT live yeast supplemented feed per kilogram. Cost of live yeast (Nutriferm™) was NRs 1000 per kg. Oat used to feed the cattle was considered free of cost and obtained from the farmland. The fixed cost and miscellaneous expenses such as cost of utensils, ropes were not considered. Total milk yield in 28 days for each treatment, average fat percentage and SNF percentage for each treatment, Net Profit and marginal gap analysis with control group was compared. Price of milk was calculated according to formula formulated by Dairy Development Cooperation (DDC) (DDC, 2015). The formula is as follows,

Price of milk Rs. =5.51 fat% + 2.64 SNF%

Statistical analysis

The observed data was tabulated in Ms-Excel and transferred to SPSS 16 version data sheet. Test statistic for milk composition (fat, SNF, lactose, protein) and profit margin due to milk yield for different treatments was analyzed with mixed design ANOVA (Split plot ANOVA) for repeated measures by General Linear Model.

RESULTS AND DISCUSSION

The data was compared for the effects of live yeast (*Saccharomyces cerevisiae*) feeding on milk composition and gross profit margin of milk production among different treatment groups and between different time periods. The data was compared for the effects of live yeast (*Saccharomyces cerevisiae*) feeding on milk composition and gross profit margin among different treatment groups across different time points of feeding.

Effect on milk composition

Effect on milk fat percentage

Mean milk fat percentage in cattle supplemented with live yeast (*Saccharomyces cerevisiae*) in feed among different treatment groups with respect to different time period is presented in Table 4. Mean Fat Percentage were found to be non-significant (P>0.05) between treatments groups during entire trial period. But irrespectively mean fat percentages were found to be significantly different in different period of experiment. Fat percentage was found to be decreased according to days of experiment with highest on 1st day (5.047 ± 0.276) followed by 7th day (4.512 ± 0.226), 14th day (4.21 ± 0.293), 21st day (4.091 ± 0.363) and 28th day (3.816 ± 0.256). Mean differences in fat percentage of the 1st day were found significantly different with the fat percentage at 28th day but was similar with that of 7th, 14th and 21st day. However, there was no significant difference among 7th, 14th and 21st day. Hence, Table 4 indicated that as time of lactation stage increased, there was gradual drop in mean fat percentages with being significant different after a month but different level of feed supplemented with yeast does not alter the milk fat percentages.

Table 4. Fat percentage of milk in different duration

	Mean ± SEM milk fat				
Treatments	1st Day	7th Day	14th Day	21st Day	28th Day
T_1(SC 0.5 kg/MT)	4.89±0.24	4.48±0.24	4.21±0.90	2.60±0.52	4.25±0.75
T_2(SC 1 kg/MT)	5.30±1.06	5.03±0.52	3.87±0.78	4.85±0.36	3.84±0.60
T_3(SC 1.5 kg/MT)	5.25±0.51	4.61±0.48	4.69±0.643	3.55±0.83	3.84±0.81
T_4(SC 2 kg/MT)	4.97±0.84	3.86±0.71	4.65±0.62	4.73±0.27	3.71±0.40
T_5(SC 0 kg/MT)	4.81±0.42	4.20±0.49	3.62±0.48	4.70±1.30	3.42±0.44
Average	5.04±0.27	4.51±0.22	4.21±0.28	4.09±0.36	3.81±0.25

Significance at P< 0.05

Our result is consistent with the finding of Nocek et al. (2011) and Promkot et al., (2013) who reported non-significant effect of *Saccharomyces cerevisiae* on milk fat percentage. Addition of *Saccharomyces cerevisiae* had no effect on milk composition in dairy cattle (Dann et al., 2000; Kalmus et al., 2009; Al-Ibrahim et al., 2010). According to Bayram et al., (2014) *Saccharomyces cerevisiae* had non-significant effect on milk fat percentage. The effect of live yeast (*Saccharomyces cerevisiae*) had no effect on milk production, milk composition, or dry matter intake (Kung et al., 1997; Kamalamma et al., 1996). There were no significant differences in the milk fat and protein percentages but, fat yield was greater in those cattle which were fed *Saccharomyces cerevisiae* than in the control group (Moallem et al., 2009). This finding do not agree with the work of Ali-Haimoud Lekal et al. (1999) which shows an increased fat content. According to Wohlt et al., (1991) and Soder & Holden (1999) milk yield and its composition are not changed by the dietary supplementation of *Saccharomyces cerevisiae*.

Effect on SNF percentage

Mean milk SNF of cattle supplemented with live yeast (*Saccharomyces cerevisiae*) in feed among different treatments with respect to different time period are presented in

Table 5. Mean SNF between the treatments were found non-significant (P<0.05) in each time periods. Similarly, the mean SNF across different time was irrespective of treatments and were also non-significant. Hence, from these above figures it is indicated that yeast supplementation in feed did not effect on the SNF content of milk.

Table 5. SNF content of milk in different duration SNF (Mean± SEM)

Treatments	1st Day	7th Day	14th Day	21st Day	28th Day
T_1(SC 0.5 g/MT)	7.98±0.87	7.69±0.19	8.16±0.27	8.49±0.17	7.96±0.10
T_2(SC 1 kg/MT)	8.33±0.11	7.98±0.18	8.32±0.17	7.98±0.27	8.13±0.12
T_3(SC 1.5 kg/MT)	8.49±0.24	8.20±0.26	7.91±0.13	8.39±0.18	8.39±0.28
T_4(SC 2 kg/MT)	7.68±0.55	7.91±0.42	7.59±0.43	7.54±0.29	7.62±0.28
T_5(SC 0 kg/MT)	8.45±0.23	8.31±0.25	8.36 ±0.24	8.03±0.36	8.46±0.12
Average	8.19±0.13	8.02±0.12	8.07±0.12	8.09±0.13	8.17±0.10

Significance at P<0.05

Referring to Bayram *et al.,* (2014) impact of *Saccharomyces cerevisiae* on milk production and its composition in dairy cattle had significant result on average daily milk yield but some milk composition as SNF percentage was statistically non-significant. Similarly, some studies showed that the addition of *Saccharomyces cerevisiae* had no any statistically significant effect on milk compositions (Fat, SNF, Lactose and Protein) in dairy cattle (Dann et al., 2000; Kalmus et al., 2009; Al-Ibrahim et al*.,* 2010; Promkot et al*.,* 2013). According to Wohlt et al., (1991) and Soder & Holden (1999) milk production and chemical composition of SNF is not altered by the dietary supplementation of *Saccharomyces cerevisiae* which is in accordance with our experiment results.

Effect on protein percentage

Mean milk protein of cattle supplemented with live yeast (*Saccharomyces cerevisiae*) in feed among different treatment groups is presented in Table 6. Mean milk protein between the treatments within each period were found non-significant (P>0.05). Similarly, the mean milk protein across different period irrespective of the treatments were also non-significant (P>0.05) with the highest in 28th day (3.048±0.045) followed by 1st day (3.045±0.049), 21st day (3.040±.059), 14th day (3.019±0.051) and 7th day (2.983±0.045).

Table 6. Protein content of milk in different duration protein (Mean± SEM)

Treatments	1st Day	7thDay	14th Day	21st Day	28th Day
T_1(SC 0.5 kg/MT)	2.977±0.033	2.867±0.073	3.040±0.099	3.157±0.063	2.965±0.035
T_2(SC 1 kg/MT)	3.107±0.042	2.977±0.068	3.090±0.069	3.022±0.128	3.062±0.059
T_3(SC 1.5 kg/MT)	3.127±0.076	3.055±0.095	2.967±0.031	3.125±0.065	3.125±0.102
T_4(SC 2 kg/MT)	2.865±0.203	2.915±0.157	2.785±0.154	2.787±0.100	2.857±0.101
T_5(SC 0 kg/MT)	3.150±0.085	3.100±0.094	3.215±0.108	3.110±0.219	3.232±0.110
Average	3.045±0.049	2.983±0.045	3.019±0.051	3.040±.059	3.048±0.045

Significant at P<0.05

The main proteins included in milk were alpha casein, beta casein and alpha lacto-albumin and beta lacto-globulin. Bayram et al. (2014) found non-significant effect of *Saccharomyces cerevisiae* on milk protein percentage but milk yield was significantly higher in Holstein Friesian. The increase in milk yield induced by supplementation of *Saccharomyces cerevisiae* in cattle feed is not always related with a change in milk fat and milk protein percentage (Wohlt et al., 1991; Soder & Holden, 1999; Ramsing et *al.,*2009; Promkot et al*.,* 2013). There was no significant effect of live yeast (*Saccharomyces cerevisiae)* on milk fat and protein percentages compared with control (Moallem et al., 2009) which is in accordance to this study results. The higher milk protein percentage was associated with the impact of *Saccharomyces cerevisiae* on rumen fermentation and nutrient digestibility which enhances ammonia uptake and improves microbial protein production (Kalmus et al*.,* 2009) which is in contrast to our findings. There were other studies which reported that *Saccharomyces cerevisiae*'s effect on milk proteins (Nocek et al*.,* 2003; Nocek & Kautz, 2006).

However, supplementation of *Saccharomyces cerevisiae* (2.5g) per cattle increased milk production and significant increase of milk fat and protein percentage was observed by Maamouri et al*.,* (2014). Furthermore, the response of animals on milk protein percentage seems to be dependent on the physiological status of the lactating animal (William & Newbold, 1990) and the nature of the diet (Dawson, 1989).

Effect on lactose percentage

Mean lactose of cattle supplemented with live yeast (*Saccharomyces cerevisiae*) in feed among different treatment groups is presented in Table 7. Mean lactose between the treatments within each period were found non-significant (P>0.05). Similarly, the mean lactose across the different period irrespective of treatments were also non-significant with the highest in 1st day (4.322±.075) followed by 7th day (4.269±.070), 14th day (4.265±.074), 21st day (4.263±.077) and 28th day (4.255±.067).

Table 7. Lactose content of milk in different duration lactose percentage (Mean± SEM)

Treatments	1st Day	7th Day	14th Day	21st Day	28th Day
T_1(SC 0.5 kg/MT)	4.205±.045	4.197±.183	4.302±.152	4.502±.098	4.195±.065
T_2(SC 1 kg/MT)	4.382±.064	4.200±.094	4.390±.099	4.225±.322	4.312±.135
T_3(SC 1.5 kg/MT)	4.470±.135	4.320±.144	4.192±.052	4.437±.107	4.435±.160
T_4(SC 2 kg/MT)	4.037±.305	4.200±.236	3.930±.234	3.902±.139	3.940±.218
T_5(SC 0 kg/MT)	4.517±.094	4.427±.146	4.512±.138	4.250±.221	4.392±.085
Average	4.322±.075	4.269±.070	4.265±.074	4.263±.077	4.255±.067

Significant at P<0.05

Lactose, that is a milk sugar, is intrinsic to milk and is the most intensive carbohydrate included in milk. The lactose values in control and treated group were 4.35±0.07 and 4.33±0.04, respectively and there was no difference between two groups (Bayram et al., 2014) which is in accordance to this study finding.

Profit margin analysis

Mean profit margin of cattle supplemented with live yeast (*Saccharomyces cerevisiae*) in feed among different treatment groups is presented in Table 8. Mean profit margin calculation of seven-day interval of the production between the treatments were found significantly different at P=0.022 within time but was non-significantly different between different time within the treatments despite the non-significant milk yield at day first between treatments. Treatment T_4 had significantly different with respect to control T_5 at P=0.017

with its mean profit margin of Rs 3737.3367±555.75, 3592.8631±574.51, 3619.49±412.12, 3152.03±350.56 at first, second, third and fourth week, respectively. However, mean profit margin of treatments T_1, T_2 and T_3 were statistically similar to control or T_5 and among each other's. Hence, supplementation of live yeast (*Saccharomyces cerevisiae*) at least at the rate of 2 kg/MT is beneficial in terms of economic return with respect to non-supplemented.

Table 8. Cost benefit analysis weekly mean gross/profit margin analysis (Mean± SEM)

Treatments	1st week	2nd week	3rd week	4th week	Average
T_1(SC 0.5 kg/MT)	2298.57	2467.12	2537.38	2627.48	2482.64
	±460.30	±294.52	±282.42	±223.83	±370.83^{ab}
T_2(SC 1 kg/MT)	2893.68	2786.89	2960.37	2957.12	2899.51
	±344.98	±177.22	±250.33	±343.92	±370.83^{ab}
T_3(SC 1.5 kg/MT)	2887.6	3046.98	2882.78	2619.19	2859.14
	±505.46	±843.85	±531.59	±361.48	±370.83^{ab}
T_4(SC 2 kg/MT)	3737.33	3592.86	3619.49	3152.03	3525.43
	±555.75	±574.51	±412.12	±350.56	±370.83^{a}
T_5(SC 0 kg/MT)	1622.28	1638.08	1491.57	1343.02	1523.74
	±115.36	±174.07	±219.75	±153.17	±370.83^{b}
Total	**2687.89**	**2706.39**	**2698.32**	**2539.77**	
	±233.87	**±244.49**	**±214.30**	**±187.26**	

Significance level at P< 0.05

CONCLUSION

Supplementation of live yeast *Saccharomyces cerevisiae* at 2 kg/ MT in basal diet does not alter the milk composition. However, significant profit margin can be achieved by supplementation of yeast *Saccharomyces cerevisiae* due to increased milk production. (Acharya & Dhital, 2018).

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