Supplements of *Saccharomyces cerevesiae* on Production Performance of Lactating Cows

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Abstract

This study was conducted to investigate three levels of yeast (*Saccharomyces cerevesiae*) as supplement (0, 10 and 90 g/day) in animal feed for dairy cow consumption. Six multiparous dairy cows were assigned in the experiment 3 × 3 latin square design. The results showed that, regarding milk yield, the control group gave the lowest milk yield with significant difference from the groups with 10 and 90 g/day of yeast (P<0.05). The supplement group with 90 g/day of yeast gave the highest milk yield and was not different from the group with 10 g/day of yeast (P>0.05). In terms of milk compositions, the control group had the lowest fat, protein and solid not fat. However, the total solid was not different from the group with 90 g/day of yeast (P>0.05). The group with 10 g/day of yeast gave the highest fat, protein, solid not fat and total solid that were not different from the group with 90 g/day of yeast (P>0.05). Regarding somatic cell count, the control group gave the highest somatic cell count which was different from the groups with 10 and 90 g/day of yeast (P<0.05). However, somatic cell count of the groups with 10 and 90 g/day of yeast were not different (P>0.05). For dry matter intake, the control group gave the highest level for pangola grass, concentrate and total intake and was different from the groups with 10 and 90 g/day of yeast (P<0.05). For the incomes of raw milk, the groups with 90 g/day of yeast gave the highest income of 200.88 bath/day followed by the group with 10 g/day of yeast and the control group of 199.94 baht/day and 192.02 bath/day, respectively. Calculation of net profit of raw milk showed that the group with 10 g/day of yeast had the highest net profit of 111.68 bath/day followed by the control group (100.80 baht/day) and the lowest net profit was from the group with 90 g/day of yeast at 94.72 bath/day.

Keywords: *Saccharomyces cerevesiae*, milk yield, animal feed, cow

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1. Introduction

Production and management of dairy cattle in Thailand has been developed and improved with technologies to increase milk production. In addition, the progress of biotechnology have also increased the production. The supplement of microorganism in feedstuff such as bacteria, fungi and yeast helps emphasizing process utility of feed intake to increase beneficial microorganism, control harmful microorganisms, and improve rumen fermentation. The microorganisms in rumen related to feedstuff and their physiology are difficult to study. More than 50 % of microorganisms in the rumen are bacteria. Most of the bacteria (more than 200 groups) do not produce spores that float in the rumen fluid. About 30 % is spreading in rumen fluid and 70 % is sticking to feedstuff, rumen wall and protozoa. Some groups of rumen bacteria require only one nutrient, but some groups require two nutrients or more. Different nutrients are developed and increased by themselves which roughages are increased cellulolytic bacteria groups and concentrates are increased amylolytic bacteria groups in rumen [1-2].

In general mechanism, protozoa digests starch and sugar and releases toxic metal ions which can reduce digestive efficiency of the bacteria in the system. When yeast is added to the mixed feedstuff, it can reduce the amount of protozoa in the rumen and increase the efficiency of bacteria. Yeast is helpful for reducing lag time and activating the utilization of nutritions of the bacteria in rumen. The yeast supplements have certain effects on digestive system. The volatile fatty acids are produced. For example, propionic acid can replace acetic acid; rate of digestive fiber is also activated in post feeding; ammonia is reduced; nitrogen metabolism does not affect the amount of bacteria in producing ammonia; and more microbial protein can flow from rumen to small intestine [3-4]. As reported by Dawson [5], supplement of YEA-SACC®1026 at 10 g/day could activate and increase the amount of bacteria. For example, *Ruminococcus albus*, *Ruminococcus favefaciens* were the group of highest activation. *Fibrobacter succinogenes*, *Bacteriodes amylophilus* and *Selenomonas ruminatium* were also highly activated and increased cellulolytic bacteria, amylolytic bacteria, proteolytic bacteria, microbial protein, acetic, and propionic acids, by passing amino acid in small intestine and reducing oxygen and lactic acid in rumen. The rumen pH was controlled by yeast. Besides, supplement of YEA-SACC® 1026 at 10 g/day helps increase milk of dairy cattle by 5.8-7.7 % and increase the body weight of beef cattle by 7.8-9.5 %.

Zaworski *et al*. [6] reported supplement of *Saccharomyces cerevesiae*)Diamond V Mills XP Co., Ltd., U.S.A.) for forty-two multiparous Holstein Friesian and cows were divided into three groups (fourteen cows in each group); (1) Supplement with yeast at 0 g/day (Control), (2) Supplement with yeast at 56 g/day and (3) Supplement with yeast at 112 g/day. As result; milk yield at 36.1, 40.7 and 41.8 kg/day and fat percentage at 4.73, 4.48 and 4.37 %.

Recently, the rumen microorganism has been studied and only 10-20 % of the role of microorganism has been known. Also, the necessity of microorganism needs to be more studied. The objective of this paper is to study effects of supplementing *Saccharomyces cerevesiae* on production performance of lactating cows.

2. Materials and Methods

2.1 Cows and feeding management

Six multiparous dairy cows (approximately ranged from 3-5 lactation ≥75% Holstein Friesian with daily milk yield ≥12 kg/day) were assigned in the experiment. Cows were randomly divided into three groups (two cows in each group); (1) Supplement with yeast at 0 g/day (Control), (2) Supplement with yeast at 10 g/day (*Saccharomyces cerevesia*, YEA-SACC® 1026 as recommended by Alltech Co., Ltd., Thailand) and (3) Supplement with yeast at 90 g/day.

An adaptation period of 14 days was given in which the cows were fed with pangola grass *ad libitum* by cutting at 30-45 day interval. The concentrate given was NRC [7] as recommended. The cows were fed at 8.00 am and 3.00 pm and milking at 7.30 am and 2.30 pm throughout the experimental period. Daily feed consumption, refusals and milk yield were recorded. Data collection period was 21 days. Milk samples and feed samples were collected at 7, 14 and 21 days for analysis. Raw milk was calculated for income, expenses and net profit.

2.2 Chemical analysis

Pangola grass and concentrate samples were analyzed for chemical composition. Moisture, dry matter (DM), ash, crude protein (CP), and crude fiber (CF) were determined according to AOAC [8]. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined as described by Van Soest [9].

Raw milk samples were analyzed for milk composition: fat, protein, solid not fat, and total solid by Lactoscan 90. Somatic cell count was analyzed by Bentley S150 (Somatic cell analyzer for milk) with Solution Bentley S150.

2.3 Statistical analysis

Data of daily milk yield, milk compositions and dry matter intake were analyzed under 3 × 3 Latin Square design using SAS general linear model (PROC GLM) [10]. Duncan's New Multiple Range Test was used to test the differences among treatment means. The statistical model was:

$$Y_{ijkl} = \mu + T_i + R_j + C_k + \varepsilon_{ijkl}$$

where Y_{ijkl} = Dependent variables
μ = Overall means
T_i = Effect of treatment - level of yeast (i =1, 2, 3)
R_j = Effect of row – period of lactation (j =1, 2, 3)
C_k = Effect of column - cow (k = 1, 2, 3)
ε_{ijkl} = Error term

3. Results and Discussion

According to the results, chemical composition presented in Table 1 showed that the pangola grass cut at 30-45 day interval had protein level of 6.70 %, lower than 7-11 % of protein level reported by the Animal Nutrition Division [11]. Tudsri [12] suggested that the cut at 45-55 day yielded protein level of 8.5-11.2 % at the height of 5-10 cm. The production and protein level depended mainly on fertility of grass management, fertilizer and water insertion, and cut interval.

Considering milk yield in Table 2, the control (yeast at 0 g/day) had the lowest yield at 13.52 kg, which were different from the other two groups (yeast at 90 and 10 g/day) which gave the yields of 14.15 and 14.08 kg ($P<0.05$), respectively. Milk yield in this experiement was similar to the report of Mediterranean Italian Breed Centre [13] which used supplements YEA-SACC®1026 for dairy buffalos and found that the supplementation of yeast at 0 g/day (control) and 50 g/day fed with corn and oat silage gave milk yield at 10.5 and 11.7 kg/day, respectively. Regarding fat percentage in Table 2, the control group (yeast at 0 g/day), the groups with yeast at 90 g/day and at 10g/day gave the similar fat percentage at 4.27 %, 4.33 % and 4.36 % ($P>0.05$), respectively.

In terms of protein concentration, the control group, the groups with yeasts at 90 and 10 g/day gave similar yields at 3.11 %, 3.13 and 3.15 % ($P>0.05$), respectively. Concerning the solid not fat, the control group, the groups with yeasts at 90 and 10 g/day gave similar yields at 7.93 %, 7.98 % and 8.01 % ($P>0.05$), respectively.

Table 1. Chemical composition of Pangola grass and concentrate

Chemical composition	Feeding	
	Pangola grass	***Concentrate***
Moisture (%)	70.22	8.44
Dry matter (%)	29.78	91.56
Ash (%)	8.18	8.11
Crudeprotein (%)	6.70	16.07
NDF (%)	71.68	-
ADF (%)	41.89	-
Crude fiber (%)	-	9.22

Table 2. Milk yield and milk compositions from supplement yeast at different levels

Parameters	Yeast (g/day)		
	0	***10***	***90***
Milk yield (kg / day)	13.52 ± 0.81^{b}	14.08 ± 0.88^{a}	14.15 ± 0.59^{a}
Fat (%)	4.27 ± 0.16^{b}	4.36 ± 0.12^{a}	4.33 ± 0.18^{ab}
Protein (%)	3.11 ± 0.12	3.15 ± 0.13	3.13 ± 0.15
Solid not fat (%)	7.93 ± 0.13^{b}	8.01 ± 0.14^{a}	7.98 ± 0.15^{ab}
Total solid (%)	12.20 ± 0.17^{b}	12.37 ± 0.19^{a}	12.31 ± 0.14^{ab}
Somatic cell count (cell / ml)	$74,417 \pm 8,290^{a}$	$50,958 \pm 7,455^{b}$	$43,583 \pm 7,921^{b}$

[a,b] Means in the same row with different superscripts are significantly difference ($P < 0.05$)

Table 3. Dry matter intake from supplement yeast at different levels

Parameters	Yeast (g / day)		
	0	***10***	***90***
Pangola grass (kg DM / day)	13.58 ± 0.83^{a}	12.79 ± 0.90^{b}	12.66 ± 0.85^{b}
Concentrate (kg DM / day)	12.85 ± 0.64^{a}	12.10 ± 0.71^{b}	11.97 ± 0.74^{b}
Total intake (kg DM / day)	26.43 ± 0.73^{a}	24.89 ± 0.81^{b}	24.63 ± 0.79^{b}

[a,b] Means in the same row with different superscripts are significantly difference ($P < 0.05$)

Table 4. Incomes, expenses and net profits of milk yield from supplement yeast at different levels

Parameters	Yeast (g / day)		
	0	*10*	*90*
Yeast expenses (bath/day)	0.00	2.35	21.15
Concentrate and pangola grass expenses (bath/day)	91.23	85.91	85.01
Raw milk income (bath/day)	192.02	199.94	200.88
Net profit (bath/day)	100.80	111.68	94.72

Note - Raw milk (grade 4) 14.20 bath / kg (Referable by Kamphaeng Saen Dairy Cooperative Limited)
- Concentrate 6.50 bath / kg (Referable by The Dairy Research & Development)
- Pangola grass 2.00 bath / kg (Referable by The Dairy Research & Development)

Regarding total solid, the control group gave the yield of 12.20 %, in similar to the groups with yeasts at 90 g/day and 10 g/day which yielded at 12.31 % and 12.37 % (P>0.05). All total solid data were similar to those reported by Kung *et al*. [14]. By giving yeast supplement to 21 dairy cows dividing into 0 (control), 10 and 20 g/day, with roughages per concentrates ratio of 50:50, they found milk yield, fat and protein were not significantly different among treatments (P>0.05).

Considering somatic cell count, the control group had the highest number of 74,417 cell/ ml whereas the groups with yeasts at 90 and 10 g/day yielded 43,583 and 50,958 cell/ml (P<0.05), respectively. Yeast supplements might have indirect effect on health of cows by reducing the white blood cell number. Somatic cell count indicated the tendency towards mastitis disease. For normal dairy cows, somatic cell count would not increase more than 200,000 cell/ml. Somatic cell count could be separated into neutrophils, macrophages and lymphocytes. If the cows were infected with mastitis disease, the neutrophils group in mammary glands would increase to eradicate the disadvantage bacteria immediately [15].

Dawson [5] suggested that with supplement of YEA-SACC®1026 at 10 g/day in dairy cows, milk yield would increase by 5.8-7.7 %, as well as the advantage rumen fiber microorganism, acetic and propionic acids. Lactic acid and oxygen in rumen would reduce but rumen pH would balance and the microbial bypass protein and retention time of amino acid in small intestine increased.

Regarding milk yield, although the group with 90 g/day yeast had the highest at 14.15 kg, it was not different from the group with yeast at 10 g/day which yielded 14.08 kg (P>0.05). However, it was different from the group with yeast at 90 g/day which was selected for the highest digestion from the research *in vitro* with bath fermentation method [16]. The variable factors on yeast level might have occurred during experiment - normally with Holstein Friesian. When the higher environmental temperature was more than 27^{o}C, milk yield and milk compositions would decrease and efficiency of feed energy for milk production would decrease as well. Shultz [17] and Bodero and Reason [18] suggested that rainfall was produced from the varied humidity. When the high humidity was more than 65 %, the cows would be affected by heat stress; therefore, gained low milk yield. Moreover, lactations period and health of cows had effects on milk yield variation as well [19].

For the dry matter intake shown in Table 3, the control group had the highest for pangola grass, concentrate and total intake and was different from the groups with yeasts at 90 and 10 g/day (P<0.05) while the groups with yeasts at 90 and 10 g/day were not different (P>0.05). From experimental results, pangola grass, concentrate and total intake were decreased. Yeast mechanism had effect on reduced protozoa in rumen and higher efficiency of bacteria fiber and yeast could reduce the lag time of bacteria and increase utilization of nutrition in small intestine of duodenum, ileum and large intestine of caecal [3].

In Table 4, incomes from raw milk of the group with supplement yeast level of 90 g/day gave the highest at 200.88 bath/day, nearly the same level with the group with yeast level of 10 g/day at 199.94 bath/day, whereas the control group was the lowest at 192.02 bath/day. The highest net profit of milk yield at 111.68 bath/day was found in the group with yeast supplement level of 10 g/day (cost of yeast was 2.35 bath). The second highest net profit at 108.80 bath/day was found from the control group. The lowest net profit at 94.72 bath/day was found in the group with yeast supplement level of 90 g/day (cost of yeast as 21.15 bath). Thus, the cost of yeast was higher, the net profit became lower. Similarly, Klottrub [20] found that giving supplements of YEA-SACC®1026 at 10 g/day to dairy cows helped increase milk yield by 1.7 kg/cow/day and the calculated net profit was 0.416 U.S. dollars. As reported by Sinckair *et al*. [21], supplement of YEA-SACC® 1026 at 10 g/day to dairy cows fed with corn silage and grass silage helped increase milk yield by 0.9 kg/cow/day.

4. Conclusions

Yeast supplement in animal feed for dairy cows at 10 g/day would optimize and increase milk yield more than no yeast supplements. Dry matter intake of pangola grass and concentrate yeast were reduced. Somatic cell count was reduced for mastitis disease. Moreover, the expenses of concentrate and pangola grass were reduced more than no yeast supplement. Therefore, yeast supplement at 10 g/day could yield the highest net profit.

5. Acknowledgements

The authors appreciate the cooperation of Alltech Co., Ltd., Thailand, the Dairy Research & Development Center, the Animal Products Research & Development Center, Suwanvajokkasikit Animal Research & Development Institute (SARDI), Laboratory Milk Quality, Department of Veterinary Medicine, Kasetsart University, Kamphaeng Saen Campus, and Laboratory Animal Nutrition, Department of Animal Science, Faculty of Agriculture, Kasetsart University, Bangkean Campus for assistance and support in this study.

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