Effects of Saccharomyces cerevisiae Culture on Production Performance, Apparent Nutrient Digestibility, and Serum Indices in Lactating Dairy Cows (Postprint)

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Abstract

This experiment aimed to investigate the effects of Saccharomyces cerevisiae culture on production performance, nutrient apparent digestibility, and serum biochemical and immune indices of lactating dairy cows. Forty-five healthy Holstein lactating dairy cows with similar milk yield, parity, and days in milk were selected and randomly divided into 3 groups, with 15 replicates per group and 1 cow per replicate. The control group was fed the basal diet, while experimental group I and experimental group II were supplemented with 1% and 2% of Saccharomyces cerevisiae culture based on concentrate amount, respectively. The pre-trial period was 10 days, and the formal trial period was 60 days. The results showed: 1) Milk yield in experimental group II was extremely significantly higher than that in the control group and experimental group I ($P<0.01$); milk yield in experimental group I increased by 0.36 kg/d compared with the control group, but the difference was not significant ($P>0.05$). 2) Dry matter intake in experimental group I and experimental group II increased by 0.22 and 0.46 kg/d compared with the control group, respectively, but the differences were not significant ($P>0.05$); there were no significant differences in milk composition and feed conversion efficiency among groups ($P>0.05$). 3) Dry matter apparent digestibility in experimental group I and experimental group II was significantly higher than that in the control group ($P<0.05$); crude protein apparent digestibility in experimental group II was significantly higher than that in the control group ($P<0.05$); there were no significant differences in neutral detergent fiber and acid detergent fiber apparent digestibility among groups ($P>0.05$). 4) Serum alanine aminotransferase activity in experimental group I and experimental group II was extremely significantly lower than that in the control group ($P<0.01$), serum immunoglobulin G content in experimen-

tal group II was extremely significantly higher than that in the control group (P<0.01), and there were no significant differences in other serum biochemical and immune indices among groups (P>0.05). In conclusion, supplementation of 2% Saccharomyces cerevisiae culture based on concentrate amount in the diet can significantly improve production performance and immune capacity of lactating dairy cows, thereby increasing economic benefits of the farm.

Full Text

Effects of Saccharomyces cerevisiae Culture on Performance, Nutrient Apparent Digestibility and Serum Indices of Lactating Dairy Cows

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Abstract: This experiment investigated the effects of Saccharomyces cerevisiae culture on production performance, nutrient apparent digestibility, and serum biochemical and immune indices in lactating dairy cows. Forty-five healthy Holstein lactating cows with similar milk yield, parity, and days in milk were randomly divided into three groups with 15 replicates per group (one cow per replicate). The control group received a basal diet, while trial groups I and II received the basal diet supplemented with 1% and 2% of Saccharomyces cerevisiae culture in concentrate, respectively. The experiment consisted of a 10-day pre-trial period followed by a 60-day trial period.

The results showed: (1) Milk yield in trial group II was significantly higher than in the control and trial group I ($P < 0.01$). Compared with the control group, trial group I showed a 0.36 kg/d increase in milk yield, though this difference was not significant ($P > 0.05$). (2) Dry matter intake (DMI) in trial groups I and II increased by 0.22 and 0.46 kg/d compared with the control group, respectively, but differences were not significant ($P > 0.05$). No significant differences were observed in milk composition or feed conversion efficiency among groups ($P > 0.05$). (3) Dry matter apparent digestibility in trial groups I and II was significantly higher than in the control group ($P < 0.05$). Crude protein apparent digestibility in trial group II was significantly higher than in the control group ($P < 0.05$). No significant differences were found in neutral detergent fiber (NDF) or acid detergent fiber (ADF) apparent digestibility among groups ($P > 0.05$). (4) Serum alanine aminotransferase (ALT) activity in trial groups I

and II was significantly lower than in the control group ($P < 0.01$), while serum immunoglobulin G (IgG) content in trial group II was significantly higher than in the control group ($P < 0.01$). No significant differences were observed in other serum biochemical or immune indices among groups ($P > 0.05$).

In conclusion, supplementation with 2% Saccharomyces cerevisiae culture in concentrate significantly improved lactating cow performance, enhanced immune function, and increased farm economic benefits.

Keywords: Saccharomyces cerevisiae culture; Holstein lactating cows; performance; serum biochemical index; serum immune index

Introduction

Saccharomyces cerevisiae culture (SC) is a product obtained through solid or liquid fermentation using Saccharomyces cerevisiae as the microbial strain, followed by concentration and drying. The product contains beneficial substances including fermentation substrates, bacterial protein, yeast metabolites, and yeast cell walls, which function to balance intestinal microflora, enhance immunity, alleviate stress, and improve production performance in animals. Previous studies have demonstrated that SC can improve performance in beef cattle, broiler chickens, and finishing pigs. Research in dairy cows has shown that SC can increase dry matter intake (DMI) and milk yield. Wohlt et al. reported that dietary SC supplementation in dairy cows not only improved milk yield and DMI but also enhanced apparent digestibility of crude protein and cellulose. Poppy et al. found that SC supplementation increased milk fat and protein yield while improving milk quality. Williams et al. demonstrated that dietary SC effectively stabilized the rumen fermentation environment. However, most SC application research in dairy cows has focused on production performance and rumen fermentation function, with limited reports on how serum hormones, enzymes, and proteins regulate systemic metabolic functions. Therefore, this study systematically examined the effects of dietary SC supplementation on production performance, nutrient apparent digestibility, and serum biochemical and immune indices in Holstein dairy cows to provide further theoretical basis for SC application in dairy production in China.

1.1 Experimental Materials

The Saccharomyces cerevisiae culture used in this experiment was provided by Anhui Dongfang Xinxin Biotechnology Co., Ltd. The product was first produced through solid fermentation with Saccharomyces cerevisiae (2.3×10 CFU/g), followed by solid fermentation with Bacillus subtilis (2.8×10 CFU/g) to form the yeast culture. The product contained 90.5% dry matter, 25.1% crude protein, 41.6% neutral detergent fiber (NDF), 22.2% acid detergent fiber (ADF), 11.5% crude ash, 5.8% ether extract, 0.9% calcium, 0.4% phosphorus, and 6.9 MJ/kg net energy for lactation (on a dry matter basis).

1.2 Experimental Design and Management

Forty-five healthy Holstein lactating cows with similar milk yield [(35.2 ± 4.6) kg], parity [(1.7 ± 0.5)], and days in milk [(135 ± 15) d] were randomly allocated into three groups with 15 replicates per group (one cow per replicate). The control group received the basal diet, while trial groups I and II received the basal diet supplemented with 1% and 2% SC in concentrate [added at 130 and 260 g/(d · head) during morning feeding and thoroughly mixed], respectively. The experiment was conducted at the Daxing Experimental Base of China Agricultural University. All experimental cows were housed in the same barn with free-stall housing to ensure consistent management and environmental conditions. The Animal Intake Monitoring System (AIMS) developed by China Agricultural University was used to feed total mixed ration (TMR) three times daily (08:00, 14:00, 20:00) with 5–10% refusals. Cows had free access to water and were milked three times daily (07:00, 13:00, 19:00). The experimental period lasted 70 days, including a 10-day pre-trial period and a 60-day trial period.

1.3 Experimental Diets

During the experiment, the basal diet consisted of TMR from the farm base, formulated with whole corn silage, oat hay, alfalfa hay, and high-yield premix concentrate at a concentrate-to-forage ratio of 60:40. The basal diet contained no SC or similar products. Diets among groups were identical in ingredient composition except for SC supplementation levels. The composition and nutrient levels of the basal diet are presented in Table 1 .

Table 1 Composition and nutrient levels of the basal diet (DM basis) %

Items	Content
Ingredients	
Whole corn silage	
Alfalfa hay	
Oat grass	
Timothy grass	
Steam-flaked corn	
Extruded soybean meal	
Spraying corn bran	
Soybean hull	
Fat powder	
High yield premix concentrate[1])	
Total	
Nutrient levels[2])	
Net energy for lactation (NEL)/(MJ/kg)	
Neutral detergent fiber (NDF)	
Acid detergent fiber (ADF)	

Items	Content
Crude protein (CP)	
Ether extract (EE)	
Calcium	
Phosphorus	

[1]) Per kilogram of high yield premix concentrate contained the following: VA 20,000 IU, VD 2,300 IU, VE 88 IU, Fe (as ferrous sulfate) 105 mg, Zn (as zinc sulfate) 65 mg, Mn (as manganese sulfate) 24 mg, Cu (as copper sulfate) 7 mg, Mg (as magnesium sulfate) 2,000 mg, K (as kalium sulfate) 10,000 mg.
[2]) NEL was a calculated value, while the other nutrient levels were measured values.

1.4 Sampling and Measurements

1.4.1 Diet Sample Collection and Nutrient Analysis During the experiment, feed and refusals were collected every 15 days. Diet samples were collected using the quartering method, dried at 65 °C for 48 h, equilibrated for 48 h, and then processed into air-dried samples for grinding and storage. Conventional nutrient composition was analyzed according to methods described by Zhang Liying.

1.4.2 Dry Matter Intake (DMI) Determination Daily feed intake and refusals were recorded using the AIMS system to calculate DMI throughout the experimental period.

1.4.3 Milk Yield and Composition Measurement Daily milk yield was recorded for each cow during the trial period. Milk samples (50 mL) were collected on days 0, 15, 30, 45, and 60 of the trial period by mixing morning, midday, and evening milk in a 4:3:3 ratio. Potassium dichromate preservative was added to milk samples, which were refrigerated at -4 °C before being sent to Beijing Dairy Cattle Center for composition analysis, including milk protein percentage, milk fat percentage, lactose percentage, somatic cell count (SCC), and dry matter content.

1.4.4 Feed Conversion Efficiency Feed conversion efficiency was calculated using the formula: Feed conversion efficiency = Milk yield / DMI.

1.4.5 Nutrient Apparent Digestibility Measurement During the last 3 days of the trial period, fecal samples were collected continuously using rectal sampling at the following times: Day 1 at 03:00, 08:00, 13:00, and 18:00; Day 2 at 04:00, 09:00, 14:00, and 19:00; Day 3 at 05:00, 10:00, 15:00, and 20:00. Approximately 300 g was collected each time. After the final collection, all fecal samples from each cow were thoroughly mixed, and 200 g was taken and

placed in a tray with 50 mL of 10% tartaric acid for nitrogen fixation. Samples were dried at 65 °C for 48 h, equilibrated for 48 h, and processed into air-dried samples for grinding. Conventional nutrient composition was determined according to methods described by Zhang Liying. Acid-insoluble ash (AIA) in feces and feed was used as an internal marker to calculate apparent digestibility using the formula described by Zhong et al.:

Nutrient apparent digestibility (%) = [1 - (Ad × Nf) / (Af × Nd)] × 100

where Ad and Af represent AIA content (g/kg) in diet and feces, respectively; Nd and Nf represent the corresponding nutrient content in diet and feces, respectively.

1.4.6 Serum Indices Measurement On days 0, 15, 30, 45, and 60 of the trial period, five cows were randomly selected from each group for blood collection (10 mL) from the tail vein using vacuum tubes before morning feeding. Blood samples were centrifuged at 4,000 r/min for 10 min, and serum was aliquoted into 1.5 mL tubes and stored at -20 °C for analysis. Serum samples were sent to Beijing Labtech Technology Development Co., Ltd. for determination of biochemical and immune indices, including alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP) activities, and total protein (TP), albumin (ALB), urea nitrogen (UN), creatinine (CRE), total bilirubin (TB), non-esterified fatty acids (NEFA), -hydroxybutyric acid (BHBA), immunoglobulin A (IgA), immunoglobulin G (IgG), and immunoglobulin M (IgM) contents.

1.5 Data Analysis

Experimental data were initially processed using Excel 2007 and analyzed using SPSS 19.0 statistical software for one-way ANOVA. Duncan' s multiple comparison test was used for significance testing, where $P < 0.05$ indicated significant difference and $P < 0.01$ indicated highly significant difference. Results are expressed as mean ± standard deviation.

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2 Results

2.1 Effects of SC on DMI, Feed Conversion Efficiency, Milk Yield, and Milk Composition

As shown in Table 2 , milk yield in trial group II was significantly higher than in the control and trial group I ($P < 0.01$). Compared with the control group, trial group I showed a 0.36 kg/d increase in milk yield, but this difference was not significant ($P > 0.05$). DMI in trial groups I and II increased by 0.22 and 0.46 kg/d compared with the control group, respectively, but differences were not significant ($P > 0.05$). No significant differences were observed in milk composition or feed conversion efficiency among groups ($P > 0.05$).

Table 2 Effects of SC on dry matter intake, feed efficiency, milk yield and milk composition of lactating dairy cows

Items	Control group	Trial group I	Trial group II	P-value
Dry matter intake (DMI) (kg/d)	22.58 ± 1.24	22.80 ± 1.61	23.04 ± 1.39	
Milk yield (kg/d)	34.01 ± 0.82	34.37 ± 0.87	34.91 ± 1.04	< 0.01
Feed efficiency	1.51 ± 0.09	1.51 ± 0.07	1.52 ± 0.09	
Milk composition				
Milk fat percentage (%)	4.06 ± 0.62	4.12 ± 0.78	4.13 ± 0.63	
Milk protein percentage (%)	3.29 ± 0.21	3.30 ± 0.23	3.35 ± 0.25	
Lactose percentage (%)	5.09 ± 0.18	5.05 ± 0.21	5.07 ± 0.23	
Dry matter content (%)	13.38 ± 0.72	13.28 ± 1.09	13.13 ± 0.86	
Somatic cell count (SCC) (×10 /mL)	10.59 ± 7.68	10.87 ± 7.79	10.20 ± 7.13	

In the same row, values with different small letter superscripts indicate significant difference ($P < 0.05$), different capital letter superscripts indicate highly significant difference ($P < 0.01$), while the same or no letter superscripts indicate no significant difference ($P > 0.05$). The same applies below.

2.2 Effects of SC on Nutrient Apparent Digestibility

As shown in Table 3 , dry matter apparent digestibility in trial groups I and II was significantly higher than in the control group ($P < 0.05$). Crude protein apparent digestibility in trial group II was significantly higher than in the control group ($P < 0.05$). No significant differences were observed in NDF or ADF apparent digestibility among groups ($P > 0.05$).

Table 3 Effects of SC on nutrient apparent digestibility of lactating dairy cows (DM basis)

Items	Control group	Trial group I	Trial group II	P-value
Dry matter (DM)	69.28 ± 1.08	71.71 ± 0.66	71.11 ± 1.69	
Crude protein (CP)	73.94 ± 0.95	75.16 ± 1.41	76.02 ± 0.44	
Neutral detergent fiber (NDF)	59.42 ± 1.71	59.81 ± 1.23	58.89 ± 1.12	
Acid detergent fiber (ADF)	53.25 ± 1.83	53.52 ± 0.74	53.32 ± 1.19	

2.3 Effects of SC on Serum Indices

As shown in Table 4 , serum ALT activity in trial groups I and II was significantly lower than in the control group ($P < 0.01$). Serum ALP activity and TP content in trial groups I and II were higher than in the control group, but differences were not significant ($P > 0.05$). Serum IgG content in trial group II was significantly higher than in the control group ($P < 0.01$). No significant differences were observed in other serum biochemical or immune indices among groups ($P > 0.05$).

Table 4 Effects of SC on serum indices of lactating dairy cows

Items	Control group	Trial group I	Trial group II	P-value
Total bilirubin (TB) (mol/L)	4.96 ± 2.57	5.10 ± 2.83	4.86 ± 2.63	
Alkaline phosphatase (ALP) (U/L)	43.60 ± 7.63	45.68 ± 14.90	45.84 ± 14.10	
Alanine aminotransferase (ALT) (U/L)	30.96 ± 6.76	26.20 ± 4.28	25.44 ± 8.92	< 0.01
Aspartate aminotransferase (AST) (U/L)	77.32 ± 11.37	76.92 ± 17.42	74.56 ± 10.88	
-hydroxybutyric acid (BHBA) (mmol/L)	0.68 ± 0.17	0.67 ± 0.11	0.68 ± 0.09	
Non-esterified fatty acids (NEFA) (mol/mL)	124.86 ± 56.52	124.79 ± 49.19	126.85 ± 30.35	
Total protein (TP) (g/L)	76.56 ± 6.18	79.04 ± 4.54	78.40 ± 8.84	
Albumin (ALB) (g/L)	34.68 ± 2.82	34.84 ± 1.84	34.80 ± 3.27	

Items	Control group	Trial group I	Trial group II	P-value
Urea nitrogen (UN) (mmol/L)	3.86 ± 0.53	3.78 ± 0.61	4.08 ± 0.82	
Creatinine (CRE) (mol/mL)	84.72 ± 9.82	84.52 ± 9.06	85.40 ± 8.59	
Immunoglobulin G (IgG) (mg/mL)	7.11 ± 2.23	8.16 ± 2.00	9.17 ± 2.01	< 0.01
Immunoglobulin A (IgA) (mg/mL)	0.20 ± 0.05	0.20 ± 0.04	0.22 ± 0.04	
Immunoglobulin M (IgM) (mg/mL)	2.38 ± 0.87	2.48 ± 0.56	2.48 ± 0.69	

2.5 Effects of SC on Economic Effectiveness

Except for different SC supplementation levels, all other dietary ingredients were identical among groups. As shown in Table 5 , farm economic effectiveness increased with increasing SC supplementation. Compared with the control group, trial groups I and II generated additional profits of 0.86 and 2.35 yuan/(d·head), respectively. These results demonstrate that dietary SC supplementation can improve farm economic benefits.

Table 5 Effects of SC on economic effectiveness of farms (yuan/(d · head))

Items	Control group	Trial group I	Trial group II
Feed cost			
Milk income			
Economic effectiveness			

3 Discussion

3.1 Effects of SC on DMI, Feed Conversion Efficiency, Milk Yield, and Milk Composition

DMI and milk yield directly reflect the production performance status of dairy cows. Desnoyers et al. reported that dietary SC supplementation significantly

increased DMI and milk yield, with a trend toward improved milk fat percentage but no effect on milk protein percentage. Poppy et al. found that SC use in dairy cows increased DMI during early lactation and significantly improved milk yield, energy-corrected milk, milk fat yield, and milk protein yield. Dias et al. similarly concluded that dietary SC supplementation increased milk yield and energy-corrected milk. In the present study, all trial groups showed higher milk yield than the control group, with the 2% SC group being significantly higher, consistent with these previous findings. In calf studies, Lesmeister et al. reported that SC supplementation in calf starter significantly increased DMI, with the 2% SC group showing a 15.6% improvement in average daily gain compared with the control group. However, Arambel et al. found that SC supplementation in diets of early to mid-lactation dairy cows had no significant effect on milk yield or DMI. In our study, DMI in lactating cows increased linearly with SC supplementation level, with all trial groups showing higher DMI than the control group, while no significant differences were observed in feed conversion efficiency among groups. These inconsistent results across studies may be attributed to factors such as feeding environment, physiological stage, and diet palatability affecting cow intake. Dann et al. and Hristov et al. reported that dietary SC supplementation had no significant effect on milk composition including milk fat percentage, milk protein percentage, and somatic cell count, which aligns with our findings. However, our results also showed slight improvements in milk fat and protein percentages in trial groups compared with the control group. We speculate that peptides and unknown growth factors in SC provided abundant fermentation substrates for rumen microorganisms, enhancing microbial protein synthesis and cellulolytic bacterial activity, which contributed to increased precursors for milk fat and protein synthesis and laid a foundation for improved milk quality.

3.2 Effects of SC on Nutrient Apparent Digestibility

Lu Hui reported that beneficial microorganisms in fermented feed can effectively stimulate the growth of rumen fiber-degrading bacteria and lactate-utilizing bacteria, thereby promoting digestibility. Other studies have indicated that Saccharomyces cerevisiae, as a beneficial microorganism, can effectively protect intestinal microflora and promote intestinal mucosal development, thereby improving nutrient digestion and absorption in animals. In lactating cow studies, Arambel et al. reported that SC supplementation had no significant effect on apparent digestibility of crude protein, ADF, and NDF. Hristov et al. similarly concluded that SC had no significant effect on nutrient digestibility. However, Wohlt et al. found that dietary SC supplementation significantly improved crude protein and fiber digestibility in early lactation dairy cows. In our study, groups supplemented with SC showed significantly higher dry matter and crude protein apparent digestibility than the control group, while no significant differences were observed in NDF and ADF apparent digestibility among groups. SC itself contains abundant vitamins and phytase, and produces numerous unknown growth factors as well as flavor-enhancing peptides and amino acids during fer-

mentation. We speculate that these beneficial substances increased cow intake and improved digestive tract absorption and utilization of dietary nutrients, thereby providing more energy for increased milk production.

3.3 Effects of SC on Serum Indices

Serum total bilirubin (TB) content is an important indicator for assessing hepatocellular bilirubin processing. Bilirubin is a product of aged red blood cell breakdown in the mononuclear-phagocyte systems of the liver, spleen, and bone marrow. Elevated serum TB content indicates enhanced bilirubin excretion 障碍 and decreased hepatocellular bilirubin processing capacity. Zuo et al. reported that reduced DMI during the peripartum period leads to insufficient energy intake, resulting in significantly increased serum TB content. In our study, no significant differences were observed in serum TB content among groups, indicating that SC supplementation had no negative effect on bilirubin excretion function in lactating cows.

ALT, AST, and ALP are enzymes distributed in cardiac muscle, skeletal muscle, liver, and kidney tissues. Damage to these tissues disrupts cell membrane integrity and increases permeability, leading to elevated blood enzyme activities. Studies have shown that increased milk production enhances certain regulatory functions (such as transamination, gluconeogenesis, and fat mobilization), which increases organ burden and causes more severe cellular damage, resulting in increased blood enzyme activities. Liu Jin found that heat stress intensifies myocardial contractility, accelerates blood circulation, and enhances myocardial cell metabolism, leading to accelerated myocardial cell damage and increased serum AST activity. The same study reported that glycerol-producing yeast culture supplementation resulted in slightly lower serum AST activity compared with the control group, suggesting that yeast culture supplementation may alleviate heat stress. Combined with our results, except for significantly lower serum ALT activity in trial groups, serum AST activity also tended to decrease compared with the control group, indicating that SC supplementation may alleviate liver and cardiac muscle damage in lactating cows under specific conditions.

Serum NEFA primarily participates in systemic metabolism and serves as an indicator of energy metabolism; increased content is an important marker of body fat mobilization. Blood BHBA is synthesized not only from NEFA oxidation in the liver but also from butyrate as a precursor, and similarly serves as an energy balance evaluation indicator. Studies have shown that in early lactation dairy cows, glycerol-enriched yeast culture supplementation reduced serum BHBA and NEFA contents while increasing hepatic gluconeogenic enzyme activity. Fat mobilization is an inevitable consequence of negative energy balance in peripartum cows, and serum NEFA content increases significantly with increased fat tissue and hepatic glycogen consumption. Research indicates that serum NEFA content rises sharply at calving, and persistently high levels indicate negative energy balance status. In our study, no significant differences were observed in serum BHBA and NEFA contents among groups, suggesting

that SC supplementation did not affect normal energy metabolism in dairy cows.

Serum TP, ALB, UN, and CRE contents collectively reflect protein absorption, synthesis, and degradation in the body. Wang Ling et al. found that complex yeast culture supplementation in dairy cow diets had no significant effect on serum TP, ALB, and CRE contents, which is consistent with our findings. Serum UN content reflects protein metabolism and dietary amino acid balance. In our study, no significant differences were observed in serum UN content among groups, indicating balanced protein absorption and utilization in cows. This result may be attributed to SC supplementation providing more abundant fermentation substrates for rumen microorganisms, facilitating the synthesis of microbial protein from ammonia nitrogen, improving protein utilization efficiency, preventing mobilization of body protein, and maintaining protein balance.

IgG, IgM, and IgA represent serum immunoglobulin content and function in antiviral, antibacterial, bactericidal, and antitoxin activities. Liu Dacheng et al. found that supplementation with two different yeast cultures increased or maintained serum IgG content in dairy cows. Wang Weizheng reported that yeast culture supplementation for 60 days significantly increased serum IgG and IgA contents in dairy cows. Chen Zuodong et al. obtained similar results in yellow cattle, showing that yeast culture supplementation significantly increased serum IgA content and tended to increase IgG content. Yeast culture contains yeast cell wall polysaccharides that can serve as immune-stimulating adjuvants and enhance immune function. In our study, serum IgG content in trial groups increased compared with the control group, with significant improvement in trial group II, while no significant differences were observed in serum IgM and IgA contents among groups. These results indicate that dietary SC supplementation can enhance antibacterial, antiviral, and antitoxin activities, effectively improve immune performance, and protect the body from viral damage.

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4 Conclusion

1. Supplementation with 2% Saccharomyces cerevisiae culture in concentrate significantly increased milk yield, dry matter and crude protein apparent digestibility, and serum IgG content, significantly decreased serum ALT activity, and generated an additional profit of 2.35 yuan per cow per day, demonstrating the best feeding effect.

2. Supplementation with 1% Saccharomyces cerevisiae culture in concentrate significantly increased dry matter apparent digestibility and significantly decreased serum ALT activity, with slight improvements in DMI and milk yield compared with the control group, generating an additional profit of 0.86 yuan per cow per day.

3. In summary, dietary supplementation with 2% Saccharomyces cerevisiae

culture in concentrate significantly improves dairy cow production performance, enhances immune function, and increases farm economic benefits.

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Note: Figure translations are in progress. See original paper for figures.