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Effect of Distiller's Dried Grains Refermented with *Saccharomyces cerevisiae* on the Growth Performance, Slaughter Performance and Meat Quality of Growing-Fattening Goats

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Key words
Distiller's grains, Saccharomyces cerevisiae, Solid fermentation, Growing-fattening goat

ABSTRACT

The purpose of this study was to investigate the effect of supplementing diets with *Saccharomyces cerevisiae* refermented sorghum distiller's dried grains (SSDDGS) on the growth performance, slaughter performance and meat quality of growing-fattening goats. Twelve growing-fattening goats (female Dazu black goats) were randomly divided into two groups: SSDDGS group fed on 5.9% SSDDGS and control group fed on sorghum wet distiller' s grains (SWDG) added to the basal diet. The results showed that the SSDDGS group's average daily gain (ADG) at 31–60 days of the experiment was significantly higher than the control group ($p < 0.05$), and the feed/gain ratio (F/G) of the SSDDGS group was significantly lower than the control group ($p < 0.05$). No significant differences were observed in the slaughter rate, eye muscle area or GR values of goats between the two groups ($p > 0.05$). The heart weight in the SSDDGS group was significantly higher than the control group ($p < 0.05$). The content of myristic acid in the longest dorsal muscle of the SSDDGS group was significantly higher than the control group ($p < 0.05$). The study indicates that SSDDGS can effectively increase ADG and reduce F/G of growing-fattening goats, without influencing slaughter performance and meat quality.

INTRODUCTION

With the rapid development of the animal industry, the shortage of feed resources has become prominent, especially the lack of high-quality protein feed resources. Making full use of unconventional feed resources to develop high-efficiency and low-cost animal feed has become the current research focus and hotspots. Distiller's grains (DG) resources are very rich in the world, especially in China. China's annual output of DG exceeds 100 million metric tons (Cheng *et al*., 2022). DG contain rich protein, fat, crude fibre and amino acid (Cheng *et al*., 2022; Cenin *et al*., 2021; Gupta *et al*., 2020). However, poor palatability and high moisture content in DG limit their wide application in animal husbandry production.

Distiller's dried grain with solubles (DDGS) processed by drying method has been widely used animal feed. DDGS have become an important ingredient in animal feed because of its abundant availability and cost competitive ability, especially in ruminant feed (Hodges *et al*., 2022; Shen *et al*., 2018). Direct feeding of *Saccharomyces cerevisiae* in the diet could improve the total and daily gain of Barki lambs (Abdel-Wahed *et al*., 2022). Pelleted DDGS does not affect milk production, but pelleted DDGS increased digestibility of (NDF) digestibility and gross energy (Krogstad *et al*., 2021). The inclusion of 25%, 27.5% or 50% DDGS in the diets of growing lambs does not affect growth and slaughter performance, but reduces feed consumption (Abudabos *et al*., 2021; Karaca *et al*., 2021). Replacing 50% of cottonseed meal and sorghum grain with DDGS improves the growth performance, carcass traits, and meat quality of Rambouillet wether lambs (Quadros *et al*., 2022). During the processes of DDGS production, the interaction

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of resistant starch and fiber with protein and other grain compounds forms enzyme-resistant aggregates, which limits the interaction between fiber-degrading enzymes and substrates, and further hindering the efficiency of exogenous enzymes (Wang *et al*., 2018). Yeast culture (YC) is a common natural product produced by yeast fermentation, which has been widely used to improve animal growth, health and feed digestion (Abbas *et al*., 2020; Maamouri and Ben, 2021). In addition to being used in the production of DDGS, DG as a substrate can also be re-fermented by *Saccharomyces cerevisiae* to produce YC, which can effectively improve the nutrient composition of DDGS and reduce the cost of YC production (Song *et al*., 2017; Hippen *et al*., 2010). Supplementing sow diets with *S. cerevisiae* refermented sorghum distiller's dried grains (SSDDGS) from late gestation to weaning has increased lactation performance and progeny growth performance (Song *et al*., 2017). Supplementing growing-fattening pig diets with *S. cerevisiae* refermented sorghum DDGS has improved the carcass traits and meat quality (Li *et al*., 2022). Few studies have investigated the effects of SSDDGS on the goat growth performance, slaughter performance and meat quality.

The present study was therefore undertaken with an aim to determine the effect of supplementing diets with a novel type of yeast culture (*S. cerevisiae* refermented sorghum distiller's dried grains) on the growth performance, slaughter performance and meat quality of growing-fattening goats.

MATERIALS AND METHODS

Experimental animals and experimental design

The experiment was conducted in the Goat Farm of Chongqing Tengda Animal Husbandry Co., Ltd. in China. Twelve growing-fattening goats (female Dazu black goats) with similar body condition and body weight of 19.67±1.76 kg were selected and randomly divided into two groups (six goats in each group). The basal diets of the experimental and control groups were supplemented with 5.90% SSDDGS and SWDG (dry matter basis), respectively, and the composition of the each group is provided in Table I. The experimental period started after 14 days of prefeeding, and the formal feeding period was 60 days.

Feed ingredients

The basic diet was the complete pellet feed, which was purchased from Pizhou Xiaohe Science and Technology Development Co., Ltd. in China. Sorghum wet distiller's grains (SWDG) were purchased from Kweichow Moutai Distillery (Group) Co., Ltd. in China. *S. cerevisiae* refermented sorghum distiller's dried grains with solubles (SSDDGS) were produced by re-fermenting and low-temperature drying of sorghum wet distiller's grains using *S. cerevisiae*, which were from the large scale production of solid state fermentation (SSF) workshop of Road Biological Technology (Gulin) Co., Ltd. in China.

Table I. Ingredients and composition of experimental diets.

Item	Control group	SSDDGS group
Ingredient, (%)		
The complete pellet feed	94.10	94.10
SWDG	5.90	-
SSDDGS	-	5.90
Total	100.00	100.00
Composition 1		
Digestible energy (DE), (MJ/kg)	12.14	12.16
Crude protein (CP), (%)	17.36	17.44
Ether extract (EE) , (%)	2.52	2.52
Neutral detergent fiber (NDF) , (%)	37.81	38.31
Acid detergent fiber (ADF), (%)	25.00	25.21
Crude ash (Ash), (%)	10.24	10.27
Calcium (Ca), (%)	1.04	1.05
Phosphorus (P), (%)	0.63	0.63

SSDDGS, supplemented diet with *Saccharomyces cerevisiae* refermented distiller's dried grains; SWDG, sorghum wet distiller's dried grains

Determination of growth performance and slaughter performance

The average daily feed intake (ADFI) of the feed was recorded daily. Fasting body weight was measured, and ADG and the feed/gain ratio (F/G) were calculated before the start of the experiment and the morning feeding on the 30^{th} and 60^{th} day of the experiment.

On the last day of the experiment, five goats in each group were randomly selected for slaughter. Live weight before slaughter and carcass weight were recorded, and the slaughter percentage was calculated.

Dressing percentage (%) = (carcass weight/ live weight before slaughter) × 100.

Eye muscle area: Use sulfuric acid drawing paper to draw the contour of the transverse section of the eye muscle above the spine between the 12^{th} and 13^{th} ribs, and then calculate the eye muscle area using the following formula:

Eye muscle area (cm^2) = eye muscle width (cm) × eye muscle height (cm) × 0.7.

GR value: The tissue thickness was measured 11 cm from the midline of the dorsal ridge between the 12th and 13th ribs of the carcass.

The head, hooves, fur, heart, liver, spleen, lungs and kidneys of all slaughtered goats were weighed using electronic scales, and the visceral organ index was calculated as follows: organ index = weight of the organ/body weight before slaughter × 100.

Determination of meat quality content

pH value: A penetrating electrode connected to the pH meter was introduced between the 12th and 13th ribs (45 min after slaughter) for the detection of pH value. Three sites of each sample were randomly selected and averaged.

Meat colour: The longissimus dorsi muscle between the 12th and 13th ribs was selected 1 to 2 h after slaughter, and the meat colour tester was used to determine the lightness (L^*), red (A^*) and yellow (B^*) values of three sites for each sample at the ambient temperature of 15 °C–22 °C. The process was repeated three times at different positions, and the average value was taken.

About 200–300 g of each meat sample was taken from the longest back muscle and sent to Chengdu Analysis Center for testing. The test indexes included moisture, CP, EE, Ash, Ca, P, intramuscular fat and content of amino acids (AA) and seven kinds of fatty acids (FA).

Statistical analysis

The test data were analysed by independent sample t tests using SAS software version 9.4. ($p < 0.05$) indicated significant differences, and the final results were expressed as mean and standard error of the mean (SEM).

RESULTS

Growth performance of growing-fattening goats

Compared with the control group, no significant differences were observed in average daily gain (ADG), ADFI and F/G of growing-fattening goats in the SSDDGS group from day 1 to day 30 of the experiment ($p > 0.05$, Table II). Compared with that in the control group, the ADG of the SSDDGS group was significantly increased ($p < 0.05$) at 31–60 days of the experiment, and the F/G of the control group was significantly decreased ($p < 0.05$). During the whole experimental period (1–60 days), the average daily gain of the SSDDGS group was clearly higher than that of the control group, and the F/G was lower than that of the control group. However, no significant difference was observed between the two groups ($p > 0.05$).

Slaughter performance of growing-fattening goats

The carcass weight, dressing percentage and loin muscle area of growing-fattening goats in the SSDDGS group were slightly higher than those in the control group, which increased by 8.32%, 2.23% and 3.73%, respectively (Table III). Moreover, the GR value was obviously higher in the SSDDGS than in the control group, which increased by 21.74%, but no significant difference was observed between the two groups ($p > 0.05$). As shown in Table IV, the heart weight of the SSDDGS group was significantly higher than that of the control group ($p < 0.05$), whereas no significant differences were observed in the weight of the head, hoofs, fur, liver, spleen, lung, kidney and visceral, and the organ index between the two groups ($p > 0.05$).

Table II. Effects of supplementing diets with SSDDGS on growth performance of growing-fattening goats.

Items	Control group	SSDDGS group	SEM	P value
Initial weight (kg)	20.70	20.52	0.43	0.853
30 days weight (kg)	22.72	22.38	0.54	0.768
60 days weight (kg)	25.33	27.00	0.67	0.231
Days 1-30				
ADG (g)	67.44	61.78	12.51	0.833
ADFI (g)	937.22	937.45	9.15	0.990
F/G	18.69	13.63	3.08	0.444
Days 31-60				
ADG (g)	87.17a	154.11b	15.83	0.026
ADFI (g)	1219.14	1212.25	7.18	0.635
F/G	13.31a	8.89b	1.15	0.049
Days 1-60				
ADG (g)	77.31	107.94	9.72	0.118
ADFI/G	1080.49	1077.10	13.90	0.904
F/G	16.69	10.63	1.92	0.118

Note: Different letters in the shoulder label of peer data indicate significant differences ($p < 0.05$), while no letters indicate insignificant differences ($p > 0.05$), as shown in the following table. ADG, average daily gain; ADF1/G, Average daily feed intake; FlG, feed/gain ratio.

Table III. Effects of supplementing diets with SSDDGS on slaughter performance of growing-fattening goats.

Items	Control group	SSDDGS group	SEM	P value
Live weight before slaughter (kg)	25.33	27.00	0.56	0.199
Carcass weight (kg)	12.98	14.06	0.42	0.216
Dressing percentage (%)	49.72	50.83	0.77	0.502
Loin muscle area (cm^2)	11.79	12.23	0.50	0.689
GR value (mm)	9.20	11.20	0.84	0.257

Table IV. Effects of supplementing diets with SSDDGS on organ weight and organ index of growing-fattening goats.

Items	Control group	SSDDGS group	SEM	P value
Organ weight				
Head weight (g)	1660.00	1718.00	28.85	0.344
Feet weight (g)	710.00	700.00	13.84	0.740
Skin+Wool weight (g)	2040.00	2110.00	117.67	0.785
Heart weight (g)	98.12a	112.00b	2.89	0.005
Liver weight (g)	588.74	641.78	22.41	0.259
Spleen weight (g)	39.50	37.94	2.52	0.776
Lung weight (g)	329.18	352.66	16.04	0.497
Kidney weight (g)	96.58	92.86	2.74	0.529
Organs index (%)				
Heart index	0.38	0.41	0.01	0.078
Liver index	2.26	2.33	0.08	0.694
Spleen index	0.15	0.14	0.01	0.527
Lung index	1.26	1.29	0.06	0.808
Kidney index	0.37	0.34	0.01	0.180

Table V. Effects of supplementing diets with SSDDGS on meat quality of growing-fattening goats.

Items	Control group	SSDDGS group	SEM	P value
Meat quality trait				
pH_{45min}	6.34	6.25	0.55	0.493
L*	28.88	28.08	0.47	0.429
a*	14.55	13.44	0.52	0.314
b*	7.78	6.43	0.38	0.074
Muscle nutrient content				
Moisture (%)	75.36	74.76	0.24	0.225
CP (%)	21.02	20.34	0.28	0.250
EE (%)	2.48	3.48	0.39	0.212
Ash (%)	1.16	1.16	0.03	1.000
Intramuscular fat (IMF) (%)	2.20	2.97	0.33	0.270
Ca (mg/kg)	41.76	47.08	3.68	0.803
P (mg/kg)	17.44	17.80	0.64	0.798

Meat quality of growing-fattening goats

As shown in Table V, no significant differences were observed in the pH and meat colour between the two groups ($p > 0.05$). The EE, intramuscular fat and Ca contents of growing-fattening goats muscles in the SSDDGS group were obviously higher than those in the control group, which were increased by 40.32%, 35.00% and 12.74%, respectively. However, no significant difference was observed between the two groups ($p > 0.05$). In addition, the contents of other nutrients in the muscle, such as moisture, protein, ash and phosphorus, showed no significant differences between the two groups ($p > 0.05$).

Table VI. Effects of supplementing diets with SSDDGS on amino acids contents of longissimus dorsi muscle of growing-fattening goats.

Items	Control group	SSDDGS group	SEM	p value
Threonine	0.86	0.88	0.01	0.453
Valine	0.97	0.98	0.01	0.610
Methionine	0.48	0.50	0.01	0.091
Isoleucine	0.89	0.91	0.02	0.363
Leucine	1.57	1.60	0.02	0.605
Phenylalanine	0.75	0.76	0.01	0.706
Lysine	1.71	1.75	0.02	0.534
Histidine	0.87	0.81	0.02	0.123
Aspartic acid	1.75	1.78	0.02	0.543
Serine	0.74	0.75	0.01	0.704
Glutamate	2.92	3.00	0.04	0.367
Glycine	0.88	0.85	0.02	0.420
Alanine	1.06	1.06	0.02	0.953
Tyrosine	0.70	0.72	0.01	0.290
Arginine	1.19	1.20	0.02	0.623
Proline	0.66	0.64	0.01	0.484
Essential amino acid (EAA)	8.11	8.18	0.11	0.751
Nonessential amino acid (NAA)	9.90	10.00	0.13	0.706
Total amino acids (TAA)	18.01	18.19	0.23	0.725
EAA/TAA	45.04	44.99	0.06	0.749
EAA/NAA	81.94	81.80	0.21	0.762

As can be seen in Table VI, no significant difference was observed in 16 AA such as threonine, valine and methionine in the longissimus dorsi muscle of goats between the SSDDGS group and the control group ($p > 0.05$). In addition, no significant differences were observed in essential AA, non-essential AA, total AA and their ratios between the two groups ($p > 0.05$). As can be seen in Table VII, the content of myristic acid in the longissimus dorsi muscle of growing-fattening goats in the SSDDGS group was significantly higher than that in the control group ($p < 0.05$), whereas no significant difference was observed in the content of other FA in the longissimus dorsi muscle of growing-fattening goats between the SSDDGS group and the control group ($p > 0.05$).

Table VII. Effects of supplementing diets with SSDDGS on fatty acids contents of longissimus dorsi muscle of growing-fattening goats.

Items	Control group	SSDDGS group	SEM	P value
(C14:0) Myristic acid	1.44a	1.89b	0.10	0.012
(C16:0) Palmitic acid	21.08	21.18	0.38	0.905
(C16:1) palmitoleic acid	1.37	1.50	0.21	0.806
(C18:0) Stearic acid	18.04	18.30	0.88	0.466
(C18:1n9c) Oleic acid	47.64	45.10	1.24	0.335
(C18:1n9t) Elaidic acid	3.26	3.55	0.13	0.310
(C18:2n6c) Linoleic acid	4.10	4.09	0.20	0.978

DISCUSSION

Growth performance of growing-fattening goats

Dietary supplementation of yeast culture (YC) is an effective strategy to improve animal growth performance and health. The YC is rich in nutrient, which contains refermented DDGS, yeast metabolites, live probiotic, and cell wall fragments (Song *et al*., 2017; Maamouri and Ben, 2021). The YC can promote a less acidic ruminal pH environment, and improve the rumen bacterial yield and digestibility of nutrients, especially the digestibility of fiber and protein (Swyers *et al*., 2014). The study by Song et al. (2021) showed that the supplementation of YC significantly increased ADG of fattening lambs by 31 g/day and improved the digestibility of NDF and ADF compared with control group, and it also altered the rumen bacterial population and species. Liu *et al*. (2019) presented that the supplementation of 2.3 g/kg YC significantly increased ADG of lambs by 20 g/d at the high dietary ratio of non-structural carbohydrate to fat (NSCFR), and the supplementation of 0.8 g/kg YC significantly increased ADG by 30 g/d and dry matter intake at the low NSCFR. Maamouri and Ben (2021) reported that the supplementation of YC significantly increased ADG of fattening calves by 200 g/d, and reduced feed conversion ratio but no effect on feed intake. A novel type of YC, *Saccharomyces cerevisiae* refermented sorghum distiller's dried grains with solubles (SSDDGS), has been developed (Song *et al*., 2017). Song *et al*. (2017) presented that the supplementation of 4% SSDDGS significantly increased ADFI and health status of sow, and progeny growth performance. However, the study by Li *et al*. (2022) showed that the supplementation of SSDDGS did not have a significant effect on ADG, ADFI and F/G of growing fnishing pigs. In the current study, the supplementation of SSDDGS significantly increased ADG of growing-fattening goats and reduced F/G in the late stage of the study, but it did not affect ADFI, which is consistent with Liu *et al*. (2019), Maamouri and Ben (2021). The increase in ADG and decrease of F/G may be due to the improved digestibility of NDF, ADF, protein and other nutrients (Swyers *et al*., 2014). Interestingly, the supplementation of SSDDGS did not affect ADG and F/G of growing-fattening goats in the early stage and all periods of the study, which may be related to the longer adaptation process of goats to the SSDDGS, shorter experiment duration, and the concentration of SSDDGS supplementation (Song *et al*., 2017; Liu *et al*., 2019; Alizadeh *et al*., 2016). Our results indicated that the supplementation of SSDDGS could effectively improve ADG and reduced F/G of growing-fattening goats.

Slaughter performance of growing-fattening goats

Few studies are available concerning the effects of supplementing diets with YC on animal slaughter performance, especially in goats or sheep. Slaughter performance is one of the most important indexes to judge the meat performance of growing-fattening domestic animals, which is mainly affected by breed, nutrition and environment. Liu *et al*. (2019) found that supplementation with 2.3 g/kg YC significantly increased carcass weight and dressing percentage of lambs in a linear fashion. In the current study, the supplementation of SSDDGS had no significant effect on carcass weight, dressing percentage, loin muscle area and GR value of growing-fattening goats. Some studies also showed that supplementation with YC or live yeast did not affect the slaughter performance. Song et al. (2021) found that supplementation of YC had no significant effect on carcass weight and dressing percentage of fattening lambs. Soren *et al*. (2013) found that supplementation of SSDDGS did not affect the arcass weight and carcass yield of growing finishing pigs (Li *et al*., 2022). Soren *et al*. (2013) found that supplementation of live yeast did not affect the arcass weight and dressing yields of Malpura lambs. Interestingly, most slaughtered organ weight and organ index did not show significant difference between the SSDDGS and control group, however, the heart weight of goats in the SSDDGS group was significantly higher than that of the control group. Song et al. (2021) also found that the heart weigh and heart index of fattening lambs in the YC supplementation group was significantly higher than that of control group, which may be related to the improvement of growing-fattening goat or sheep weight by YC supplementation. With the increase of animal body weight, the body has more needs to transport nutrients, which leads to the continuous increase of heart weight to adapt to the change of body weight (Chanda *et al*., 2016; Yin *et al*., 2021). The reason for the inconsistent effect of this YC on animal slaughter performance may be related to the composition and dose of YC, the daptation time of animal on the YC and the growth stage of animals. Our studies indicated that supplementation with SSDDGS in goat diets had no adverse effect on the slaughter performance.

Meat quality of growing-fattening goats

Meat color is an important parameter of meat quality, which is a key factor in driving customer purchases. Meat colour is particularly influenced by feed composition in the diet (Su *et al*., 2022; Jacqes *et al*., 2017). pH is a main factor affecting meat color, which is negatively correlated with lightness of meat (Jacqes *et al*., 2017). It is generally considered that the lower the L* and b* values, and the higher the a* value in meat, the better the meat color (Su *et al*., 2022; Jacqes *et al*., 2017; Wang *et al*., 2021). Li *et al*. (2022) found that supplementation with SSDDGS in growing-finishing pig diets significantly reduced b* and L* values of longissimus dorsi muscle, while the pH value was significantly increased. In addition, the a* value in the SSDDGS group was also significantly increased. In this study, no significant differences were observed in pH and L*, a* and b* values in the goat muscle between the SSDDGS and control groups, which is consistent with the findings of Cheng *et al*. (2022) who found that supplementation of fermented Moutai distillers' grain with YC in finishing cattle had no significant effect on pH, L*, a* and b* values in the muscle compared to that of the control group. This inconsistent result may be related to the different degrees of digestion and absorption of nutrients in YC by different animals.

The main indexes for evaluating routine nutrition of goat or sheep meat quality include water, CP, EE, Ash, intramuscular fat, Ca and P. Generally speaking, the higher content of CP, intramuscular fat, Ash, Ca and P, the higher nutritional value of mutton (Ovinge *et al*., 2018; Kim *et al*., 2021). Li *et al*. (2022) showed that the addition of SSDDGS in the growing finishing diets significantly increased the CP and Ash contents in the longissimus dorsi muscle. The higher CP and Ash contents may be due to the re-fermentation process of SDDGS, which increased the digestibility of nutrients in the animal diets supplemented with SSDDGS by reducing the contents of anti-nutritional tannins and favonoids (Li *et al*., 2022; Ahmed *et al*. 2016; Ovinge *et al*., 2018). In this study, the EE, intramuscular fat and Ca contents in the muscle of the SSDDGS group were obviously higher than those of the control group, which increased by 40.32%, 35.00% and 12.74%, respectively, however, no significant differences were observed between the the SSDDGS and control groups, which may be due to the different degrees of digestion and absorption of nutrients in YC by different individuals or the short feeding time.

The composition and content of amino acids in meat is an important indicator for evaluating meat quality. Amino acids in meat are the building blocks of protein, and their composition and content determine the quality of protein in meat (Li *et al*., 2022). In addition, certain amino acids also enhance the flavor and palatability of meat (Kim *et al*., 2021). In recent years, researchers have found that adding live microbial probiotics or fermented cultures of probiotics to animal diets could effectively improve amino acids levels in animal muscles (Cheng *et al*., 2022; Li *et al*., 2022; Tang *et al*., 2021). Cheng *et al*. (2022) showed that supplementation of 30% fermented Moutai distillers' grain with YC in finishing cattle significantly increased the contents of various amino acids including essential amino acid and umami amino acid in beef, which was due to the high contents of various amino acids in diets supplemented with fermented Moutai distillers' grain with YC. Li *et al*. (2022) also found that supplementation with SSDDGS in growing-finishing pig diets significantly improved glycine and proline contents of pork. Proper industrial fermentation process with benefcial probiotics could increase amino acid contents in feed and further improve the availability of dietary protein. In this study, no significant difference was observed in the amino acid contents of goat muscles between the SSDDGS and control groups, which may be related to the nutritional characteristics and digestibility of YC.

The types and content of fatty acids in meat is another important indicator for evaluating meat quality. The types and contents of fatty acids in the muscle are important factors affecting flavor and palatability of meat. The content of polyunsaturated fatty acids (PUFA) in meat is a key factor in determining the quality of meat eaten by humans. Therefore, reducing the content of saturated fatty acids (SFA) in meat and increasing the content of PUFA has become the goal of many researchers (Liu *et al*., 2019). Liu *et al*. (2019) presented that the supplementation of 2.3 g/kg or 0.8 g/kg YC in lamb diets significantly reduced the contents of SFA such as myristic acid (14:0), palmitic acid (C16:0), heptadecanoic acid (C17:0) in the high dietary NSCFR, and significantly improved the contents of PUFA such as linoleic acid (C18:2n6c). The contents of monounsaturated fatty acids (MUFA) such as oleic acid (C18:1n9c) did not show the significant difference between the supplementation of YC group and the control group (Liu *et al*., 2019). In the low dietary NSCFR, the supplementation of 2.3 g/kg or 0.8 g/kg YC in lamb diets significantly reduced the contents of SFA such as myristic acid (14:0), palmitic acid (C16:0), and the contents of MUFA such as oleic acid (C18:1n9c) (Liu *et al*., 2019). In this study, we detected the contents of the SFA such as myristic acid (14:0), palmitic acid (C16:0) and stearic acid (C18:0), the MUFA such as palmitoleic acid (16:1), oleic acid (C18:1n9c), and elaidic acid (C18:1n9t), the PUFA such as linoleic acid (C18:2n6c) in goats between the SSDDGS and control groups. The result showed that the content of myristic acid (14:0) in the SSDDGS group was significantly higher than that in the control group, but the content of myristic acid (1.89%) in the SSDDGS group was far lower than that all groups of Liu *et al*. (2019). No significant differences were found in the contents of other fatty acids between the SSDDGS group and control group. Our studies indicated that supplementing diets with SSDDGS did not adversely affect the meat quality of growing-fattening goats.

CONCLUSIONS

The addition of *Saccharomyces cerevisiae* Refermented Distiller's Dried Grains (SSDDGS) in the diet can effectively improve the average daily gain and reduce the ratio of feed to gain of growing-fattening goats, but did not affect the slaughter performance and meat quality.

DECLARATIONS

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IRB approval

The study and animals experiment in the study were reviewed by the Southwest University Institutional Animal Care and Use Committee.

Ethics statement

All experimental procedures were approved by the Southwest University Institutional Animal Care and Use Committee. (IACUC-20210625-04).

Statement of conflict of interest

The authors have declared no conflict of interest.

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