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Effects of Urea-Sodium Bicarbonate Composite Anaerobic Treatment of Wheat Straw on Lactation Performance and Serum Biochemical Parameters in Laoshan Dairy Goats (Postprint)

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Abstract

This experiment was conducted to investigate the effects of urea-sodium bicarbonate composite anaerobic treated wheat straw on lactation performance and serum biochemical indices of Laoshan dairy goats. Twenty-four healthy second-parity Laoshan dairy goats with body weight of (53.20±1.75) kg and milk yield of (1.41±0.22) kg/d were randomly allocated to 4 groups using a single-factor randomized design, with 6 replicates per group and 1 goat per replicate. The experimental diets were formulated by mixing concentrate, whole-plant corn silage, and straw at a ratio of 4:3:3. The straws used in the 4 groups were wheat straw, composite anaerobic wheat straw (treated with 2.5% sodium bicarbonate and 4% urea and ensiled for 30 d), corn straw, and peanut vines, respectively. The experimental period lasted 75 days, including a 15-day preliminary period and a 60-day formal period. The results showed: 1) Dry matter intake (DMI) in the composite anaerobic wheat straw group was extremely significantly higher than that in the wheat straw, corn straw, and peanut vine groups ($P<0.01$), with increases of 25.67%, 11.37%, and 10.33%, respectively. 2) Milk yield in the composite anaerobic wheat straw group was extremely significantly higher than that in the wheat straw group ($P<0.01$), increased by 20.16%; there was no significant difference in 4% fat-corrected milk yield between the composite anaerobic wheat straw group and the peanut vine or corn straw groups ($P>0.05$). 3) There was no significant difference in milk protein percentage between the composite anaerobic wheat straw group and the wheat straw, peanut vine, or corn straw groups ($P>0.05$); milk fat percentage was significantly lower than that of the peanut vine group ($P<0.05$); there were no significant differences in lactose percentage or milk solids-not-fat percentage among the 4 groups ($P>0.05$); the yields of milk fat, milk protein, lactose, and milk solids-not-fat in the composite anaerobic wheat straw group were significantly or extremely significantly higher than those in the wheat straw group ($P<0.05$ or $P<0.01$), with no significant differences compared with the corn straw and peanut vine groups ($P>0.05$). 4) Serum total cholesterol content in the composite anaerobic wheat straw group was significantly lower than that in the other 3 groups ($P<0.05$), while serum triglyceride content was lower than that in the other 3 groups but the difference was not significant ($P>0.05$); there were no significant differences in serum glucose, blood urea nitrogen, total protein, albumin, or globulin contents among the 4 groups ($P>0.05$). In conclusion, feeding urea-sodium bicarbonate composite anaerobic wheat straw to Laoshan dairy goats can increase DMI, milk yield, milk fat percentage, and milk protein percentage, and increase milk component yields. The feeding effect is superior to untreated wheat straw and comparable to corn straw and peanut vines, with no adverse effects on serum biochemical indices, and can be promoted as a roughage for Laoshan dairy goats.

Full Text

Abstract

This experiment was conducted to investigate the effects of compound anaerobic treated wheat straw with urea and sodium bicarbonate on lactation performance and serum biochemical indices of Laoshan dairy goats. Twenty-four healthy second-parity Laoshan dairy goats with body weight of (53.20±1.75) kg and milk yield of (1.41±0.22) kg/d were randomly allocated into four groups using a single-factor randomized design, with six replicates per group and one goat per replicate. The experimental diets were all mixed with concentrate, whole-plant corn silage, and straw at a ratio of 4:3:3. The straw sources for the four groups were wheat straw, compound anaerobic wheat straw (supplemented with 2.5% sodium bicarbonate and 4% urea, ensiled for 30 days), corn stover, and peanut vine, respectively. The experiment lasted for 75 days, including a 15-day pre-trial period and a 60-day formal trial period. The results showed: 1) Dry matter intake (DMI) in the compound anaerobic wheat straw group was extremely significantly higher than that in the wheat straw, corn stover, and peanut vine groups ($P<0.01$), with increases of 25.67%, 11.37%, and 10.33%, respectively. 2) Milk yield in the compound anaerobic wheat straw group was extremely significantly higher than that in the wheat straw group ($P<0.01$), with an increase of 20.16%; the 4% fat-corrected milk (FCM) yield in the compound anaerobic wheat straw group showed no significant difference compared with the peanut vine and corn stover groups ($P>0.05$). 3) Milk protein percentage in the compound anaerobic wheat straw group showed no significant difference from the wheat straw, peanut vine, and corn stover groups ($P>0.05$), while milk fat percentage was significantly lower than that in the peanut vine group ($P<0.05$). No significant differences were observed among the four groups in lactose percentage and milk non-fat solid percentage ($P>0.05$). The yields of milk fat, milk protein, lactose, and milk non-fat solids in the compound anaerobic wheat straw group were significantly or extremely significantly higher than those in the wheat straw group (P<0.05 or P<0.01), but showed no significant difference from the corn stover and peanut vine groups (P>0.05). 4) Serum total cholesterol content in the compound anaerobic wheat straw group was significantly lower than that in the other three groups (P<0.05), while serum triglyceride content was lower than that in the other three groups but the difference was not significant (P>0.05). No significant differences were observed among the four groups in serum glucose, urea nitrogen, total protein, albumin, or globulin contents (P>0.05). In conclusion, feeding compound anaerobic treated wheat straw with urea and sodium bicarbonate to Laoshan dairy goats can improve DMI, milk yield, milk fat percentage, and milk protein percentage, increase milk component yields, and produce feeding effects superior to untreated wheat straw and comparable to corn stover and peanut vine, without adverse effects on serum biochemical indices. Therefore, urea-sodium bicarbonate compound anaerobic treated wheat straw can be promoted and applied as a roughage source for Laoshan dairy goats.

Keywords: compound anaerobic treatment; roughage; lactation performance; serum biochemical indices

Introduction

Straw is an important roughage resource in China, and its full utilization is of great significance for alleviating the current shortage of high-quality roughage. Due to factors such as high lignification degree, low crude protein content, low nutrient digestibility, and poor palatability, direct feeding of straw yields poor results. Appropriate processing treatments can improve the utilization rate of medium- and low-quality roughage [1]. Alkali treatment of straw can weaken the hydrogen bonding within fibers, destroy ester or ether bonds, cause fiber molecules to swell, and dissolve hemicellulose and partial lignin, making it easier for rumen fluid to penetrate and for rumen microorganisms to function, thereby improving straw palatability and increasing intake and digestibility [2]. Additionally, adding urea to straw allows the ammonia released from urea decomposition to react with organic matter in the straw to form ammonium salts, effectively increasing the crude protein content of straw [3]. In recent years, straw anaerobic alkali treatment technology has attracted increasing attention due to its advantages of significant effects, low cost, environmental protection, and suitability for large-scale application. Shi et al. [4–5] used calcium oxide anaerobic treatment of corn stover to effectively prevent mold deterioration, and this treatment method could significantly improve the effective degradation rates of dry matter, organic matter, and neutral detergent fiber (NDF) in the rumen as well as in vitro gas production. Shreck et al. [6] replaced 20% of untreated wheat straw and corn stover in beef cattle diets with 20% calcium oxide-alkali treated wheat straw and corn stover, respectively, resulting in average daily weight gain increases of 9.7% and 12.5%, and feed-to-gain ratio reductions of 10.7% and 5.0%. Anaerobic alkali treatment can significantly improve the feeding value of medium- and low-quality roughage, but few studies have reported on the effects of compound anaerobic alkali treatment of straw on lactation performance and serum biochemical indices of dairy goats. This experiment investigated the effects of urea-sodium bicarbonate compound anaerobic treated wheat straw on lactation performance and serum biochemical indices of Laoshan dairy goats, aiming to explore the feeding effects of compound anaerobic treated straw on dairy goats and provide a theoretical basis for its application.

Materials and Methods

1.1 Experimental Materials

Wheat straw, corn stover, and peanut vine were collected from large-scale goat farms in Shandong Province, naturally dried, and chopped to 3–5 cm for later use. The preparation method for compound anaerobic wheat straw was as follows: fresh wheat straw after grain harvest was chopped to 3–5 cm, then sodium bicarbonate and urea were added at 2.5% and 4% of straw dry matter weight, respectively. After mixing thoroughly, water was added to adjust moisture content to 35%, and the mixture was immediately packed into silage bags, compacted, sealed, and anaerobically treated for 30 days, then naturally dried before feeding. The urea used in the experiment was analytical grade with nitrogen content 46.7%, purchased from Yangmei Group Yantai Juli Chemical Fertilizer Co., Ltd. Sodium bicarbonate was chemically pure with purity 99.9%, purchased from Qingdao Soda Ash Development Co., Ltd. The nutrient levels of wheat straw before and after compound anaerobic treatment are shown in Table 1 .

1.2 Experimental Animals and Diets

Twenty-four healthy second-parity Laoshan dairy goats with body weight of (53.20±1.75) kg and milk yield of (1.41±0.22) kg/d were selected and randomly allocated into four groups using a single-factor randomized design, with six replicates per group and one goat per replicate. The experimental diets were all mixed with concentrate, whole-plant corn silage, and straw at a ratio of 4:3:3. The straw sources for the four groups were wheat straw, compound anaerobic wheat straw, corn stover, and peanut vine, respectively. The composition and nutrient levels of experimental diets are shown in Table 2 . The experiment lasted for 75 days, including a 15-day pre-trial period and a 60-day formal trial period.

1.3 Animal Management

Goats were housed individually and fed at 06:30, 11:30, and 17:30 daily, with ad libitum access to feed and clean water. Machine milking was performed at 06:00 and 18:00 daily, with feed intake and health status recorded simultaneously. All groups had identical feeding and management conditions.

1.4 Measurements

1.4.1 Dry Matter Intake (DMI) During the formal trial period, feed offered and refusals were accurately recorded at each feeding to calculate DMI.

1.4.2 Milk Yield During the formal trial period, morning and evening milk yields were accurately recorded daily to calculate 4% fat-corrected milk (FCM) yield using the following formula: 4% FCM yield = (0.4 + 15 × milk fat yield) × milk yield.

1.4.3 Milk Composition Milk samples were collected at 06:00 and 18:00 on days 1, 20, 40, and 60 of the formal trial period. The two samples were mixed at a 1:1 ratio and stored at 4°C. Milk composition was determined using an HZDY-UL80BC milk composition analyzer.

1.4.4 Serum Biochemical Indices Blood samples were collected on days 1 and 60 of the formal trial period. Five milliliters of venous blood was collected from each goat using sodium heparin anticoagulant tubes, centrifuged at 4,000 r/min for 10 min, and the supernatant was transferred to 2 mL centrifuge tubes and stored at -80°C. Serum glucose (GLU), urea nitrogen (UN), total protein (TP), albumin (ALB), globulin (GLOB), total cholesterol (CHOL), and triglyceride (TG) contents were determined using kits provided by Nanjing Jiancheng Bioengineering Institute.

1.5 Statistical Analysis

Experimental data were initially processed using Excel 2010 and analyzed using SPSS 17.0 software for one-way ANOVA. Duncan' s multiple comparison test was used to examine significant differences among groups. Data were expressed as mean ± standard error, with $P<0.05$ and $P<0.01$ as the criteria for significant and extremely significant differences, respectively.

Results

2.1 DMI, Milk Yield, and Milk Composition

As shown in Table 3 , DMI in the compound anaerobic wheat straw group was extremely significantly higher than that in the wheat straw, corn stover, and peanut vine groups ($P<0.01$), with increases of 25.67%, 11.37%, and 10.33%, respectively. The corn stover and peanut vine groups were extremely significantly higher than the wheat straw group ($P<0.01$). Regarding milk yield, the compound anaerobic wheat straw group was extremely significantly higher than the wheat straw group ($P<0.01$), with an increase of 20.16%, but showed no significant difference from the corn stover and peanut vine groups ($P>0.05$). The 4% FCM yield in the wheat straw group was significantly lower than that in the peanut vine group ($P<0.05$), while the compound anaerobic wheat straw group showed no significant difference from the corn stover and peanut vine groups (P>0.05), and was 8.73% higher than the wheat straw group.

Milk fat percentage in the wheat straw group was extremely significantly lower than that in the corn stover and peanut vine groups (P<0.01). Milk fat percentage in the compound anaerobic wheat straw group was significantly lower than that in the peanut vine group (P<0.05), but showed no significant difference from the wheat straw and corn stover groups (P>0.05). When converted to milk fat yield, the wheat straw group was significantly lower than the compound anaerobic wheat straw, corn stover, and peanut vine groups (P<0.05). Milk protein percentage in the wheat straw group was significantly lower than that in the peanut vine group (P<0.05), but showed no significant difference from the compound anaerobic wheat straw and corn stover groups (P>0.05). When converted to milk protein yield, the compound anaerobic wheat straw and peanut vine groups were extremely significantly higher than the wheat straw group (P<0.01), and the corn stover group was significantly higher than the wheat straw group (P<0.05). No significant differences were observed among the four groups in milk non-fat solid percentage and lactose percentage (P>0.05). However, milk non-fat solid and lactose yields were significantly higher in the compound anaerobic wheat straw and peanut vine groups compared with the wheat straw group (P<0.05), with no significant difference from the corn stover group (P>0.05).

2.2 Serum Biochemical Indices

As shown in Table 4 , serum total cholesterol content in the compound anaerobic wheat straw group was significantly lower than that in the other three groups (P<0.05), while serum triglyceride content was lower than that in the other three groups but the difference was not significant (P>0.05). No significant differences were observed among the four groups in serum glucose, urea nitrogen, total protein, albumin, or globulin contents (P>0.05).

Discussion

3.1 Effects of Urea-Sodium Bicarbonate Compound Anaerobic Treated Wheat Straw on DMI of Laoshan Dairy Goats

DMI is a necessary condition for animals to obtain required energy and nutrients and maintain health. Factors affecting ruminant DMI include animal, diet, environment, and management aspects. In this experiment, animal factors, environmental factors, and management methods were consistent, with diet being the main factor affecting DMI of dairy goats. Dietary effects on DMI manifest in two aspects: physical and chemical factors of the diet, and nutrient content in the diet [8]. In this experiment, different roughage sources were used to feed Laoshan dairy goats. DMI in the wheat straw group was extremely significantly lower than that in the compound anaerobic wheat straw, corn stover, and peanut vine groups, while DMI in the compound anaerobic wheat straw group was extremely significantly higher than that in the corn stover and peanut vine groups. The possible reason is that the NDF content in the compound anaerobic wheat straw group was lower than that in the other three groups, and feeding diets with low NDF content can reduce rumen digesta volume and increase animal DMI [9]. After anaerobic alkali treatment, some functional groups in wheat straw were cleaved, breaking the three-dimensional network macromolecular structure composed of cellulose, hemicellulose, and lignin into smaller molecules, destroying the siliceous cell surface layer in the cell wall, increasing straw hydrophilicity, making the straw soft and loose with a pleasant aroma, thereby improving diet palatability and increasing DMI [10]. Zorrilla-Rios et al. [11] reported that urea treatment could enhance the brittleness of wheat straw, accelerating its passage through the rumen and thus increasing intake. Additionally, sodium bicarbonate supplementation can increase the alkali reserve of ruminants, neutralize acidic substances in the rumen, promote gastrointestinal motility, increase rumen fluid pH, and improve palatability [12]. Cao et al. [13] used urea, calcium hydroxide, and salt compound treatment of wheat straw and rice straw to feed beef cattle, increasing intake by 6.8%–23.5% and rumen dry matter degradation rates by 20.6% and 25.3% compared with untreated straw, which is basically consistent with the results of this experiment. DMI in the corn stover and peanut vine groups was higher than that in the wheat straw group, with increases of 12.83% and 13.90%, respectively. The possible reason is that the in vitro dry matter degradation rate of wheat straw (34.33%) was significantly lower than that of corn stover (46.84%) and peanut vine (54.14%) [14], and dry matter degradation rate is an important factor affecting diet intake that is positively correlated with DMI [15].

3.2.1 Milk Yield

Milk yield is one of the important indicators for measuring the economic status of dairy goats. The main factors affecting ruminant milk yield include genetics, physiology, and environment, with external environmental factors accounting for 70%–75% of the influence, and dietary nutrition level being the most important factor among external environmental factors. In this experiment, milk yield in the compound anaerobic wheat straw group was extremely significantly higher than that in the wheat straw group, and the corn stover and peanut vine groups were significantly higher than the wheat straw group. DMI may be the main reason affecting milk yield, as there is a positive correlation between milk yield and DMI in dairy goats. DMI determines the amount of nutrients available for maintenance and production in dairy goats, and increased nutrient intake leads to increased energy intake, which directly affects milk yield [16]. The addition of urea and sodium bicarbonate in the compound anaerobic wheat straw group may also be an important reason for improving milk yield. Ammonia released from urea can synthesize microbial protein with dietary carbohydrates under the action of rumen microorganisms. Microbial protein has high biological value, and the amino acids it provides account for 40%–80% of the total amino acids in the small intestine of ruminants, providing substantial protein nutrition for the animal [17]. Related studies have shown that milk yield of dairy goats increases with increasing dietary protein levels [18]. Both urea and sodium bicarbonate can alter rumen volatile fatty acid composition and increase acetic acid content [19-20], and increased acetic acid content can improve both milk yield and milk fat percentage. Che [21] added urea to dairy cow diets, increasing average milk yield from 8.68 kg/d at the beginning to 9.22 kg/d at the end of the experiment, an increase of 6.22%. DMI and milk yield in the wheat straw group were lower than those in the corn stover and peanut vine groups, possibly related to the NDF content of the three straw types. NDF is mainly composed of cellulose, hemicellulose, and lignin. Cellulose and hemicellulose can be utilized in the rumen, while lignin cannot be utilized by microorganisms at all. The lignin contents of wheat straw, corn stover, and peanut vine are 7.04%-7.44%, 5.28%, and 3.35%, respectively [22-24], and lignin content affects the degradation rate of NDF in the rumen. Li [25] reported that increasing NDF degradation rate can significantly increase feed intake and milk yield of dairy cows. The NDF degradation rates of wheat straw, corn stover, and peanut vine in the rumen are 28.70%, 36.79%, and 38.18%, respectively [14]. The lower NDF degradation rate of wheat straw resulted in the lowest milk yield in the wheat straw group. After converting milk yield to 4% FCM yield, the wheat straw group remained significantly lower than the peanut vine group, possibly because the wheat straw group had poorer palatability, lower DMI, lower milk yield, and lower degradable NDF content, which could not meet the energy and protein nutritional requirements of dairy goats, resulting in lower milk yield and milk fat percentage, and consequently lower 4% FCM yield.

3.2.2 Milk Composition

Milk fat, milk protein, milk non-fat solids, and lactose in milk composition are the main indicators for measuring milk quality and dietary nutritional value. The ratios and yields of milk components are affected by various factors including genetics, DMI, milk yield, dietary concentrate-to-roughage ratio, and energy intake. Milk fat percentage consists of short-chain and medium-chain fatty acids in milk and is easily affected by dietary composition [26]. Milk protein mainly includes casein, whey protein, and a small amount of milk fat globule membrane protein. Dietary energy and its utilization by the animal are the main factors affecting milk composition, especially milk protein concentration. Decreased energy leads to reduced milk protein and milk fat percentages [27], and high-quality roughage fermented in the rumen can meet the needs of ketone acids and ATP for microbial protein synthesis. In this experiment, milk fat percentage and milk fat yield in the wheat straw group were significantly lower than those in the corn stover and peanut vine groups, and milk protein percentage and milk protein yield were significantly lower than those in the peanut vine group. The lower milk composition and yields in the wheat straw group may be due to the lower nutritional level of wheat straw. Peanut vine and corn stover have higher crude protein content and lower crude fiber content, making them superior to wheat straw [28]. The digestible energy values of wheat straw, corn stover, and peanut vine are 1.65, 2.57, and 2.22 MJ/kg, respectively [29], and wheat straw has lower digestible energy than corn stover and peanut vine. Adding wheat straw to the diet reduced the digestibility of nutrients in dairy goats and significantly decreased milk quality and milk component yields. In this experiment, no significant differences were observed in milk component ratios between the wheat straw and compound anaerobic wheat straw groups, but after converting to milk component yields, the compound anaerobic wheat straw group showed significantly or extremely significantly higher yields of milk fat, milk protein, milk non-fat solids, and lactose than the wheat straw group. In addition to the higher nutritional level of the compound anaerobic wheat straw group, sodium bicarbonate supplementation may have increased animal water intake [30]. Increased milk yield dilutes milk components, and there is a significant negative correlation between milk yield and milk component concentration [31]. The higher milk component yields in the compound anaerobic wheat straw group indicate that anaerobic alkali-treated wheat straw significantly improved milk component quality compared with untreated wheat straw. The increase in milk protein percentage and yield may be closely related to microbial protein synthesized from ammonia released by urea decomposition in the rumen, as increased microbial protein content improved milk protein yield. The increases in milk fat percentage, milk fat yield, lactose percentage, and lactose yield may be because the compound anaerobic wheat straw group had significantly higher DMI than the wheat straw group, and carbohydrates produced large amounts of volatile fatty acids under the action of rumen microorganisms. Volatile fatty acids can provide 70%–80% of the energy requirements for ruminants [32], with acetic acid and propionic acid accounting for approximately 62.9%–69.3% and 18.6%–30.1% of total volatile fatty acids, respectively [7]. Acetic acid and propionic acid are important precursors for milk fat and lactose, respectively, so increased DMI may be an indirect reason for increased milk fat and lactose yields. Milk non-fat solid percentage increases with increasing milk components and their yields [33]. Mao et al. [34] used 2.5% urea and 5% calcium hydroxide compound-treated barley straw pellets to replace Leymus chinensis in feeding lactating dairy cows and found that milk fat percentage and lactose percentage in the compound-treated barley straw pellet group showed no significant difference from the high-quality Leymus chinensis group. Wanapat et al. [35] used 5.5% urea or 2.2% urea + 2.2% calcium hydroxide to treat rice straw for feeding dairy cows. Compared with the untreated rice straw group, milk protein percentage increased by 17.86% and 21.43%, and milk fat percentage increased by 7.89% and 13.16%, respectively, with numerical improvements in lactose percentage and milk non-fat solid percentage. These reports are consistent with the results of this experiment. Sodium bicarbonate supplementation may also be an important reason for improved milk quality in the compound anaerobic wheat straw group. Zheng et al. [36] and Sun [37] reported that sodium bicarbonate could increase rumen fluid pH, shift rumen fermentation toward acetic acid type, and promote rumen microbial activity, thereby improving the synthesis efficiency of milk fat and milk protein.

3.3 Effects of Urea-Sodium Bicarbonate Compound Anaerobic Treated Wheat Straw on Serum Biochemical Indices of Laoshan Dairy Goats

Serum biochemical components are the material basis reflecting animal life activities, and their contents and changing patterns are important biological characteristics of the animal body. Changes in serum glucose content reflect the dynamic balance state of sugar absorption, transport, and metabolism in the body [38]. Serum urea content can reflect animal protein metabolism status, mainly derived from rumen-degradable protein in the diet and ammonia nitrogen absorbed from the rumen wall. It is the end product of protein and amino acid metabolism in the animal body, and serum urea nitrogen content is inversely proportional to dietary nitrogen utilization efficiency [39]. Serum total protein consists of albumin and globulin, generally reflecting protein synthesis in the body. Albumin is an important indicator for judging animal energy and protein nutritional status, participating in liver function synthesis and fatty acid transport. Decreased albumin is one of the signs of liver function damage. Globulin is the main protein involved in immune responses in the body, affecting animal humoral immune function [40]. Serum triglyceride is the main energy source in the body, and its content reflects fat metabolism. When lipid metabolism is impaired, blood lipid content will significantly increase [41]. In this experiment, the four diets had no adverse effects on serum glucose, urea nitrogen, total protein, albumin, or globulin contents in Laoshan dairy goats, indicating that compound anaerobic wheat straw had basically no effect on glucose metabolism, protein metabolism, nitrogen utilization efficiency, or immune function compared with wheat straw, corn stover, and peanut vine. These results are basically consistent with the research reports of Liu [42] and Zhou et al. [43]. In this experiment, serum triglyceride content in the compound anaerobic wheat straw group was numerically lower than that in the wheat straw, corn stover, and peanut vine groups, and serum total cholesterol content was significantly lower than that in the other three groups. However, the total cholesterol content of experimental animals ranged from 1.89 to 2.58 mmol/L, all within the normal range [44]. Triglyceride can directly participate in total cholesterol synthesis and is a form of energy storage in the body and one component of blood lipids, existing in dynamic equilibrium. Serum triglyceride reflects the body' s utilization of lipids, and lower content means higher fat utilization efficiency. Therefore, the results of this experiment indicate that the compound anaerobic wheat straw group could effectively reduce serum total cholesterol content and improve fat utilization efficiency. The reduction in serum triglyceride and total cholesterol contents in this experiment may be related to urea supplementation. Che [21] added 90 g/d urea to dairy cow diets and observed a decreasing trend in serum total cholesterol content. The specific mechanism of urea' s effect on reducing serum total cholesterol and triglyceride requires further research.

Conclusion

1. Using wheat straw treated with 2.5% sodium bicarbonate and 4% urea under compound anaerobic conditions as roughage for Laoshan dairy goats increased DMI, milk yield, milk fat percentage, and milk protein percentage by 25.67%, 20.16%, 8.47%, and 6.57%, respectively, compared with untreated wheat straw. DMI in the compound anaerobic wheat straw group was 11.37% and 10.33% higher than that in the corn stover and peanut vine groups, respectively. Milk yield, 4% FCM yield, milk composition, and milk component yields were comparable to those of corn stover and peanut vine.

2. Feeding Laoshan dairy goats with wheat straw treated with 2.5% sodium bicarbonate and 4% urea under compound anaerobic conditions reduced serum total cholesterol and triglyceride contents without adverse effects on serum biochemical indices.

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