Effects of Alfalfa Meal on Growth Performance and Economic Benefit Analysis in Boer Goats: Postprint

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Abstract

The present study was conducted to investigate the effects of alfalfa meal on growth performance and economic benefit analysis in Boer goats. Seventy-five female Boer goats with body weight of 24–28 kg were selected and allocated into 5 groups using a completely randomized block design, with 3 replicates per group and 5 goats per replicate. The control group was fed a basal diet, while the other four groups (treatment groups I, II, III, and IV) were fed diets in which peanut vine was replaced by 10%, 20%, 30%, and 40% alfalfa meal, respectively. The preliminary period lasted 7 days, and the formal experimental period lasted 60 days. Results showed that there was no significant difference in average daily feed intake among the five groups ($P>0.05$), but it exhibited a decreasing trend as the replacement level of alfalfa meal increased. The average daily gain of treatment groups III and IV was significantly higher than that of the other three groups, and showed an increasing trend with increasing alfalfa meal replacement level. The feed conversion ratio of the four treatment groups was lower than that of the control group, with treatment groups III and IV being significantly lower than the control group ($P<0.05$), and treatment group IV had the lowest value at 6.53. These results suggest that replacing peanut vine with alfalfa meal in Boer goat diets can increase average daily gain and reduce feed conversion ratio, and a 40% replacement level of alfalfa meal resulted in better growth performance, but feed costs increased.

Full Text

Effects of Alfalfa Meal on Growth Performance of Boer Goats and Economic Benefits Analysis

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Abstract

This experiment investigated the effects of alfalfa meal on growth performance and economic benefits in Boer goats. Seventy-five healthy Boer goat ewes weighing 24–28 kg were allocated to five treatment groups using a completely randomized block design, with three replicates per group and five goats per replicate. The control group received a basal diet, while experimental groups I, II, III, and IV received diets in which 10%, 20%, 30%, and 40% of peanut vine in the basal diet was replaced with alfalfa meal, respectively. Following a 7-day pre-trial period, the formal trial lasted 60 days. Results showed no significant differences in average daily feed intake (ADFI) among the five groups ($P > 0.05$), though ADFI tended to decrease with increasing alfalfa substitution levels. Average daily gain (ADG) in groups III and IV was significantly higher than in the other three groups ($P < 0.05$), with ADG showing an upward trend as alfalfa substitution increased. Feed-to-gain ratio (F/G) in all four experimental groups was lower than in the control group, with groups III and IV being significantly lower ($P < 0.05$); group IV achieved the lowest F/G at 6.53. These findings indicate that replacing peanut vine with alfalfa meal in Boer goat diets can increase ADG and reduce F/G, with 40% substitution yielding optimal growth performance, albeit at increased feed cost.

Keywords: Boer goat; alfalfa meal; growth performance; economic benefits

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Introduction

With rising living standards and evolving dietary preferences, consumers increasingly seek high-quality protein sources and nutritional balance, accelerating the development of herbivorous livestock production. In northern China, peanut vine serves as the primary roughage for goat feeding. Although annual peanut vine production reaches 27–30 million tons, seasonal limitations and challenges in intensive production constrain modern goat farming development [1]. Consequently, large-scale production of high-quality forage and processed forage products has become imperative [2]. Alfalfa, known as the "king of forages,"

offers advantages including high yield, rich nutrition, excellent forage quality, good palatability, and ecological benefits [3], making it the most important leguminous forage in northern China, including North China, Northwest, and Northeast regions. Previous research demonstrates that alfalfa utilization improves growth performance in dairy cows and other livestock [4–12], though studies in meat sheep production remain relatively limited [13]. Processing alfalfa into meal can address seasonal imbalances in roughage supply for meat sheep production while providing high nutritional value. Pelleted total mixed rations (TMR) significantly improve diet palatability, effectively prevent selective feeding, maintain relatively stable rumen environment and microbial populations, and sustain normal digestion, fermentation, absorption, and metabolism, providing crucial support for ruminant growth [14]. This study investigated the effects of replacing peanut vine with alfalfa meal in pelleted TMR on Boer goat growth performance and analyzed the economic implications to provide scientific reference for alfalfa application in meat sheep production.

Materials and Methods

Experimental Design Seventy-five healthy Boer goat ewes approximately three months old, weighing 24–28 kg with good body condition and normal appetite, were selected and allocated to five groups using a completely randomized block design based on similar body weight: control, experimental I, experimental II, experimental III, and experimental IV. Each group contained three replicates with five goats per replicate.

Experimental Diets and Management The control group received a basal diet composed of 40% concentrate, 40% peanut vine, 15% cassava distiller' s grains powder, and 5% selfheal powder, with nutrient levels formulated according to the *Feeding Standard of Meat Sheep* (NY/T 816-2004). Experimental groups received diets in which 10%, 20%, 30%, and 40% of peanut vine was replaced with equivalent amounts of alfalfa meal. Diet composition and nutrient levels are presented in Table 1 . Roughage and concentrate were accurately weighed according to formulation, thoroughly mixed, and pelleted into cylindrical TMR pellets measuring 0.80 cm in diameter and 1.5–2.0 cm in length. The pre-trial period lasted 7 days, followed by a 60-day formal trial period.

The entire trial was conducted under housed conditions. Prior to the experiment, all pens were cleaned and disinfected. Selected goats of the same age with good health and similar size were weighed, numbered, and grouped, then dewormed and vaccinated. During the pre-trial period, all goats received the same basal diet while their behavior and health status were closely monitored for timely adjustments. Goats were fed twice daily at 08:00 and 16:00 with ad libitum access to feed and water. Feed troughs were cleaned each morning before feeding, and residual feed was recorded. Throughout the trial, feed intake, water consumption, and excretion were carefully observed and recorded. Pens were cleaned every two days and disinfected every 30 days to prevent infectious

diseases.

Measurements **Average Daily Feed Intake (ADFI):** Feed offered was recorded at each feeding, and residual feed was weighed each morning before feeding to calculate ADFI.

Average Daily Gain (ADG): Goats were fasted and weighed on the first morning of the formal trial (initial weight) and subsequently fasted and weighed every 30 days. ADG was calculated accordingly.

Feed-to-Gain Ratio (F/G): Feed conversion efficiency was measured using F/G ratio, calculated as ADFI divided by ADG.

Economic Analysis Feed cost per kilogram of weight gain (RMB/kg) was calculated as: total feed intake × total feed cost / total weight gain.

Statistical Analysis Data were processed using Excel 2007 and analyzed using SPSS 20.0 software with ANOVA models. Results are expressed as "mean ± standard deviation,"and Duncan's multiple comparison test was used for inter-group comparisons, with $P < 0.05$ considered statistically significant.

Results

Average Daily Feed Intake at Different Growth Stages The effects of alfalfa meal on ADFI at different growth stages are shown in Table 2 . ADFI varied among groups at different stages, with intake during days 31–60 showing an increasing trend compared to days 1–30. During days 1–30, all four experimental groups had lower ADFI than the control group, with intake decreasing as alfalfa substitution increased, though differences were not significant ($P > 0.05$). During days 31–60, no significant differences were observed among the five groups ($P > 0.05$). Over the entire 60-day period, the control group had the highest ADFI, while all experimental groups had lower intake that decreased progressively with increasing alfalfa substitution, though differences remained non-significant ($P > 0.05$).

Average Daily Gain at Different Growth Stages The effects of alfalfa meal on ADG at different growth stages are presented in Table 3 . ADG differed among groups across stages, with gains during days 31–60 exceeding those during days 1–30. During days 1–30, all four experimental groups showed significantly higher ADG than the control group ($P < 0.05$), with ADG increasing as alfalfa substitution rose; group IV was significantly higher than the other three experimental groups ($P < 0.05$). During days 31–60, group I was significantly lower than the control ($P < 0.05$), while group III was significantly higher than both the control and groups I and II ($P < 0.05$). Over the entire 60-day period, all experimental groups except group I had higher ADG than the control, with groups III and IV being significantly higher ($P < 0.05$). Among experimental

groups, III and IV were significantly higher than I and II ($P < 0.05$), showing a progressive increase with alfalfa substitution level.

Feed-to-Gain Ratio The effects of alfalfa meal on F/G ratio are shown in Table 4 . All four experimental groups had lower F/G ratios than the control, with groups III and IV being significantly lower ($P < 0.05$). Group IV was significantly lower than groups I, II, and the control ($P < 0.05$), achieving the lowest F/G ratio of 6.53 and thus the highest feed conversion efficiency.

Economic Analysis Economic analysis results are presented in Table 5 . The control group without alfalfa meal had the lowest feed cost and lowest cost per kilogram of weight gain. Experimental groups with alfalfa meal showed increased feed costs and higher costs per kilogram of weight gain.

Discussion

Effects of Alfalfa Meal on Average Daily Feed Intake As herbivores, Boer goats efficiently utilize dietary crude fiber. Alfalfa hay is rich in fiber with high digestible components, making it an important roughage resource. Alfalfa meal contains 16–22% crude protein, abundant minerals, vitamins, and pigments, as well as saponins, polysaccharides, and unidentified growth and reproductive factors. Its crude fiber content is approximately 25%, with a large proportion of digestible components, making it highly palatable for livestock. Research on alfalfa meal' s effects on animal growth performance remains limited with inconsistent results [15]. Xu et al. [13] found that substituting 0%, 10%, 20%, 30%, and 40% of dietary roughage with alfalfa hay had no significant effects on growth performance of Dorper × Han crossbred sheep. Liu et al. [1] reported no significant differences in intake between alfalfa-fresh-feeding and control groups throughout their trial. Huang et al. [16] observed slightly increased ADFI when adding 5% or 10% alfalfa meal to basal diets, possibly because alfalfa meal' s lower energy value could not meet pigs' energy requirements, triggering physiological mechanisms to increase intake. Conversely, Wang et al. [17] found ADFI tended to decrease with increasing alfalfa meal inclusion. In our study, all four experimental groups had lower ADFI than the control, though differences were not significant. This may be attributed to alfalfa' s high digestible energy for goats; as substitution increased, dietary energy rose, reducing intake. Another possible reason is that finely ground alfalfa meal may generate gas in the rumen, creating satiety and reducing intake.

Effects of Alfalfa Meal on Average Daily Gain Previous studies on alfalfa application in meat sheep production demonstrate that processed alfalfa products (hay, meal, pellets) can improve growth performance. Chu et al. [18] reported that replacing equal proportions of grass hay with 20% alfalfa meal increased weight gain by 21.47% in Hu sheep. Chen et al. [19] found that feeding 200 g of alfalfa pellets daily to fattening lambs increased ADG to 292.20

g, a 33.00% improvement over the control. Wang et al. [20] observed a trend toward increased ADG and decreased F/G when replacing cottonseed hulls and peanut vine with alfalfa hay at 0, 2.5, 5.0, and 7.5 kg/d in beef cattle. Li et al. [21] reported optimal fattening results for Dorper × local Mongolian crossbred sheep when alfalfa meal inclusion was controlled between 40.0% and 47.5%. Our results align with these findings, showing ADG in Boer goats increased with alfalfa substitution level. Improved ADG may result from: (1) alfalfa' s rich content of crude protein, vitamins, minerals, and unidentified growth factors, which increase with substitution level and can be effectively utilized by goats; and (2) improved rumen fermentation conditions facilitated by alfalfa meal.

Effects of Alfalfa Meal on Feed-to-Gain Ratio Feed-to-gain ratio reflects feed quality and feeding efficacy—the lower the ratio, the better the feed utilization [22]. Our results showed that while ADFI decreased and ADG increased with alfalfa substitution, the changes were not significant. However, F/G ratio progressively decreased with increasing alfalfa substitution among the four experimental groups, with groups III and IV being significantly lower than the control.

Economic Analysis With improving living standards, consumer expectations for mutton quality have increased, making meat quality research increasingly important [22–30]. The concept of premium pricing for superior quality has gained acceptance. Although alfalfa meal is more expensive than peanut vine, increasing feed costs, its inclusion reduces F/G ratio and, as our subsequent meat quality analyses revealed, improves mutton tenderness and increases dry matter, crude protein, and ash content in meat. Alfalfa feeding also enriches essential and umami amino acids, reduces stearic acid content, and increases palmitoleic, oleic, and linolenic acids, thereby elevating n-3 polyunsaturated fatty acid levels [31]. According to the premium pricing principle, mutton from goats fed quality forage should command higher prices. Market surveys indicate substantial price differences between premium and ordinary mutton. In this trial, group IV' s feed cost per kilogram of gain was only 1.48 RMB higher than the control. Given rising demand for high-quality mutton driven by health consciousness, using alfalfa products to produce premium mutton offers broad market prospects and will ultimately generate considerable economic returns for producers.

Conclusion

Replacing peanut vine with alfalfa meal in Boer goat diets can increase average daily gain and reduce feed-to-gain ratio. A 40% alfalfa substitution level yields optimal growth performance, though it increases feed costs.

References

[1] Liu QW, Wang CZ, Yan XB, et al. Effects of fresh alfalfa feeding on slaughter traits and meat quality of Boer goats [J]. *Acta Prataculturae Sinica*, 2010, 19(1): 158-165.
[2] Lv XD. Study on introduction and comparison of foreign alfalfa varieties in Tumochuan Plain [D]. PhD thesis. Hohhot: Inner Mongolia Agricultural University, 2013: 67-78.
[3] Zhang CM, Wang CZ, Hu XF, et al. Research progress on nutritional value and application of alfalfa [J]. *China Feed*, 2005(1): 15-18.
[4] Yang L, Xu AK. Nutrition, feeding methods and application of alfalfa in animal husbandry [J]. *Jilin Agricultural Sciences*, 2012, 33(2): 12-15.
[5] Long RJ, Shi SL, Wei XH, et al. Alfalfa nutrition and feeding techniques [J]. *China Dairy*, 2002(2): 16-18.
[6] Liu QW, He Y, Wang CZ, et al. Research progress on alfalfa application in ruminant feed [J]. *Cereal & Feed Industry*, 2006(3): 30-31.
[7] Eklund M, Rademacher M, Sauer WC, et al. Standardized ileal digestibility of amino acids in alfalfa meal, sugar beet pulp, and wheat bran compared to wheat and protein ingredients for growing pigs [J]. *Journal of Animal Science*, 2014, 92(3): 1037-1043.
[8] Baurhoo B, Mustafa A. Short communication: Effects of molasses supplementation on performance of lactating cows fed high-alfalfa silage diets [J]. *Journal of Dairy Science*, 2014, 97(2): 1072-1076.
[9] Laudadio V, Ceci E, Lastella NMB, et al. Low-fiber alfalfa (*Medicago sativa* L.) meal laying hen diet: effects on productive traits and egg quality [J]. *Poultry Science*, 2014, 93(7): 1868-1874.
[10] Escarcha JF, Callaway TA, Byrd JA, et al. Effects of dietary alfalfa inclusion on *Salmonella typhimurium* populations in growing layer chicks [J]. *Foodborne Pathogens and Disease*, 2012, 9(10): 945-951.
[11] Wildeus S, Turner KE, Collins JR. Growth, intake, diet digestibility, and nitrogen use in three hair sheep breeds fed alfalfa hay [J]. *Small Ruminant Research*, 2007, 69(1/2/3): 221-228.
[12] Bosco AD, Mugnai C, Roscini V, et al. Effect of dietary alfalfa on the fatty acid composition and indexes of lipid metabolism of rabbit meat [J]. *Meat Science*, 2014, 96(1): 606-609.
[13] Xu H, Li GZ, Gao YG, et al. Effects of alfalfa hay on production performance, rumen pH and ammonia nitrogen of Dorper × Han F1 sheep [J]. *Acta Agrestia Sinica*, 2013, 21(5): 1012-1017.
[14] Liu TY, Jia YS, Ge GT, et al. Effects of forage-based total mixed ration on lamb meat quality [J]. *Acta Agrestia Sinica*, 2012, 20(2): 378-382.
[15] Pan JL, Li ZT, Wang CZ, et al. Application of alfalfa meal in animal feed [J]. *Feed Research*, 2006(7): 63-65.
[16] [To be supplemented]
[17] Wang YH, Cheng NN, Zheng AR, et al. Effects of alfalfa meal and alfalfa saponins on growth performance and antioxidant capacity of finishing pigs [J]. *Chinese Journal of Animal Nutrition*, 2013, 25(12): 2981-2988.

[18] Chu GL, Ding JY, Hua WH, et al. Study on fattening effect of alfalfa meal on Hu sheep [J]. *Jiangsu Agricultural Sciences*, 2002(6): 67-68.
[19] Chen WF, Yang YJ, Tang XL, et al. Experiment on feeding fattening lambs with alfalfa pellets [J]. *China Herbivores*, 2004, 35(S1): 143-144.
[20] Wang WJ, Li XD, Shi YH, et al. Effects of alfalfa hay on production performance and cholesterol metabolism of beef cattle [J]. *Pratacultural Science*, 2010, 27(10): 135-141.
[21] Li ZQ, Zhang C, Shao T. Effects of alfalfa meal supplementation on fattening and muscle nitrogen deposition in Dorper × local crossbred sheep [C]//Proceedings of 2009 China Grassland Development Forum. Hefei: Chinese Grassland Society, 2009: 404-412.
[22] Qian WX, Yan H, Cui WX. Study on flavor substances in grazing and housed Tan sheep [J]. *Animal Husbandry and Veterinary Medicine*, 2007, 39(1): 17-20.
[23] Sudesiqin, Biligebateer, Xin MX, et al. Study on meat performance and quality characteristics of Chahar sheep [J]. *China Herbivore Science*, 2014, 34(1): 11-16.
[24] Yang YW, Zhou YX, Sun ZP. Overview of factors influencing mutton quality and regulation measures [J]. *Journal of Domestic Animal Ecology*, 2013, 34(12): 82-85.
[25] Wu TM. Effects of different feeding modes on fattening performance, slaughter performance and meat quality of cashmere goat kids [D]. PhD thesis. Hohhot: Inner Mongolia Agricultural University, 2013.
[26] Huang QC, Cheng ZB, Li SJ, et al. Study on slaughter performance and meat physicochemical characteristics of Longling yellow goat kids [J]. *Journal of Yunnan Agricultural University*, 2008, 23(5): 634-637.
[27] Wang GY, Gao AQ, Dabuxilatu, et al. Analysis report on meat quality characteristics of Wulate sheep [J]. *Xinjiang Agricultural Sciences*, 2010(S1): 173-178.
[28] Connor WE. Importance of n-3 fatty acids in health and disease [J]. *American Journal of Clinical Nutrition*, 2000, 71(S1): 171S-175S.
[29] Scollan ND, Enser M, Gulati SK, et al. Effects of including a ruminally protected lipid supplement in the diet on the fatty acid composition of beef muscle [J]. *British Journal of Nutrition*, 2003, 90(3): 709-716.
[30] Raes K, De Smet S, Demeyer D. Effect of dietary fatty acids on incorporation of long chain polyunsaturated fatty acids and conjugated linoleic acid in lamb, beef and pork meat: a review [J]. *Animal Feed Science and Technology*, 2004, 113(1/2/3/4): 199-221.
[31] Han KK. Effects of alfalfa meal on growth performance, slaughter performance and meat quality of Boer goats [D]. Master' s thesis. Zhengzhou: Henan Agricultural University, 2016: 32-46.

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