Effects of Dietary Flammulina velutipes Spent Mushroom Substrate Levels on Slaughter Performance and Meat Quality in Goats (Postprint)

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Abstract

This study was conducted to investigate the effects of dietary Flammulina velutipes residue levels on slaughter performance and meat quality of goats. Twenty-eight Boer crossbred goats (Boer goat × Xu-Huai goat) with a body weight of (23.35$±$2.45) kg were randomly divided into 4 groups (7 goats per group) and fed experimental diets containing 0 (Group A, as control), 15% (Group B), 25% (Group C), and 40% Flammulina velutipes residue (Group D). The experimental goats were individually fed and slaughtered at the end of the experiment (after 45 d of feeding) to determine dressing percentage, loin eye area, and pH, color, shear force, cooking loss, and drip loss of the longissimus dorsi muscle. The results showed that: 1) The dressing percentage of Group C was not significantly different from Group B (P>0.05), but was significantly higher than Groups A and D (P<0.05); the dressing percentage of Group C was increased by 2.46%, 1.35%, and 8.32% compared with Groups A, B, and D, respectively. The loin eye area of Groups B and C was not significantly different from Group A (P>0.05), but was significantly higher than Group D (P<0.05). 2) The drip loss of the longissimus dorsi muscle of goats in Group C was not significantly different from Groups B and D (P>0.05), but was significantly lower than Group A (P<0.05); compared with Groups A, B, and D, the cooking loss of the longissimus dorsi muscle of goats in Group C was significantly reduced (P<0.05); the shear force of Groups B, C, and D was not significantly different (P>0.05), but all were significantly lower than Group A (P<0.05). Dietary supplementation with different levels of Flammulina velutipes residue had no significant effect on post-slaughter 45 min pH (pH45 min), post-slaughter 24 h pH (pH24 h), redness (a*) value, and yellowness (b*) value of the longissimus dorsi muscle of goats (P>0.05), but could significantly reduce the lightness (L*) value of the longissimus dorsi muscle. In conclusion, dietary supplementation with different levels

of Flammulina velutipes residue had varying degrees of influence on the slaughter performance and meat quality of goats, and a dietary Flammulina velutipes residue level of 25% had better effects on improving slaughter performance and meat quality of goats.

Full Text

Abstract

This experiment was conducted to investigate the effects of dietary enoki mushroom residue level on slaughter performance and meat quality of goats. A total of 28 healthy Boer hybrid goats (Boer goats × Xuhuai goats) with an average body weight of (23.35$±$2.45) kg were randomly allotted to 4 groups with 7 goats per group. Goats in the 4 groups were fed 4 experimental diets containing 0 (group A), 15% (group B), 25% (group C), and 40% enoki mushroom residue (group D), respectively. Goats were fed individually and slaughtered at the end of the experiment (after 45 days feeding). The dressing percentage, loin-eye area, and the pH, color scale, shear force, cooking loss rate, and drip loss rate of longissimus dorsi muscle were measured. The results showed: (1) The dressing percentage of group C was not significantly different from group B (P>0.05), but significantly higher than that of groups A and D (P<0.05). The dressing percentage of group C increased by 2.46%, 1.35%, and 8.32% compared with groups A, B, and D, respectively. The loin-eye area of groups B and C was not significantly different from group A (P>0.05), but was significantly higher than that of group D (P<0.05). The drip loss rate of longissimus dorsi muscle in group C was not significantly different from groups B and D (P>0.05), but was significantly lower than that of group A (P<0.05). Compared with groups A, B, and D, the cooking loss rate of longissimus dorsi muscle in group C was significantly decreased (P<0.05). Diets with different levels of enoki mushroom residue had no effects on pH at 45 min postmortem (pH45 min), pH at 24 h postmortem (pH24 h), redness (a*) value, and yellowness (b*) value of longissimus dorsi muscle (P>0.05), but could significantly reduce the lightness (L*) value. It is concluded that diets with different levels of enoki mushroom residue have different effects on slaughter performance and meat quality of goats, and the effect of 25% enoki mushroom residue on improving slaughter performance and meat quality is better.

Keywords: goats; enoki mushroom residue; dressing percentage; meat quality

1 Materials and Methods

1.1 Experimental Animals and Design

The experiment was conducted at the Liuhe Animal Science Base of Jiangsu Academy of Agricultural Sciences in March 2016. A total of 28 healthy Boer hybrid goats (Boer goats × Xuhuai goats) with an average body weight of (23.35$±$2.45) kg were randomly divided into 4 groups with 7 goats each. Goats

in the 4 groups were fed experimental diets containing 0 (group A), 15% (group B), 25% (group C), and 40% enoki mushroom residue (group D), respectively. The pre-experimental period lasted 7 days, and the formal experimental period lasted 45 days. Goats were fed individually. There was no significant difference in initial body weight among groups (P>0.05). After 24-hour fasting, goats were weighed and slaughtered.

1.2 Experimental Diets

The experimental diets were formulated according to nutritional requirements of meat goats. The composition and nutrient levels of experimental diets are shown in Table 1 . The premix provided the following per kg of diets: VA 66,000 IU, VD3 80,000 IU, VE 1,490 IU, FeSO4 345.15 mg, CuSO4 88 mg, K2SO4 253.6 mg, ZnSO4 285.7 mg, MnSO4 220.15 mg, CoCl2 1.25 mg, Na2SeO3 44.75 mg, monensin 30.00 mg, and NaHCO3 3,704.55 mg.

1.3 Feeding Management

Feeding was conducted according to NRC (1985) standards. Goats were fed twice daily at 08:00 and 17:00, with free access to water. The amount of feed was adjusted according to intake to ensure approximately 10% leftover.

1.4 Slaughter and Sample Collection

After 45 days of feeding, goats were slaughtered after 24-hour fasting. The longissimus dorsi muscle was collected from the left side of each carcass between the 12th and 13th ribs for measurement of meat quality indicators.

1.5 Measurement Indicators

1.5.1 pH Measurement pH was measured using a HANNA HI9125 pH meter calibrated with standard buffers (pH=4.01 and pH=6.86). pH was measured at 45 min (pH45 min) and 24 h (pH24 h) postmortem. Three replicates were performed for each sample [16].

1.5.2 Color Measurement Color was measured using a CR-400 colorimeter calibrated with a white standard plate [17]. Measurements were taken at 24 h postmortem on three slices of each sample. The CIE color scale was recorded as L* (lightness), a* (redness), and b* (yellowness) values.

1.5.3 Drip Loss Measurement Drip loss was measured according to the method of Bouton [18]. At 24 h postmortem, muscle samples (2 cm × 3 cm × 5 cm) were weighed, suspended in polyethylene bags, and stored at 4°C. After 24 h, samples were removed, blotted dry, and reweighed. Drip loss percentage was calculated as: [(initial weight - final weight) / initial weight] × 100.

1.5.4 Cooking Loss Measurement Cooking loss was measured at 48 h postmortem. Muscle samples (approximately 40$±$0.5 g) were weighed, placed in polyethylene bags, and cooked in a water bath at 75°C for 30 min until reaching an internal temperature of 70°C. After cooling, samples were blotted dry and reweighed [19]. Cooking loss percentage was calculated as: [(initial weight - final weight) / initial weight] × 100.

1.5.5 Shear Force Measurement Shear force was measured according to Bouton [20]. Cooked samples were cut into 1.27 cm diameter cores with a length of 3-5 cm. Three cores were sheared perpendicular to fiber direction using a Warner-Bratzler shear device. The average of three measurements was recorded.

1.6 Statistical Analysis

Data were processed using Excel 2010 and analyzed using SAS V8 software. Duncan' s multiple comparison test was used for mean separation, and Pearson correlation analysis was performed. Statistical significance was declared at $P<0.05$.

2 Results

2.1 Slaughter Performance

As shown in Table 2 , the dressing percentage of group C was not significantly different from group B ($P>0.05$), but was significantly higher than that of groups A and D ($P<0.05$). Compared with groups A, B, and D, the dressing percentage of group C increased by 2.46% ($P<0.05$), 1.35% ($P>0.05$), and 8.32% ($P<0.05$), respectively. The loin-eye area of groups B and C was not significantly different from group A ($P>0.05$), but was significantly higher than that of group D ($P<0.05$).

2.2 Meat Quality

2.2.1 pH Value As shown in Table 3 , there was no significant difference in pH45 min among the four groups ($P>0.05$), with values ranging from 6.53 to 6.66. Similarly, no significant difference was observed for pH24 h ($P>0.05$).

2.2.2 Drip Loss Rate, Cooking Loss Rate, and Shear Force As shown in Table 4 , the drip loss rate of group C was not significantly different from groups B and D ($P>0.05$), but was significantly lower than that of group A ($P<0.05$). The cooking loss rate and shear force of group C were not significantly different from groups B and D ($P>0.05$), but were significantly lower than those of group A ($P<0.05$).

2.2.3 Color Scale As shown in Table 5 , the L* value of group A was significantly higher than that of groups B, C, and D ($P<0.05$), while no significant difference was observed among groups B, C, and D ($P>0.05$). There were no significant differences in a* and b* values among all groups ($P>0.05$).

3 Discussion

The dressing percentage is an important economic trait in meat production. This study showed that adding 25% enoki mushroom residue to the diet significantly improved the dressing percentage of goats, which is consistent with previous research results [4, 7, 8-10]. The improvement may be attributed to the high fiber content in enoki mushroom residue promoting rumen development and nutrient utilization efficiency. However, excessive addition (40%) reduced dressing percentage, possibly due to decreased energy concentration and nutrient digestibility.

The loin-eye area reflects muscle development. This study found that 15% and 25% enoki mushroom residue supplementation had no adverse effects on loin-eye area, while 40% supplementation significantly reduced it, suggesting that high levels of mushroom residue may limit muscle growth.

Meat pH is a critical indicator of quality. The pH45 min and pH24 h values in this study were within the normal range (6.53-6.66 and 5.56-5.66, respectively) and were not affected by dietary treatment, indicating that enoki mushroom residue does not affect postmortem glycolysis and acidification.

Drip loss and cooking loss reflect water-holding capacity. This study demonstrated that 25% enoki mushroom residue significantly reduced drip loss and cooking loss compared with the control group, suggesting improved water-holding capacity. This may be related to the antioxidant components in mushroom residue reducing lipid oxidation and protein denaturation [21]. Shear force, an indicator of tenderness, was also reduced by mushroom residue supplementation, consistent with improved water-holding capacity.

Color is an important sensory quality trait. The L* value represents meat lightness, and lower values indicate darker but more desirable meat color. This study found that enoki mushroom residue supplementation significantly reduced L* values, possibly due to increased myoglobin content or antioxidant activity. The a* (redness) and b* (yellowness) values were not significantly affected, indicating that mushroom residue does not adversely affect meat color.

4 Conclusion

Dietary supplementation with different levels of enoki mushroom residue has varying effects on slaughter performance and meat quality of goats. The 25% supplementation level showed the best effects, significantly improving dressing percentage, reducing drip loss and cooking loss, decreasing shear force, and improving meat color. These results suggest that enoki mushroom residue can be

effectively used as a feed ingredient in goat production at appropriate inclusion levels.

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