Journal of Animal and Feed Sciences, 16, Suppl. 2, 2007, 488–493

Effect of crossbreed on the physical meat indicators in Yun-ling Black goats*

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ABSTRACT

Twenty castrated male goats each of Yun-ling Black goats (YLB goat), NY(Nubian ♂ × YLB goats♀) hybrid goats and BY(Boer♂× YLB♀) hybrid goats were used to evaluate the effect of crossbreeding on the meat quality in the YLB goats of China. There were no significant difference for tenderness, flavour and overall acceptability for the three types of goats. The meat from BY hybrid goat had significantly higher (P<0.05) CIE (Commission Internationale de l'Eclairage) L* and a* values of *L. dorsi* muscle (LD) while the YLB goats had significantly higher (P<0.05) b* value in loin muscle and rump muscle (*B. femoris*, BF). No significant differences among the breeds were measured for water holding capacity (WHC) of LD muscle. However, WHC of BF muscle in NY hybrid goat was the highest among the breeds (P<0.05). The hybrid goats had higher pH values than YLB goats (P<0.05) in both types muscle at 45 min and 24 h of post-mortem. In contrast, YLB goat had a significantly higher juiciness, cooking rate, shear force value and connective tissue compared to BY and NY hybrid goats (P<0.05) and no significant difference was measured between the two types hybrid goats. The muscle fibre diameter were significantly higher (P<0.05) in the YLB goats than the hybrid goats both in the two types of muscles and the converse results were observed for the muscle fibre density (P<0.05) and no significant difference for muscle fibre characteristics were observed between the hybrid goats.

KEY WORDS: Yun-ling Black goat, crossbreeds, meat, physical indicators

INTRODUCTION

There is also a worldwide tendency for rapid increase in demand for goat meat (Stankov et al., 2002) due to goats depositing more internal fat and less

* Supported by the Project No. 2003BA766C and Project No. 2004NG04, P.R. China
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subcutaneous and intramuscular fat compared with sheep (Kirton, 1988). Therefore, consumers are interested in goat meat as a source of relatively lean meat, especially in developed countries with a high incidence of cardiovascular diseases (Banskalieva et al., 2000). There are many local pure-bred goat breeds in the P.R. China, especially in Yunnan Province. YLB goats are an important, largest goat breed and main distribution in mountain area in the Yunnan Province. The goats are both used for leather and meat and are main husbandry economic income in poor rural area of Yunnan Province. Like other goat breed, YLB goats are well adapted to the harsh environment and limited feed, utilize marginal land and digest feed with high efficiency to produce high protein products, and are disease resistant (Anonymus, 1999). However, there was very little information on the meat quality for YLB goats. Therefore, the present study is to evaluate effect of crossbreeding on the meat quality in YLB goats.

MATERIAL AND METHODS

Twenty castrated male kids each of YLB goats, NY hybrid goats (Nubian ♂ x YLB goats♀) and BY hybrid goats (Boer♂ x YLB goats♀) were randomly selected at birth with the average birth weight 2.86 kg for YLB goat, 2.95 kg for NY hybrid goats and 3.13 kg for BY hybrid goats. These kids were castrated with elastrators at 2 week of age (TRT) and weaning at the age of 90 days. Three breed groups were fed in nature grazing grass land to 24 months to study effect of crossbreed on the meat quality - physical composition. The goats were slaughtered by stunning electrically prior to exsanguination with the average liveweight at 37.6 kg for YLB goats, 40.0 kg for NY hybrid goats and 42.8 kg for NB hybrid goats. The carcass was eviscerated and the head, feet and tail were removed. Samples of the loin muscle (LD) and the rump muscle (BF) were obtained within 30 min of slaughter for analyses of meat quality.

The procedures described in Anonymus (2000) were used to measure for water holding capacity (WHC), cooking rate, water drip loss and characteristics of muscle fibres. The pH was measured at 45 min and 24 h after slaughter using a pH meter (Hanna-HI9025, Italy) at the 11th rib on the exposed surface of the freshly-cut LD and BF muscle. Meat colour was measured at 45 min and 24 h after slaughter for BF muscle and LD muscle on the freshly-cut surface of the 7th rib. A colorimeter (Model CR-400, Japan) was used and two observers assessed lightness (L*), redness (a*) and yellowness (b*). The tenderness of loin muscle was measured using a tenderness analyser (CLM25 Tenderness PRC).

Data were subjected to variance (ANOVA), using Duncan's post-hoc test (SPSS11.0).

RESULTS

Effect of crossbreeding on meat properties of the LD muscle are summarized in Table 1. There were no significant differences for tenderness, flavour and overall acceptability for the three types of goats. YLB goat had significantly higher ($P<0.05$) juiciness, shear force value and connective tissue and lower drip loss ($P<0.05$) compared to BY and NY hybrid goats. NY hybrid goats had a significantly higher cooking rate ($P<0.05$) across the breed groups of goats.

Table 1. Physical indicators of the loin muscle

Parameters	YLB goat	BY hybrid	NY hybrid	SE
Shear force value (N)	5.3[a]	4.0[b]	4.0[b]	0.32
Cooking rate, %	61.4[b]	58.3[c]	64.3[a]	0.78
Drip loss, %	1.5	1.6	1.5	0.13
Sensory evaluation				
tenderness	5.5	5.3	5.6	0.17
juiciness	5.5[a]	4.8[b]	5.3[a]	0.14
flavour	5.7	5.3	5.7	0.15
overall acceptability	5.6	5.4	5.6	0.16
connective tissue	5.8	5.2	4.3	0.16

[a,b,c] means with different letters in the same row are significantly different, $P<0.05$

The meat colour, pH value, water holding capacity and muscle fibre characteristics are summarised in Table 2. They were measured both in LD and BF muscles. The meat from BY hybrid goat had significantly higher ($P<0.05$) a* values of LD muscle while the YLB goats had significantly higher ($P<0.05$) b* value in both types of muscle. The b* value significantly increased and a* significantly decreased in both types of muscle and all breeds with post-mortem ageing ($P < 0.05$). No significant differences among the breeds were measured for water holding capacity (WHC) of LD muscle. However, WHC of BF muscle in NY hybrid goat was the highest among the breeds ($P<0.05$). The pH values for YLB goats were lower than the hybrids ($P<0.05$) in both types muscle at 45 min and 24 h of post-mortem. The muscle fibre diameter was significantly higher ($P<0.05$) in the YLB goats than the hybrid goats both in the two types of muscles and the converse results were observed for the muscle fibre density ($P<0.05$) and no significant difference for fibre diameter and density characteristics were observed between the hybrid goats.

Table 2. Physicochemical properties of loin and rump muscle

Parameter	YLB goat	BY hybrid	NY hybrid	SE
Colour (45 min), LD muscle				
lightness (L*)	30.4[b]	34.7[a]	30.3[b]	0.62
redness (a*)	16.1[b]	18.2[a]	16.5[b]	0.47
yellowness (b*)	3.0[a]	1.7[b]	1.3[b]	0.11
Colour (45 min), BF muscle				
lightness (L*)	33.6	33.5	31.9	0.62
redness (a*)	20.2	21.2	20.1	0.52
yellowness (b*)	4.8[a]	2.7[b]	2.5[b]	0.24
Colour (24 h), LD muscle				
lightness (L*)	32.2[b]	34.6[a]	29.6[c]	0.77
redness (a*)	15.2[c]	17.9[a]	16.8[ab]	0.55
yellowness (b*)	5.7[a]	4.6[a]	3.0	0.45
Colour (24 h), BF muscle				
lightness (L*)	33.7[a]	33.4[a]	30.7[b]	0.64
redness (a*)	18.7	19.6	18.9	0.48
yellowness (b*)	6.7[a]	4.5[b]	3.2[c]	0.30
WHC, %				
LD muscle	18.4	18.7	18.7	0.85
BF muscle	18.1[b]	18.3[b]	22.0[a]	0.79
pH_{45min}				
LD muscle	6.2[b]	6.5[a]	6.4[a]	0.08
BFmuscle	6.1[b]	6.5[a]	6.5[a]	0.08
$pH_{24\ h}$				
LD muscle	5.5[b]	5.7[b]	6.2[a]	0.10
BF muscle	5.4[c]	5.9[b]	6.6[a]	0.10
Muscle fibre diameter, μm				
LD muscle	59.5[a]	50.3[b]	51.3[b]	1.93
BF muscle	64.5[a]	49.2[b]	50.2[b]	1.56
Muscle fibre density, No./mm^2				
LD muscle	478.5[a]	617.0[b]	577.5[b]	16.58
BF muscle	474.2[a]	626.2[b]	631.9[b]	21.13

[a,b,c] means with different letters in the same row are significantly different, $P<0.05$

DISCUSSION

YLB goat had a significantly higher shear force value and connective tissue compared to BY and NY hybrid goats. The difference in shear force values between the breed groups may be due to the greater connective tissue content (Light et al., 1985). The data from shear force values are consistent with the muscle fibre characteristics. It has been shown that the muscle fibre diameter were significantly

higher in the YLB goats than the hybrid goats both in the two types of muscles and the converse results were observed for the muscle fibre density. It has been reported previously that tenderness of beef (Ashmore, 1974) and pork (Sheng and Xu, 1984) improves as the density of muscle fibres increases.

BY hybrid goats had a significantly lower cooking rate across the breed groups of goats. This data were consistent with WHC. Increased cooking loss percentage is reflection of the decreased WHC (Kadim et al., 2006) and cooking loss is more dependent on the ultimate pH value (Trout, 1988).

The present study indicated that meat from BY hybrid goat had significantly higher a* values of LD muscle while the YLB goats had significantly higher b* value in both types of muscle. The b* value significantly increased and a* significantly decreased in both types of muscle and all breeds with post-mortem ageing. These results supports the findings that the meat colour was affected more by breed, ageing and ultimate pH (Kadim et al., 2003, 2006). The meat colour from Omani goat breed was lighter and less red than other reported goat breeds thus being similar to lamb meat colour. The difference may be due mainly to the different intramuscular fat content (Kadim et al., 2003). Fat colour became more yellow with increase in age, which is evident from higher subjective scores and b* values (Dhanda et al., 1999). The present data from meat colour are consistence with the meat chemical composition, in which the crude fat content was the highest in YLB goat meat compare with the hybrid goats (Jia et al., 2007).

The data for WHC are in agreement with Han et al. (1996) where they reported that there are no WHC differences among LD muscle. The pH value of muscle is regarded as one of the important parameters affecting meat quality (Dutson, 1983). NY hybrid and BY hybrid goats had higher pH values than the YLB goats in both types muscle at 45 min and 24 h of post-mortem. The present data for pH values were broadly consistent with the meat colorimetric values. The increasing a* value of muscle could due to elevated pH value (Kadim et al., 2003). In the present study, the meat pH value of YLB goat was the lowest between the three breed groups and with the highest WHC. In agreement with the previous reports, that goat meat pH value was related to properties such as better colorimetric values (Simela et al., 2004).

CONCLUSIONS

The crossbreeding significantly improved in shear force value, muscle fibre characteristics and connective tissue as well. On the other hand, the crossbreeding had negative effect on the meat quality of Yun-ling Black goats, such as change in water holding capacity, meat colour, pH value and drip loss.

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