

Short Communication

Correlation between serum esterase polymorphism and production performance of Yuxi fat-tailed sheep

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The polymorphism of serum esterase (Es) of Henan Yuxi fat-tailed sheep was detected through polyacrylamide gel electrophoresis (PAGE), and the correlation between serum esterase and productivity was analyzed. The research result indicated that there are two alleles on the Es loci of Henan Yuxi fat-tailed sheep: Es⁺ and Es⁻. The gene frequencies of Es⁺ and Es⁻ were 0.55 and 0.45, respectively. Besides, the frequencies of three genotypes (Es⁺⁺, Es⁺⁻ and Es⁻⁻) are 0.425, 0.250 and 0.325, respectively. The recommended height of Es⁺⁺ genotype is significantly higher than that of Es⁺⁻ genotype ($P < 0.05$), but the above two produce indistinctive difference in recommended height with Es⁻⁻ genotype ($P > 0.05$). The chest circumference of Es⁺⁺ genotype is significantly higher than that of Es⁻⁻ ($P < 0.05$), but the above two produce indistinctive difference in chest circumference with Es⁺⁻ genotype ($P > 0.05$). Es exerts no significant impact on other indexes ($P > 0.05$).

Key words: Henan Yuxi fat-tailed sheep, serum esterase (Es), polymorphism.

INTRODUCTION

Belonging to the sheep of Mongolian Group and originating from Middle Asia and Far East areas, Henan Yuxi fat-tailed sheep was domesticated and bred for a long time by people in western Henan Province, which is mainly distributed in original Luoyang area and north of original Nanyang, mainly in Linru County, thus named as "Henan Yuxi fat-tailed sheep". It is one of the old sheep varieties in Henan Province. The polymorphism of blood proteins (protease) can be used to not only study the genetic structure of livestock, but also explore the correlation among breed's origin and differentiation, genetic relationship and economic characters, thus enabling the detection and strain selection in early stage. As the most common index of genetic marker in blood biochemistry, blood proteins (protease) always played an

important role in animal genetic marker field. Currently, there are reports of abundant researches on the blood proteins polymorphism of excellent sheep breed both in domestic and foreign countries (Zhang et al., 1995, 2009; Ma et al., 2002; Yang et al., 2004; Zang et al., 2010). The existing researches revealed that the polymorphism of serum esterase (Es) is correlated with sheep productivity to some extent (Yang et al., 2009). This research mainly focused on analyzing the correlation between Es of Henan Yuxi fat-tailed sheep and its body size index as well as its litter size, which can provide significant academic value in illustrating the germplasm characteristics, genetic relationship, origins, evolution and other aspects of Henan Yuxi fat-tailed sheep.

MATERIALS AND METHODS

Blood specimen collection

Fresh blood sample were collected from 80 purebred Henan Yuxi fat-tailed sheep, 5 ml/sheep, and the sample was brought back to the laboratory under low temperature. The blood sample was centrifuged at 1 500 r/min for 20 min, the upper blood plasma was

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Abbreviations: PAGE, Polyacrylamide gel electrophoresis; Es, serum esterase.

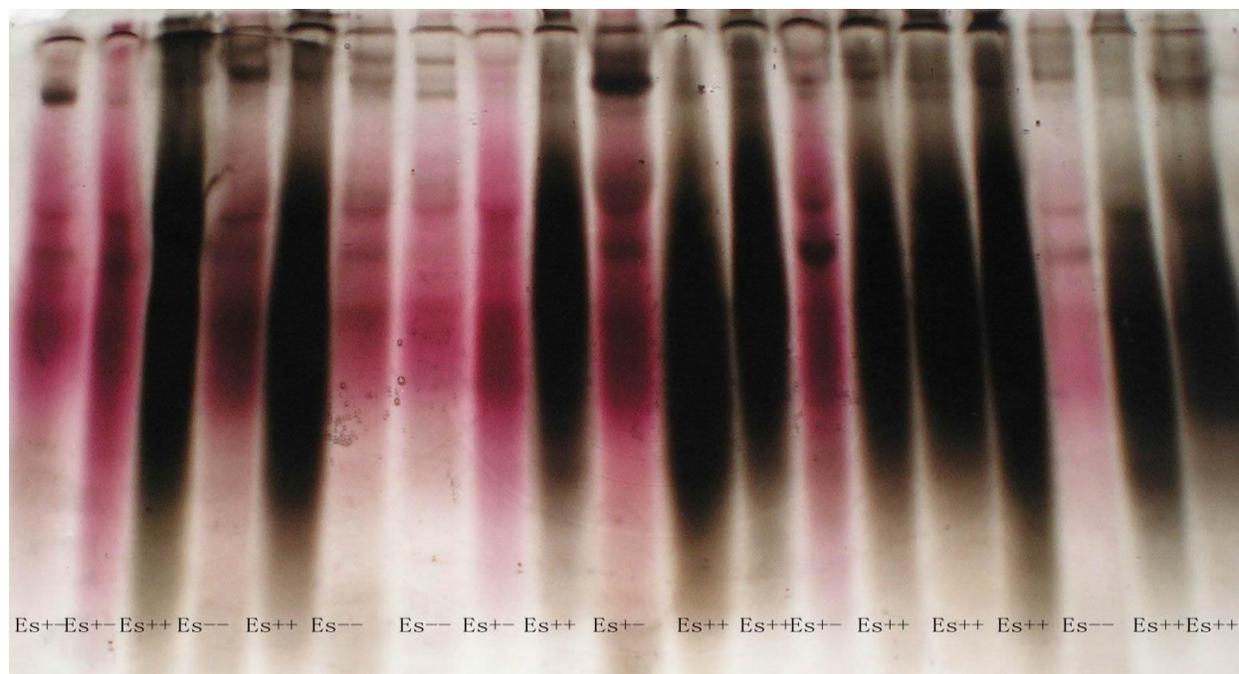


Figure 1. Serum esterase electrophoresis results.

drawn into a small sterilized bottle and labeled. It was stored in the freezer at -20°C .

Polyacrylamide gel electrophoresis (PAGE)

The applied gels were 8% separation gel and 3.5% spacer gel. A pre-electrophoresis was first carried out for 15 min under 160 V and then formal electrophoresis was done under a steady voltage of 200 for 2.5 to 3 h. The gel after electrophoresis was rinsed with distilled water and then put into the staining fluid of Es (Mix 200 mg of α -NA and 200 mg of β -NA into 10 ml acetone and 0.15 mol/L phosphate buffer) (pH=7.5), respectively. Before using them, 10 ml upper liquid was taken from each and 100 mg fast blue RR salt was added, and then 0.15 mol/L phosphate buffer was used to form the constant volume of 100 ml for 20 min at 37°C . The gel was taken out and rinsed with deionized water. The Es belt showed purple and brown, and was then stored in 7% acetic acid. The method of Yang et al. (2004a) was used to evaluate the type of Es. In other words, before the first 15 min, those showing brown banding were Es++ genotype, and those showing blurry brown banding were Es+- genotype, and those showing purple red activate banding were Es-- genotype.

RESULTS AND DISCUSSION

Gene and genotype frequency of Es

As shown in Figure 1, there was Es polymorphism in Henan Yuxi fat-tailed sheep, which can be divided into Es++, Es+- and Es-- according to the color of chromosome banding. Es includes carboxylesterase, cholinesterase and arylesterase, among which only the arylesterase has polymorphism (Ma et al., 2002).

Therefore, the serum Es of Henan Yuxi fat-tailed sheep is arylesterase, and the genotype frequencies of Es++, Es+- and Es-- are 0.425, 0.250 and 0.325, respectively with the Es++ genotype been the dominate genotype of Henan Yuxi fat-tailed sheep (frequency: 0.425). The serum Es has two alleles: Es+ and Es- whose gene frequencies are 0.55 and 0.45, respectively. Therefore, it is obvious that Es+ gene is the protogene of Henan Yuxi fat-tailed sheep (frequency: 0.55). The research result of Zhang et al. (1995) revealed that sheep can be divided into two categories according to the gene frequency of Es: the first category is that where Es- occupies the dominant absolute advantage and the gene frequency of Es- values within 0.8 and 1.0; for the other category, the gene frequencies of Es+ and Es- are basically equal to each other. The gene frequency of Es- of Henan Yuxi fat-tailed sheep is 0.45, thus belongs to the second category. Researches (Yang et al., 2004b) showed that Gansu Tibetan Sheep and Small-tail Han Sheep has Es-- as the favorable genotype, with frequencies of 0.3704 and 0.4592, respectively; Gansu Alpine Merino, Qinghai Merino and Qinghai Tietan Sheep has Es+- as the favorable genotype, while Tan Sheep has Es++ as the favorable genotype. If calculated on the basis of protogene, Small-tail Han Sheep and Qinghai Merino has Es- as the protogene, while Gansu Alpine Merino, Qinghai Tietan Sheep, Gansu Tibetan Sheep and Tan Sheep has Es+ as the protogene. In this research, Es in the Henan Yuxi fat-tailed sheep has Es+ as the protogene, thus serving as the special protein loci of one population different from other populations.

Table 1. The effect of different serum esterase genotypes on production performance.

Genotype	Es++	Es+-	Es--
Genotype frequencies	0.425	0.25	0.325
Body length	67.82 ^a	63.00 ^a	63.38 ^a
Body height	64.76 ^a	59.50 ^a	60.15 ^a
Recommended high	64.82 ^a	57.90 ^b	61.00 ^{ab}
Chest circumference	83.76 ^a	78.60 ^{ab}	74.62 ^b
Chest deep	31.59 ^a	28.40 ^a	28.46 ^a
Chest width	15.71 ^a	14.90 ^a	15.09 ^a
Pipe circumference	8.47 ^a	7.90 ^a	7.77 ^a
The first parities lambing number	1.33 ^a	1.14 ^a	1.11 ^a
The second parities lambing number	1.67 ^a	1.57 ^a	1.44 ^a
The third parities lambing number	1.67 ^a	1.57 ^a	1.44 ^a

Values with same letters for the same row are not significantly different ($P > 0.05$); values with different lowercase letters of the same row are significantly different ($P < 0.05$).

Correlation between serum Es and productivity

The researches carried out by Yang et al. (2009) indicated that the litter size of Small-tail Han Sheep of Es++ genotype ($P < 0.05$) is significantly higher than that of Es-- and Es+- genotypes. The effect of different serum Es genotype of Henan Yuxi fat-tailed sheep on body size and litter size are presented in Table 1, from which it is shown that based on the order of Es--, Es+- and then Es++, the first, second and third litter sizes produced a successive increasing trend. However, the serum Es of different genotype exerted indistinctive impact on the litter size ($P > 0.05$). Furthermore, the serum Es of different genotype exerted indistinctive impact on body size index and other indexes ($P > 0.05$) except for the recommended height and chest circumference ($P < 0.05$). The recommended height of Es++ genotype is significantly higher than that of Es+- genotype ($P < 0.05$), but the above two produce indistinctive difference in recommended height with Es-- genotype ($P > 0.05$). The chest circumference of Es++ genotype is significantly higher than that of Es-- genotype ($P < 0.05$), but the above two produce indistinctive difference in chest circumference with Es+- genotype ($P > 0.05$).

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REFERENCES

- Ma HM, Men ZM, Han JL (2002). Study on polymorphism of amylase (Amy), arylesterase (Es), and malate dehydrogenase (MDH) in *Lanzhou fat-tailed sheep*. China J Gansu. Agric. Univ. 37(4):442-446.
- Yang CQ, Li XY (2009). Serum esterase polymorphisms and their associations with prolificacy in *Small tail han sheep*. China J. Anhui. Agri. Sci. 37(9):4149-4150.

- Yang GL, Luo YZ (2004a). Correlation of blood protein polymorphism to prolificacy of *Small-tail han sheep*. China J. Gansu. Agri. Unive. 4:381-385.
- Yang GL, Luo YZ (2004b). Research and application of prolific trait in *sheep*. China J. Gansu. Agric. Unive. 39(1):77-81.
- Yang JN (2007). Comparative study on the fecundity on blood protein (Enzyme) loci of *Small-tailed han sheep*. China J. Anhui. Agri. Sci. 35 (33) :10626-10627.
- Yang YX, Cui TB, Yan X, Yang JN, He JP (2004). Polymorphism of serum esterase in *Small-tail han sheep*. China J. Gansu. Agri. Unive. 39(5): 475-477.
- Zang RX, Yang JT, Xu HW, Cai Y, Lu JX, Liu LX, He HJ (2010). Study on the polymorphism of blood protein in *Lanzhou fat-tailed sheep*. J Tradit Chin Vet Med. 2:21-23.
- Zhang CJ, Zhang WX, Liu CM (1995). Investigation on polymorphism of biochemistry genetics in *Xinjiang fine-wool sheep* imported into qinghai province. J Qinghai Anim Husb. Vet Med Col. 12(1):10-13.
- Zhang CJ, Wang Y, Lu F (2009). Investigation of polymorphism of serum esterase in *oula sheep* and relationship of them with blood indexes. China Qinghai J. Anim. Vet. Sci. 39(1):1-3.