

THE GENETIC PATTERNS AND THE PERFORMANCE TESTING OF MULTIVERTEBRAE MONGOLIA SHEEP

L.Zhang¹, B.Siqin²

¹Department of Animal Science, Inner Mongolia Institute of
Agriculture and Animal Husbandry, 010018, P.R. China

²Xilingole Institute of Animal science and Veterinary, Xilinhot, 026000, P.R. China

SUMMARY

The multivertebrae rates in Mongolia sheep were higher than that of other breeds. The vertebral formulae of thoracic and lumbar vertebrae in Mongolia sheep were T13L6(10.57%), T13L7(63.19%), T14L6(19.67%) and T14L7(6.57%). The T14 and the L7 were the results of mutations of Homeobox genes located in the 9th and the 11th paralogue groups which determined the morphology of individual vertebra of the thoracic and lumbar column. Among F₁ of reciprocal cross of T14 and T13, T13 held 67.57% and 78.57%, T14 held 32.43% and 21.43%. Among F₁ of T14, T14 and T13 held 80.19% and 19.91%. Among F₁ of T13, T13 and T14 held 88.24% and 11.76%. These tests proved: 1. the phenotypes of T14 and/or L7 were recessive characters and showed incomplete penetrance; 2. the T13 and/or L6 were wild-types and were made up of homozygotes and heterozygotes. The frequencies of T₁₄⁻, T₁₃⁺, L₇⁻ and L₆⁺ were 0.5123, 0.4877, 0.8352 and 0.1648. The frequencies of T₁₃⁺⁺, T₁₃⁺, T₁₄⁻, L₆⁺⁺, L₆⁺, L₇⁻ were 0.2379, 0.4997, 0.2624, 0.0271, 0.2753, 0.6979. The length of thoracic and lumbar vertebrae, the live weight, the carcass weight, the meat weight, the area of eye muscle and the meat percentage had the same order: T14L7>T14L6>T13L7>T13L6.

Keyword: multivertebrae, Mongolia sheep, Homeobox gene, mutation.

INTRODUCTION

The Mongolia sheep have lived under the strong continental climatic conditions of Mongolian plateau for thousands years. This breed has been famous for its excellent adaptability, high quality of meat and its unique characteristic of high percentage of multivertebrae (such as T14L7, T14L6, T13L7 etc.). Among the most sheep breeds, the general vertebral formula may be

given as C7T13L6(7)S4Cy16-18(Dyce *et al.* 1987),and some variation are also in existence.For example,the thoracic vertebrae are usually 13 but it may vary from 12 to 14 occasionally(Robert 1975);the lumbar vertebrae are 6 or 7,but the former are more frequent than the latter.Correspondingly,the ribs are generally 13,but in some case,there may be 14 and less often 12.The 13th rib generally is a floating one and similarly the 14th rib when it is present(May 1970).

The situations of Mongolia sheep are different from the common case above.The 14 thoracic and 7 lumbar vertebrae in this breed are more frequent than those in other breeds(Zhang 1996a) and the 13th rib is not floating but the 14th rib is floating and its length is 10 to 15 *cm*.There is not any 12 thoracic vertebrae individual in the pure Mongolia sheep population.But this kind of sheep may appear among the crossbreed sheep(Zhang 1996b).In recent 10 years,more and more shepherds demand multivertebrae breeding stocks to increase the proportion of multivertebrae in their flocks of sheep.Supported by the National Natural Science Foundation of China,a research on the genetic law of the multivertebrae Mongolia sheep has been engaged in and some valuable discoveries have been made.

MATERIALS AND METHODS

All tested animals were purebred Mongolia sheep.For the purpose of this study,the standard vertebral formula of thoracic and lumbar section was defined as T13L6.the multivertebrae formulae were defined as T13L7,T14L6,T14L7.These formulae were identified by counting the ribs and the transverse processes on lumbar vertebrae for living sheep and were confirmed by X-ray check.The general survey of the vertebral formulae was made by checking the skeletons in the slaughterhouse,totalled 1016 in 1982 and 2176 in 1996.The 929 skeletons were measured for lengths of thoracic and lumbar vertebrae.T14xT14,T13xT13,T14xT13 and T13xT14 were set up and the numbers of thoracic vertebrae in F₁ were recorded.The 36 sheep at the 8 months age and the 20 months age in T13 and in T14 were tested for the live weight,the carcass weight,the meat weight,the meat percentage and the area of eye muscle.The gene frequencies and genotype frequencies were estimated by Hardy-weinberg Law.

RESULTS AND DISCUSSION

The lengths from first thoracic vertebra to the last lumbar vertebra for T13L6,T13L7,T14L6,

T14L7 were 52.13 ± 4.12 (n=390), 54.47 ± 4.23 (n=343), 55.00 ± 4.44 (n=167), 58.00 ± 4.56 (n=29) cm respectively. The thoracic vertebrae length of T14 was longer than that of T13 by 2.4 cm. The lumbar vertebrae length of L7 was longer than that of L6 by 3.5 cm.

The numbers and the rates of 4 kinds of vertebral formulae in 1982 and 1996 revealed that the rate of T14L7 rising speed was the fastest of all, while the rate of T13L6 dropped sharply from 42.91% in 1982 into 10.57% in 1996.

Table 1. Numbers and rates of 4 types of the thoracic and the lumbar vertebrae

Year	Number	T13L6		T13L7		T14L6		T14L7	
1982	1016	436	42.19%	372	36.61%	177	17.42%	31	3.05%
1996	2176	230	10.57%	1375	63.19%	428	19.67%	143	6.57%

The rate of increasing for L₇ frequency from 1982 to 1996 was quicker than that of T₁₄. Both of the frequencies were higher than that of their allele in 1996 (table 2). The results of positive assortative mating and the reciprocal cross for T13 and T14 were shown that the incomplete penetrance of T14 (table 3). The performance testing results for T13 and T14 were shown that all the performances of T14 were much better than that of T13 (table 4).

Table 2. Frequencies of gene and genotype for the normal and multivertebrae sheep

Section	Year	Number	Gene frequency		Genotype frequency		
			+	-	++	+-	--
Thoracic	1982	1016	0.5203	0.4797	0.2725	0.4957	0.2318
	1996	2176	0.4877	0.5123	0.2379	0.4997	0.2624
Lumbar	1982	1016	0.3702	0.6298	0.1370	0.4660	0.3967
	1996	2176	0.1648	0.8352	0.0271	0.2753	0.6976

Table 3. Results of positive assortative mating and reciprocal cross for T13 and T14

Ram	Ewe	T13 number and % in F ₁		T14 number and % in F ₁		Total of F ₁
T14xT14		19	19.19	80	80.91	99
T14xT13		50	67.57	24	32.43	74
T13xT14		14	78.57	3	21.43	17
T13xT13		17	88.24	2	11.76	19

Table 4. Performance testing results for T13 and T14

Age (month)	Thoracic vertebral number	Number of animal	Live weight (kg)	Carcass weight (kg)	Meat weight (kg)	Meat percentage (%)	Area of eye muscle (cm ²)
8	14	18	43.70	22.20	19.00	43.48	19.40
8	13	18	40.00	19.69	16.50	41.25	17.45
20	14	18	51.10	26.20	22.70	44.42	20.66
20	13	18	47.23	23.75	20.10	42.56	18.20

REFERENCES

- Dyce, K.M., *et al.* G. (1987) "Textbook of Veterinary Anatomy". W.B. Saunders Company.
- May, N.D.S. (1970) "Anatomy of the Sheep" 3rd ed. University of Queensland Press.
- Robert, G. (1975) "The Anatomy of the Domestic Animals", Vol. 1, 5th ed. W.B. Saunders Company.
- Zhang, L. (1996a) *J. Mongolia Institute of Agriculture and Animal Husbandry*. 17:29-33
- Zhang, L. (1996b) *J. Chinese Sheep and Goat Production*. (4):1-3.

