INHERITANCE OF DOWN HAIR AND LIVE WEIGHT TRAITS FOR INNER MONGOLIA CASHMERE GOATS IN CHINA

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INTRODUCTION

China is the largest producer and exporter of cashmere in the world. And Inner Mongolia cashmere goats, a large population of 13 million individuals, are the country's most important contributors to the cashmere production, and economic earners, which provides approximately 30% of the world's cashmere. The further enhancement of the fibre quality is necessary for the competition in the world market. Therefore, better control of the quality is of importance for cashmere production to satisfy the consumer's requirements for a consistently desirable product. Knowledge of the extent of genetic variability is a prerequisite for the genetic improvement of the primary traits. Some genetic parameters and genetic correlation or phenotypic correlation amongst particular traits in some breeds of cashmere goat have been estimated (Patties *et al.*, 1989 ; Baker *et al.*, 1991 ; Rose *et al.*, 1992 ; Bigham *et al.*, 1993 ; Ning *et al.*, 1995). However, there is little scientific literature available on the genetic background of main production traits in Inner Mongolia cashmere goat, which requires an analysis on variance component estimates and accurate genetic parameter evaluation under animal models in characteristics for the seed-stock selection and progress of genetic improvement in Inner Mongolia cashmere goats.

MATERIALS AND METHODS

Data and animals. Data used for the analysis were collected from Inner Mongolia cashmere goat flock in the state- run Albas seed-stock farm located in Inner Mongolia in China from 1988 to 2000. The animals were extensively kept in the pasture all year around and distributed in twelve different flocks by age and sex. The average flock size was about 300. All does were artificially inseminated, each was individually identified and all records for different traits and performances were maintained intact. Consequently, full information about pedigree is well known. Combing of down hair was annually done from April to June. Raw cashmere weight and live weight were recorded at same time, as well as a patch of down hair mixed with guard hair was sampled from a site of shoulder for the analysis of fibre length and down diameter.

Statistical analysis. The estimates of variance components for the different traits were obtained by using SAS (1989) and the different genetic parameters were evaluated through VCE software (Groeneveld, 1997). A general multi-trait model was used to estimate heritabilities and genetic correlations of cashmere weight, fibre length, fibre diameter and live weight traits :

$$Y_i = Xf_i + Za_i + Wm_i + Qp_i + e_i$$

Where Y_i is a vector of records for the *i*th trait; fi is a vector of fixed environmental effects (sex, age, year, herd, dam age and birth type) for the *i*th trait; a_i is a vector of direct genetic

effect for the *i*th trait ; m_i is a vector of additive maternal genetic effect for the *i*th trait ; pi is a vector of permanent environmental effect for the *i*th trait ; e_i is a random vector of residuals for the *i*th trait ; X, Z, W and Q are known incidence relating the records to the effects of the model.

Repeatabilities were evaluated as the ratio of the sum of direct additive genetic and permanent environmental components to the total variance.

Table 1. Characteristics of the data structure

Items	N
No. of records in data	11415
No. of animals in total	7102
No. of animals with own records	5419
No. of sire	572
No. of sire with own records	54
No. of sire with own progeny	572
No. of dam	3033
No. of dam with own records	1865
No. of dam with own progeny	3033
No. of grand sire	19
No. of grand dam	1489

RESULTS AND DISCUSSION

Characteristics of the data structure is shown on table 1. Basic statistics of the different cashmere production traits given on table 2 indicated the high potential of the Inner Mongolian cashmere goat : mean annual raw cashmere weight harvested by combing is 530 g and up to 1.4 kg with an average down fibre diameter of 13.6μm.

Table 2. Mean and standard deviation of the different production traits studied in the Inner Mongolian cashmere goat

Traits	No. of records	Mean	s. d.
Cashmere weight (g)	11406	527.7	144.2
Fibre diameter (μm)	4949	13.6	1.1
Fibre length (cm)	4949	9.2	1.5
Live bodyweight (kg)	10760	28.3	7.3

The evaluation of genetic parameters and of phenotypic and inheritable potentials for fibre traits and live bodyweight were performed as shown in Table 3.

The estimated values of heritability for traits describing the dimensions of the fibre, namely the length (FL), diameter (FD) and weight of cashmere (CW) were moderate, being 0.23, 0.32 and 0.28, respectively, while heritability estimate of live bodyweight (LBW) is low (0.10). Our results were in agreement with other results, except for live bodyweight, obtained in the Liaoning cashmere goat having also a high production potential (Ning *et al*., 1995), but not with other researcher's results (Bigham *et al*., 1993 ; Couchman *et al*., 1987 ; Pattie *et al*.,

1989 ; Restall *et al*.; 1984 ; Bishop and Allain, 2000). However, all these results were obtained on animal derived by a few generation of selection from composite populations of cashmere-bearing goats and feral goats and having a 2 or 3 times lower cashmere producing potential than animals of Chinese breeding type.

The additive maternal genetic effects on each trait were very low, close to zero and could be ignored : 0.03, 0.03, 0.01 and 0.07, for cashmere weight (CW), fibre diameter (FD), fibre length (FL) and live bodyweight (LBW) respectively. No other literature is available on additive maternal genetic effects for production traits of cashmere goats. However, the current estimates are in accordance with those observed in angora goats (Taddeo *et al*., 1998).

Table 3. Heritability (bold on diagonal), repeatability (in brackets on diagonal), phenotypic (below diagonal) and genetic correlations (above diagonal) estimates of cashmere production traits in the Inner Mongolia cashmere goat

Traits	CW	FL	FD	LBW
CW	**0.28** (0.44)	0.36	0.02	0.25
FL	0.25	**0.23** (0.40)	-0.19	0.18
FD	0.25	0.01	**0.32** (0.38)	0.41
LBW	0.33	0.17	0.44	**0.10** (0.38)

There were low to moderate phenotypic correlations among the four traits, ranging from the maximum of 0.44 to the minimum of 0.01 (Table 3).

Genetic correlations between cashmere production traits are moderate to low (table3), which indicates that selection and improvement of a trait described here can not be expected by the correlative coefficients. The values of repeatabilities are moderate for all traits : 0.44, 0.40, 0.38 and 0.39 for cashmere weight, live bodyweight, fibre length and fibre diameter respectively. These results illustrated that the selections of the traits observed here are credible for Inner Mongolia cashmere goats based on the performance records.

CONCLUSION

Heritability estimates of the traits describing quantity and quality of cashmere fibre are moderate, but lower than results obtained on non-Chinese cashmere-producing goats. There were low to moderate values of genetic correlations between the different production traits. These scientific literatures provide a reliable basis for undertaking a valuable program of stock animal selections and genetic improvement of the Inner Mongolian cashmere goat.

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