Genetic parameters for conformation traits in seven goat breeds


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Introduction

For goat producers the conformation traits are usually of interest for marketing, but their main importance is due to the relationship they have with production, longevity and profitability within the herd, so they should be included in breeding programs (Castañeda-Bustos et al., 2017). The linear appraisal system of the ADGA evaluate thirteen conformation traits: stature (STA), strength (STR), dairyness (DAI), rump angle (RUA), rump width (RUW), rear legs (REL), fore udder (FUD), rear udder height (RUH), rear udder arch (REU), medial suspensory ligament (MSL), udder depth (UDP), teat placement (TEP) and teat diameter (TDI), in a scale from 1 to 50 points. Also final score (FIS) is included based on the general appearance according to several weighted criteria, on a scale between 50 and 99 points (ADGA, 1993).

Genetic parameters are necessary to develop selection indexes and optimize breeding programs (Hofer, 1998). Although there are some studies related to the estimation of heritabilities ($h^2$) and genetic correlations for conformation traits in dairy goats, they have been only for Alpine and Saanen breeds (Luo et al., 1997; Manfredi et al. 2001; Rupp et al., 2011). At present there is no information on genetic parameters for conformation traits for Toggenburg, Oberhasli, La Mancha, Nigerian Dwarf and Nubia goat breeds, and therefore research is necessary in this regard. The objective of this study was to estimate genetic parameters for conformation traits in seven goat breeds.

Material and Methods

Data from seven breeds of goats belonging to the ADGA were used: Saanen (SA), Alpina (AL), La Mancha (LM), Nubia (NU), Toggenburg (TO), Nigerian Dwarf (ND) and Oberhasli (OB). A data editing process was carried out to ensure the estimation of genetic parameters, eliminating those with incomplete genealogical or productive information or those whose scores were outside the limits established by ADGA. The total number of records, after purging the files, was 15,234. The genetic parameters were estimated for fourteen conformation traits (STA, STR, DAI, RUA, RUW, REL, FUD, RUH, REU, MSL, UDP, TEP, TDI and FIS), whose qualifications were previously adjusted for appraisal age.
The genetic parameters were estimated for the seven breeds and analyses for all breeds together were carried out as well.

In order to use all the available conformation records, the re qualifications of the goats (n=4648 records) were included in the data for analyzes and they represented 30.5% of the total. For this reason, univariate and bivariate mixed models of repeatability within and between breed were used and included the effects of number of calving-season of calving as fixed, linear and square appraisal age as covariates and herd-year, permanent environment and animal as random effects. REML procedure was used to estimate the variance components with the ASreml program (Gilmour et al., 2006).

**Results and Discussion**

Heritabilities for conformation traits by breed are shown in table 1. Values of 0.03 was obtained for TDI for the Nigerian Dwarf breed and 0.80 for STA in this same breed, observing some important differences in h² between breeds for the different traits evaluated and even for the same trait. Although all genetic correlations were obtained among all conformation traits for each breed, only some of those that had higher values are presented in table 2. The variation in the results obtained in heritabilities and genetic correlations of this study can be explained in part by different sample size, data structure and breed (Moioli et al., 2007).

**Table 1. Heritabilities (±standard errors) for conformation traits in seven goat breeds.**

<table>
<thead>
<tr>
<th>Trait</th>
<th>Nubia (n=4215)</th>
<th>Alpine (n=2858)</th>
<th>La Mancha (2652)</th>
<th>Saanen (n=2070)</th>
<th>Toggenburg (n=1246)</th>
<th>Nigerian Dwarf (n=1466)</th>
<th>Oberhasli (n=727)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIS</td>
<td>0.44±0.02</td>
<td>0.47±0.06</td>
<td>0.58±0.03</td>
<td>0.54±0.03</td>
<td>0.36±0.08</td>
<td>0.31±0.08</td>
<td>0.44±0.08</td>
</tr>
<tr>
<td>STA</td>
<td>0.68±0.02</td>
<td>0.72±0.05</td>
<td>0.75±0.05</td>
<td>0.71±0.06</td>
<td>0.70±0.07</td>
<td>0.80±0.02</td>
<td>0.55±0.13</td>
</tr>
<tr>
<td>STR</td>
<td>0.29±0.03</td>
<td>0.29±0.03</td>
<td>0.27±0.04</td>
<td>0.33±0.04</td>
<td>0.30±0.05</td>
<td>0.24±0.05</td>
<td>0.42±0.07</td>
</tr>
<tr>
<td>DAI</td>
<td>0.17±0.03</td>
<td>0.21±0.03</td>
<td>0.30±0.03</td>
<td>0.16±0.06</td>
<td>0.06±0.05</td>
<td>0.26±0.05</td>
<td>0.32±0.08</td>
</tr>
<tr>
<td>RUA</td>
<td>0.30±0.02</td>
<td>0.34±0.03</td>
<td>0.40±0.03</td>
<td>0.37±0.04</td>
<td>0.37±0.04</td>
<td>0.27±0.05</td>
<td>0.28±0.08</td>
</tr>
<tr>
<td>RUW</td>
<td>0.38±0.02</td>
<td>0.45±0.03</td>
<td>0.50±0.03</td>
<td>0.50±0.06</td>
<td>0.42±0.07</td>
<td>0.31±0.05</td>
<td>0.55±0.06</td>
</tr>
<tr>
<td>REL</td>
<td>0.17±0.03</td>
<td>0.20±0.03</td>
<td>0.25±0.03</td>
<td>0.33±0.04</td>
<td>0.27±0.04</td>
<td>0.22±0.05</td>
<td>0.24±0.07</td>
</tr>
<tr>
<td>FUD</td>
<td>0.19±0.04</td>
<td>0.28±0.03</td>
<td>0.32±0.04</td>
<td>0.43±0.03</td>
<td>0.19±0.07</td>
<td>0.14±0.05</td>
<td>0.34±0.08</td>
</tr>
<tr>
<td>RUH</td>
<td>0.32±0.03</td>
<td>0.25±0.03</td>
<td>0.31±0.03</td>
<td>0.34±0.04</td>
<td>0.15±0.07</td>
<td>0.11±0.05</td>
<td>0.51±0.07</td>
</tr>
<tr>
<td>REU</td>
<td>0.27±0.03</td>
<td>0.29±0.03</td>
<td>0.35±0.03</td>
<td>0.34±0.03</td>
<td>0.30±0.05</td>
<td>0.25±0.05</td>
<td>0.09±0.09</td>
</tr>
<tr>
<td>MSL</td>
<td>0.35±0.04</td>
<td>0.35±0.05</td>
<td>0.40±0.05</td>
<td>0.29±0.06</td>
<td>0.31±0.07</td>
<td>0.23±0.08</td>
<td>0.35±0.07</td>
</tr>
<tr>
<td>UDP</td>
<td>0.28±0.03</td>
<td>0.34±0.03</td>
<td>0.37±0.03</td>
<td>0.31±0.04</td>
<td>0.29±0.05</td>
<td>0.30±0.05</td>
<td>0.28±0.08</td>
</tr>
<tr>
<td>TEP</td>
<td>0.46±0.04</td>
<td>0.40±0.05</td>
<td>0.41±0.05</td>
<td>0.37±0.06</td>
<td>0.62±0.03</td>
<td>0.38±0.05</td>
<td>0.39±0.12</td>
</tr>
<tr>
<td>TDI</td>
<td>0.47±0.04</td>
<td>0.43±0.05</td>
<td>0.60±0.05</td>
<td>0.53±0.06</td>
<td>0.45±0.09</td>
<td>0.03±0.05</td>
<td>0.63±0.11</td>
</tr>
</tbody>
</table>

n=number of data, FIS=final score, STA=stature, STR=strength, DAI=dairyness, RUA=rump angle, RUW=rump width, REL=rear legs, FUD=fore udder, RUH=fore udder height, REU=rear udder arch, MSL=medial suspensory ligament, UDP=udder depth, TEP=teat placement, TDI=teat diameter.
Many of the heritabilities and genetic correlations estimated in this study are in the range of values obtained by Wiggans & Hubbard (2001) and Rupp et al. (2011) for Saanen and Alpine goats. Despite obtaining high standard errors (EE) in the heritabilities of some traits in some breeds, most are acceptable considering $3\text{EE} < h^2$. It is possible to use the results of present study to establish breeding programs in different populations of goats, in particular for the Oberhasli, Nigerian Dwarf, Toggenburg, Nubia and La Mancha breeds, and to improve functional traits of the animals through selection.

Conclusions

New genetic parameters were obtained in present study for conformation traits for some breeds of goats. Conformation traits analyzed in the present study showed moderate to high genetic variation. The highest heritabilities were obtained for stature, final score, rump angle and for some udder traits. Differences in heritabilities and genetic correlations among traits and between breeds were observed.

$$\begin{array}{cccccc}
\text{Traits} & \text{Lower} & \text{Breeds} & \text{Average} & \text{Highest} & \text{Breeds} & \text{All breeds}\ast \\
\text{STA-STR} & 0.13\pm0.09 & \text{TO} & 0.20 & 0.27\pm0.06 & \text{SA} & 0.19\pm0.03 \\
\text{STA-DAI} & 0.14\pm0.09 & \text{SA} & 0.24 & 0.41\pm0.21 & \text{TO} & 0.20\pm0.03 \\
\text{STA-RUA} & 0.68\pm0.03 & \text{AL} & 0.73 & 0.76\pm0.06 & \text{ND} & 0.69\pm0.02 \\
\text{STR-DAI} & -0.43\pm0.10 & \text{TO} & -0.79 & -0.98\pm0.11 & \text{ND} & -0.90\pm0.03 \\
\text{STR-FIS} & -0.16\pm0.15 & \text{ND} & 0.23 & 0.46\pm0.06 & \text{AL} & 0.26\pm0.03 \\
\text{DAI-REL} & 0.22\pm0.16 & \text{ND} & 0.40 & 0.54\pm0.33 & \text{TO} & 0.35\pm0.05 \\
\text{RUA-RUW} & 0.02\pm0.16 & \text{OB} & 0.28 & 0.45\pm0.10 & \text{TO} & 0.26\pm0.03 \\
\text{RUA-RUH} & -0.04\pm0.07 & \text{LM} & -0.18 & -0.29\pm0.08 & \text{SA} & -0.14\pm0.03 \\
\text{REL-FUD} & -0.08\pm0.22 & \text{OB} & -0.19 & -0.31\pm & \text{NU} & -0.14\pm0.04 \\
\text{FUD-FIS} & -0.29\pm0.14 & \text{TO} & 0.55 & 0.82\pm0.09 & \text{OB} & 0.62\pm0.04 \\
\text{RUH-REU} & 0.22\pm0.15 & \text{TO} & 0.41 & 0.72\pm0.70 & \text{OB} & 0.39\pm0.04 \\
\text{MSL-UDP} & -0.29\pm0.20 & \text{OB} & -0.46 & -0.63\pm0.10 & \text{TO} & -0.47\pm0.03 \\
\text{TEP-FIS} & 0.02\pm0.16 & \text{OB} & 0.31 & 0.63\pm0.09 & \text{ND} & 0.26\pm0.04 \\
\end{array}$$

TO=Toggenburg, SA=Saanen, AL=Alpine, NU=Nubia, ND=Nigerian Dwarf, OB=Oberhasli; LM=LaMancha; FIS=final score, STA=stature, STR=strength, DAI=dairyness, RUA=rump angle, RUW=rump width, REL=rear legs, FUD=fore udder, RUH=rear udder height, REU=rear udder arch, MSL=medial suspensory ligament, UDP=udder depth, TEP=teat placement, TDI=teat diameter; *=data of all breeds were included in the analysis

List of References


