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Estimation of genetic parameters for chosen udder traits of different dairy ewes

PAVOL MAKOVICKÝ[1], PETER MAKOVICKY[2], MILAN MARGETÍN[3] and MELINDA NAGY[4]

J Selye University, Bratislavská cesta 3322, 945 01 Komárno, Slovak Republic

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Relationship between udder shape characteristics and milking performance in dairy ewes has been investigated since the 1970s (Sagi and Morag 1974, Gootwine *et al.* 1980) as an effort to adapt the ewe to machine milking. Labussière (1988) proposed that the use of morphology selection criteria benefit the milking ability of ewes; declared the need of vertically implanted teats at the lowest point of the cistern and to introduce improved udder traits in the selection objectives of ovine breeding schemes, which was addressed in selection programs in the Mediterranean countries only a decade later (De la Fuente *et al.* 1996, Marie-Etancelin *et al.* 2006). The reason for the increased interest on dairy sheep udder and new breeding schemes was baggy udder, found in sheep selected for high milk yield. In such sheep, the cisternal part of the udder below the teat orifice is enlarged, as is the angle between the teat and the vertical axis of the udder (Fernández *et al.* 1995, Marie-Etancelin *et al.* 2005, Makovický *et al.* 2014, 2017). Milking of these baggy udders is not efficient because part of the cisternal milk remains below the teat orifice unless the milker applies manual manipulation of the udder during stripping (Bruckmaier *et al.* 1997, Bruckmaier and Blum 1998). Additionally, horizontally implanted teats cannot hold the weight of the milking unit, and it tends to fall off. That kind of additional manipulation during milking prolongs the total milking time of the herd, with milking already being one of the most time-demanding procedures on ewe milk farms. It can also lead to an inadequately milked udder that is undesired for udder health. Depending on the breed, incomplete milk removal during milking can be marked in the total daily yield of the herd. Therefore, the mammary gland morphology is an important factor in determining the aptitude for the machine milking of dairy animals.

Nine different sheep genotypes, viz. Purebred Improved Valachian (IV), Improved Valachian × Specialized Dairy Breeds (25%), Improved Valachian × Specialized Dairy Breeds (50%), Improved Valachian × Specialized Dairy Breeds (75%), Purebred Tsigai (T), Tsigai × Specialized Dairy Breeds (25%), Tsigai × Specialized Dairy Breeds (50%), Tsigai × Specialized Dairy Breeds (75%), Purebred Lacaune (LC). were included in this experiment to determine the morphological traits of the ewes

Three-breeding crosses with 25%, 50% and 75% of the genetic contribution of both specialized dairy breeds, viz. Lacaune and East-Friesian (SBD) formed during the entire period were significantly less from the assessed population (5% of the assessed population). For estimation of covariance components and genetic parameters determining the linear udder traits of sheep, data from measurements carried on one experimental flock were used. Estimation of covariance components followed by calculation of genetic parameters was conducted using restricted maximum likelihood method (REML) and the multiple-trait animal model BLUP-AM, using the REMLF90 and VCE 4.0 programs (Groeneveld and García-Cortés 1998). The estimation of covariance was based on a multiple trait animal model including 7 traits.

Genetic parameters were determined separately for udder depth (UD), cistern depth (CD), teat position (TP), teat size (TS), udder cleft (UC), udder attachment (UA) and udder shape (US) besides external udder measurements namely udder length (UL), udder width (UW), rear udder depth (RUD), cistern depth (CDe), teat length (TL) and teat angle (TA). Linear assessments (1145) were carried from 356 ewes and 1055 external udder measurements (327 ewes) using untransformed data. In addition to genetic correlations, the value was set using the Pearson phenotype correlation, for the calculation the same data sets were used as the calculation for genetic correlations. Phenotypic correlations were calculated using CORR procedure in SAS (SAS 2002–2008).

For estimation of covariance components and genetic parameters for all of the above parameters, the following model was used:

$$y_{ijklmno} = m + Y_i + LS_j + GEN_k + P_l + b^{*}DIM_{ijklm} + a_m + tp_n + e_{ijklmno}$$

where $y_{ijklmno}$, dependent variables studied; Y_i, year (fixed

Present address: [1]Assistant Professor (makovicky.pavol @gmail.com), [4]Associate Professor (nagymelinda@gmail.com), Faculty of Education, Department of Biology. [2]Assistant Professor (pmakovicky@email.cz), Laboratory of Veterinary Histopathology in Komárno, Komárno, Slovak Republic. [3]Professor (milan.margetin@uniag.sk), Faculty of Agrobiology and Food Resources, Department of Animal Production, Slovak University of Agriculture, Nitra, Slovak Republic.

effect with 5 to 7 levels); LS_j, lactation stage (fixed effect with 4 levels; from 40th to 99th lactation day, from 100th to 129th lactation day, from 130th to 159th lactation day and from 160th to 210th lactation day); GEN_k, genotype (breed group, fixed effect with 9 levels); P_l, parity (fixed effect with 3 levels; first, second, third and further parity); a_m, additive genetic effect of ewes; DIM_{ijklm}, days in milk (covariate; 40 to 210 days in milk); tp_n, permanent environmental effect of ewes; $e_{ijklmno}$, residual error.

Table 1 shows the coefficients of heritability (on the diagonal), genetic correlations (above the diagonal) characterizing the linear udder traits of sheep. Heritability coefficients calculated (h^2), using a 7 character system, were low and ranged from 0.090 (for udder attachment) to 0.294 (for cistern depth). Coefficients of heritability (on diagonal), genetic correlations (above diagonal) characterizing the external udder traits of sheep are given in Table 2. Heritability coefficients calculated using a 7 character were low and ranged from 0.081 (for udder width) to 0.480 (for cistern depth). Moreover, the heritability estimates in this study were in agreement with the estimates for other sheep breeds. Estimates for udder-type traits ranged from 0.20 to 0.37 for TA, 0.16 to 0.25 for UD (Ugarte *et al.* 2001, Casu *et al.* 2002, Serrano *et al.* 2002, Fernández *et al.* 1997) and equal to 0.19 for UC (Casu *et al.* 2002).

Knowledge of the morphology of the mammary gland is critical for the deployment of technified dairy production, since it is directly related to the efficiency of milking.

Table 1. Heritability coefficients (on diagonal), genetic (above diagonal) correlations for linear udder traits

Trait	UD	CD	TP	TS	UC	UA	US
Udder depth	0.217	0.580	0.550	0.005	–0.064	–0.095	0.445
Cistern depth		0.294	0.980	–0.261	–0.380	0.071	0.061
Teat position			0.242	–0.381	–0.404	0.096	0.075
Teat size				0.275	–0.391	–0.117	0.096
Udder cleft					0.205	–0.323	–0.274
Udder attachment						0.090	0.756
Udder shape							0.117

Table 2. Heritability coefficients (on diagonal), genetic (above diagonal) correlations for external udder measurements

Trait	UL	UW	RUD	CD	TL	TA
Udder length	0.219	0.468	0.871	0.415	0.113	0.349
Udder width		0.081	0.101	0.549	0.013	0.717
Rear udder depth			0.223	0.448	0.252	0.256
Cistern depth				0.480	–0.090	0.958
Teat length					0.358	–0.195
Teat angle						0.290

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SUMMARY

Morphology of udder in ewes in one experimental herd was examined on the basis of linear evaluation (7 traits; 9 points scale; 1145 data for each trait) and exact measurements of udder (6 parameters; 1055 measurements at each trait) were taken. Estimation of covariance components and genetic parameters were done using REML and BLUP-AM (VCE 4.0 package) for 7 traits (linear evaluation) or 6 traits (udder measurements) . Heritability coefficients for individual traits of linear evaluation varied from 0.090–0.294. Heritability coefficient (h^2) for teat position was 0.242, 0.275 for teat size , and 0.294 for cistern depth, which is related to teat position. The highest value of genetic correlation (rg=0.980) was found between cistern depth and teat position. Negative genetic correlation was detected between teat position and teat size (–0.381), and teat position and udder cleft (–0.404). Heritability coefficients and genetic correlations of exact measurements of udder were comparable with traits of linear evaluation. For the parameter, udder length and rear udder depth, the detected band-measures were h^2 = 0.219 or 0.223. Highest h^2 was found for cistern depth (0.480), teat length (0.358) and teat angle (0.290) similar to linear evaluation.

REFERENCES

Bruckmaier R M, Paul G, Mayer H and Schams D. 1997. Machine milking of Ostfriesian and Lacaune dairy sheep: udder anatomy, milk ejection and milking characteristics. *Journal of Dairy Research* **64**: 163–72.

Bruckmaier R M and Blum J W. 1998. Oxytocin release and milk removal in ruminants. *Journal of Dairy Science* **81**: 939–49.

Casu S, Fresi P and Carta A. 2002. *Estimation of the genetic parameters of udder traits in Sarda sheep using a sire model with random contemporary groups*. Proceedings of the 7th World Congress on Genetics Applied to Livestock Production, 19–23 August 2002, Montpellier, France Communication no. 09–04.

De la Fuente L F, Fernández G and San Primitivo F. 1996. A linear evaluation system for udder traits of dairy ewes. *Livestock Production Science* **45**: 171–78.

Fernández G, Álvarez P, San Primitivo F and De la Fuente L F. 1995. Factors affecting variation of udder traits of dairy ewes. *Journal of Dairy Science* **78**: 842–49.

Fernández G, Baró J A, De la Fuente L F and San Primi-tivo F. 1997. Genetic parameters for linear udder traits of dairy ewes. *Journal of Dairy Science* **80**: 601–05.

Gootwine E, Alef B and Gadeesh S. 1980. Udder conformation and its heritability in the Assaf (Awassi × East Friesian) cross of dairy sheep in Israel. *Annales de Génétique et de Sélection Animale* **12**: 9–13.

Groeneveld E and García-Cortés A. 1998. VCE 4.0, a (co) variance components package for frequentists and Bayesians. Proceedings of the 6th World Congress on Genetics Applied to Livestock Production, Armidale. pp 455–56.

Labussière J. 1988. Review of physiological and anatomical factors influencing the milking ability of ewes and the organization of milking. *Livestock Production Science* **18**: 253–74.

Makovický Pa, Nagy M and Makovický Pe. 2014. The comparison of ewe udder morphology traits of improved Valachian, Tsigai, Lacaune breeds and their crosses. *Mljekarstvo* **64**: 86–93.

Makovický Pa, Margetín M and Makovický Pe. 2017. Estimation of genetic and phenotypic parameters for udder morphology traits in different dairy sheep genotypes. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis* **65**: 105–10.

Marie-Etancelin C, Astruc J M, Porte D, Larroque H and Robert Granié C. 2005. Multiple-trait genetic parameters and genetic evaluation of udder-type traits in Lacaune dairy ewes. *Journal of Dairy Science* **97**: 211–18.

Marie-Etancelin C, Manfredi E, Aurel M R, Pailler F, Arhainx J, Ricard E, Lagriffoul G, Guillouet P, Bibé B and Barillet F. 2006. Genetic analysis of milking ability in Lacaune dairy ewes. *Genetics Selection Evolution* **38**: 183–200.

Sagi R and Morag M. 1974. Udder conformation, milk yield and milk fractionation in the dairy ewes. *Annales de Zootechnie* **23**: 185–92.

Serrano M, Pérez-Guzmán M D, Montoro V and Jurado J J. 2002. Genetic analysis of udder traits in Manchega ewes. *Livestock Production Science* **77**: 355–61.

SAS Institute (2002–2008). Version 9.2. SAS Institute Inc., Cary, North Carolina, USA.

Ugarte E, Legarra A, Beltran de Heredia I and Arranz J. 2001. *Udder morphology: a new trait to introduce in the Latxa breeding program*. Proceedings of the International Workshop on Genetic Improvement of Functional Traits in Cattle Bull. International Committee for Animal Recording, Wageningen.