VETERINARSKI ARHIV 85 (5), 577-582, 2015

Genetic parameters for the linear udder traits of nine dairy ewes - short communication

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MAKOVICKÝ, P., M. MARGETÍN, P. MAKOVICKÝ: Genetic parameters for the linear udder traits of nine dairy ewes - short communication. Vet. arhiv 85, 577-582, 2015.

ABSTRACT

The udder is one of the most important physiological and conformational characteristics of all dairy animals. Genetic parameters have been estimated for linear udder traits (Udder depth, Cistern depth, Teat position, Teat size, Udder cleft, Udder attachment and Udder shape) - 1275 assessments for each trait were included in the analysis of 381 ewes of 9 genotypes. Nine breeds and genotypes were included in these experiments: Improved Valachian (IV), Tsigai (T), Lacaune (LC) ewes, and IV and T crosses with genetic portion of Lacaune and East Friesian (EF) - 25 %, 50 % and 75 %. Primary data were processed using the restricted maximum likelihood method (REML) and the multiple-trait animal model, using the programs REMLF90 and VCE 4.0. Heritability coefficients estimated for linear udder traits were low and ranged from: $h^2 = 0.09$ for udder attachment and for cistern depth: $h^2 = 0.30$. This study suggests that selection programs can be effective for modifying udder morphology, particularly teat test placement and cistern height traits. Further research is needed to better define udder traits and linear scores for use as selection criteria for improvement in the machine milking aptitude of these breeds.

Key words: correlation, dairy sheep, heritability, udder traits

Introduction

A number of studies have investigated the relationships between the dairy performance of different dairy species and morphological udder traits and these relationships have been measured in dairy ewes (LEGAZ et al., 2011; POURLIS, 2011; PRPIĆ et al., 2013;

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ISSN 0372-5480
Printed in Croatia

AYADI et al., 2014; LERIAS et al., 2014), goats (EYDURAN et al., 2013; TORRES et al., 2013; UPADHYAY et al., 2014), cows (BOBIĆ et al., 2014; KASAP et al., 2014; LIU et al., 2014), camels (AYADI et al., 2013), buffaloes (PRASAD and LAXMI, 2014) and donkeys (D'ALESSANDRO et al., 2015). Breeding programmes and measures to improve milk quality and udder health in European dairy breeds may benefit from more detailed information about the relationships between these traits. According to DE LA FUENTE et al. (2011) breeding programs to increase milk yield in dairy ewes have led to increased cistern height and more horizontal teats, which dimish machine milking-ability.

Udder morphology has been recognized as one of the main factors affecting the ability to machine-milk dairy ewes (GOOTWINE et al., 1980; LABUSSIÈRE, 1988; MAVROGENIS et al., 1988; FERNÁNDEZ et al., 1997). Morphological udder traits have not been considered as a primary objective in dairy sheep selection. Nevertheless, these traits determine several aspects of machine milking and manageability. Taking this into account, mammary traits must be considered as economically important traits, especially in highly selected herds. Better understanding of morphological variations would identify those traits which are most appropriate for incorporation in the listed breeds selection programs. The objective of this work was to find the genetic characteristics of selected parameters characterizing the linear udder traits of ewes.

Materials and methods

Nine different sheep genotypes were included in this study to determine the morphological traits of ewes belonging to the following populations: Purebred Improved Valachian (IV), n = 232; Improved Valachian x East Friesian (25 %), n = 68; Improved Valachian x East Friesian (50 %), n = 93; Improved Valachian x East Friesian (75 %), n = 82; Purebred Tsigai (T), n = 289; Tsigai x East Friesian (25 %), n = 18; Tsigai x East Friesian (50 %), n = 170; Tsigai x East Friesian (75 %), n = 46; Purebred Lacaune (LC), n = 277.

Three-breeding crosses with 25 %, 50 % and 75 % of genetic proportion of both specialized dairy breeds: Lacaune and East-Friesian (SBD) formed during the entire period were significantly fewer in number than the assessed population (about 5 %). For estimation of covariance components and genetic parameters determining the linear udder traits of sheep were used from our own database, where the measurements were made on one experimental flock. Estimation of covariance components followed by calculation of genetic parameters was conducted using the restricted maximum likelihood method (REML) and the multiple-trait animal model, 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) using untransformed data: 1275 linear assessments were taken in the 7 year experimental process, from 381 ewes. Two hundred and nine of them were purebred, and 172 crossbred. In addition to genetic correlations, values were set using Pearson phenotype correlations, for calculation of the same data sets were used as the calculation for genetic correlations. Phenotypic correlations were calculated using the CORR procedure in mathematical-statistical program package SAS/STAT v. 9.2, 2002 - 2008.

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

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

where:

$y_{ijklmno}$ = is the vector of observations for the investigated characteristics (see above for details); Y_i = year (fixed effect with 5 to 7 levels; depending on the analysed indicator); LS_j = lactation stage (fixed effect with 4 levels; from the 40th to the 99th lactation days, from the 100th to the 129th lactation days, from the 130th to the 159th lactation days and from the 160th to the 210th lactation days); GEN_k = genotype (breed group, fixed effect with 9 levels; see above for characterization); P_l = parity (fixed effect with 3 levels; first, second, third and further parity); a_m = is the additive genetic effect of ewes; DIM_{ijklm} = days in milk (covariate; 40 to 210 days in milk); tp_n = is the permanent environmental effect of ewes; $e_{ijklmno}$ = is the residual error.

Results

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

Traits	UD	CD	TP	TS	UC	UA	US
Udder depth	***0.22***	0.58	0.56	0.05	-0.06	-0.09	0.45
Cistern depth	0.45	***0.30***	0.98	-0.26	-0.38	0.07	0.06
Teat position	0.36	0.85	***0.24***	-0.38	-0.40	0.09	0.08
Teat size	0.18	-0.11	-0.12	***0.28***	-0.39	-0.18	0.09
Udder cleft	-0.04	-0.19	-0.23	0.06	***0.21***	-0.32	-0.27
Udder attachment	0.24	-0.06	-0.08	0.04	0.33	***0.09***	0.76
Udder shape	0.53	0.25	-0.03	0.06	0.26	0.75	***0.12***

In dairy ewes, estimating correlations between traits are useful in determining the predictive power of a screen in deciding whether to select directly for a target trait or indirectly for a secondary or correlated trait. Table 1 shows the coefficients of heritability (on the diagonal), genetic correlations (above the diagonal) and phenotypic correlations

(below the diagonal), characterizing the linear udder traits of sheep. Heritability coefficients calculated, using a 7 character system, were low and ranged $h^2 = 0.09$ for udder attachment and for cistern depth: $h^2 = 0.30$. The knowledge of the relationships between morphological udder traits would permit prediction of future correlated responses in milk-oriented selection schemes.

Discussion

Heritabilities of udder traits reported in Assaf ($h^2 = 0.23$ to 0.42; GOOTWINE et al., 1980), Chios ($h^2 = 0.50$ to 0.83; MAVROGENIS et al., 1988), and Sarda with the seven expanded typologies ($h^2 = 0.55$; CARTA et al., 1999) gave higher values but, as indicated by the last authors, they were probably overestimated. SERRANO et al. (2002) also reported the importance of udder depth as an intermediate optimum trait for machine milkability, due to its high genetic correlation with milk yield. MAVROGENIS et al. (1988) estimated considerably higher heritabilities in the Chios breed for udder depth (0.50), udder circumference (0.54), and teat size (0.64 to 0.83). CHARON (1990) reported heritabilities of 0.43 and 0.28 for udder depth and circumferences, and 0.6 for teat size and placement. SERRANO et al. (2002), working in the Spanish Manchega breed, reported very low estimates of heritability for udder attachment (0.06), which they attributed to poor assessment by the scorers, and for teat size (0.10).

Conclusion

The genetic parameters estimated for linear udder traits in this study were in general agreement with other estimates in the available scientific literature. The genetic variability and heritability of the studied udder traits indicate that the efficiency of breeding programs could be improved, and some selection pressure on udder traits in long-term breeding programs needs to be considered. The utilization of a selection index, including udder depth in selection programs, in order to increase the milkability of dairy sheep, is also recommended.

Acknowledgements

The study was performed during the realization of the project MLIEKO 26220220098, funded by the Operational Program for Research and Development of the European Regional Development Fund.

References

AYADI, M., R. S. ALJUMAAH, A. MUSAAD, E. M. SAMARA, M. M. ABDELRAHMAN, M. A. ALSHAIKH, S. K. SALEH, B. FAYE (2013): Relationship between udder morphology traits, alveolar and cisternal milk compartments and machine milking performances of dairy camels (*Camelus dromedarius*). Span. J. Agric. Res. 11, 790-797.

AYADI, M., A. M. MATAR, R. S. ALJUMAAH, M. A. ALSHAIKH, M. A. ABOUHEIF (2014): Evolution of udder morphology, alveolar and cisternal milk compartment during lactation and their relationship with milk yield in Najdi sheep. Span. J. Agric. Res. 12, 1061-1070.

BOBIĆ, T., P. MIJIĆ, G. VUČKOVIĆ, M. GREGIĆ, M. BABAN, V. GANTNER (2014): Morphological and milkability breed differences of dairy cows. Mljekarstvo 64, 71-78.

CARTA, A., S. R. SANNA, G. RUDA, S. CASU (1999): Genetic aspects of udder morphology in Sarda primiparous ewes. In: Milking and Milk Production of Dairy Sheep and Goats. (Barillet, B., N. P. Zervas, Eds.), EAAP Publication No. 95, Wageningen Pers., Wageningen, pp. 363-368.

CHARON, K. M. (1990): Genetic parameters of the morphological traits of sheep udder. World Rev. Anim. Prod. 25, 73-76.

D'ALESSANDRO, A. G., M. MARIANO, G. MARTEMUCCI (2015): Udder characteristics and effects of pulsation rate on milking machine efficiency in donkeys. J. Dairy Res. 82, 121-128.

DE LA FUENTE, L. F., C. GONZALO, J. P. SÁNCHEZ, R. RODRÍGUEZ, J. A. CARRIEDO, F. SAN PRIMITIVO (2011): Genetic parameters of the linear body conformation traits and genetic correlations with udder traits, milk yield and composition, and somatic cell count in dairy ewes. Can. J. Anim. Sci. 91, 585-591.

EYDURAN, E., I. YILMAZ, A. KAYGISIZ, Z. M. AKTAS (2013): An investigation on relationship between lactation milk yield, somatic cell count and udder traits in first lactation turkish Saanen goat using different statistical techniques. J. Anim. Plant Sci. 23, 956-963.

FERNÁNDEZ, G., J. A. BARÓ, L. F. DE LA FUENTE, F. SAN PRIMITIVO (1997): Genetic parameters for linear udder traits of dairy ewes. J. Dairy Sci. 80, 601-605.

GOOTWINE, E., B. ALEF, S. GADEESH (1980): Udder conformation and its heritability in the Assaf (Awassi x East Friesian) cross of dairy sheep in Israel. Ann. Génét. Sél. Anim. 12, 9-13.

GROENEVELD, E., L. A. GARCÍA-CORTÉS (1998): VCE 4. 0: A (Co)variance components package for frequentists and Bayesians. Proceedings of 14th World Congress on Genetics Applied to Livestock Production. Animal Genetics and Breeding Unit., Armidale, Vol. 27. pp. 455-456.

KASAP, A., D. ŠKORPUT, D. KOMPAN, G. GORJANC, B. MIOČ, K. POTOČNIK (2014): The effect of time elapsed from milking to scoring on udder linear scores and estimation of genetic parameters. Vet. arhiv 84, 9-18.

LABUSSIÈRE, J. (1988): Review of physiological and anatomical factors influencing the milking ability of ewes and the organization of milking. Livest. Prod. Sci. 18, 253-274.

LEGAZ, E., I. CERVANTES, M. A. PEREZ-CABAL, L. F. DE LA FUENTE, R. MARTINEZ, F. GOYACHE, J. P. GUTIERREZ (2011): Multivariate characterisation of morphological traits in Assaf (Assaf. E) sheep. Small Rumin. Res. 100, 122-130.

LERIAS, J. R., L. E. HERNANDEZ-CASTELLANO, A. SUAREZ-TRUJILLO, N. CASTRO, A. POURLIS, A. M. ALMEIDA (2014): The mammary gland in small ruminants: major morphological and functional events underlying milk production-a review. J. Dairy Res. 81, 304-318.

LIU, S., H. TAN, L. YANG, Y. I. JIANMING (2014): Genetic parameter estimates for selected type traits and milk production traits of Holstein cattle in southern China. Turk. J. Vet. Anim. Sci. 38, 552-556.

MAVROGENIS, A. P., C. PAPACHRISTOFOROU, P. LYSANDRIDES, A. ROUSHIAS (1988): Environmental and genetic factors affecting udder characters and milk production in Chios sheep. Génet. Sél. Evol. 20, 477-488.

POURLIS, A. F. (2011): A review of morphological characteristics relating to the production and reproduction of fat-tailed sheep breeds. Trop. Anim. Health Prod. 43, 1267-1287.

PRASAD, R. M. V., P. J. LAXMI (2014): Studies on the temperament of Murrah buffaloes with various udder and teat shapes and its effect on milk yield. Buffalo Bull 33, 170-176.

PRPIĆ, Z., B. MIOČ, I. VNUČEC, V. DRŽAIĆ, V. PAVIĆ (2013): Non-genetic factors of udder morphology traits in Istrian ewes. Mljekarstvo 63, 72-80.

SAS Institute. Version 9.2. SAS Institute Inc., Cary, North Carolina, 2002-2008, USA.

SERRANO, M., M. D. PÉREZ-GUZMÁN, V. MONTORO, J. J. JURADO (2002): Genetic analysis of udder traits in Manchega ewes. Livest. Prod. Sci. 77, 355-361.

TORRES, A., N. CASTRO, L. E. HERNANDEZ-CASTELLANO, A. ARGUELLO, J. CAPOTE (2013): Effects of milking frequency on udder morphology, milk partitioning, and milk quality in 3 dairy goat breeds. J. Dairy Sci. 96, 1071-1074.

UPADHYAY, D., B. H. M. PATEL, S. KERKETTA, S. KASWAN, S. SAHU, B. BHUSHAN, T. DUTT (2014): Study on udder morphology and its relationship with production parameters in local goats of Rohilkhand region of India. Indian J. Anim. Res. 48, 615-619.

Received: 22 July 2014
Accepted: 9 June 2015

MAKOVICKÝ, P., M. MARGETÍN, P. MAKOVICKÝ: Genetski pokazatelji za linearna svojstva vimena kod devet genotipova mliječnih ovaca - kratko priopćenje. Vet. arhiv 85, 577-582, 2015.

SAŽETAK

Po svojim fiziološkim i konformacijskim obilježjima vime je od posebne važnosti kod svih životinja namijenjenih za proizvodnju mlijeka. U radu su procijenjeni genetski pokazatelji za linearna svojstva vimena: dubina vimena, dubina cisterne, položaj sisa, veličina sisa, izraženost suspenzornog ligamenta, spoj vimena i oblik vimena. Analizom 381 ovce, razvrstane u 9 različitih genotipova, obuhvaćeno je ukupno 1275 procjena za svako svojstvo. Pasmine, odnosno genotipovi, ovaca bili su: oplemenjena valaška (OV), cigaja (C), lakon (L) te križanci OV i C s genetskim udjelom lakon pasmine i istočnofrizijske pasmine od 25 %, 50 % i 75 %. Primarni podaci obrađeni su uz pomoć programa REMLF90 i VCE 4.0 koji su uključivali REML (restricted maximum likelihood) metodu te metodu animalnog modela za više svojstava. Koeficijenti heritabiliteta procijenjeni za linearna svojstva vimena bili su niski i kretali se u rasponu od $h^2 = 0,09$ za povezanost vimena, do $h^2 = 0,30$ za dubinu cisterne. Istraživanje pokazuje da programi odabiranja mogu biti učinkoviti u mijenjanju morfologije vimena, posebno s obzirom na smještaj sisa i visinu cisterne. Potrebna su daljnja istraživanja kako bi se bolje definirala svojstva vimena i linearna ocjena kao selekcijski kriteriji kojima bi se poboljšale sposobnosti promatranih pasmina za strojnu mužnju.

Ključne riječi: korelacija, mliječne ovce, heritabilitet, svojstva vimena