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Relationships between morphological udder characteristics in Improved Valachian, Tsigai and Lacaune dairy sheep breeds

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Abstract
Udder morphology traits were measured and subjectively assessed by the use of linear scores and cistern cross-section areas were scanned by ultrasound machine were examined in 266 dairy ewes of Tsigai (TS), Improved Valachian (IV) and Lacaune (LC) dairy ewes. Animals were recorded repeatedly within and between lactations, therefore 772 sets of measurements were collected in total. Analysis of variance was conducted with the mixed procedure of SAS statistical package. The model included effects of experimental day, parity, day in milk, random effect of animal and residual error. Subsequently correlations between random animal effects for udder measurements and linear scores were computed. Subjectively assessed linear scores for udder depth, cistern depth, teat angle and teat size showed high correlations with actual measurements of appropriate traits on udder in all examined breeds (r_p=0.65-0.80).

Material and methods
Investigations were performed during the years 2002-2005 in 5 flocks of dairy sheep in the Slovak Republic. Totally 266 purebred Tsigai (T), Improved Valchian (IV) and Lacaune (LC) ewes were included into experiment. Animals were recorded repeatedly within and between lactations, therefore 772 sets of measurements and linear scores were collected in total. Udder morphology measurements and subjective linear appraisals were made on the ewes approximately 12 hours after previous milking.

External udder measurements of 6 traits (Figure 1) were performed by one technician and included udder length measured by tape (UL), udder width (UW), rear udder depth (RUD), cistern depth (CD), teat length (TL), teat angle from the vertical (TA). Additionally the measurements of udder cistern cross-section areas were carried out by the ultrasound technique from the side (SCA) according to the methodology of Ruberte et al. (1994) and from below in a water bath (BCA) as was described by Bruckmaier and Blum (1992). The linear assessments were done subjectively by one experienced assessor using 9 point scale. Linear assessment scheme contained 7 characteristics of udder and teats: udder depth (1-low, 9-high) cistern depth below the teat level (1-none, 9-high), teat placement (1-vertical, 9 horizontal), teat length (1-short, 9-long), udder attachment (1-narrow, 9-wide), udder cleft (1- not detectable, 9-expressive), udder shape from the point of view of machine milking (1-bad, 9-ideal).

Data were processed by MIXED procedure from the SAS statistical package (SAS Institute, 2000). Following statistical model was used for all investigated traits:

$$Y_{ijkl}=ED_i+PAR_j+an_k+a*dim_{ijkl}+b*dim_{ijkl}^2+e_{ijkl}$$

where:

- Y_{ijkl} = measured or assessed trait
- ED_i = experimental day (fixed effect – 12 levels for T and IV, 8 levels for LC)
- PAR_j = parity (fixed effect – 3 levels- 1st; 2nd; 3rd and further lactations)
- an_k = animal (random effect)
- dim_{ijkl} = days in milk (covariable – min. = 42 days; max. =191 days)
- e_{ijkl} = residual error

Estimated random animal effects (an_k) included in addition to genetic effects of individuals also life-wide and within lactation permanent environmental effects. Pearson correlation coefficients between estimates of random animal effect (an_k) for udder measurements and for the traits of linear assessment scheme were computed by the use CORR procedure from the SAS statistical package.

Results

Table 1: Correlation coefficients between subjectively assessed linear scores and measurements of characteristics of udder morphology in Tsigai dairy ewes.

	Udder measurements							
Linear score	UL	UW	RUD	CD	TL	TA	BCA	SCA
Udder depth	0.687	0.758	0.778	0.251	n.s.	n.s.	0.488	0.516
Cistern depth	0.329	n.s.	0.237	0.760	-0.205	0.614	0.281	n.s.
Teat position	0.192	n.s.	n.s.	0.666	-0.266	0.694	0.261	n.s.
Teat size	n.s.	n.s.	n.s.	n.s.	0.746	-0.175	n.s.	n.s
Udder cleft	n.s.	n.s.	n.s.	-0.238	n.s.	-0.235	n.s.	n.s.
Udder attachment	0.468	0.712	0.568	n.s.	n.s.	n.s.	0.292	0.442
Udder shape	0.577	0.727	0.671	n.s.	n.s.	-0.178	0.371	0.479

Explanations: UL- udder length, UW –udder width, RUD-rear udder depth, CD-cistern depth, TL-teat length, TA-teat angle, BCA-cistern cross-section area measured from bottom, SCA-cistern cross-section area measured from side

Table 2: Correlation coefficients between subjectively assessed linear scores and measurements of characteristics of udder morphology in Improved Valachian dairy ewes.

	Udder measurements							
Linear score	UL	UW	RUD	CD	TL	TA	BCA	SCA
Udder depth	0.756	0.721	0.802	0.587	n.s.	0.316	0.578	0.571
Cistern depth	0.434	0.284	0.413	0.795	-0.275	0.693	0.379	0.247
Teat position	0.325	n.s.	0.299	0.560	-0.360	0.762	0.244	n.s.
Teat size	n.s.	n.s.	n.s.	n.s.	0.654	-0.294	n.s.	n.s.
Udder cleft	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	0.215	0.269
Udder attachment	0.321	0.656	0.440	0.251	n.s.	n.s.	0.255	0.371
Udder shape	0.588	0.746	0.721	0.417	n.s.	n.s.	0.464	0.488

Table 3: Correlation coefficients between subjectively assessed linear scores and measurements of characteristics of udder morphology in Lacaune dairy ewes.

	Udder measurements							
Linear score	UL	UW	RUD	CD	TL	TA	BCA	SCA
Udder depth	0.799	0.528	0.761	0.293	n.s.	n.s.	0.560	0.583
Cistern depth	0.404	n.s.	n.s.	0.765	n.s.	0.755	0.324	n.s.
Teat position	0.389	n.s.	n.s.	0.692	n.s.	0.738	0.309	n.s.
Teat size	0.356	n.s.	0.315	n.s.	0.695	n.s.	0.302	n.s.
Udder cleft	n.s.	n.s.	n.s.	-0.276	n.s.	n.s.	n.s.	n.s.
Udder attachment	n.s.	0.412	n.s.	n.s.	n.s.	-0.385	n.s.	n.s.
Udder shape	n.s.	0.574	n.s.	n.s.	n.s.	-0.305	n.s.	0.318

Conclusions

Subjectively assessed linear scores for udder depth, cistern depth, teat angle and teat size showed high correlations with actual measurements of appropriate traits on udder in all three examined breeds (r_p=0.65-0.80). It would appear that the used linear scoring system is appropriate for evaluating in dairy ewes of Tsigai, Improved Valachian and Lacaune in the Slovak Republic. Nevertheless for final designing of linear scoring scheme in Slovakia also knowledge about relationships between udder traits assessments and milk yield, resp. machine milk flow characteristics is needed. Interbreed differences in relationships between linear scores for udder shape and some other udder morphology characteristics suggested that udder shape assessment is more influenced by those characteristics which are far from the ideal udder shape. The knowledge about relationships between morphological udder traits would permit to predict future correlated responses in milk-oriented selection schemes.

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