Journal of Animal and Feed Sciences, 2, 1993, 117–127

Morphological characteristics of udders as selection criteria for improvement of mammary gland health and productivity of sheep. 2. The relationship between udder morphology and the health and productivity of ewes

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(Received 23 February 1993; accepted 21 June 1993)

ABSTRACT

The health of the mammary gland and productivity of three breeds of sheep, Polish Merino, Polish Lowland and Polish Highland, were studied in relation to udder morphology. The contamination of milk by pathological strains of bacteria (*Staphylococci* and *Streptococci*) was found in 15–20% of ewes. The ewes with over- or undersized ($> \bar{x} \pm SD$, $< \bar{x} \pm SD$) udders developed mastitis more frequently than did those with udder sizes within the limits of $\bar{x} \pm SD$. Significant correlations were found between the morphological traits of udders and milk yield of the Polish Highland ewes and the rearing results of Merino and Polish Lowland lambs.

KEY WORDS: morphological udder structure, milk yield, body weight gain, sheep

INTRODUCTION

The problem of correlation between mammary gland morphology and mammary gland health has not received much attention in sheep breeding, as indicated by the lack of literature on this subject. On the other hand, numerous studies carried out on cows confirm the existence of a correlation between udder morphology and udder health. Many authors (Magid et al., 1983; Seykora and McDaniel, 1985; Pander and Chopra, 1987) have shown that cows with sagging udders develop mastitis much more often than those with round or box-shaped udders. As regards the relationship between size and shape of teats and susceptibility to mastitis opinions differ. Some authors (Hibbitt, 1983; Binde and

ISSN 1230-1388

Bakke, 1984) have found a higher mastitis rate in cows with cylindrical teats, while others (Bakken, 1981; Ryniewicz, 1981) believe that funnel-shaped teats facilitate infection of the mammary gland. In addition to teat shape, teat size also affects udder health. It has been found that cows with long and wide teats are less resistant to infection than cows with smaller teats (Ryniewicz, 1981; Magid, 1983; Jensen et al., 1985; Pander and Chopra, 1987). The suggestions that selection of females should take into account the proper morphology of their udders (Ryniewicz, 1981; Poutrel, 1983; Jensen et al., 1985) seems therefore to be well justified and should become an essential element of modern breeding practices aimed at protecting the health of the udder and improving milk yield. The health of the mammary gland affects its productivity. Negative genetic and phenotypic correlations (within the limits of -0.2 to -0.4) have been found very frequently between the somatic cell count in milk and the milk yield of cows (Hibbitt, 1983; Bunch et al., 1984; Batra, 1986). Studies carried out on sheep (Mackie and Rodgers, 1986; Fthenakis and Jones, 1987) have proven that deterioration of udder health has a negative effect on milk yield and, in effect, on lamb rearing results. Smaller gains and even lamb mortality are the consequences not only of poor milk quality (e.g. the presence of pathogenic bacteria), but also of its diminished amount.

MATERIAL AND METHODS

The health of the mammary gland was analyzed in Polish Lowland, Polish Merino and Polish Highland sheep (see Methods, Part 1). Milk samples were collected separately from each half of the udder three times during lactation (at the end of the first, second and third month) from Lowland and Merino ewes and six times (three times in the sheep-house during rearing of lambs and three times at pasture during dairy use) from Polish Highland ewes.

The health state of the udders was diagnosed on the basis of a somatic cell count (SCC) in 1 ml of milk, determined by way of the Fossomatic 15610 apparatus. The correlation observed in cattle (Heon et al., 1987; Hueston et al., 1987) between the somatic cell count in the milk and the occurrence of mastitis, supported by results of studies on the applicability of diagnostic tests for mastitis in cows (Emanuelson et al., 1984) and sheep (Green, 1984; Maisi et al., 1986), justifies the use of this parameter in the assessment of udder health.

300,000 somatic cells/ 1 ml of sheep milk (Zarzycki et al., 1983) was accepted as the physiological SCC standard.

In order to obtain a normal distribution neccessary for statistical calculations (Ali and Shook, 1980) a logarithm of the number of somatic cells (LSCC) was used.

Most of the milk samples were tested for the presence of pathogenic bacteria using routine bacteriological tests.

The intraclass correlation of paternal half-sibs was used to estimate the heritability of the SCC in 1 ml of milk and the genetic correlations between SCC and morphological traits of the udders of Polish Lowland and Merino ewes. The sire component of variance was estimated by (co)variance analysis (Harvey, 1987; mixed model 2), carried out according to the linear model:

$$Y_{ijkl} = \mu + A_i + b_j + C_k + e_{ijkl}$$

where:

Y_{ijkl} – value of the trait in individual k, in year i, after sire j,
μ – general mean,
A_i – fixed effect of the year of study ($i = 1 \ldots 6$ for Polish Lowland ewes, $i = 1 \ldots 5$ for Merino ewes),
b_j – random effect of sire genotype ($j = 1 \ldots 54$ for Polish Lowland ewes, $j = 1 \ldots 48$ for Merino ewes),
C_k – fixed effect of stage of lactation ($k = 1 \ldots 3$ for Polish Lowland and Merino ewes),
e_{ijkl} – error.

Apart from estimating the correlation between somatic cell count and udder morphological traits, an analysis of the frequency of mastitis occurrence, depending on the values of morphological traits of udders, was carried out. The values of the studied morphological traits were classified into three groups: (i) values within the range of $(\bar{x} - SD; \bar{x} + SD >$, (ii) values below the lower limit and (iii) values above the upper limit of the given range. The frequency of occurrence of milk samples with a determined SCC was calculated for each of these groups. In order to obtain a clear picture of this relationship, milk samples containing over 300,000 cells and those containing over 500,000 cells per 1 ml were subjected to further analysis.

The influence of udder morphology on sheep productivity was analyzed. In the case of Highland sheep, which are a dairy breed, data on milk yield was available and based on test milkings carried out in two-week intervals. This made it possible to estimate the phenotypic correlation between dam productivity for 100 days of lactation and the morphological traits of their udders. However, due to the small sample size, genetic correlations between these traits were not estimated.

The genetic and phenotypic correlations between the morphological traits of udders in Polish Lowland and Merino ewes and the results of rearing lambs

(body weight of Merino lambs at 28 days and weight gain of Lowland lambs from birth to weaning) were studied by (co)variance analysis (Harvey, 1987; mixed model 2), according to the following linear model:

$$Y_{ijk} = \mu + A_i + b_j + e_{ijk}$$

where:

Y_{ijk} – value of the trait in individual k, in year i, after sire j,
μ – general mean,
A_i – fixed effect of the year of study ($i = 1 \ldots 6$ for Polish Lowland ewes, $i = 1 \ldots 5$ for Merino ewes),
b_j – random effect of sire genotype ($j = 1 \ldots 54$ for Polish Lowland ewes, $j = 1 \ldots 48$ for Merino ewes),
e_{ijk} – error.

In order to eliminate the influence of additional factors, the weight gain of Polish Lowland lambs was adjusted (by regression) for sex, number of lambs in litter and number of weaned lambs from one mother (Harvey, 1987; model 1).

RESULTS AND DISCUSSION

A bacteriological analysis of the milk from the ewes examined revealed a similar degree of infection in ewes of different breeds (about 19% in Merino, 22% in Lowland and 23% in Highland sheep). The bacteria most frequently isolated were *Staphylococci* and *Streptococci.*

The heritability coefficients for LSCC estimated for the studied population of Lowland and Merino ewes are presented in Table 1. These values are similar to results obtained by Bunch et al. (1984) and Coffey (1985) for cows.

TABLE 1

Heritability coefficient of somatic cell count in milk of Polish Lowland and Polish Merino sheep

Week of lactation	Polish Lowland sheep			Polish Merino		
	number of sample	h^2	SE	number of sample	h^2	SE
4th	1215	0.23	0.07	756	0.13	0.08
8th	1366	0.37	0.09	714	0.13	0.08
12ve	1370	0.16	0.06	555	0.21	0.11
Total	3951	0.24	0.05	2025	0.15	0.03

The correlations between morphological traits of udders and teats and the SCC of milk from Polish Lowland and Merino ewes are given in Tables 2 and 3.

TABLE 2

Phenotypic and genotypic correlation coefficients between udder morphological traits and somatic cell count in 1 ml of milk of Polish Lowland sheep

Traits	1st month		2nd month		3rd month		Total	
	rp	rg	rp	rg	rp	rg	rp	rg
Observations, n	1215		1366		1370		3951	
Udder length	–	0.17	–		–	0.16	–	–
„ width	–	–	–	0.13	–	–	–	–
„ depth	–	–		–	–	0.21	–	0.09
„ trans. cir.	–	0.22	–	–	–	0.10*	–	–
„ long. cir.	–	0.14	–	–	–	0.30	–	0.09
Distance between teats	–	–	–	0.15		0.13	–	0.12
Teat angle (left)	–	0.11	–	−0.20		0.24	–	–
„ angle (right)		0.11	–	−0.19	–	0.15	–	–
„ length (left)	0.10	–	0.11	0.18	0.07*	0.15	0.09	0.12
„ length (right)		–	0.10	0.34	0.08*	0.24	0.09	0.23
„ diam. (left)	0.10	–	0.13	0.36	0.09	0.28	0.10	0.24
„ diam. (right)	0.10	–	0.10	0.20	0.11	0.35	0.10	0.19

–) correlation coefficient nonsignificant,
*) correlation coefficient significant at $P \leqslant 0.05$,
other correlation coefficients significant at $P \leqslant 0.01$

TABLE 3

Phenotypic and genotypic correlation coefficients between udder morphological traits and somatic cell count in 1 ml of milk of Polish Merino

Traits	1st month		2nd month		3rd month		Total	
	rp	rg	rp	rg	rp	rg	rp	rg
Observations, n	756		714		555		2025	
Udder length	–	−0.22	−0.14	−0.35	–	0.13	−0.09	−0.12
„ width	−0.08	−0.39	−0.19	−0.37	−0.13	–	−0.12	−0.28
„ depth	0.11	−0.68	–	−0.22	–	0.14	–	−0.15
„ trans. cir.	–	–	−0.07*	−0.30	−0.10*	−0.25	–	−0.16
„ long. cir.	–	−0.46	−0.10	−0.31	–	−0.20	–	−0.31
Distance between teats	–	−0.41	–	0.70	−0.18	−0.69		0.25
Teat angle (left)	–	−0.40		0.23	−0.12	−0.85	–	−0.34
„ angle (right)	–	−0.48	–	−0.21	–	−0.73	–	−0.50
„ length (left)	0.13	−0.11	0.12		–	−0.11	0.09	–
„ length (right)	0.13	–	0.09	–	–	–	0.09	–
„ diam. (left)	0.10	0.19	–	0.12	–	0.09	0.10	0.14
„ diam. (right)	0.13	0.53	–	0.16	–	0.26	0.10	0.39

–) correlation coefficient nonsignificant,
*) correlation coefficient significant at $P \leqslant 0.05$,
other correlation coefficients significant at $P \leqslant 0.01$

Among the udder traits of Lowland ewes, only its depth, longitudinal circumference and distance between teats showed a significant positive correlation with the mean (for the whole period of lactation) LSCC value. In the Merino ewes, however, a negative phenotypic correlations were found between the udder health and its length, width and longitudinal circumference as well as distance between teats. These different correlations are well justified. Both udders that are too large and too small show a greater tendency to develop mastitis. Thus, in the Merino ewes, which have significantly smaller udders than Polish Lowland ewes, as the values of the morhpological traits of udder decreased, the somatic cell count of the milk increased, i.e. the health condition of the udder deteriorated. On the other hand in the Polish Lowland ewes a concomitant rise in udder size and SCC of their milk was observed.

The estimation of the genetic correlation between udder and teat morphology and the health of the mammary gland is difficult. Although the correlation coefficients obtained in this study range between about – 1 to 0.8, they are burdened with a large error. This may be caused by the sample size being too small.

The correlation between udder morphology traits and udder health is additionally supported by the frequency of milk samples with elevated somatic cell counts from ewes characterized by certain values of morphological parameters (Table 4). In Merino ewes, mastitis was observed more frequently in those dams which had smaller udders, whereas deviations in teat length and width had a significant influence on udder health in both breeds. This effect was clearly visible in the class of ewes with large (long and wide) teats. These results are in agreement with those of Gonzalo et al. (1985) obtained for the dairy sheep breed, Churra. One of the reasons for an increased incidence of mastitis in ewes with large teats may be the retention of milk in the gland as lambs find suckling difficult during the first weeks after birth.

The values of the phenotypic correlation coefficients between the analyzed morphological traits and milk yield of Polish Highland ewes for a 100 days of lactation are presented in Table 5. Udder length, measured from its base, was found to have the greatest influence on milk production by the ewes studied ($r_p = 0.42$). A similar value of the correlation coefficient ($r_p = 0.38$) between these traits was found by Labussière (1988) for Manchega, and a slightly higher value for Lacaune, Karagouniko and Cygaja ewes ($r_p = 0.61$, 0.59 and 0.59, respectively). The remaining morphological traits of the udders of primipara Polish Highland ewes had a somewhat lesser effect on the milk yield. No significant effect was found, however, of the size, distance between and slant of teats on the milk yield of the studied ewes. The correlation between udder circumference and milk productivity of ewes given by Camalesa (1974) ($r_p = 0.43$) and Papachristoforou and Mavrogenis (1981) ($r_p = 0.79$) was slightly higher than that obtained in this

TABLE 4

Frequency of milk samples with defined somatic cell count in 1 ml in sheep of determined values of morphological traits of udders

Traits		Polish Lowland sheep			Polish Merino		
		$\langle \bar{x} - S$	$\bar{x} \pm S$	$\rangle \bar{x} + S$	$\langle \bar{x} - S$	$\bar{x} \pm S$	$\rangle \bar{x} + S$
Udder length	a	17.41	14.20	16.58	20.27	12.36	13.55
	b	12.59	9.51	10.84	14.53	9.55	11.36
Udder width	a	16.34	14.19	17.63	21.53	13.02	6.99
	b	12.08	9.67	10.34	17.01	9.99	4.84
Udder depth	a	15.78	10.06	21.19	17.35	12.84	21.05
	b	11.03	9.01	14.75	13.70	9.64	13.88
Udder transv.	a	15.63	14.25	17.91	19.95	11.60	16.67
circ.	b	12.38	9.09	12.11	15.03	9.08	12.28
Udder longit.	a	16.36	13.07	22.70	17.19	12.43	16.79
circ.	b	11.86	8.52	16.03	12.28	9.71	13.06
Distance between	a	19.22	13.56	19.13	24.47	12.56	9.71
teats	b	13.98	8.92	13.21	20.21	9.32	7.61
Teat angle (left)	a	15.24	14.67	16.20	17.63	13.47	10.64
	b	10.97	9.87	10.31	11.19	10.77	8.51
Teat angle (right)	a	12.37	15.15	17.08	17.23	13.13	12.81
	b	8.53	10.39	10.56	12.16	10.36	9.69
Teat length (left)	a	11.14	14.04	23.98	9.80	13.16	19.35
	b	7.57	9.44	16.33	6.54	10.05	16.07
Teat length (right)	a	14.31	13.86	21.89	10.45	12.87	22.62
	b	9.80	9.44	14.15	7.46	9.74	19.05
Teat diam. (left)	a	11.90	14.62	21.18	12.54	12.74	21.12
	b	8.26	10.06	12.83	9.97	9.51	17.75
Teat diam. (right)	a	11.47	14.30	22.30	9.79	12.90	21.90
	b	8.78	9.46	14.99	6.64	9.90	17.88

a – over 300,000 somatic cells in 1 ml of milk
b – over 500,000 somatic cells in 1 ml of milk

TABLE 5

Phenotypic correlations between udder morphological traits and milk yield of Polish Mountain sheep during 100 days' lactation

Udder morphological traits	Milk yield
Udder length	0.42
„ width	0.27
„ depth	0.24
„ transversal ciercumference	0.23
„ longitudinal circumference	0.31

All coefficients significant statistically at $P \leqslant 0.01$

study. In the opinion of the cited authors udder circumference measured during the peak of the first lactation should be a selection factor in breeding for improved milk yield of ewes.

In spite of the small number of dairy sheep in Poland, the problem of milk yield remains very important in sheep breeding. High milk productivity of ewes determines the proper nutrition of lambs during initial period of their life. The variability in gains of lambs during the first month of life exceeding 75% is related to the amount of milk they receive and there is a high correlation between daily yield of ewes and gains of their lambs during this period ($r_p = 0.75$, to 0.90; Sormunen, 1979).

The correlation coefficients between morphological traits of udders and the results of rearing lambs estimated for the studied herd are presented in Table 6.

TABLE 6

Relationship (r_p and r_g) between udder morphological traits and lamb rearing results of Polish Lowland Sheep (PLS) and Polish Meriono (PM)

Traits	Daily gain of PLS lambs during nursing period			Body weight of PM lambs at 28 day of life		
	r_p	r_g	SE	r_p	r_g	SE
Udder length	0.13	0.31	0.31	0.19	0.36	0.60
„ width	0.14			0.14	0.11	0.58
„ depth	0.11	0.52	0.26	0.12	0.89	0.61
„ trans. cir.	0.09	0.06*	0.28	0.21	1.08	0.50
„ long. cir.	0.13	0.54	0.26	0.25	0.72	0.31
Distance between teats	0.07*	−0.31	0.27	0.22	0.68	0.43
Teat angle (left)	–	−0.22	0.28	–	0.23	0.42
„ angle (right)	–	−0.33	0.28		0.56	0.47
„ length (left)	–	−0.45	0.27	0.11	0.24	0.37
„ length (right)	–	−0.55	0.28	0.09	0.44	0.41
„ diam. (left)	–	−0.28	0.30	–	−0.45	0.90
„ diam. (right)	–	−0.08	0.29	–	−0.27	0.53

–) correlation coefficient nonsignificant,
*) correlation coefficient significant at $P \leqslant 0.05$,
other correlation coefficients significant at $P \leqslant 0.01$.

The phenotypic correlations for all the studied teat traits for Polish Lowland ewes and almost all for Merino ewes were found to be not significant statistically. However, the size of error with which this parameter was determined somewhat obscures the interpretation of these results. Among the morphological traits of the udder of greatest importance seem to be the depth and longitudinal circumference. In both of the studied breeds these traits were characterized by the highest correlation with the results of lamb rearing.

The opposite signs of the coefficient of genetic correlation between the teat-to-teat distance or their slant with the body weight of 28-day-old Merino lambs and daily gain of Lowland lambs is explained by the values of these morphological traits. The Merino dams were characterized by a significantly smaller distance between teats and a smaller slant than the Polish Lowland ewes. Labussière (1988) showed that those ewes which have horizontal teats are characterized by a single milk flow peak, i. e. they have a lower milk yield than those ewes whose teats are almost vertical (their milk flow curve has two peaks).

The higher, negative, value of the coefficients of genetic correlation between teat width of Merino ewes and lamb rearing results ($r_p = -0.45$ and -0.27 for the left and right teat, respectively) may arise from the fact that their dams had significantly wider teats than the Polish Lowland ewes, which may, to a certain extent, make suckling more difficult.

It is interesting to compare the values, especially the signs, of the correlation between lamb rearing results and the morphological traits of their dams' udders (Table 6) with analogous correlation parameters between the morphology and health of the mammary gland (Table 2). This comparison indicates that there is a strict relationship between the health of ewe udders and the rearing results of lambs. For example, the teat morphological traits of Lowland ewes are negatively correlated with daily gains of their lambs, while being positively correlated with the somatic cell count in milk. A comparison of the correlation between body weight of Merino lambs at 28 days and the morphological traits of their dams' udders (length, width, depth, transverse and longitudinal circumference) (Table 3) with the analogous coefficient of the relationship between somatic cell count in milk and the above – mentioned traits indicates that the decrease in body weight of lambs accompanying decreasing udder size may result from the deteriorating health of this gland.

Studies conducted for several years in England (M.L.C., 1988) have shown a dramatic drop in milk yield of ewes suffering from mastitis, and as a result, of decreased gains of their lambs.

CONCLUSIONS

1. An analysis of the health of the mammary gland of three breeds of sheep carried out in this study has shown that the udders of 15–20% of the ewes were infected with mastitis-causing bacteria.
2. The health of udders depends among other on the morphology of this gland. Ewes with extremely large or extremely small udders are particularly susceptible to infection.
3. The estimated correlations suggest that the morphology of the udder and teats plays an important role in lamb rearing results and milk productivity of ewes.

LITERATURE

Ali A.K.A., Shook G.E., 1980. An optimum transformation for somatic cell concentration in milk. J. Dairy Sci. 63, 487–490

Bakken G., 1981: Relationships between udder and teat morphology, mastitis and milk production in Norwegian Red cattle. Acta Agric. Scand. 31, 438–444

Batra T.R., 1981: Relationship of somatic cell concentration with milk yield in dairy cows. Can. J. Anim. Sci, 66, 607–614

Binde M., Bakke H., 1984. Relationships between teat characteristics and udder health. Nord. Vet. Med. 36, 111–116

Bunch K. J., Heneghan D. J. S., Hibbitt K. G., Rowlands G. J., 1984. Genetic influences on clinical mastitis and its relationship with milk yield, season and stage of lactation. Livest. Prod. Sci. 11, 91–104

Camalesa N., 1974. Recherches concernant quelques aspecte de la conformation de la glande mammaire et de la symétrie fonctionelle chez les races ovine Tsigaja et Turcana élevées en Roumanie. Symp. sur le Trait Mecanique des Petits Ruminants, Millau. Ann. Zootech, 23, 69–75

Coffey E. M., 1985. A study of the potential of somatic cell concentration of milk as a sire selection criterion to reduce mastitis in dairy cattle. Diss. Abstr. Int., B, 46, 416–417

Emanuelson V., Philipsson J., 1984. Studies on somatic cell counts in milk from Swedish dairy cows. II. Estimates of genetic parameters for monthly test-day results. Acta Agric. Scand., 34, 45–53

Fthenakis G. C., Jones J. E. T., 1987. The effects of subclinical mastitis on the productivity of lactating ewes. 38 Ann. Meet. EAAP, Lizbona, Portugalia, 1–13

Gonzalo C., Vijil E., Requera O., 1985. Study of milk yield, health condition of the mammary gland and udder shape throughout lactation in machine milked Churra sheep. 36 Ann. Meet. EAAP, Kallithea, Halkidiki, Greece, 448–449

Green T. J., 1984. Use of somatic cell counts for detection of subclinical mastitis in ewes. Vet. Rec. 114, 43

Harvey W. R., 1987. User's Guide for LSMLMW Mixed Model Least-Squares and Maximum Likelihood Computer Program. Monogr., Ohio Univ.

Heon D. J., Renshaw E. M., Moore J. J., Fairchild T. P., 1987. Somatic cell counts and bulk tank bacteria counts as indicators of clinical mastitis in fourteen New Hampshire dairy herds. J. Dairy Sci. 70, 167

Hibbitt K. G., 1983. Inherited resistance to mastitis. Vet. Ann. 23, 65–70

Hueston W. D., Heider L. E., Harvey W. R., Smith K. L., 1987. The use of high somatic cell count prevalence in epidemiologic investigations of mastitis control practices. Prev. Vet. Med. 4/5/6, 447–461

Jensen N. E., Madsen P., Larsen B., Klastrup O., Nielsen S. M., Madsen P. S., 1985. Heritability and markers of resistance against mastitis in the Danish RDM breed. Kiel. Milchwirt. Forschungsber. 37, 506–510

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

Mackie D. P., Rodgers S. P., 1986. Mastitis and cell content in milk from Scottish Blackface ewes. Vet. Rec. 118, 20–21

Magid S. A., 1983. The effect of selection for milk yield flow and udder measurements. Diss. Abstr. Int., B, 44, 1652

Magid S. A., Freeman A. E., Kelley D. H., Berger P. J., 1984. Effect of selection for milk flow, udder measurements and mastitis. J. Dairy Sci. 67, (suppl. 1), 193–194

Maisi P., Seppänen J., Juntilla J., 1986. Detection of mastitis in ewes. Symp. on Mastitis Control and Hygienic Production of Milk, Espoo, Finland, 193–197

M. L. C., 1988. Sheep Yearbook. Mastitis in ewes., Milton Keynes, 39–40

Pander B. L., Chopra S. C., 1987. Incidence of subclinical mastitis et implantation to production traits and udder and teat phenotype in cross-bred dairy cattle. Indian J. Dairy Sci. 40, 363–364

Papachristoforou C., Mavrogenis A. P., 1981. Udder characteristics of Chios sheep and their relation to milk production and machine milking. Technical paper 20. Agric. Research Inst., Nicosia, Cyprus, 1–9

Poutrel B., 1983. Les mammites de la chèvre et de la brebis. Dossiers de l'Elevage, 5, 37–45

Ryniewicz H. Z., 1881. Współzależność między niektórymi cechami fizjologicznymi i budową wymienia a podatnością krów na mastitis. Thesis. Institute of Animal Genetics and Breeding, Polish Academy of Sciences, Jastrzębiec, 1–71

Seykora A. J., McDaniel B. T., 1985. Heritabilities of teat traits and their relationship with milk yield, somatic cell count and percent two-minute milk. J. Dairy Sci. 68, 2670–2683

Sormunen R., 1979. Milk production of Finnsheep ewes. Symp. on Intensive Sheep Production, Helsinki, Finland, 88–94

Zarzycki J., Tyszka Z. J., Skolasiński W., 1983. Próba wyznaczenia granicy dla fizjologicznej zawartości elementów komórkowych w mleku owczym. Med. wet. 39, 738–740

STRESZCZENIE

Cechy morfologiczne wymion jako kryteria selekcji w celu poprawy zdrowotności gruczołu mlekowego i produkcyjności owiec. 2. Związek między budową morfologiczną wymienia a stanem zdrowia i produkcyjnością owiec

Badano stan zdrowotny gruczołu mlekowego i wyniki producyjne owiec trzech ras - merynos polski, polska owca nizinna i polska owca górska w zależności od budowy morfologicznej wymienia. Zainfekowanie mleka bakteriami chorobotwórczymi (gronkowce, paciorkowce) stwierdzono u 15 20% owiec. Maciorki o zbyt dużych lub małych ($> x + S$, $< \bar{x} - S$) wymionach częściej zapadały na mastitis niż owce o wymiarach wymion w granicach $\bar{x} \pm S$.

Stwierdzono istotne korelacje między cechami morfologicznymi wymion a wydajnością mleczną maciorek polskiej owcy górskiej oraz wynikami odchowu jagniąt merynosowych i polskiej owcy nizinnej.