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ESTIMATION OF CORRELATION COEFFICIENTS BETWEEN MILK YIELD AND MORPHOLOGICAL TRAITS IN A POPULATION OF LACAUNE SHEEP

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Abstract

The aim of the study was to estimate correlations between milk yield and growth traits. The biological material was 282 Lacaune ewes and traits studied were: milk yield (MY), body weight (BW), height at withers (HW), height at rump (HR), torso length (TL), chest width (CW), rump width (RW), chest depth (CD), chest girth (CG) and metacarpal circumference (MC). The data obtained were statistically processed and interpreted. Average values for milk yield was 120.86 kg for 135 days; average values for morphological traits was 65.10 kg for BW, 62.48 cm for WH, 63.23 cm for RW, 55.25 cm for TL, 25.04 cm for CW, 23.60 cm for RW, 24.06 cm for CD, 84.07 cm for CG and 6.91 cm for MC. Correlations were determined by Pearson test and correlation coefficients had values of +0.13 between MY x BW, -0.02 between MY x WH, -0.19 MY x RH, +0.12 between MY x TL, -0.03 between MY x CW, -0.08 between MY x RW, +0.03 between MY x CD, +0.002 between MY x CG and -0.06 between MY x MC.

Key words*: body traits, correlation coefficient, Lacaune, milk yield.*

INTRODUCTION

At the moment, there is an upward trend among consumers to purchase high-quality food products, ecologically produced and from local producers. Sheep milk and dairy products can represent some of these foods that show a growing demand from the population of European countries and beyond.

In Romania, despite a tradition of sheep breeding, supported by the large number of sheep raised nationally - 10.1 million in 2021 (FAO, 2021), the consumption of products obtained from this species is relatively low but with some growth in recent years. In this context, it is considered necessary to study sheep populations to identify methods for conserving specialized breeds for milk production and improving their production.

The success of milk production selection in sheep, as well as in other species, lies not only in the direct improvement of this complex of traits (milk quantity, fat or protein content in milk), but also in the improvement of other traits related to body development or functional characteristics of the organism (Žujović et al., 2011). On the other hand, the determination of absolute body dimensions is also very important, as these represent the morphological and physiological basis not only for highlighting body development but also for optimal expression of production and reproductive traits (Riva et al., 2004, cited by Žujović et al., 2011). Considering these aspects, the study of correlations between milk production and body development becomes important. Determining body dimensions can provide essential information on the course of animal development as well as the expression of certain traits.

The purpose of this article is to highlight the correlations between quantitative milk production and certain body dimensions in order to use the data in selection methods for

valuable breeding animals. At the same time, determining body dimensions in Lacaune sheep is rarely emphasized in the specialized literature.

The choice of studying this breed of sheep derives from the fact that the population is small compared to those of native breeds raised in the country (Tsurcana and Tsigai), but the milk production is significantly higher compared to these breeds.

MATERIALS AND METHODS

The biological material consisted of 282 Lacaune ewes included in the Official Performance and Recording Scheme (COP), on which the total milk yield obtained from the tests was calculated using the technical rules of the International Committee for Animal Recording (ICAR). In our case, we used the alternating monthly test (AT) method, which involves measuring the amount of milk recorded for each sheep in the flock during one of the two daily milkings, and the average recording interval is monthly (30 days) (ICAR Guidelines, 2018). The total control period for the studied flock was 120 days, which includes four milk tests, carried out after the weaning period. The amount of milk calculated at the end of the tests was expressed in liters and represented by total milked milk (TMM), which represents the milk yield produced during the milking-only period (ICAR Guidelines, 2018). The milking was done by machine, and the quantitative recording for each ewe was determined at each test.

In the studied farm, during the winter period, ewes are fed exclusively with quality hay, mash, grains, and concentrates, which are administered on the feed alleys located in the middle of the shelter. During the summer, the forage is of mixed type, so in the warm and rainless periods, the animals are grazed on the plots intended for this purpose, and in the cold and rainy periods, the sheep are fed with hay and mowed green grass along with the concentrates supplement.

Regarding body measurements, they were determined at the third milk test in the morning, before introducing the sheep for milking. The tools used for measurement were an electronic scale, measuring stick, compass, and tape measure. The morphometric traits determined were as follows: body weight (BW); height at withers (HW) - vertical distance from the highest point of the interscapular region to the soil (Riva et al., 2004); height at rump (HR) - the vertical distance from the top of the pelvic girdle to the ground (Cam et al., 2010); torso length (TL) - length from the anterior shoulder point to the posterior extremity of the pin bone (Cam et al., 2010); chest width (CW) - distance between scapulae tubers; rump width (RW) - the distance between coxal tubers; chest depth (CD) - distance from the highest point of the interscapular region to the lowest point of sternum; chest girth (CG) (or heart girth as stated by Cam et al., 2010; Carneiro et al., 2010; Stanjko et al., 2010; Riva et al., 2004) - largest circumference of the thorax, passing by the sternum, and metacarpal circumference (MC) (Azarpajouh et al., 2021) or cannon bone circumference (Anila et al., 2021; Sun et al., 2020).

Body weight was determined using an electronic scale; height, length, and some width dimensions were determined using a measuring stick (Lydthin's rod) (Stajnko et al., 2010). A compass was also used for width measurements, and a metric tape was used for circumference measurements.

The data analysis for this paper was generated using the Real Statistics Resource Pack software (Release 7.6), Copyright (2013-2022) Charles Zaiontz. The variability of the analyzed traits was described using descriptive statistical parameters, and correlations between traits were determined using the Pearson correlation coefficient.

RESULTS AND DISCUSSIONS

Basic parameters of descriptive statistics for milk yield and individual measures of body development (Table 1) showed that the small values of SD and CV% obtained for the majority of parameters indicates that the studied population is a uniform one in terms of milk yield and morphological variability. The average milk yield during the 120-day lactation and control period was 120.86 ± 8.59 kg, values close to those obtained by Libis-Márta et al., who recorded an average milk production of 197.72 ± 37.43 kg over a 229-day lactation

period. Following the measurements taken to determine BW, HW, HR, TL, CW, RW, CD, CG, and MC, mean values of 65.1 ± 3.76 kg, 62.48 ± 2.75 cm, 63.23 ± 3.17 cm, 55.25 ± 3.20 cm, 25.04 ± 2.35 cm, 23.60 ± 2.35 cm, 24.06 ± 2.14 cm, 84.07 ± 3.52 cm and 6.91 ± 0.52 cm, respectively, were obtained. These values highlight the belonging of the studied sheep population to the dairy type, a fact suggested in other studies on other dairy sheep breeds, such as Frizarta (Kominakis et al., 2009) and Spanish Asaaf (Ángeles Pérez-Cabal et al., 2013), where near values were determined.

Table 1. Average values and variability of milk performance and morphometric traits of Lacaune sheep breed

Traits	N	$\bar{x}$	SD	CV %	Min.	Max.
MY (kg)	282	120.86	8.59	7.11	98.68	144
BW (kg)	282	65.1	3.76	5.78	57.16	72.88
HW (cm)	282	62.48	2.75	4.41	57.06	68.96
HR (cm)	282	63.23	3.17	5.02	57.20	70.98
TL (cm)	282	55.25	3.20	5.79	49.03	61.97
CW (cm)	282	25.04	2.35	9.40	20.15	29.91
RW (cm)	282	23.60	2.35	9.96	19.01	28.75
CD (cm)	282	24.06	2.14	8.88	20.11	27.96
CG (cm)	282	84.07	3.52	4.19	77.17	90.64
MC (cm)	282	6.91	0.52	7.49	6.00	8.00

$\bar{x}$ - average, SD - standard deviation, CV% - coefficient of variation, MY - milk yield, BW - body weight, HW - height at withers, HR - height at rump, TL - torso length, CW - chest width, RW - rump width, CD - chest depth, CG - chest girth, MC - metacarpal circumference

The correlation is one of the most common and useful statistics that describes the degree of relationship between two variables. (Sun et al., 2020).

Regarding the obtained results, positive values of milk production correlations were identified in relation to BW ($r = 0.13$, $p<0.05$), TL ($r = 0.12$, $p<0.05$), CD ($r = 0.038$, $p>0.05$), and CG ($r = 0.002$, $p>0.05$), where the p value showed that the level of correlations was significant for BW and TL, but not significant for CD and CG. Negative correlations were not significant between MY and HW ($r = -0.02$, $p>0.05$), MY and CW ($r = -0.03$, $p>0.05$), MY and RW ($r = -0.086$, $p>0.05$), but strongly significant between MY and HR ($r = -0.19$, $p<0.01$) (Table 2).

Table 2. Results relating to study of the strenght of correlation between milk performance and certain body development measures of Lacaune sheep breed

r	MY (kg)	BW (kg)	HW (cm)	HR (cm)	TL (cm)	CW (cm)	RW (cm)	CD (cm)	CG (cm)	MC (cm)
MY										
BW	0.13*									
HW	-0.02ns	0.21***								
HR	-0.19**	0.09 ns	0.17**							
TL	0.12*	0.19**	0.16**	0.200***						
CW	-0.03ns	0.05 ns	0.24***	0.248***	0.21***					
RW	-0.09ns	0.15*	0.13*	0.251***	0.11ns	-0.008ns				
CD	0.04ns	-0.004 ns	-0.05ns	0.074ns	-0.01ns	-0.008ns	0.13*			
CG	0.002ns	0.004 ns	0.04ns	0.025ns	-0.04ns	0.06ns	0.05ns	-0.05ns		
MC	-0.06ns	0.05ns	-0.02ns	-0.095ns	-0.11ns	-0.06ns	-0.01ns	0.03ns	0.03ns	

* = p<0.05, ** = p<0.01, *** = p<0.001 NS = non significant; MY - milk yield, BW - body weight, HW - height at withers, HR - height at rump, TL - torso length, CW - chest width, RW - rump width, CD - chest depth, CG - chest girth, MC - metacarpal circumference

The simple regression equations regarding the relationship between MY and the other nine morphometric traits of Lacaune sheep breed population studied (Figure 1) returned values which show that body weight is the most highly related to milk yield.

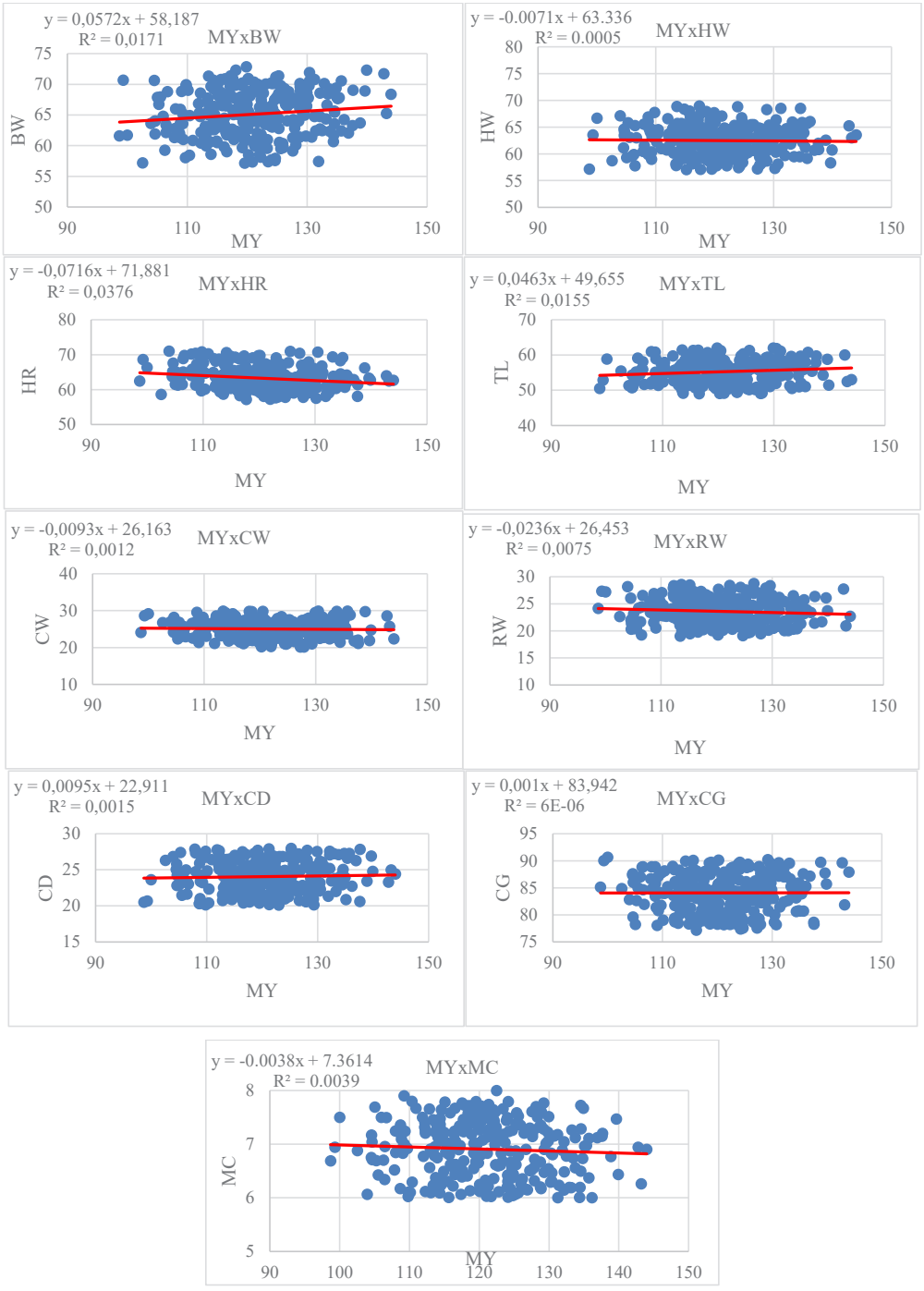

Figure 1. Relationship between milk yield and the studied morphometric traits of Lacaune sheep breed population

Regarding the positive correlation between milk production and body weight, Angeles Hernandez et al. obtained close values (r = 0.44) in the East Friesian sheep breed. Additionally, Gootwine (2011), in his genetic improvement program for the Awassi breed, reported that higher milk production is associated with an increase in sheep body mass.

Other positive values of correlations between MY x BW (r = 0.48, r = 0.132), (r = 0.48) were also determined in some goat breeds in the works of Iloeje and Van Vleck (1978) and respectively Žujović et al. (2011).

However, some studies (Mavrogenis and Papachristoforou, 2000 cited by Angeles Hernandez et al., 2018) suggest that body weight is not a determinant of milk volume produced in Chios sheep and Damascus goats, as they obtained very low genetic and phenotypic correlations (r = 0.08). Some authors (Berry et al., 2007) suggest that these low values may be a feed management-related characteristic.

The correlations between all body measurements varied in the range of -0.11 to 0.25. The strongest positive correlations were identified between HR x CW, HR x RW, and BW x HW.

Other authors (Sun et al., 2020; Anila et al., 2021) obtained similar correlation values between the same traits, but they obtained higher values between other traits (i.e. BW x HW: r = 0.62, r = 0.87) in Jamuna sheep breed and Bardhoka sheep breed, respectively. The strongest negative correlations were found between TL x MC and TL x HR.

The low values of some correlation coefficients between morphometric traits compared to literature values may be due to the differences between age and parity of the studied ewes which could have influenced some of the measurements , the small number of animals or calculation errors.

CONCLUSIONS

The results shows that certain morphometric traits: body weight, trunk length, chest depth, and trunk circumference have a direct effect on the milk production of the sheep population studied. Dimensions such as wither height, trunk width, rump width, and pin bone circumference have negative but insignificant correlations with milk production. In this case, we can conclude that in the selection of individuals for reproduction, body weight and trunk length can be taken into account as heritable traits that could have an effect on the future milk production of the offspring from the studied sheep population.

The regression analysis showed that milk yield could not be predicted from body morphometric trait data alone. However, when correlated with other information such as pedigree and environment, these traits can become an important tool for breeders and farmers to select the best individuals for breeding and increase milk yield.

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