APTITUDE TO MACHINE MILKING OF «MERINO BEIRA BAIXA» EWES

I. Morphological characteristics of the udder

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SUMMARY

For morphological characterization of the udder of «Merino Beira Baixa» ewes (double aptitude), from centre interior of Portugal, 4 series of measurements were performed with 3 weeks intervals, since the beginning of milking (57•7 days after lambing). We have observed the next parameters: lenght, width, volume and posterior area of udder; width between teats and their relative positions, the angle between the teats and the vertical axis, lenght and width of teats; cisternal width. Daily milk production represents about 80 % of the udder volume and the correlation coeficient for these parameters (r=0.54), was the highest one founded. Observed coeficient correlation between daily milk production and width between teats was r=0.53 . All studied variables (morphological characteristics), explain 38.13 % of milk production variability. Udder volume and width between teats explain 37.99 % of the same variability. Results suggest that udder morphology of «Merino Beira Baixa» ewes is a weak indicator of animal's milk value.

1. INTRODUCTION

Merino Beira Baixa sheep represent aproximately 7,6 % of the National livestock and are explored in their double ability (milk and meat). The first milk records were iniciate in the flock of Escola Superior Agraria of Castelo Branco in 1984.

Related to other Portuguese breeds explored for the milk or double production, only the Bordaleira Serra da Estrela has been submitted to milk records for 40 years.

According to MIKUS (1), in countries where ewes are hand milking there is not necessity of studying the udder morphology, because shepherd get used to it

during the lactation period.

In Portugal, because of the lack of workers, the necessity of using the mechanized system is growing. This work is a consequence of the necessity of the morphologic characterization of the udder and adaptability of the Merino Beira Baixa ewes to machine milking, in order not to fall in the mistake of embracing selective criterious used in other breeds, with so different characteristics of the animals that we studied.

We hope that this work will be a step to other future works, in order to determine the adaptability to the present milking machine and bring possible changes into use.

According to LABUSSIERE (2), its easier to change the machine than the udder phisiology of the less evoluted breeds.

2. MATERIAL AND METHODS

This work was performed in a flock of 300 sheep Merino Beira Baixa belonging to the Escola Superior Agraria de Castelo Branco, Portugal.

The animals which were chosen by chance (32 animals) recluded in equal number of ewes belonging to the 1st, 2nd, 3rd and 4th lactation.

The measurement materials were:

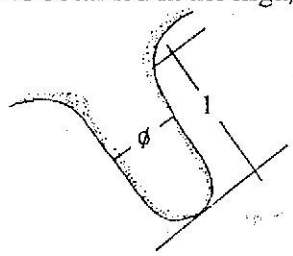
- A transparency upon a transparent acrilic plate to draw the hinder uberus surface which allowed to get the teats angle, the height of the cisterns and the width of the udder;
- Vernier sliding-calliper: udder height and depth; length and diameter of teats.
- A plastic transparent vessel divided by a 10 ml step: udder volume.
- A plastic liter test tube divided by a 10 ml step: milk production.

One hour before morning milking measurements were made during the 1st, 4th, 7th, and 10th week after the beginning. Each measurement was made by an operator.

The methodology used was that described by LABUSSIERE et al. (3) and PURROY et al. (4) which is:

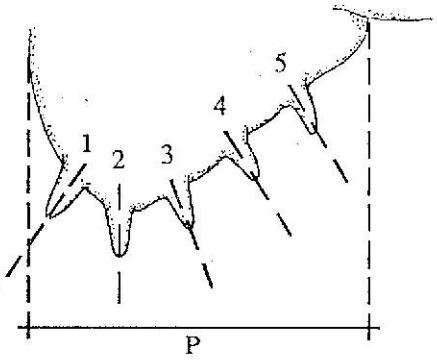
- The length of the teat is the measure between the udder insertion and the sphincter. The diameter is obtained in the high/medium zone (fig. 1);

Figure 1



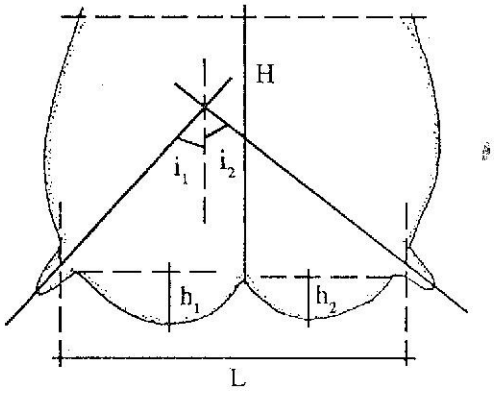
- The udder depth is obtained between the hinder zone (perineal zone) and its abdominal insertion (fig. 2);

Figure 2



- The udder volume was estimated after being sink in a vessel full of tepid water: so its volume is equal to the removed water;
- The width of the udder, the height of the cisterns and the teats angle were estimated through the draw of the udder hinder surface (fig. 3). The

Figure 3



width of the udder is the distance of one teat to the external insertion

of other; The height of the cistern is the distance between the internal teat insertion and its basis support; The teats inclination was obtained by using a transfer to measure the angles between the vertical line and the teats axis (fig. 3);

- The teats position was determined in relation to a vertical plan, giving a value of one to five: 1 when the teat shows a back hinder inclination; 2 when it's vertical; 3 when it shows a slightly inclination ahead; 4 when the inclination is more prominent and 5 when it's much prominent (fig. 2). This measure is subjective because it's an optical observation, without measure instrument;
- The height of the udder was made a direct vertical measure from the distance between the perineal superior insertion and its medium suspensory binding (fig. 3).

All values were analysed by multiple regression and analyse of variance for the full regression. The simple regression of milk production on udder volume was obtained by the least squares method (SNEDECOR, 5).

For the statistical analyses of average values of measurements between lactations four groups of 8 ewes were established. Four measures were taken (1st, 4th, 7th and 10th weeks after the beginning of milking). The trial was delineated in a Randomized Complete Block (RCB)(GOMEZ et GOMEZ, 6)

3. DISCUSSION AND RESULTS

3.1. Average dimensions

LABUSSIERE (7),in a review, points to some breeds the values of Table I.

PEREZ LINARES et al. (8) refers to the Manchega breed the following mean dimensions: udder volume: 755.47 ml • 22.01; udder depth: 106.98 mm • 1.48; teats width namely right and left: 29.36 mm • 0.53 and 28.4 mm • 0.57; teats diameter: 5.44 mm • 0.26 to the right and 14.92 mm • 0.21 to the left.

Comparing the values above refered with those obtained by us (Table II), we verify that, generaly, the mean udder dimension of Merino Beira Baixa ewe are inferior, excluding the udder depth of Lacaune and Churra breeds and the cisterns height and udder volume for Serra da Estrela ewe which shows similar values. For the average measurements of the teats were obtained close values to those refered

to other races, excluding the teats inclination which is superior for the majority of the named races.

TABLE I

REPRESENTATIVE PARAMETERS OF UDDER MORPHOLOGY. COMPARISON BETWEEN BREEDS (LABUSSIERE, 1983)

	71 ewes Teigaia x, (S/ n)	63 ewes Karagouniko x, (S/ n)	87 ewes Lacaune x, (S/ n)	72 ewes Sarda x, (S/ n)	70* ewes Manchega x, (S/ n)	70 ewes Churra x, (S/ n)	71 ewes Serra Estrela x, (S/ n)
Udder Volume (ml)	655.0 (26.0)		945.6 (20.8)	1468.0 (24.0)	535.5 (21.1)	792.5 (27.9)	876.3 (29.7)
Udder depth (mm)	107.4 (1.9)	106.9 (2.0)	79.1 (1.2)	107.0 (3.4)	83.8 (1.6)	81.3 (1.7)	114.6 (1.6)
Cistern height (mm)	10.9 (0.9)	13.1 (0.7)	19.3 (1.0)	31.9 (0.8)	6.9 (0.4)	18.8 (1.1)	9.0 (0.4)
Teat length (mm)	27.0 (0.6)	33.3 (0.8)	30.6 (0.3)	27.2 (0.3)	30.7 (0.6)	26.1 (0.5)	26.4 (0.5)
Teat diameter (mm)	16.3 (0.2)	17.7 (0.4)	14.3 (0.1)	16.0 (0.1)	17.9 (0.2)	16.0 (0.3)	17.2 (0.3)
Teat position (1-5)	2.9 (0.1)	2.5 (0.1)	3.2 (0.1)	3.7 (0.1)	3.0 (0.1)	3.4 (0.1)	3.3 (0.1)
Teat inclination (degrees)	34.5 (0.9)	42.5 (0.9)	48.0 (1.2)	57.2 (0.9)	43.4 (1.2)	50.7 (1.2)	52.9 (1.5)

The method used is that of the FAO study (LABUSSIERE, 1983).
*Trial carried out in Valencia

LABUSSIERE (2) holds the opinion that selecting for the milk prodution the udder enlarges, and also the cisterns.

LABUSSIERE (7) also refers that, unfortunately, big cisterns are normaly associated with unfavorable teats position (more horizontal). PARTEARROYO et FLAMANT (9) share this same opinion.

TABLE II

AVERAGE VALUES FOR THE UDDER AND TEATS MEASUREMENTS

	Teats				Udder				
	Length l(cm)	Diameter ∅(cm)	Inclination i(°)	Position p(1-5)	Depth P(cm)	Height H(cm)	Width L(cm)	Volume V(ml)	Cisterns height h(cm)
$\bar{x}$	3.76	1.51	37.17	2.99	9.12	10.61	11.06	419.41	0.87
SD	0.49	0.24	19.36	0.59	1.69	1.49	1.03	122.08	0.39

Milk production - 335.91 ± 140.97

3.2. Udder measurements

3.2.1. Evolution during lactation

Table III shows the average values of the udder measurements in the 4th controls and the parameter rate obtained.

Analising the table we came to the conclusion that the cisterns height, the milk production, the udder depth and width show a tendence to decrease during lactation.

The depth and volume show a sudden fall from the 1st to the 4th week, slightly from the 4th to the 7th and increases again from the 7th to the 10th, representing this increase to the depth 3.57 % and to the volume 34.35 % . This fact was coincident with the substantial improvement of grazing pasture.

TABLE III

AVERAGE VALUES FOR THE UDDER MEASUREMENTS IN THE PERFORMED CONTROLS AND TOTAL AVERAGE

Week	Control	n	Parameter	Heigth H(cm)	Width L (cm)	Depth P (cm)	Volume V(ml)	cistern h. left	cistern h. rigth	Milk Prod. (ml)
1	1	32	$\bar{x}$	11.33	11.40	9.68	524.06	1.14	1.20	386.0
			SD	1.59	0.95	1.90	104.17	0.53	0.46	138.0
4	2	32	$\bar{x}$	10.13	11.20	7.98	356.88	0.80	0.91	349.0
			SD	1.30	0.96	1.20	83.41	0.43	0.42	137.0
7	3	32	$\bar{x}$	10.46	10.92	7.29	339.38	0.70	0.78	266.0
			SD	0.93	0.96	1.06	82.42	0.37	0.35	125.0
10	4	32	$\bar{x}$	10.53	10.73	7.55	457.34	0.71	0.74	322.0
			SD	1.99	1.24	1.40	122.38	0.25	0.25	165.0
	TOTAL	128	$\bar{x}$	10.61	11.10	8.12	419.00	0.89	0.91	336.0
			SD	1.55	1.06	1.69	124.00	0.44	0.43	145.0

The milk production followed the volume evolution during the lactation, with less expression . From the 1st to the 2nd control there was namely a fall of 10 % and 47 % , and an increase from the 3rd to the 4th of 12.6 % and 34.35 %

The udder height after the fall of the 1st to the 2nd control shows a slight tendency to increase, which is related with the decrease depth of the udder.

For all the parameters there is a more or less decrease of the 1st to the 2nd

control. That was performed 3 days after the beginning of the handmilking which can be the explanation for this disparity.

From the 3rd to the 4th control (7th to 10th week) the values show a tendency to stand or to increase, according to reasons previously refered for volume and depth.

Figure 4

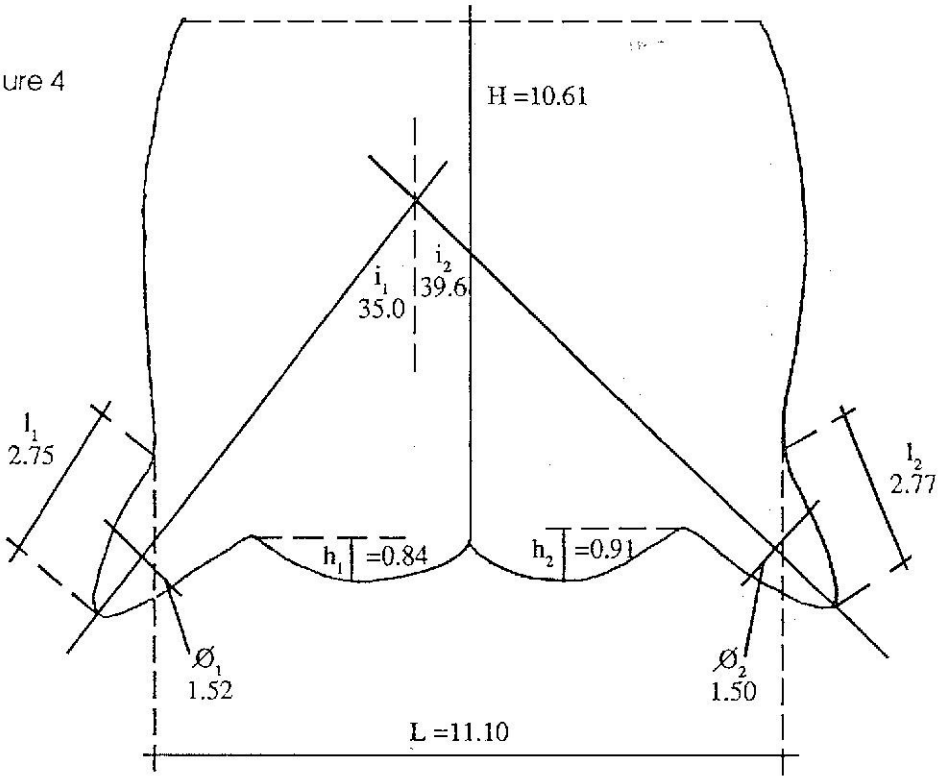
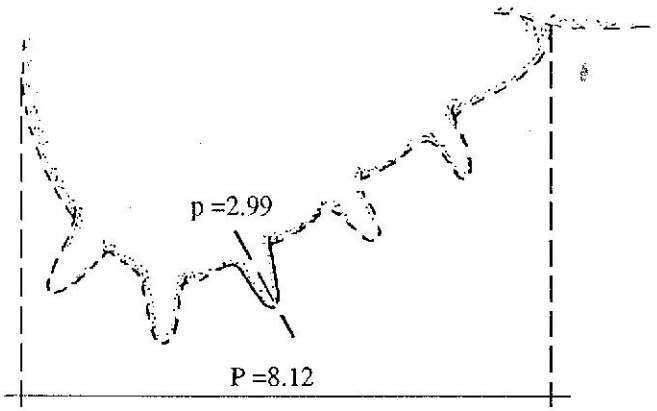


Figure 5



3.2.2. Evolution related to the age

As the values of the Table IV shows, there is a growing evolution from the 1st to the 3rd lactation, in almost all the cases, although there is little evidence and it is not significant.

In relation to the left and right cistern's height there is a tendency to increase from the 1st to the 3rd lactation mainly to the left cistern which shows always inferior values from the right one. The hight rate of both cisterns show an equal increase tendency up to the 3rd lactation, decreasing in the 4th lactation. The milk prodution shows an equal evolution to the cisterns height, showing a correlation of 19.8% (Table VII).

1st lactation - 0.80 • 0.36
2nd lactation - 0.84 • 0.34
3rd lactation - 1.03 • 0.47
4th lactation - 0.83 • 0.34

TABLE IV

PARAMETERS EVOLUTION OF THE UDDER RELATED TO LACTATION

Lactation	n	Parameter	Heigth H(cm)	Width L (cm)	Depth P (cm)	Volume V(ml)	Cistern h. h1(cm)	h2(cm)	Milk Prod. (ml)
1	32	$\bar{x}$	10.12	10.76	8.15	419.84	0.73	0.88	299.3
		SD	1.28	0.91	1.69	107.23	0.41	0.41	112.3
2	32	$\bar{x}$	10.36	11.11	8.06	413.75	0.80	0.87	339.4
		SD	1.67	0.86	1.72	126.01	0.37	0.36	149.0
3	32	$\bar{x}$	10.90	11.27	8.26	438.13	1.03	1.04	370.5
		SD	1.61	1.18	1.54	144.47	0.50	0.47	144.6
4	32	$\bar{x}$	11.04	11.12	8.02	405.94	0.80	0.85	334.4
		SD	1.41	1.16	1.78	110.62	0.40	0.38	158.1

3.3. Teats measurements

3.3.1. Evolution during lactation

The table V shows the average values of the teats measurements obtained in the controls we made and the parameter rate obtained in all controls.

TABLE V

AVERAGE VALUES FOR THE TEATS MEASUREMENTS IN THE PERFORMED CONTROLS AND TOTAL AVERAGES

Week	Controls	n	Parameter	Length (cm)		Diameter (cm)		Position		Inclination (°)	
				left	right	left	right	left	right	left	right
1	1	32	$\bar{x}$	2.70	2.76	1.52	1.53	2.97	2.97	43.09	42.38
			SD	0.70	0.66	0.32	0.26	0.65	0.54	14.56	9.79
4	2	32	$\bar{x}$	2.76	2.73	1.41	1.43	2.94	3.00	34.31	42.01
			SD	0.41	0.42	0.24	0.29	0.67	0.62	10.76	10.41
7	3	32	$\bar{x}$	2.87	2.82	1.52	1.46	3.03	2.97	33.09	40.09
			SD	0.64	0.58	0.27	0.26	0.69	0.93	13.02	11.84
10	4	32	$\bar{x}$	2.68	2.77	1.65	1.60	3.03	3.06	29.69	33.84
			SD	0.54	0.56	0.22	0.26	0.59	0.62	8.91	12.04
	TOTAL	128	$\bar{x}$	2.75	2.77	1.52	1.50	2.99	3.00	35.00	39.60
			SD	0.58	0.56	0.28	0.27	0.65	0.59	12.66	11.46

The teats lenght shows a tendency to increase during the milking, though in the last measurement we could observe a decrease , which coincided with the udder depth and volume growth.

The teats diameter doesn't show a great amplitude during decreasing tendency, which is notoriously bigger for the left one.

3.3.2. Evolution related to the age

TABLE VI

PARAMETER EVOLUTION OF THE TEATS RELATED TO LACTATION

Lactation	n	Parameter	Length (cm)		Diameter (cm)		Position		Inclination(°)	
			left	right	left	right	left	right	left	right
1	32	$\bar{X}$	2.57	2.56	1.45	1.41	2.88	2.88	33.81	40.19
		SD	0.48	0.42	0.25	0.22	0.60	0.70	8.79	8.20
2	32	$\bar{X}$	2.67	2.68	1.50	1.49	3.06	3.06	35.06	38.75
		SD	0.38	0.51	0.21	0.23	0.66	0.66	10.80	11.45
3	32	$\bar{X}$	2.77	2.88	1.51	1.50	3.16	3.06	38.13	37.36
		SD	0.43	0.58	0.22	0.22	0.62	0.66	15.75	13.80
4	32	$\bar{X}$	3.01	2.96	1.63	1.60	2.88	3.00	33.19	40.91
		SD	0.82	0.60	0.36	0.36	0.65	0.71	14.13	10.66

Related to the teats average measurements, in the above Table we can observe an increase tendency from the 1st to the 4th lactation, excluding the teats position where we can notice a decrease from the 3rd to the 4th lactation. The teats inclination doesn't show any tendency because left and right teat measurements evolute in an opposit way. Though, analysing both teats average inclination we came to conclusion that between lactations it keeps almost stand (36.9-37.75°). There were no significant differences to any measurement.

TABLE VII

CORRELATIONS BETWEEN MILK PRODUCTION, UDDER AND TEATS MEASURSMENTS

	Pl	V	L	H	P	h	l	ϕ	i	p
Milk production(Pl)	1.000									
Udder volume (V)	0.540	1.000								
Udder width (L)	0.526	0.459	1.000							
Udder height (H)	0.364	0.457	0.344	1.000						
Udder depth (P)	0.393	0.545	0.389	0.529	1.000					
Average of cisterns height (h)	0.196	0.285	0.194	0.171	0.298	1.000				
Avg. of teats length (l)	0.195	0.216	0.281	0.237	0.116	-0.145	1.000			
Avg. of teats diameter (ϕ)	0.083	0.262	0.260	0.122	0.041	-0.132	0.664	1.000		
Avg. of teats inclination (i)	-0.064	-0.048	-0.065	0.041	0.093	0.499	-0.462	-0.398	1.000	
Avg. of teats position (p)	-0.124	-0.072	0.017	-0.038	-0.149	0.076	-0.148	0.049	0.093	1.000

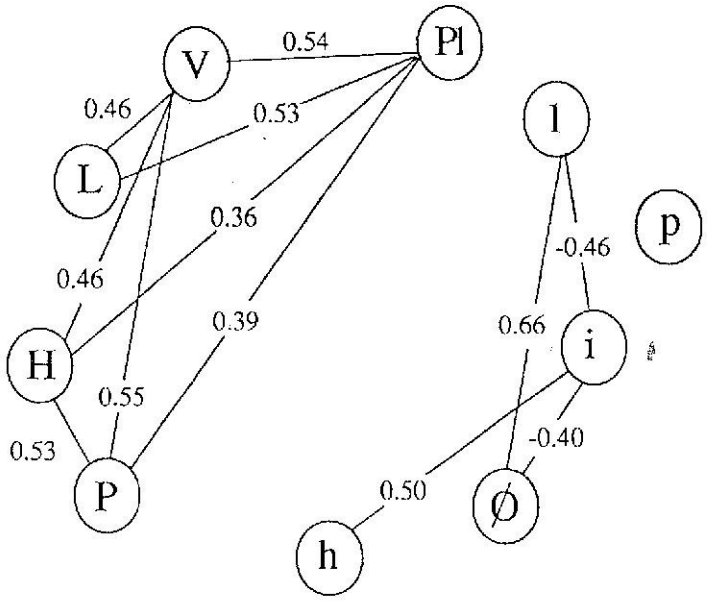


Figure 6 - Most significative correlations

3.4. Correlations analyses

According to PURROY (4) the more important variables are the volume and the udder depth, which give as mush information as the all (72.41 % vs 81.80 %). In the trial we carried out the udder volume and width explain 37.99 % of the milk production variability, as far as all the variables already studied explain 38.36 %.

TABLE VIII

MULTIPLE REGRESSION BETWEEN MILK PRODUCTION, VOLUME AND WIDTH OF UDDER

Model fitting results

Variable	Coefficient	Stnd Error	T value	Prob(>*T*)
Constant	-382.889413	107.536317	-3.5606	.0005
Udder volume	0.442221	0.091813	4.8165	.0000
Udder width	48.209877	10.766777	4.4777	.0000

ANALYSES OF VARIANCE FOR THE FULL REGRESSION

Source	Sum Squares	DF	Mean Square	F
Model	1037985.8	2	518992.9	39.9**
Error	1625541.1	125	13004.3	
TOTAL (corr.)	2663526.9	127		

R-Squared = 0.389704
R-Squared (adj. for DF) = 0.379939
Stnd Error of Est. = 114.037

There were also found less important correlations to the depth (r=0.39) and to the udder's height (r=0.36) (Table VII).

The milk production can be determined through the following equation (Table VIII):

$$y = -382.889413 + 0.442221\ x1 + 48.209877\ x2$$

y - milk production
x1- udder volume
x2- udder width

The greater correlation with the milk production was obtained to the udder volume. LABUSSIERE (7) says that the production daily rate in the 10 first weeks

of machine milking is nearly equivalent to the udder volume. There is no mention of how many days after lambing correspond 10 weeks of milking.

For the same 10 weeks, corresponding nearly 18 weeks after lambing the average milk production (336.0 • 145.0) represents 80.19 % of the volume (419.0 • 124.0)

TABLE IX

SIMPLE REGRESSION OF MILK PRODUCTION ON UDDER VOLUME

Parameter	Estimate	Stnd Error	T value	Prob(>|T|)
Intercept	71.3551	38.2747	1.8643	0.064608
Slope	0.630764	0.0875389	7.2055	4.67508E-11

ANALYSES OF VARIANCE

Source	Sum of Squares	DF	Mean Square	F
Model	777257.26	1	777257.26	51.92**
Error	1886269.6	126	14970.4	
TOTAL (corr.)	2663526.9	127		

Correlation coefficient = 0.540199
Stnd Error of Est. = 122.354

From the analyses of milk production regression related to the volume (Table IX) we obtained the following expression:

$y = 71.3551 + 0.630764\ x$
y - milk production
x - volume

The average cisterns height was of 0.87 cm, smaller than that refered by LABUSSIERE et al. (3) to the Lacaune (1.3 cm) and smaller than the Sarda (4 - 6 cm) refered by SANNA et PICINELLI (1974) quoted by LABUSSIERE et al. (3). This value of cisterns height suggests Merino Beira Baixa ewes have difficulty in bearing big breaks during the milking.

In what concerns to teats dimensions we didn't find big differences in relation to those refered in the bibliography (Table I). The inclination is smaller than in the other breeds. JATSCH et SAGI (10) say that the milk production decreases when

the teats position in the udder becomes higher.

Although we found correlation between udder measurements and milk production, they are of little interest as selective characters. JATSCH (11) says that the udder conformation has low repetition in future lactations.

Anyhow, the milking records collected since 1984 have been showed a great variance on milk production, which may us to think that the response to milk production selection can be high.

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RESUME

Pour essayer de caracterizer la morphologie de la mamelle des brebis d'aptitude mixte (viande et lait) de race "Merino Beira Baixa" du centre interieur du Portugal, on a realizé 4 séries de mensures avec trois semaines d'intervalle, à partir du début de la traite (57•7 jours aprés le mise bas). On a observé les paramètres suivants: profondeur, hauteur, volume et surface arrière de la mamelle; largeur entre les trayons et sa position relative, inclination, largeur et longueur des trayons; hauteur des cisternes. La production total journalière de lait represent environs 80% du volume de la mamelle, et le coefficient de corrélation (r) entre ces deux paramètres à été de 0.54, correspondant au plus haut coefficient obtenu. Entre la production de lait et la largeur entre trayons, on a obtenu r=0.53. Toutes les variables étudiées (caracteristiques morphologiques) expliquent 38.13% de la variabilité de la production de lait. Le volume de la mamelle et la largeur entre trayons, elles mèmmes, representent 37.99% de la variabilité. Les resultats obtenus, sugerent que la morphologie de la mamelle des brebis «Merino Beira Baixa» est un faible indicateur de sa production laitiére.

RESUMEN

Con el objetivo de caracterizar la morfologia de la ubre de las ovejas de doble aptitud de la raza «Merino Beira Baixa», ubicada en el centro interior de Portugal, se han realizado quatro mediciones, con tres semanas de intermedio, después del inicio de ordeño (57•7 dias post-partum). Han sido estudiados los seguintes parámetros: longitud, anchura, inclinación y posición de los pezones; altura, volumen, longitud y anchura de la ubre; altura de las cisternas. El volumen de la producción media diaria de leche es cerca de 80 p. 100 del volumen de la ubre y el coeficiente de correlación (r) entre los dos ha sido de 0.54. Esto fué el parámetro con la

correlación más alta entre los estudiados. Entre la producción lechera y la anchura de la ubre se ha obtenido r=0.53. Todas las variables (caracteristicas morfologicas) explican el 38.13 p. 100 de la variabilidad de la producción de leche. El volumen y anchura de la ubre, tan solo explican 37.99 p. 100 de dicha variabilidad. Los datos obtenidos, dan la idea que la morfologia de la ubre de esta raza suministran poca información no reflejando su valor lechero.

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