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Breeding of dairy sheep for the Mediterranean region of Croatia

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SUMMARY – The Mediterranean region of the Republic of Croatia shows notable advantages for breeding dairy sheep compared to the continental area. Therefore, crossbreeding between domestic Istrian sheep (IS) and imported Sardinian (S) and East-Friesian (EF) sheep has been made in order to create improved domestic dairy sheep. This study presents results of breeding work over several years in the region of Istria. Data on the conformation of domestic genotypes, milk production, fertility and fattening capability are reported. Results have shown an increased milk production of the new sheep genotypes, which has an influence on the increasing profitability of this type of stock production.

Key words: Dairy sheep, genotype, crossbreeding.

RESUME – *"Amélioration génétique des ovins laitiers dans la région méditerranéenne de la Croatie". En comparaison avec la région continentale, la région méditerranéenne de la Croatie possède de nombreux avantages pour l'élevage ovin laitier. Cependant les croisements effectués entre la race ovine domestique d'Istrie et les races importées de Sardaigne et de Frise-Orientale ont pour but de créer une race plus performante pour la production de lait. Cette étude présente les résultats obtenus pour la croissance des différentes races durant plusieurs années dans la région d'Istrie. Les données des performances de la race locale, sur la production laitiere, la fertilité et les possibilités d'engraissement ont été reportées. Les résultats obtenus montrent l'augmentation de la production de lait des nouveaux génotypes ovins qui ont une influence sur la croissance de la prolificité de ce type de production animale.*

Mots-clés : *Mouton laitier, génotype, croisement.*

Introduction

The basis for genetic development of the domestic dairy sheep was the domestic Istrian sheep. The first detailed description of that breed was given by Rako (1957) who said that in Istria he had an opportunity to learn about the domestic type of sheep with extensive capabilities for milk production. The exact origin of this breed is not known, but its appearance suggests that this is a Pramenka, the type of Mediterranean sheep influenced by North-Italian sheep (Bergamo sheep), imported to this region in the past.

Regarding the production, the Istrian sheep is a combined milk-meat-wool type with milk (as processed into cheese) having over 60% share in the gross value of complete production. Lamb meat is the second most important product of Istrian sheep. Less interest is shown for wool because of its lower economic value on the domestic market. Besides good milk production, relatively big body frame, places the Istrian sheep among the biggest in Croatia.

Results of some body measures of 1.5 and 3 year old sheep are shown in Table 1.

Body measures are well developed and in relation to the other sheep in Croatia (especially those from Primorje and Dalmatia), the Istrian sheep is bigger. That is also proven by the fact that the Istrian sheep is about 40% bigger than the Paska sheep.

The average milk production during the milking period of lactation is about 100 l (Rako, 1957), milk fat content being between 5.5 and 8%. When 35 l of milk sucked by the lamb during the suckling

period (30-45 days) is added to that result, the total amount of milk produced is around 130 l during the lactation period of approximately 7 months.

Table 1. Body measures of Istrian sheep at the age of 1.5 and 3 years (Mikulec *et al*., 1982; 1984)

Body measure	Age (1.5 years)	Age (3 years)
Height at withers (cm)	64.87	69.22
Body length (cm)	68.73	73.35
Chest depth (cm)	27.47	30.13
Chest width (cm)	16.75	18.40
Pelvis width (cm)	22.85	23.82
Body weight (kg)	40.25	46.84

According to the research conducted by Mikulec *et al*. (1984), Istrian Pramenka ewes produce 89.6 l of milk with milk fat content of 5.13% during 146 days of the first lactation.

Summer vegetation has a big influence on the length of lactation. While humidity is sufficient, milking can be done till the end of August, and in the dry periods until the middle or the end of July. The mating season starts in July and lasts until September, so the lambing begins in December and lasts till February. The fertility rate is around 90% and 20-25% of ewes lamb twins. Lambs bodyweight at parturition is around 3 kg, and relatively high daily gain during the suckling period enables them to reach 10-12 kg of bodyweight on day 30 and 15-18 kg on day 60. Dressing percentage is around 56%. Wool is of mixed character with marked characteristics of rough fibre. The average wool yield is 1.4 kg of unwashed wool with average diameter of fibre that is 36.304 micrometers.

Since the work on the program for creating the domestic dairy sheep has started, we have presumed that the sheep with the previously mentioned characteristics could be used as a basis for genetic development. The presumption was based on the fact that the Istrian sheep had the required body frame and was completely adapted to the specific conditions in the Mediterranean region of Croatia. The aim of the breeding work was to improve the productivity of Istrian sheep which should be shown through the increase of milk production (in optimal lactation that should be around 180-200 l during 7 months and a bigger daily gain of lambs during the suckling period).

Resistance of newly created sheep should be considered when talking about results achieved, because the aim is to increase the number of lactations (at least 5) without affecting body frame and health status of sheep. To accelerate the fulfilling of this aim, Istrian sheep ewes were crossed with the specialized milk type rams. Sardinian and East-Friesian breeds were used as meliorator-breeds.

The aim of this work is to show some results given at the start of the Istrian sheep improvement with the above-mentioned breeds.

Material and methods

With the aim of getting F_1 crossbreeds between Istrian ewes and Sardinian rams, during the autumn of 1989, 220 ewes suitable for the type and age to be the starting generation of thoroughbred domestic sheep were chosen. All the ewes were mating freely and naturally with 7 Sardinian rams bought in Italy whose female ancestors had milk production of 200-300 l. Of 244 lambs lambed, 117 were F_1 female crossbreeds and 113 were left for further breeding. In same way, in 1991 85 female offspring were obtained, and during the same year two Sardinian rams were bought and the artificial insemination started. At the same time when rams were imported, 45 Sardinian ewe-hoggets were imported from Italy and they mated with pure breeds. In Table 2 the number of ewes and female offspring is given year by year (1990-1995). According to the genotype the ewes were marked as IP (thoroughbred Istrian Pramenka), S (thoroughbred Sardinian sheep), F_1 (IP x S) (first generation of crossbreeds between IP ewes and S rams), F_2 ($IPSF_1$ x S) (second generation of crossbreed between

female crossbreed of first generation and S rams) and F_3 ($IPSF_2$ x IF) (three-breed crossbreed between the second generation crossbreed and East-Friesian rams).

Due to the restricted financial resources groups of the previously-mentioned crossbreeds were kept in one big flock together with the "commercial" part of the farm flock, making recording of production and reproductive data more difficult. That was the reason for taking into consideration only the smaller number of data that had been checked and was reliable. Particular big problems occurred during lambing and introduction to milking when a number of ewes was dropped out from further treatment because of late lambing, loss of lamb and/or early drying up. Besides, some procedures, e.g. artificial insemination, were conducted on the whole flock (both commercial and breeding part of flock). The number of sheep and crossbreeds with different genotypes are shown in Table 2.

Table 2. Number of sheep and crossbreeds with different genotype

Year	Genotype				
	IP	S	F_1 (IP x S)	F_2 ($IPSF_1$ x S)	F_3 ($IPSF_2$ x IF)
1989	220	45			
1990		10	113		
1991		8	83		
1992			55	38	
1993			18	63	5
1994				52	14
1995					
Total	220	68	269	153	19

Results and discussion

Conformation

In accordance with the aim of the research, through the process of breeding the domestic improved milk type of sheep, we directed our attention to the expression of body measures in different type of crossbreeds. Also, we had in mind the significance of whole body development as well as the development of particular parts for all physiological functions, resistance to diseases and productive capabilities of sheep.

For that purpose all the major body measures were taken from all ewes. The measuring was done by using the stick at the mating maturity when ewe-hoggets were approximately 1.5 years old. Comparative values for some body measures in different types of crossbreeds are given in Table 3.

Table 3. Body measures of sheep with different genotype

Body measure	Genotype									
	IP		S		F_1 (IP x S)		F_2 ($IPSF_1$ x S)		F_3 ($IPSF_2$ x IF)	
	$\bar{x}$	CV %	$\bar{x}$	CV %	$\bar{x}$	CV %	$\bar{x}$	CV %	$\bar{x}$	CV %
Height at withers (cm)	67.5	5.6	63.1	2.3	64.2	4.4	63.2	5.1	64.5	4.0
Body length (cm)	68.5	4.7	65.9	4.0	65.8	4.2	64.7	5.9	65.4	3.5
Chest depth (cm)	30.1	5.0	27.9	9.9	26.6	5.1	25.8	5.8	26.9	5.6
Chest width (cm)	18.9	7.9	18.1	9.2	17.4	6.1	18.3	7.7	20.3	17.2
Pelvis width (cm)	20.2	7.9	19.8	7.8	20.5	5.1	21.1	8.5	22.1	6.8
Body weight (kg)	46.2	13.1	40.2	9.6	37.4	8.9	39.3	10.9	43.6	7.1

Data show a better expression of body measures of Istrian Pramenka ewes compared to other types of crossbreeds. That can partially be explained by the fact that at the moment of measuring, ewes of this group were older (3.5-9.5 years) than the group of crossbreeds of 1.5 years of age. Differences in expression of some measures between Sardinian breed and different types of crossbreeds were small, which supports the relative homogeneity of conformation. However, it should be pointed out that somewhat better expression of back part measures and body weight of crossbreeds with East Friesian rams could mean a contribution to enlargement of body frame when compared to crossbreeds with Sardinian breed.

Fertility

Regular fertility and obtaining the biggest possible number of lambs in each litter is one of the most important indicators of adaptation of certain genotype to the keeping conditions. Throughout our work, we were facing a number of problems that were disabling realistic comparison of this factor both within the groups of pure breeds, and within the different types of crossbreeds. First of all, Istrian Pramenka fertility records refer to the average values of lambings II-VII, while data for Sardinian breed and for crossbreeds are given for the first lambing only. Then, financial problems have constantly caused too small a number of quality rams and the impossibility of conducting planned natural mating, so in some periods of the research either AI or natural mating was used. Method of AI was used on the part of commercial flock – F_2 generation of Istrian Pramenka and Sardinian breed rams crossbreeds. Table 4 contains the fertility data after the planned natural mating when ewes were during the mating season (lasting 45-60 days) kept in the stable, divided into groups of 30-35 and each group was allocated to a ram.

Table 4. Results of natural mating of ewes with different genotype

Index	Genotype				
	IP	S	F_1 (IP x S)	F_2 ($IPSF_1$ x S)	F_3 ($IPSF_2$ x IF)
Number of lambed sheep Number of mated sheep (%)	88	67	78	87	60
Number of lambs Number of lambed sheep	1.24	1.07	1.09	1.15	1.30

Table 4 shows significant variations between ewes of different genotypes regarding number of ewes lambed as well as number of lambs per lambing. Evaluating the real contribution to the higher fertility, which is expected by bringing in East-Friesian breed genes, will only be possible in the forthcoming period when a higher number of crossbreeds is expected and when the influence of each lambing season on the achieved fertility will be examined.

Survival rate of lambs during the suckling period was very good, which means that between 1% and 3% of lambs died and the differences between ewes of different genotypes were not significant. Poor vitality of lambs (especially of twins), loss of milk in ewes and traumatic injuries of lambs (suffocation, squeezing) are some reasons for early (until day 5) dying of lambs.

Fattening capability and slaughtering quality in lambs

As the important economical benefit of selling lambs is expected from the new type of improved sheep, our attention was directed to lambing data (measured within 24 hours post partum), body weight at the moment of slaughtering and carcass value. In smaller number of lambs, experimental fattening with the aim of examining earlier weaning was carried out. The results are given in Table 5.

Expressed results were achieved under the conditions of commercial production in which the controlled groups were kept together with the rest of the flock and with a suckling period of between 45-55 days. With this length of suckling period, the most productive part of lactation is being used for

lamb feeding and considerable quantity of milk is being used for relatively slow growth of lambs instead of processing into cheese.

Table 5. Weights and dressing percentage of lambs of sheep with different genotype

Indicator	Genotype				
	IP	S	F_1 (IP x S)	F_2 ($IPSF_1$ x S)	F_3 ($IPSF_2$ x IF)
Weight at parturition (kg)	3.2	3.8	3.6	3.7	4.3
Weight at slaughter (kg)	17.3		16.2	17.5	17.3
Dressing percentage (%)	57.2		56.2	53.8	54.4

Wool production

Despite the fact that in Republic of Croatia the interest for buying off the wool does not exist, and that wool produced by breeds used in this program has a rather low quality, during our research, we turned our attention to this kind of exploitation of sheep. But, due to the technical reasons, we were not able to collect all data needed. So, Table 6 gives only the data on fleece weight in purebred Istrian Pramenka and Sardinian sheep and their F_1 generation of crossbreeds. Results for clean wool yield and wool fibre diameter, as well as all indicators for sheep with genotype F_2 ($IPSF_1$ x S) and F_3 ($IPSF_2$ x IF) will be established later.

Table 6. Average fleece weight (kg) in sheep with different genotype

Indicator	Genotype				
	IP	S	F_1 (IP x S)	F_2 ($IPSF_1$ x S)	F_3 ($IPSF_2$ x IF)
Fleece weight (kg)	1.9	1.8	1.7		

Milk yield

As the milk was considered to be the most important product of the improved type of domestic sheep and as milk recording was not conducted under experimental, but productive conditions, we believe that we should give some methodological explanations:

(i) Experimental groups of sheep were kept under the productive conditions together with "commercial" part of flock. That to a great extent made their control more difficult. Because of the large number of milked ewes (over 700), errors occurred more frequently, e.g. late weaning of lamb and including in milking, drying up too early as a result of the loss of lamb, errors in ewe identification, etc.

(ii) To achieve the unification of lactation phases in milk production calculation, only the ewes that have lambed (and whose lambs were weaned) within the margin of ±10 days were included.

(iii) Milk yield data referred to the amount of milked milk (not suckled by lamb) only.

(iv) Milk production is recorded during the "milking season", that means 4 months (120 days) each year (March, April, May and June). Therefore, milk production calculation includes ewes that lambed January that have nursed their lambs for, on average, 50 days (40-60 days), so milking had started in March and had lasted till the end of June. During the first half of July ewes were dried out and that period was not included in the calculation.

(v) Total amount of milked milk was calculated by adding the amounts of milk produced through 4 one-month milking periods. Those periods lasted for 30 days on average (26-34 days). The basis for

milk yield calculation in milking period was "daily milk production", that is, amount of milk recorded through evening milking and next day's morning milking. The sum of these two values was multiplied by the number of days passed since the previous control (30 days).

(vi) Milk production was measured directly on the mechanized milking line, by using graduated measuring cylinder with 200-2800 ml scale.

Because of the significant influence of the year and the number of lactations, data on milk milked from ewes of different genotypes are divided according to two indicators mentioned (Table 7).

Table 7. Amount of milk (l) milked through 120-day period in sheep with different genotype

Lactation	Genotype	Year					
		1990	1991	1992	1993	1994	1995
1	IP	61.7					
	S	70.3		76.0	79.6		
	F_1 (IP x S)			83.2	91.4	73.0	79.5
	F_2 ($IPSF_1$ x S)					64.2	78.1
	F_3 ($IPSF_2$ x IF)						80.5
2	IP		65.9				
	S		80.1		84.9	81.2	
	F_1 (IP x S)				90.8	97.1	97.6
	F_2 ($IPSF_1$ x S)						89.0
	F_3 ($IPSF_2$ x IF)						
3	IP			81.7			
	S			95.1		91.6	93.9
	F_1 (IP x S)					96.5	99.1
	F_2 ($IPSF_1$ x S)						
	F_3 ($IPSF_2$ x IF)						
4	IP				79.0		
	S				88.2		90.1
	F_1 (IP x S)						92.8
	F_2 ($IPSF_1$ x S)						
	F_3 ($IPSF_2$ x IF)						
5	IP						
	S					86.7	
	F_1 (IP x S)						
	F_2 ($IPSF_1$ x S)						
	F_3 ($IPSF_2$ x IF)						
6	IP						
	S						78.1
	F_1 (IP x S)						
	F_2 ($IPSF_1$ x S)						
	F_3 ($IPSF_2$ x IF)						

Conclusions

In spite of the problems and early phase of work, it is our opinion that the results that have been achieved by now justify the continuance of the research based on the following facts:

(i) The crossbreeds between the domestic Pramenka and imported breeds (Sardinian and East-

Friesian) are relatively adapted to the specific keeping conditions because they showed medium fertility.

(ii) Although the body frame decreased in relation to the Istrian sheep (especially by mating with Sardinian rams), the crossbreeds mostly kept the relatively big format and it is to be expected that further mating with East-Friesian rams will contribute to the increase of body measures.

(iii) Milk yield, that was the primary aim of the breeding shows an increasing trend of increase in crossbreeds (especially the F_1 generation between the Istrian and Sardinian breed), that could be even bigger under better feeding and keeping conditions.

(iv) Established milk production refers only to the amount of milk milked during the standard period (120 days), and results established for the growth of lambs speak for relatively big amount of sucked milk. That amount should be checked (by introducing the milk recording in the primary phase of lactation and by earlier weaning of lambs) and included in the total appreciation of the production capacities of crossbreeds.

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