

PRODUCTIVITY OF KRIVOVIR STRAIN AND ITS IMPORTANCE ON SHEEP FARMING IN REPUBLIC OF SERBIA

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Abstract

The area of central Serbia is very suitable for sheep production, because of its hilly and mountainous configuration. Such area is rich in pastures for ruminants. In the territory of central Serbia, representative of autochthonous (indigenous) sheep breeds is pramenka (zackel) with its differentiated strains: Sjenica strain, Svrlijig strain, Krivovir strain, Karakachan strain, Pirot strain, Lipa strain and Bardoka (White Metohian strain). Aim of this study was to investigate Krivovir strain: number of controlled heads and their part in total sheep population, their productivity parameters and milk parameters. In this study, total of 789 adult animals were observed. Average observed body weight (BW) of lambs were: BW on birth 3.22 kg, BW after 30 days 10.55 kg and BW on weaning 24.99 kg, while BW of adult sheep was 50.52 kg. Fertility index was 1.17 and average wool production was 2.88 kg. Average lactation after weaning lasted for 100 days, with milk production 65.16 kg, 3.91% protein and 6.72% milk fat. Krivovir strain is participating with 0.4% of total number of controlled sheep in central Serbia. Although in small number, this strain is irreplaceable in sustainable systems because they are evolutionary adapted to the conditions in which they are reared and because of their contribution to gene pool and agro-biodiversity.

Keywords: indigenous breeds, genetic resources, sustainable development, zackel, wool, milk

INTRODUCTION

Due to its mainly mountainous region, rich in pastures, the area of central Serbia is very suitable for sheep production. Out of 826,834 ha of grassland and 601,152 ha meadow in Serbia, about 86% are located in mountain area where it is about 50% of the rural population (Petrovic *et al.*, 2017). Autochthonous genotypes of sheep and goats are mainly reared in the hilly-mountainous region, predominantly economically undeveloped regions with modest food sources (Žujović *et al.*, 2011). In the territory of Serbia, total number of is more than

1,704,000 heads (Statistical yearbook, 2018). Sheep breeds in Serbia can be divided into two major groups: autochthonous populations (pramenka, or zackel with distinguished strains) and imported genotypes of sheep. Autochthonous populations of Pramenka (Zackel) sheep represent a unique genetic inheritance existing thousands of years and as such are an important element of regional agro-biodiversity, tradition and cultural heritage of Serbia (Ružić Muslić *et al.*, 2015). Local name “Pramenka” and it derives from the form and the type of the fleece of this breed: the word “Pramen” in all South Slavic languages means “a lock of wool

or hair” (Bogdanovic *et al.*, 2011). Autochthonous (indigenous) populations are characterized by triple combined production ability, and is reared for the production of meat, milk and wool (Cekić *et al.*, 2018). The zackel is divided into strains formed in different conditions. Because of different climatic and nutritive conditions they differ in the exterior and productive parameters. These strains are named by the geographical regions, or towns where they were originally formed. Zackel strains on the territory of central Serbia are: Sjenica strain, Svrljig strain, Krivovir strain, Karakachan strain, Pirot strain, Lipa strain and Bardoka (White Metohian strain). Zackel strains are mainly used for lamb meat and sheep milk, which are most often processed into traditional products (Važić *et al.*, 2017). Krivovir strain (or krivovir sheep) is named after the village Krivi Vir, in eastern part of Serbia, where is traditionally bred. The color of wool is white, while the head and legs are covered with yellowish hair. Ewes are polled, and rams have horns. This genotype has narrow, long head. The ears are short, covered with yellowish hair and semi erected, horizontally oriented. The tail is long, reaching the ground. In literature data, the average body weight of ewes is 50–55 kg, and rams 60–70 kg, while lambing index is 1.1 (Mekić *et al.*, 2007).

Indigenous breeds are less demanding, sturdier than imported genotypes, and with lower production inputs. However, due to the rearing of imported, more productive genotypes zackel sheep with it's strains deteriorated in number. Because of that, their populations become very endangered. This problem is recognized by the government and process of revitalizing and prevention of further deterioration has started throughout the strategy on the improvement of indigenous breeds. This strategy contains breeding programs of genetic resources, and there are significant funding resources for breeders for production of quality breeding animals, and animal genetic resources. With better organization, production costs are reduced, and along with the increased promotion of autochthonous genotypes they can be promoters of sustainable development, besides their primary impact on the maintenance of agro-biodiversity.

The aim of this study was to analyze number and most important productive parameters of Krivovir strain and to summarize their role in sustainable development of rural area of Serbia.

MATERIALS AND METHODS

The research included Krivovir strain ewes and rams. The number of animals is shown through the number of heads controlled by the production parameters, that is, through the number registered in the main book (Herdbook) as well as the number of immature animals. Number of animals is taken from the Annual Report of the Institute for Animal Husbandry from 2019. The data were collected

from the territory of central Serbia. Determination of the status of Krivovir strain is determined according to the current List of Genetic Reserves of Domestic Animals (Ministry of Agriculture, Forestry and Water management, 2017). The endangerment status is calculated using the formula:

$$Ne = 4 \times Nm \times Nf/N, \quad (1)$$

where is Ne – effective size of population; Nm – number of breeding rams, Nf – number of breeding sheep, N – total number of breeding animals. In relation to the level of endangerment, genotypes are classified into four groups: critically endangered ($Ne \leq 50$), highly endangered ($Ne > 50$ and $N \leq 200$), potentially endangered ($Ne > 200$ and $N \leq 1000$) and not endangered ($N > 1000$). Number of animals is taken from the Annual Report of the Institute for Animal Husbandry from 2018. The data were collected from the territory of Republic of Serbia.

The weight of adult animals was measured at the beginning of the mating season, while the lambs were measured at birth, with 30 days and on weaning, which was 90 days in the case of this genotype.

The index of lambing is calculated as the index of the total number of descendants based on the total number of animals that gave birth. In addition to these parameters, yield of raw wool were measured.

Milk parameters that are followed are: lactation duration, milk yield for lactation after the weaning, average daily milk production, and average protein content and average milk fat content. Milk control was carried out by a modified absolute (AT) method, carried out at intervals of 28–34 days, alternating in the morning and evening (ICAR, 2009). The first measurement was done after the weaning of lambs, and the milk components (proteins and milk fat) were determined by Ekomilk and Milkoscan apparatus.

The collected data were processed using the statistical package Statistica for Windows (Stat. Soft Inc.), whereby the basic parameters of descriptive statistics (arithmetic mean, variation coefficient and standard deviation) were calculated.

RESULTS

In Tab. I is showed number of controlled heads in last five years.

In Tab. II is showed number of mature breeding animals (ewes and rams), number of lambs left for reproduction (breeding lambs), and calculated effective population size (Ne).

Control of productive parameters is done on 789 animals and results are presented in Tab. III.

Control of milk production is done on 293 animals, and the average results are presented in Tab. IV. It is evident that milk production of this genotype is modest, but it has great potential for increasing production by improving rearing conditions.

I: Number of controlled heads of Krivovir sheep in last five years

	Year				
	2014	2015	2016	2017	2018
Number of heads	382	429	476	616	816

II: Number of controlled heads and breeding lambs of Krivovir sheep in 2018 and their effective size of population

Ewes	Rams	Breeding lambs	Effective population (Ne)
789	27	450	104.43

III: Productive parameters of Krivovir sheep

Genotype	No. of controlled heads	Statistical parameter	Weight on birth (kg)	Weight on 30 days (kg)	Weight at weaning (kg)	Weight of adults (kg)	Lambing index	Wool yield (kg)
Krivovir strain	789	Mean	3.22	10.55	24.99	50.52	1.17	2.88
		SD	0.62	1.16	2.00	3.62	0.38	0.45
		CV (%)	19.29	10.96	8.01	7.16	32.51	15.57

*Mean – arithmetic mean; SD – standard deviation, CV – coefficient of variation

IV: Control of milk production of Krivovir sheep

Number of heads	Statistical parameter	Lactation period (days)	Total milk yield (kg)	Daily milk production (kg)	Average protein content (%)	Average milk fat content (%)
293	Mean	100	65.16	0.84	3.91	6.72
	SD	17.12	18.51	0.15	0.46	0.44
	CV (%)	17.05	28.41	22.57	11.78	6.61

*Mean – arithmetic mean; SD – standard deviation, CV – coefficient of variation

DISCUSSION

Krivovir sheep is located in hilly and mountainous area of eastern Serbia and reared in extensive system, which includes grazing in non-cultivated pastures. Although number of animals is in increase in the last 5 years (Tab. I), increasing rate is still insufficient for achieving the required size of stable population. As shown in Tab. II, total number of controlled breeding animals is 816, with 450 lambs left by the breeders for further reproduction. As such, effective population size is $N_e = 104.43$, and this population is classified as potentially endangered. In 2017, this population was listed as highly endangered (Cekić *et al.*, 2018), so progress is evident. Although number of animals is increasing, their number is still not satisfactory. If population of krivovir sheep is compared to total number of controlled sheep in central Serbia (198,302), this population takes only 0.4%. However, even this small percentage is very important for maintaining of gene pool and biodiversity. For the preservation of one breed, race or strain it is of main importance to maintain the heterozygosity that is the genetic variability and as long as the heterozygosity is present in the population, it is possible to perform the selection in a pure race of stock (Bogdanović *et al.*, 2007). To maintain this, number of animals must be increased, and measures of its

conservations must be intensified. Methods for preservation of genetic resources are *In situ* and *Ex situ*. For now, only conservation method for this strain is *In situ*. *Ex situ* conservation includes using long-term cryopreservation of sperm, oocytes, embryos or reproductive tissue (testis and ovaries) (Stančić and Stančić, 2013).

The average productive parameters are showed in Tab. III. Lack of similar researches is present, and there is only few papers that investigate krivovir strain, which makes comparrison of data values for productive and milk parameters difficult. Birth weight of lambs is 3.22 kg which is accordant to conclusions of Petrović *et al.* (2011). Weight of lambs after 30 days of life is 10.55, while Petrović *et al.* (2011) reported 8.70. Body weight of lambs in first month is highly correlated with milk production of their mothers. Lambs of krivovir sheep are weaned at the age of three months, and average body weight of weaned lambs is 24.99. This is higher then values reported in Petrović *et al.* (2011). As for the body weight of the adult animals, it largely depends on the current condition of the animals at the moment of measurement. Namely, the ewes that came out of the winter husbandry regime, and/or are in the first stage of lactation, or that are kept on poorer pastures will have lower body mass than animals, which, for example, are in the first

phase of pregnancy. As a result, published data indicate that this parameter varies most. Average body weight of adult animals (50.52) are lower than 54.80 reported in Petrović *et al.* (2011), but in line with Mekić *et al.* (2007). Lambing index of autochthonous genotypes is on average 1–1.3 (Cekić *et al.*, 2018). Lambing index of krivovir sheep, as representative of autochthonous genotypes, is 1.17 and in line with this values. Yield of raw wool is higher than reported by Petrović *et al.* (2011), but accordant to Mekić *et al.* (2007).

Control of milk production was performed on a total of 293 heads and Tab. IV shows the average milk production properties. For lactation, which lasted 100 days on average, ewes gave an average of 65.16 kg of milk, with protein content of 3.91% and average milk fat content 6.72%. This milk production is acceptable for autochthonous breeds, because of their triple production (meat, milk, wool). Most of the milk from autochthonous breeds is used for making traditional products such as different kinds of quality cheese. These products can make extra profit for breeders.

CONCLUSION

Number of Krivovir strain increased in last few year, and now is in potentially endangered status. This positive trend is mainly because of the stimulating measures of government. Although increasing, this number is insufficient, because this genotype is still in danger of extinction. Production of Krivovir strain in extensive system is satisfactory, but compared to imported, more productive, genotypes, it is too low. Because of that it is necessary to provide better support to breeders, so they have a financial interest in preservation, besides moral one. This support must certainly be covered by professional, scientific and economic measures. Currently in Republic of Serbia measures of conserving zackel strains are implemented. If the huge importance that these genotypes have on the agro-biodiversity of the Republic of Serbia, and the whole of the Balkans is considered, it is evident that protection measures must be intensified. In addition to In situ, it has to be started with an Ex situ conservation, and then cryopreservation, for all the zackel strains, and other genotypes that are considered genetic resources.

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