

Karyotype variability of the ukrainian mountain-carpathian sheep breed

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Abstract

The main purpose of this work was to describe the karyotype variability of the Ukrainian Mountain-Carpathian sheep breed. Cytogenetic studies were carried out on a group of 25 sheep Ukrainian Mountain-Carpathian breed. The cultivation of lymphocytes, preparing the cytogenetic samples, classification and registration of chromosome aberrations were held using conventional methods. It was established that the number and structure of the chromosomes of sheep of the Ukrainian Mountain-Carpathian breed corresponds to the norm typical for this species of animals. Chromosomal variability of the studied population includes 19.22% of numerical and structural aberrations. By the number and structure of the chromosome set of the Ukrainian Mountain-Carpathian sheep breed do not differ from other breeds of sheep. Accurate identification of individual chromosomes with routine coloring allows using cytogenetic studies in breeding practice in sheep breeding.

Key words: karyotype, chromosomal instability, sheep breeding

Introduction

Animals of the Ukrainian Mountain-Carpathian sheep breed – wool-milk-meat production direction. Their wool is a valuable raw material for both light industry and folk crafts. The local population in the Carpathians is traditionally engaged in the production of Hutsul carpets and bedsteads. From Ukrainian Mountain-Carpathian sheep after weaning lambs for two months of lactation receive 30–40 kg of commodity milk, in the best public utilities and the individual sector – 50 and more kilograms. Milk is used for the production of sheep cheese-brynza, which is in high demand among customers. Indicators of meat productivity depend on the level of feeding: after feeding on natural mountain pastures, 8-9-month lambs have a live weight of 28–30 kg, after intensive feeding of for fattening – 36–38

kg. Slaughter output yield – 42–45%, the output of meat yield from the carcass – 70–75%. After slaughter, the Ukrainian Mountain-Carpathian sheep give excellent quality sheep skin, which are used for the manufacturing of fur-hood products.

The economic efficiency and profitability of the sheep breeding industry depends on the quality of the product, which is determined by its genetic potential. Therefore, in order to preserve and improve the productive and breeding qualities of animals, one should know the genetic structure of both a separate herd and a breed in general. However, such an important agricultural object as a sheep remains cytogenetically underestimated. The study of the karyotype of sheep has theoretical and practical significance, since in the chromosomes there are genes that determine the development of all the features of

the organism and chromosomal aberration of any type can be the reason for reducing their economic value and reproductive function [1–4].

Materials and methods

The object of the study was the number of sheep of the Ukrainian Mountain-Carpathian breed ($n = 25$), which are breeding in the FH “Radwan-Nova” Miloshovichi, Pustomyty district in Lviv region. The cytogenetic study was carried out at the Genetics Laboratory of the Institute of Animal Breeding and Genetics named after MV Zubets (Chubinskoye) using special techniques and appropriate equipment. For the preparation of chromosomes, samples of culture of lymphocytes of peripheral animal blood were used. Lymphocytes (0.5 ml) were cultured for 72 hours in a nutrient environment RPMI-1640 (2 ml) with the addition of inactivated serum of cattle (0.5 ml), concanavalin (0.1 ml) and gentamicin (0.001 ml – for 1 ml nutrient environment). Two hours before completion of cultivation, a solution of colchicine was added to the medium at a final concentration of 0.05 $\mu\text{g/ml}$. The hypotonic treatment was performed using a 0.56 M solution of KCL for 30 minutes, followed by fixation in a freshly prepared and cooled fixative-methyl alcohol and glacial acetic acid (3:1). The routine staining of chromosome preparations was performed by Gimza dye. Cell analysis under a microscope was conducted at an imestation increase of 1000 times and photographed. For analysis and

photographing, metaphase plates were selected, in which the chromosomes were separated from each other [5]. The obtained experimental data were worked out analyzed by the methods of variation statistics.

Results and discussions

The karyological analysis carried out by us showed that the diploid set of chromosomes of the sheep of the Ukrainian Mountain-Carpathian breed, as shown by other authors who obtained their results at different times and with the help of cytogenetic technology of various levels [5–7], consists of 54 chromosomes 26 pairs of autosomes and one pair of sex chromosomes (XX or XY) (Fig. 1).

The karyotype of the sheep of the Ukrainian Mountain-Carpathian breed consists of chromosomes, which, by morphological structure, can be divided into two groups: acrocentric and metacentric. In all studied samples, a series of autosomes is represented by three pairs of large metacentrics. The remaining 23 pairs form a series of gradually decreasing acrocentric chromosomes, most of which have a terminal located centromere. The acrocentric chromosomes of the sheep do not have a significant difference in size, which makes it difficult to identify them without a banding techniques.

The group of metacentric chromosomes distinguishes the first pair, which is obviously larger than other chromosomal pairs. The difference

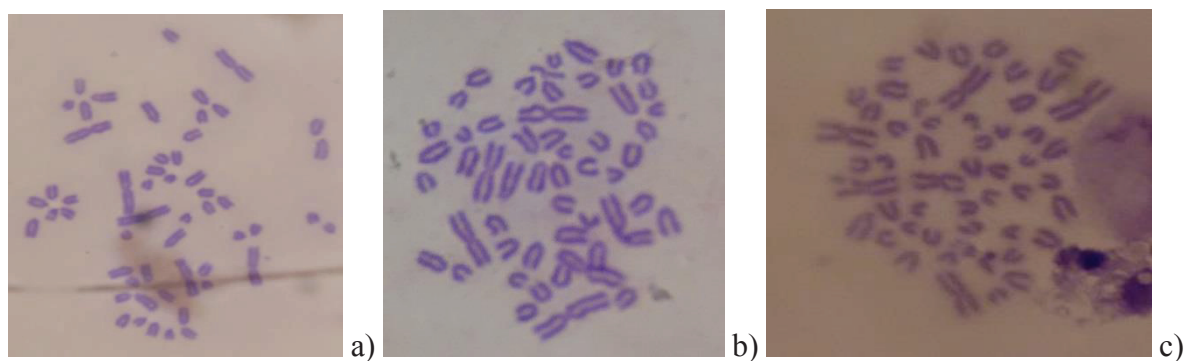


Fig. 1. Preparations of chromosomes at the stage of metaphase: a) chromosomal set in normal; b) aneuploid chromosome set; c) a set with a chromosome with a break.

in size between the second and third pairs is less obvious. The ratio of the short shoulder to the long in the first pair is 1 : 1.3. In the second and third pairs, this ratio is somewhat less. The most successful preparations of the chromosomes of the second and third pairs can be distinguished by the position of centromere, which is located more centrally in chromosomes of the third pair. The remaining autosomes form a series of gradual transitions from large acrocentrics to very small ones.

The individual characteristic of the chromosomes of sheep under routine coloring is very complicated. Most clearly, one can identify the first pair of chromosomes and X-chromosome – the first pair is the largest metacentric, sex X-chromosome – the largest acrocentric. The relative sizes of the X-chromosome considerably vary. Sometimes the predominance of the length of the X-chromosome, comparing to the largest of the acrocentric autosomes, reached 15%, in other chromosomal plates this prevalence was negligible. On separate preparations of the X-chromosome can be isolated according to the elongated short shoulder, the frequency of such morphological features are no more than 0,5% (2–3 to 50 examined cells).

It is known from the literature that the Y-chromosome is a small odd sub-metacentric chromosome which present in male karyotypes and absent in females [8]. We examined the karyotype only as a females, and therefore, the Y-chromosome, of course, was not studied.

Chromosomal polymorphism in the form of numerical variations in karyotype (aneuploidy and polyploidy), morphological aberrations, and associations of individual chromosomes is typical for sheep of the Ukrainian Mountain-Carpathian breed, as well as for other sheep breeds [9, 10]. The results of the analysis of chromosomal variability found that among the 722 analyzed metaphase plates of sheep of the Ukrainian Mountain-Carpathian breed, the proportion of aberrant cells was 19.22%, of which aneuploidy cells – 8.6%, polyploidy – 0.86%, cells with chromosomal breaks – 2.22%, the frequency of isochromosome fragments was 2.66% and the frequency of cells with premature centromere

Table 1. The frequency of aberrations in the karyotype of sheep

Animals	25	
Investigated metaphases	722	
Total aberrant cells,%	19.22 ± 3.80	
Frequency of genomic aberrations, %	aneuploid cells	8.60 ± 1.72
	polyploid cells	0.86 ± 0.16
Frequency of structural aberrations of chromosomes, %	breaks	2.22 ± 0.44
	fragments	2.66 ± 0.52
	PCDMC	4.88 ± 0.96

division of mitotic chromosomes (PCDMC) was 4.88% (table 1).

The main proportion of aneuploids is represented by hypoploids, the proportion of hyperploids, as a rule, is negligible. The stability of the parameters of aneuploidy of the sheep is confirmed by studies of many cytogenetics and can be considered as a special feature. Aneuploidy occurs more often among the sheep than, for example, in cattle and it is formed by the small acrocentrics.

The frequency of polyploidy cells of sheep ranges from 0.53 to 1.36% and is lower than in pigs and higher than in cattle. The sheep are registered four-, six-, eight-, 16-plodity and more. The bulk of polyploids are tetraploids (64%) and octaploids (21%). The number of triploids and other polyploids is insignificant and is approximately 15%.

In the investigated sheep population, was detected that approximately 2% of the cells have chromosomal breaks. Structural changes of the chromosomes, in particular translocations, were not detected among animals of the studied population of the Ukrainian Mountain-Carpathian breed.

Conclusions

By the number and structure of the chromosome set of sheep of the Ukrainian Mountain-Carpathian breed do not differ from other breeds of sheep. From the 27 pairs of chromosomes of

the sheep karyotype, the chromosomes of the first group, metacentric structure and chromosomes larger than other, according to size and sex are identified with sufficient accuracy. In connection with this feature, it is possible to determine the frequency with which these chromosomes participate in structural aberrations, which allows the use of cytogenetic studies in the practice of breeding work in sheep breeding.

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