EVALUATION OF THE EFFECT OF A GENETICALLY MODIFIED PRODUCT ON THE MORPHOLOGICAL PARAMETERS OF THE LIVER OF LABORATORY ANIMALS

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Genetically modified (GM) products are completely identical to their natural samples in their main characteristics, such as color, smell, and appearance [2,3,5,8,9,10,11].

Genetic modification studies are also conducted on animals. In the case of animals, research is mainly aimed at improving disease resistance, controlling their growth, or changing the quality of wool and milk components. As a result of these studies, fish became the only animal produced economically [1,4,6,7,12].

The purpose of this study was to develop a method for evaluating the effect of a genetically modified product on the morphological parameters of the liver of laboratory animals in an experiment.

Materials and methods

Experimental studies were conducted on white mongrel rats. These laboratory animals, received from the nursery, were subjected to a mandatory veterinary examination for the detection of existing diseases, assessment of fatness and age. The accepted animals were quarantined for 21 days in order to prevent the introduction of infectious diseases into the vivarium.

All laboratory animals were divided into 3 groups:

- experimental group-laboratory animals whose general vivarium standard diet included GM soy (soy flour) at a dose of 0.02-0.03 g per 1 rat weighing 160-180 g for 30 days (n=30);
- comparison group-laboratory animals whose general vivarium standard diet included soy without GM (soy flour) at a dose of 0.02-0.03 g per 1 rat weighing 160-180 g for 30 days (n=30);
- control group - laboratory animals kept only in the general vivarium standard diet (n=30).

All the groups were formed at the same time. The laboratory animals that participated in the experiment were representative by age, sex, weight, conditions of keeping and feeding. After 30 days of feeding, groups of laboratory animals were humanely killed, and then autopsies were performed. During the killing and opening laboratory animals, the rules of biological safety and ethical principles of working with laboratory animals were observed [2].

The experimental preclinical study of laboratory animals was conducted on the basis of the official letter of the Ethics Committee of the Ministry of Health of the Republic of Uzbekistan No. 4/14-1439 dated September 21, 2020 on permission to conduct these studies (extract from the minutes No. 4 of the meeting of the Ethics Committee of the Ministry of Health of the Republic of Uzbekistan dated August 26, 2020).

To study the morphological parameters of the organs of laboratory animals, research methods widely used in experimental studies (anatomical dissection) were used.

Research results

After the autopsy, we performed a macroscopic description of the internal organs of each laboratory animal, and also weighed the organs with special scales.

Macroscopic examination of the liver of laboratory animals revealed differences between the compared experimental groups. Thus, 76.7±7.7% (n=23) of the experimental group animals showed a noticeable increase in liver size, while in the comparison group this indicator was 13.3±6.1% (n=4), which is significantly lower (P<0.001) than the parameter of the experimental group. In the control group, the liver size remained within the normal range in all rats.

We observed almost the same trend of changes in the liver structure in animals, where the parameters were significantly different (P<0.001) - 80.0±7.3% (n=24), 6.7±4.6% (n=2) and 3.3±3.2% (n=1), respectively. Liver discoloration and soft liver consistency of laboratory animals after autopsy were observed only in the experimental group.

After we established visual changes in the liver of animals macroscopically, we studied the average weight of the liver and the relative weight of the liver per 100 g of body weight of the animal.

Both of the above indicators of laboratory animals of the experimental group (8.12±0.93 g and 4.10±0.27 g, respectively) significantly differed from the data of the comparison group (5.79±0.95 g and 3.26±0.11 g) and the control group (5.23±0.84 g and 3.05±0.19 g) - P<0.05.

Macroscopic examination of the liver revealed an increase in the liver size in 76.7% of the experimental group, while in the comparison group this indicator was 13.3%, in the control group the liver size remained within the normal range in all rats. There were also significant differences in the structure of the liver-respectively, in groups of 80.0%, 6.7% and 3.3% of animals. Changes in liver color and its soft consistency after autopsy were observed only in the experimental group. In addition, there was a significant increase in the average and relative liver weight per 100 g of animal body weight, in the experimental group, relative to these animals of the comparison group and the control group.

The study of histological preparations showed that no visible pathological changes were observed in the liver of intact white mongrel rats of the control group, kept on a general vivarium diet and the group receiving GM and non-GM conventional soy (Fig. 1).

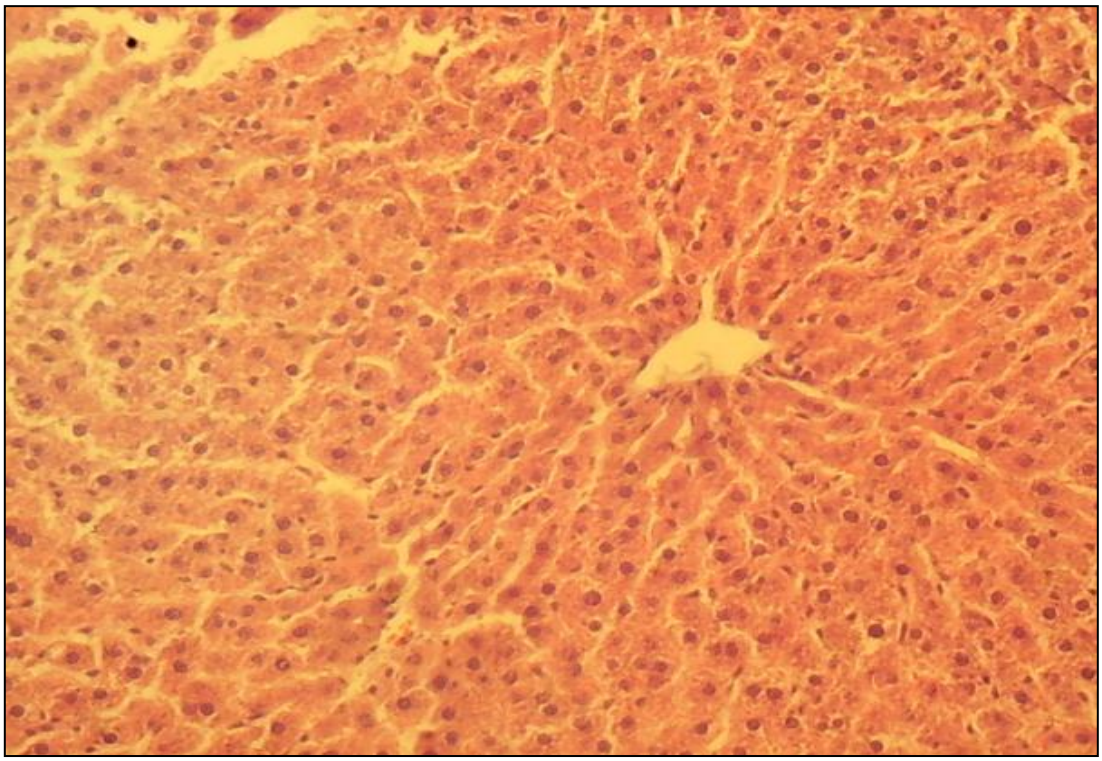

Fig. 1. Histological picture of the liver of a white mongrel rat of the control group - standard diet (without pathological abnormalities, stained with hematoxylin-eosin)

If no pathological changes were detected in the study of histological preparations of the liver of experimental animals of the control group (Fig. 1), then signs of organ damage accompanied by its increase, changes in the parenchyma, as well as hepatocytes and blood vessels were observed in animals of the experimental group and the comparison group. In this connection, the morphological parameters of the liver of these groups of animals were markedly different from similar data of laboratory animals of the control group.

In particular, in the experimental animal comparison group, 86.7% of the animals (n=26) showed no visible pathological changes, while the histological preparations of the liver of 4 animals revealed hyperplasia, fatty dystrophy of hepatocytes, cellular infiltration, and a violation of the relief of the hepatic beams (Fig. 2).

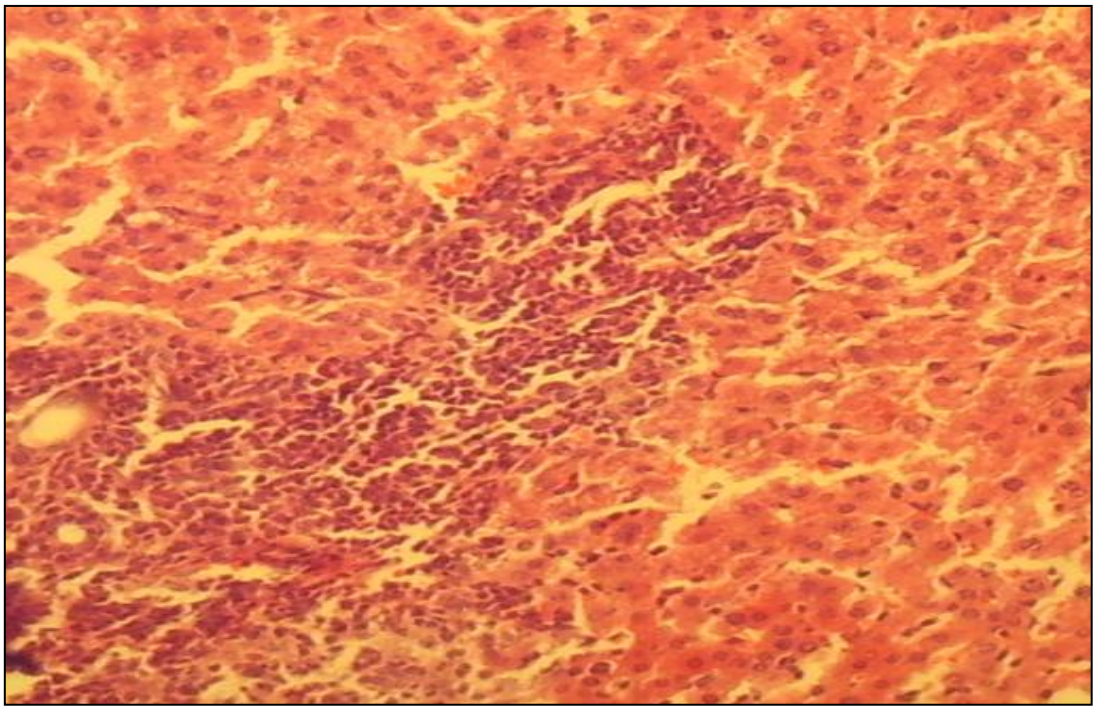

Fig. 2. Histological picture of the liver of a white mongrel rat of the comparison group-soy without GM (hematoxylin-eosin staining)

Quite a different picture was in animals whose diet was added to GM soy. Almost all animals showed more pronounced changes in the liver, which differed from the data of the comparison group, and even more so from the indicators of the animals of the control group. In the liver of animals, under the influence of GM soy, there were obvious signs of toxic hepatitis: diffuse dystrophic changes-pronounced fatty dystrophy, pericellular edema, sharp swelling of hepatocytes with their vacuolization, increased blood filling of blood vessels with signs of blood stagnation (Fig. 3).

The revealed pathological changes in the liver of animals of the experimental group indicate that the GM product (GM soy) under study has a negative effect on the structure of the organ after 30 days of feeding the latter with this product. This fact is also confirmed by the fact that the toxic effect was observed in almost all animals of this group (n=30).

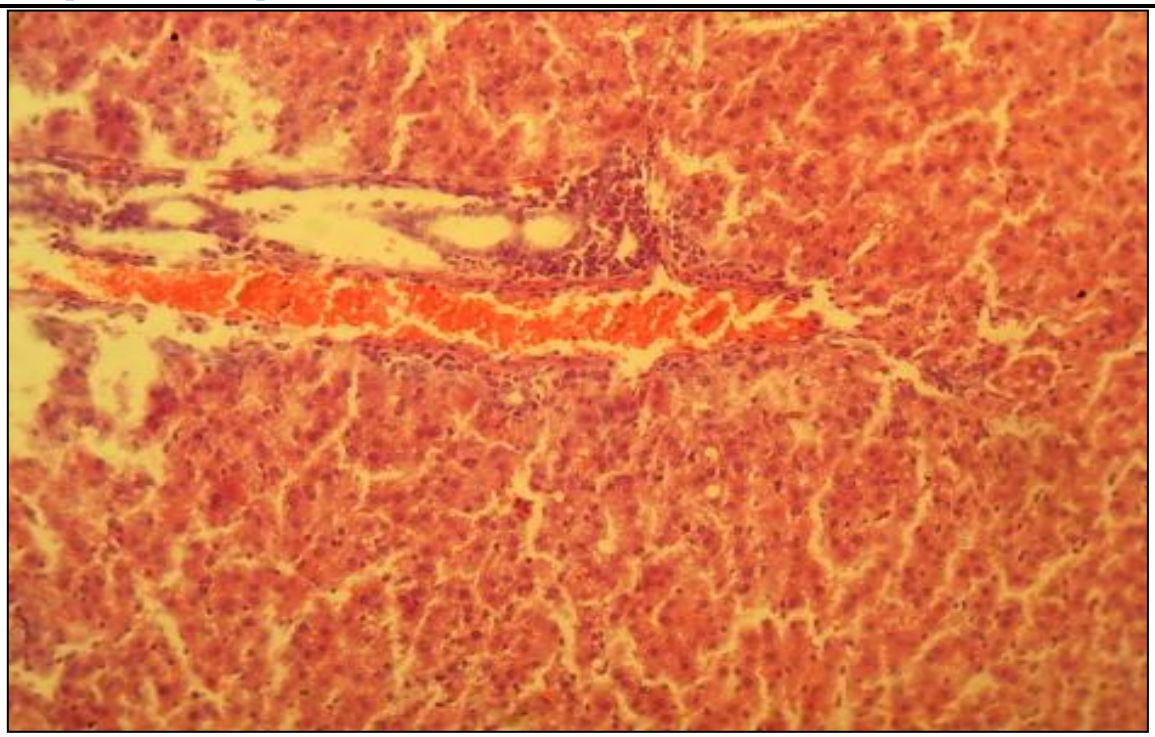

Fig.3. Histological picture of the liver of a white mongrel rat of the experimental group-GM soy (hematoxylin-eosin staining)

Thus, the detected pathological changes in the liver structure of the studied laboratory animals, with signs characteristic of toxic hepatitis, accompanied by the development of diffuse dystrophic changes, in particular, fatty dystrophy, pericellular edema, sharp swelling of hepatocytes and their vacuolization, fullness of blood vessels, signs of blood stagnation, indicate a negative effect of the GM product on the structure and condition of the liver of experimental animals. This is proved by the fact that in other compared groups, no obvious pathological abnormalities of the liver were observed.

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