

Safety study of jelly (kissel) concentrates in the in vivo experiments

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Abstract—The aim of this paper was to study the influence on morpho-functional indicators of the organism of experimental animals by regular consumption of jelly (kissel) concentrates in industrial production in comparison with the jelly (kissel) prepared according to the set of technical standards. The impact evaluation of jelly (kissel) concentrates was carried out using biological methods in animal experiments using morphological research of organs and tissues obtained after dissection of animals of experimental and control groups. The results of the study showed that regular consumption of jelly (kissel) from concentrates may have an adverse effect on the body. This fact must be considered when formulating rations, and the preparation of cold sweet dishes according to the traditional technology is preferred.

Keywords—jelly (kissel) concentrates, in vivo experiments, influence on the body

I. INTRODUCTION

In everyday human nutrition, including the nutrition of children, and especially in social institutions, increasingly, dishes and products using traditional technology are replaced by concentrates of industrial production. Moreover, many authors [1,2] noted the changes in nutritional status, towards the insufficiency of essential substances. Therefore, determining the effect of particular food products on the body, especially from concentrates, is of high importance.

There are no rigorous preclinical studies in the literature on the safety of regular consumption of concentrates.

Jellied sweet dishes, such as jelly (kissel), are widely used in public, social, children's and medical catering (diets No. 1, 2, 4, 5, 6, 7, 10, 11, 13, 15 - gastritis, peptic ulcers, pancreatitis, intestinal diseases, hepatitis, etc.) [3,4]. Fruit and berry jellies (kissel) are sources of critically distinctive types of carbohydrates. They contain a significant amount of easily digestible sugars (up to 26% of the total dry solids), starch (from 3 to 10% of the total dry solids), pectin and cellulose (from 0.7 to 1.5% of the total dry solids), as well as organic acids and vitamin C.

II. EXPERIMENTAL

Together with the jellies (kissel) made according to Compendium of technical regulations, for children nutrition in preschool institutions, educational institutions, institutions of primary and secondary vocational education, in medical institutions, they apply jelly (kissel) concentrates prepared in an industrial way. Regulatory documents recommended the use of this type of product in children's nutrition (SRN 2.4.5.2409 - 08 "Sanitary and epidemiological requirements for the catering of students in general educational institutions, primary and secondary vocational education"; SRN 2.4.1.3049-13 "Sanitary and epidemiological requirements for the device, content and organization of the working hours of preschool educational organizations "(as amended on August 27, 2015). The popularity of jelly (kissel) from concentrates in catering establishments is due to the fact that their preparation is economically and technologically more profitable than a similar dish from raw materials.

Jellies (kissel) from concentrates are similar in nutritional and energy values to the dishes prepared using traditional technology, however, it should be noted that a significant difference in the balance of carbohydrates by their type can be observed in them. In addition, these products contain extracts of fruits and berries, a number of food additives (food dyes, flavorings, etc.), which cannot be equivalent to the natural raw material component according to the recipes of the Compendiums.

The aim of this paper was to study the effect on experimental morphological and functional parameters of the organism of experimental animals with regular consumption of jellies (kissel) from industrial concentrates in comparison with the ones prepared according to the Compendium of Technical Regulations.

Research materials: cranberry jelly (kissel) (No. 1082 Compendium of technical regulations. A collection of recipes for catering, 2016.) and the same jelly (kissel) from concentrates of Russian and Polish companies in labile price categories for social catering.

Research methods

The effect on the body of animals by jellies (kissel) from concentrates in comparison to the traditionally prepared, with prolonged consumption, was studied using pathomorphological and histological research methods.

Animal studies were carried out on the basis of a certified vivarium, the educational and scientific-technological center "Veterinary Hospital" and the laboratories of the Department of Morphology, Animal Pathology and Biology of the Saratov State Vavilov Agrarian University and were conducted in accordance with the "Regulations for the work on experimental animals" [5-11].

All experimental studies were performed on groups of clinically healthy rats of the same breed, one sex, one age, one weight. The animals were fed for 45 days; during the entire experiment, the rats were kept in individual cages (10 animals in each group).

The research was carried out on four groups of clinically healthy rats (10 animals in each group), formed according to the principle of analogues taking into account breed, sex, age (1.5 months), live weight and clinical condition: the control group received the usual full diet; experimental group 1 received a complete diet and jelly (kissel) according to the traditional recipe; experimental group 2 received the usual high-grade diet and briquette concentrate kissel (Russia); 3 experimental group received the usual full diet and powdered concentrate jelly (kissel), Poland. Replacement was carried out without prejudice to the nutritional and energy value of the daily diet of animals. Prior to the introduction of products into the diet, animals were kept in quarantine for 21 days and transferred to the diet in accordance with the experimental plan.

Necropsy was carried out with detailed recording and photographing of the material. Pathomorphological changes were studied on the material from 40 euthanized animals [7-11].

The necropsy of the animals was carried out in the first 2 hours after the euthanasia. For histological examination, pieces of the liver and spleen were taken. In order to fix the pathological material, we used a 10% solution of neutral formalin.

Sections were obtained on a freezing microtome model 2515 (Reichert Wien). The prepared histological sections were stained with Ehrlich hematoxylin and eosin, followed by microscopy. The morphological structure of organs was studied in 30 fields of view of the microscope on various histological sections. A histological examination of the preparations was carried out under different magnifications, with detailed recording and photographing of the studied areas. Microphotography of histological preparations was carried out using a CANON Power Shot A460 IS camera.

The research results were processed by methods of mathematical statistics (GOST R 8.736-2011 National Measurement Assurance System (NMAS Direct multiple measurements. Methods of processing the measurement results. Main provisions) when they are repeated at least 5 times, $p = 0.95$.

III. RESULTS AND DISCUSSION

From Table I, it is seen that the animals of the first experimental group were slightly different in weight gain (4%) from the control group (Fig. 1-4).

At the same time, in the second group, in comparison with the control and experimental group 1, there was an increase in weight by 12.2% and 8.2%, respectively. This fact is most likely due to the fact that the prevailing carbohydrates in the briquetted concentrate (Russia) are simple sugars and starch.

Significant weight changes were noted in the experimental group 3, and amounted to 89.1%, which is 60.9% and 56.9% more than in the control and experimental group 1, respectively. The results obtained allow us to make an assumption about impaired carbohydrate metabolism in rats of the experimental group 3.

As a result of the studies, it was found that in the small intestine of the rats of the control group there were changes typical of serous and serous-catarrhal enteritis. On the mesentery, a small amount of body fat was noted, having a soft consistency. The average width of adipose tissue was 3 mm (Table II).

In the intestines of animals of the first experimental group (jelly (kissel) according to the recipe No. 590) no pathological processes were revealed. Adipose tissue had a denser consistency than the one of the rats of the control group, which indicates a favorable effect of jelly (kissel) on the digestive canal. The average width of adipose tissue on the mesentery was 3 mm (Table II).

In the bodies of rats of the second experimental group (briquetted concentrate, Russia), focal serous enteritis was observed. It should be noted that the adipose tissue on the mesentery had a denser consistency, its average width was 4.3 mm (Table II), which is 43% more compared to the animals of the control and the first experimental groups.

In the bodies of the rats of the third experimental group (powder concentrate, Poland), changes typical of serous-catarrhal enteritis were detected. At the same time, significant fat gain was observed on the mesentery, the average width of which was 6.2 mm, which is 106.6% (Table II) more than in animals of the first and second experimental groups.

TABLE I. THE DYNAMICS OF LIVE WEIGHT OF EXPERIMENTAL ANIMALS

Animal groups	The average weight before feeding, grams	The average weight after feeding, grams	Gain in live weight in grams and %	
			grams	%
Control	163,7±1,5	209,9±0,8	46,2	28,2
Experimental group 1	162,9±5,3	215,5±0,9	52,6	32,2
Experimental group 2	158,8±8,06	223,03±1,3	64,2	40,4
Experimental group 3	155,6±2,7	294,3±0,9	138,7	89,1

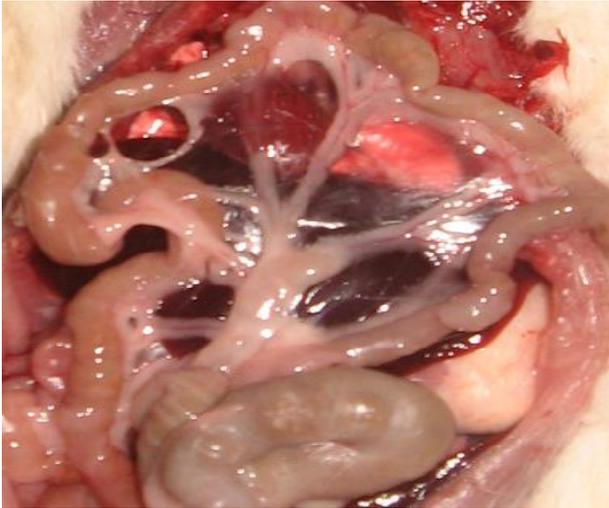


Fig. 1. Intestine of rats in the control group

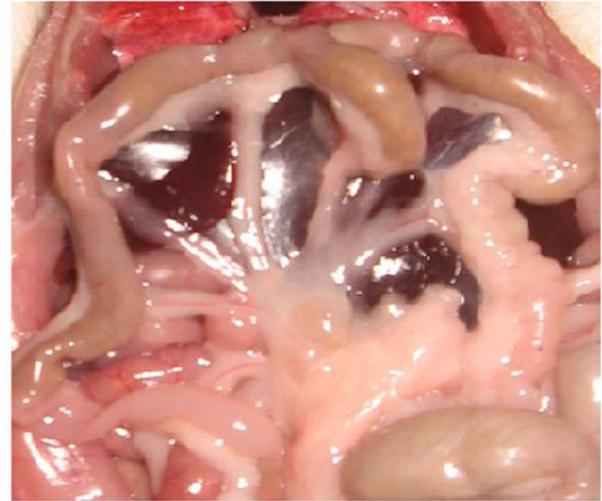


Fig. 4. Intestine of rats of the experimental group 3

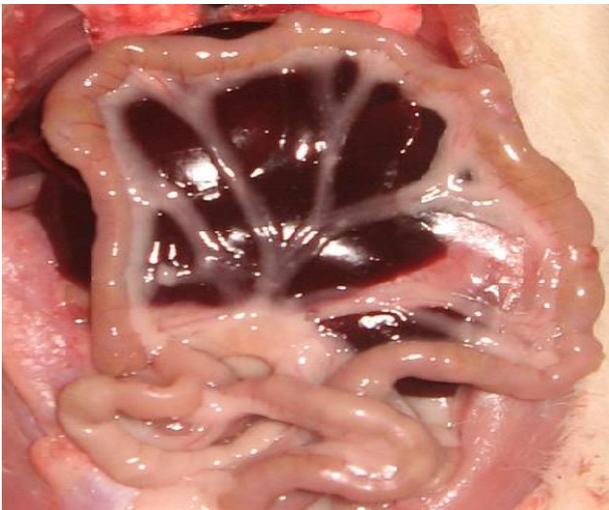


Fig. 2. Intestine of rats of the experimental group 1

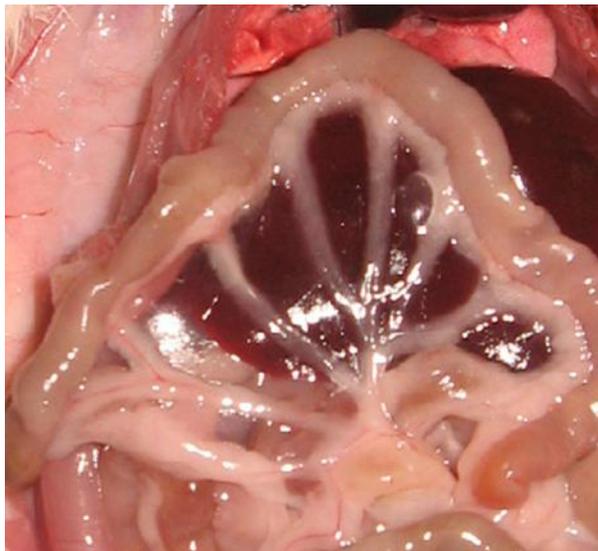


Fig. 3. Intestine of rats of the experimental group 2

The results of morphological studies of the spleen and liver of experimental rats showed that the changes in the animals of the control group and the first experimental group did not significantly differ from the physiological norm. In the spleen of rats of the second and third experimental groups, micronecrosis, edema of the connective tissue stroma and rarefaction of the follicle substance were observed, which may indicate an immunodeficiency state.

In the liver of the rats of the second and third experimental groups, granular and diffuse fatty degeneration (up to the cricoid form), the presence of diapedetic hemorrhages (especially in the third experimental group), discomplexation of the beam structure, and violation of the tinctorial properties of hepatocytes were revealed. Such changes indicate structural and functional disorders of the organ, and indirectly, depletion of the liver with glycogen, due to carbohydrate pathological metabolism because of regular consumption of jellies (kissel) from concentrates. The results of morphological studies are presented in Fig. 5-8.

TABLE II. THE AVERAGE WIDTH OF THE ADIPOSE TISSUE OF THE MESENTERY

Group number	Adipose tissue width	
	mm	%
Control	3,0 ± 0,1	100,0
Experimental group 1	3,0 ± 0,2	100,0
Experimental group 2	4,3 ± 0,1	143,3
Experimental group 3	6,2 ± 0,3	206,6

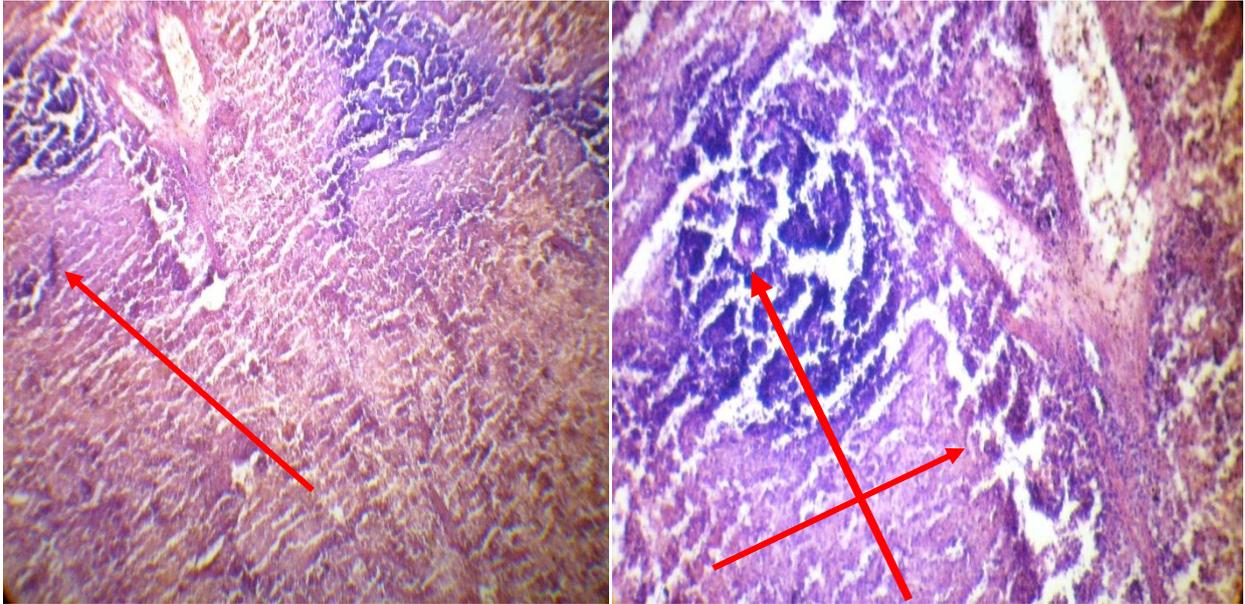


Fig. 5. Spleen of rats of the 2nd experimental group. a) Necrobiotic processes in the perifollicular zones. HE x 70, b) Swelling of the stroma of the organ and substance of the follicle. HE x 150.

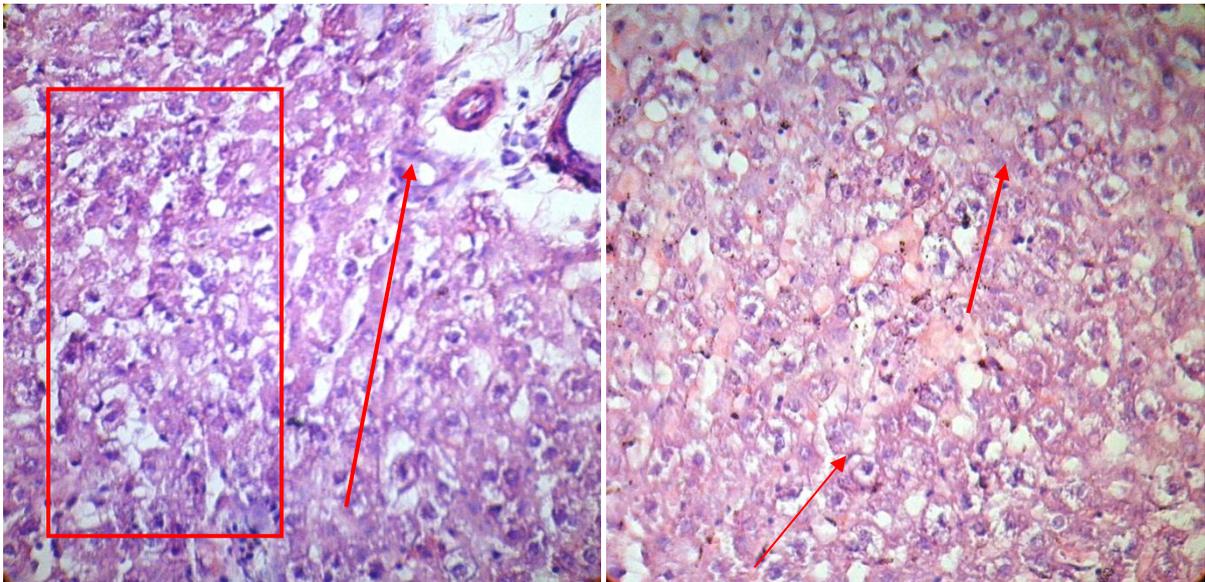


Fig. 6. Liver of rats of the 2nd experimental group. a) Discompletion of the beam structure, perivascular and pericellular edema. HE x 70, b) Diffuse fatty degeneration, violation of the tinctorial properties of hepatocytes. HE x 70.

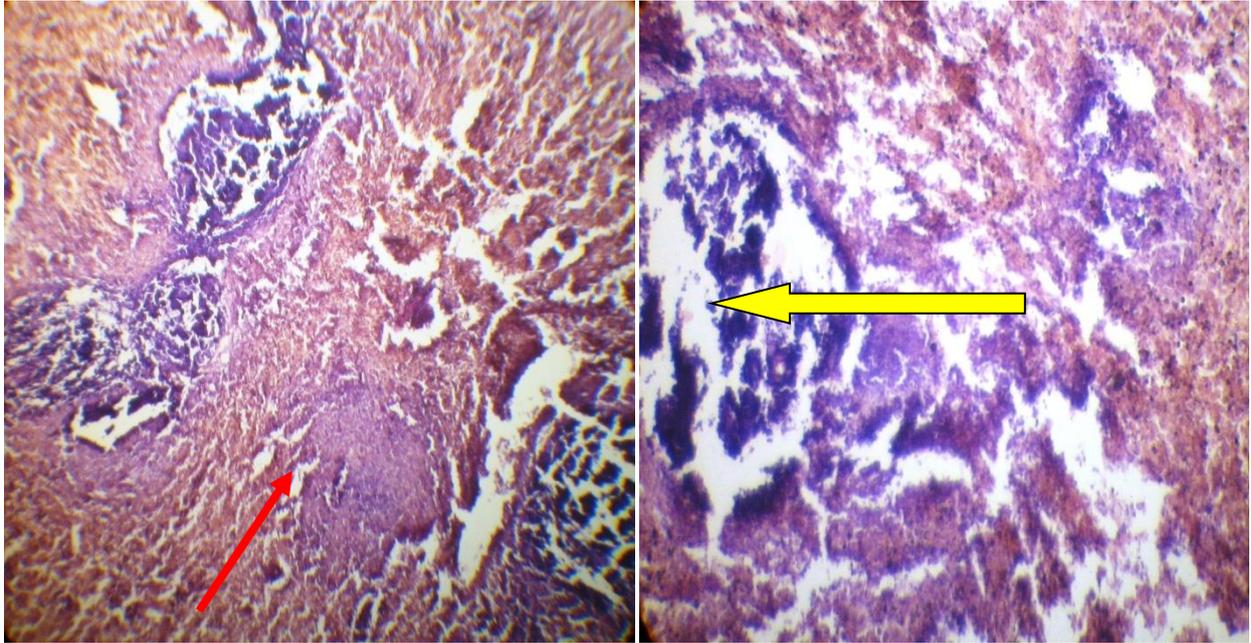


Fig. 7. Spleen of rats 3 of the experimental group. a) Micronecrosis in the red pulp. HE x 150, b) Exhaustion and swelling of the substance of the follicles. HE x 300

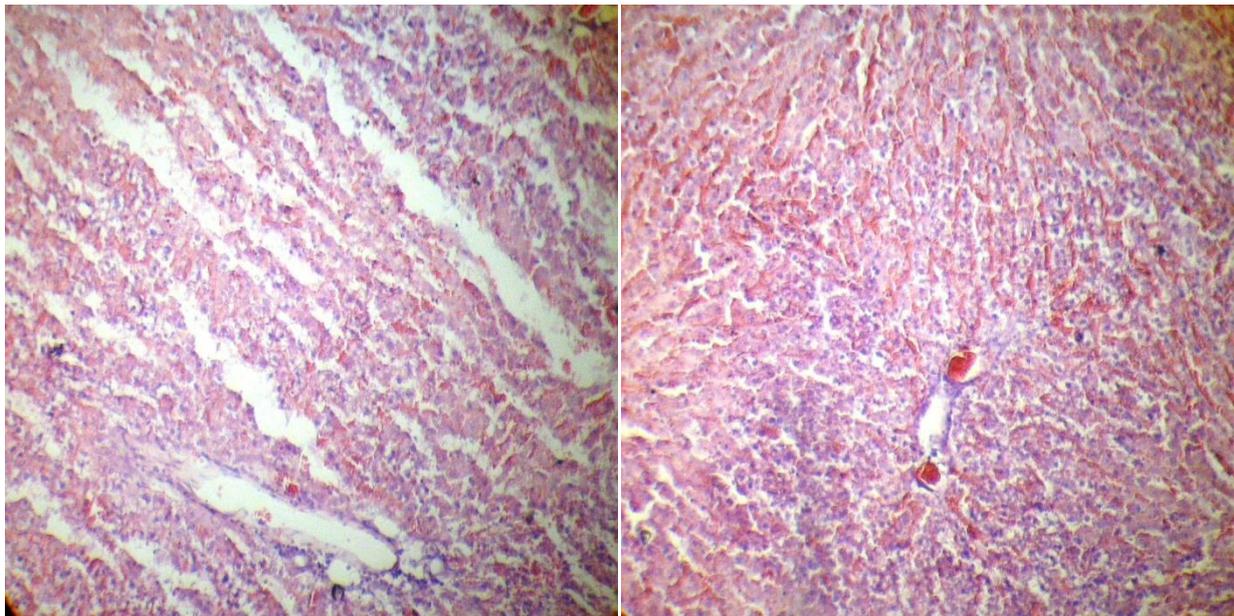


Fig. 8. Liver of rats the 3rd experimental group. a) Discompleteness of the beam structure, granular and fatty degeneration. HE x 70, b) Multiple diapedetic hemorrhages. HE x 70

IV. CONCLUSION

The research results are as follows:

- Regular consumption of jellies (kissel) from concentrates contributed to a weight gain of experimental animals. In the third experimental group, the weight deviation is 60.9% higher than in the control group;
- The necropsy showed that in the bodies of the rats receiving jelly (kissel) from concentrates, the fat on the mesentery was significant (106.6% higher than in the control group). In the third experimental group, changes typical of catarrhal enteritis were detected;

- The rats fed with jelly (kissel) from concentrates developed granular and diffuse fatty degeneration (up to the cricoid form), discompleteness of the beam structure and disorders in tinctorial properties of hepatocytes, diapedetic hemorrhages (especially in the third experimental group).

Proceeding from the above, regular consumption of jellies (kissel) from concentrates can have an adverse effect on the body. This fact must be taken into account when developing diets, and preference should be accorded to the preparation of cold sweet dishes using traditional technology. In addition, it is recommended to reduce the use of concentrates of sweet foods in children and therapeutic nutrition.

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