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Synthetic polymers and the problem of their detection in the human body

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The term “polymery” was first introduced to science by J. Berzelius (1933) to designate the kind of isomerism in which substances of the same composition have different molecular weights. By origin, polymers are divided into natural, or biopolymers, and synthetic ones. All tissues of living organisms consists of biopolymers (proteins, DNA, RNA, cellulose, etc.). Synthetic polymers were first mentioned in 1838-39. Now, almost two centuries later, it is safe to say that synthetic polymers have become a necessary attribute of our lives. Due to their mechanical strength, elasticity, electrical insulation and other valuable properties, they are widely used in industry and everyday life. They are plastics, rubber, fibers, lacquers, paints, adhesives, high-molecular medical solutions, household products. The results of close contact with synthetic polymers are already affecting the human body and creating environmental problems. To date, we know methods of determining individual polymers – dextrane and polyvinylpyrrolidone – taken by us as a prototype (Pirs, 1962).

This study was aimed to develop a method for detecting methacid (polyhexamethylene guanidine hydrochloride) in the hepatic tissue. For this purpose, autopsy material of toxic hepatitis was used. The comparison group included episodes of acute and chronic, alcoholic hepatitis, liver cirrhosis, and injuries. As a result of the research work done, the analysis of macroscopic and histological studies results, we established a method of histochemical detection (staining) of methacid in the liver after formalin fixation and battery wiring. This method has been considered an invention (S.A. Friss, 2011, patent of RF N2433409) relating to the field of medicine, to histochemistry (histology) in

particular, and can be used for qualitative determination of polymers with basic properties in the liver.

The proposed staining method is employed in histological laboratory settings. Prepare a 2% solution of Congo red in 10% alcohol. Apply 2-3 drops of the staining solution relating to acid dyes onto slides. Incubate for 10-15 minutes. Discard the remnants of the dye. Rinse by dipping the slides 8-10 times into a laboratory glass with distilled water. Soak with filter paper and put the slides in glycerol.

The liver slides are histologically examined under light-optical microscope. The redox reaction aimed at properties of chemical compounds with basic properties to bind acid tissue dyes identifies the basic properties of the substrate stained with Congo red. Around inclusions present in the bile cylinders, an orange border is formed, the cytoplasm of Kupffer cells, hepatocytes also turns orange which suggests the presence of methacid – polyhexamethylene guanidine hydrochloride (PHMG-HC) – in the analyte.

Thus, the proposed method, unlike the prototype, allows to detect such polymer in the liver tissue indicating slowly resolving cholestasis in toxic hepatitis, to distinguish toxic hepatitis from alcoholic liver disease, poisoning with other substances.