*Sys Rev Pharm 2020;11(12):1190-1194*
A multifaceted review journal in the field of pharmacy

# Functional-Morphological Features of Enterosorbent in Animal Cells

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## ABSTRACT

Today it is impossible to present any human activity thatis directly or indirectly notaffected by live organisms of toxic substances that continue to grow. Studying the pathomorphology of changecaused by and the effect of toxic substances at the intercellular and interfabric level plays a large role inunderstanding the pathogenesis of various diseases. One avenue of studying intercellular and interfabric relationship is the identification of interaction between fabrics facing impact of toxic substances. In the human body, this is especially relevant as the relationship between fabrics and their cellular elements helps to reveal morphofunctionalfeatures of cells. Toxic substances acting on an organism triggersmorphofunctional processes thatlead to destructive changes inorganisms. Chronic poisoning with cadmium and lead, for instance, destroys animal cells, leading to the dysfunction of internal organs. An excess of cadmium interferes withthe metabolism of metals, especially iron and calcium, distorts theeffect of zinc and other metalenzymes, blocks sulfhydryl groups of enzymesand interrupts DNA synthesis. Lead interferes with biosynthesis, and is considered the strongest neurotoxin, causingaggressive reactions where it is present. In this experiment, morphological changes in the internalorgans of white, not purebred, rats that are given1.5 mg/kg of cadmium and 25 mg/kg oflead in anenterosorbentare investigated using 1 g/kg Ingo2 within 30 days of its use. Two groups of rats show strong destructive changes in their internal organs i.e. necrosis, puffiness, gidropic dystrophy, reduced pathological processes and increasedcompensatory reaction. Two other groups of rats show the effects of damage due to poisoning, but these effects are reduced after use ofenterosorbentIngo2. The results of thisresearch demonstrate that the enterosorbentIngo2 promotes efficiency in occluding cations of lead and cadmium.

**Keywords:** organs, destruction, enterosorbent, histology, morphology, necrosis, pathology

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## INTRODUCTION

An urgent problem facing the authorities today is how to provide organic food produced in environmentally friendly ways as food today has become a source and carrier of a large number of potentially dangerous and toxic substances. In recent years the environment has becomepolluted by various toxic substances, and this has only worsened the ecological crisis facing the nations of the world. Many geographical areas have been to be contaminated with an accumulation of toxic substances in the soil, water and flora. One of the most widespread pollutants of the biosphere are heavy metals, which due to their large number of trophic chains, is hazardous to the health of humans and animals. Among the more deadly heavy metal pollutants are cadmium and lead. Therefore, this research tasked itself withstudying theaction of cadmium and lead on human and animal cells. Cadmium and lead are twoof the most toxic elements in Mendeleyev's table. The sphere of their application is rather wide, ranging fromnonferrous metallurgy to the automobile and other industries and chemical uses. Cadmium in the environment does not decompose and finds its way into food chains. Lead can lead toprotoplasmatic poisoning, causing changes in the nervous, cardiovascular and circulatory systems. It also blocks enzymatic reactions necessary for hemoglobin synthesis, prevents vitamin exchange and reducesimmunobiological reactivity in organisms (Arch, 2006;Adonaylo, 1999;Annabi, 2007; AlBakheet, 2013; Dan, 2000; Emily, 2000; Institoris, 2006; Konuhova, 2006; Lepesbayev, 2002;Szkoda 2005).

The main danger of cadmium and lead is their propensity to accumulate in the cells of live organisms, leading gradually to the breakdown of pathological processestovarying severity. Even when taken in lower doses, concentrated metals are lethal toxicants. Studying the pathomorphology of changecaused by and the effect of toxic substances at the intercellular and interfabric level plays a huge role inunderstanding thepathogenesis of various diseases. One avenue of studying intercellular and interfabric relationship is the identification of interaction between fabrics facing impact of toxic substances. In the human body, this is especially relevant as the relationship between fabrics and their cellular elements helps to reveal morphofunctional features of cells. The pathological processes in an organism have their own importance to the body and are acted upon depending on the number of compounds of the heavy metals acting on them. The main ways of cadmium and lead intake for humans and animals is through the digestive tract and the lungs. Aggressive damage to the organs leads to damagetointerfabricinteraction (Ahmet, 2006; Yessimsiitova,2014; Kramarova,2005; Kazuo,2000; Meulenbelt,2000; Miranda, 2006; Newairy, 2007; Safronova,2008a; Salomeina, 2004; Safronova,2008b).

In studying the action of cadmium and lead on human and animal cells, it is first necessary to study their accumulation and distribution in organisms. It is necessary in order to define the quantity of a toxic element in an organism and body structure. Studying the accumulation and distribution of cadmium and lead to determine their action onpathomorphologicprocesses in human and animalorgans demonstrates the correlation between pathological processes in the organs, the maintenance of toxic elements in them and changes caused in them by these toxic elements. The speed of absorption of compounds of heavy metals, their distribution and their toxicity depend not only on biological features of the digestive organs, but also on their physical and chemical properties, the soaked-up substances, their interaction with food components and thepresence ofvarious additives.

Heavy metals in food, as a rule, do not cause sharp poisoning of animals; however, having cumulative properties, they negatively affect many internalorgans and systems of a live organism. In animals, biochemical processes are broken, the activity of enzymes is inhibited, proteinaceous and nucleinic exchanges are oppressed and receipt of the vital elements is blocked. In addition, the resistance of animals decreases, and their susceptibility to various diseases rises. The leading mechanism of the toxic action of compounds of heavy metals is oppression of many fermental systems by blocking sulfhydryls and other functional groups in the active centres and other biologically important sites of proteinaceous molecules.

Recently there have been more records of pollution of foodstuff by heavy metals. However, the toxic effect of metals in humans and animals is not sufficiently studied.For instance, the efficiency of entersorbents in mixed toxinshas not been defined. Therefore, there is a need fordeeper studying of the combined effect of heavy metals and research intoeffective entersobentsforsimultaneous impact on animal cells by the action of several toxicants (Tashkent, 1980; Dudarev, 2010; Tkachenko, 2014; Tokarev, 2011;Ying, 2006).

Today, medical science is showing growing interest in enterosorbtiondue to rising environmental pollution and food produced is often stale and artificial, leading to the consumptionof harmful and unnecessary substances. The growing importance of enterosorbentsled to this studyof the pathomorphologicchanges in the internal organsof white, not purebred, rats that were given a dose of 1.5 mg/kg of cadmium and 25 mg/kg of lead in 1 g/kg of theenterosorbentIngo2within 30 days. The enterosorbent was derived from raw vegetablesas because raw vegetables have good absorption as well as good correctional properties in addition to restoring homeostasis of an organism and promoting increase in compensatory and adaptive reactions and removal of toxic and toxic agents and absorbing harmful substances in the stomach or intestines andneutralising poisons.

The objectives of this research were to studythe histological and morphological changes of internalorgansof animals exposed to poisoning with cadmium and lead in an application of anenterosorbentsuch asIngo2 and tocharacterise specific and morphofunctional properties of anenterosorbentfor clarification of organismsexposed to poisoning with cadmium and lead.

## RESEARCH METHOD

This research studied the effect of cadmium and lead on animals *in vitro*. During the experiment, conditions of chronic poisoning with cadmium and lead were created. The control group of animals received the same forage in the same quantities and proportions, but without addition of lead and cadmium. A dose of 25 mg/kg of lead and 1.5 mg/kg of cadmiumwas systematically added to the diet of three groups of experimental rats within 30 days. Rats in the fourth and fifth groups were given cadmium and 1g/kg ofenterosorbent.

**Morphological Method of Research**

Anexperiment on 60 white, not purebred male rats 3 monthsold showing the initial weight of 160-180 gwas conducted. During the experiment all the ratsremainedin identical, standard conditions of a vivarium. Decapitation of the rats was done between 9 and10 a.m. The research object was the internal organs of the rats. The subsequent processing of the internal organs of the rats and the control rats was carried out as a comparative histological and morphological analysis. Histological processing of the materialswascarried out using the traditional method of microscopic observation of thin cutoffs (Volkova & Yelets, 1982). In the cutoffs the dye hematoxylin was used to colourthe basophil cellular structures and the spirit dye eosin was used to colour theeozinophil structures of thecell. Basophil structures, as a rule, contain nucleic acids (DNA and RNA) and are found in the cellular kernel, ribosomes and RNA-rich sections of the cytoplasm. Eozinophil structures contain intra- and extracellular proteins. Viewing and photography of the received histological medicines was done using a luminous microscope, the Leica DMLS, which came with aLeica DFS 280 digital camera.

## RESULT AND DISCUSSION

When carrying out histological research the most careful analysis of morphological changes in cells and the synthesis of observed changes in their interrelation is necessary. Studying the dynamics of morphological changes caused byvarious diseases and comparing those changes with functional displays of a disease, provides a pathological morphology of the mechanism of the diseasesor their pathogenesis.In this research, the effects of cadmium and lead in the gastrointestinal tract of white rats were studied. The organs examined were the liver, gullet, stomach and lungs. It is known that intake of toxic substances in food will pass through the gastrointestinal tract. Some of the toxic substances accumulatein organs that have a high level of metabolismsuch as the liver, while some of them are removedfrom the body through the kidneys and the skin. The reactions are observedat the same time in cell and tissues of the liver, stomach and kidneys, among other organs of the body. In this research, the gastrointestinal tract was chosen for study because it is among the first to receive any impact from toxic substances taken into the body with food and, thus, can serve as an indicator of the degree of toxicity of different nutritional supplements, medicines and other consumed substances.

The histological analysis of the internalorgans of the rats of the control group showed that their liver hadthe characteristic lobular structure. In interlobular intervals there were portal tracts containing branches of theportal vein as well asthehepatic artery,cholic ducts, lymphatic vessels and nerves. The hepatic lobes weresurrounded by a layer of connective tissue. Hepatocytes had formed accurately expressed radially lying beams between which there weremoderate venous sine. The proximal canaliculus had a cavity that varied from narrow cleft to wide spherical lumen. The hepatocytes had spherical cores with a huge number of chromatin and fine-grained cytoplasm. On the periphery,the hepatic beams werelocated a little chaotically and the radial course of the sinusoid were not traced. The series of hepatic cells bordering a lobe on the perimeter formed a boundary plate. Hepatic cells within a lobe weremorphologically non-uniform. The epithelium of a proximal canaliculus consisted of cubic cells of the same kind with evenly painted cytoplasm. Cores of rounded shapes with an accurately expressed chromatinic structurewere also visible.The structural heterogeneity of hepatocytes reflects differences in their functional activity, which, in turn, depends both on age of the cell and on conditions of microcirculation. The hepatic sinusoids thatwerebetween the hepatic beams werewell visible and appearedas narrow, empty spaces. In their walls formed by endotheliocytes the fixed macrophages or Kupfer cells werewell discernible. Mostly, they werein the sinusoids of the periportal zones.

Thehistological analysisof the lungs revealed that the walls of the bronchial tubes of average calibrewere covered with a singlelayer of multirowciliar epithelium or single-layer, single-row vibrating in the bronchial tubes of small calibre. The mucous membrane consisted of a friable connecting fabric. The mucous layer wasformed by a layer of smooth muscle cells focussed on a spiral. The submucous basis wascreated from a friable connecting fabric and included trailer departments of mucous and proteinaceous glands in the structure. The fibrous and cartilaginous cover of the bronchial tubes of average calibrewascharacterised by extensive cartilaginous plates, which in the bronchial tubes of small calibrewerecompletely absent. Respiratory bronchioles broke up into alveolar courses which, branching, came to an end showing alveolar bags consisting of a set of respiratory alveoli. The alveoliwerecovered by asingle-layer epithelium located on a basal membrane (Figure 1).

Thegullet of the control rats consisted of mucous, submucous, muscular and external covers. The mucous membrane wascovered with a multilayered epithelium. Unlike in humans and some other mammals, the epithelium of the gullet of a rat ismultilayered and flat. The multilayered, flat epithelium of rat gullet consists of basal, brilliant and horn layers. The granular layer in the gullet of the control rats was absent. Cells of organism very seldom which are met in grains of keratogialinand didnot form a layer as in skin epithelium. The basal layer waspresent

Results of the histological analysisof the first control group showed that the mucous membrane of the stomach had uneven contours. The epithelium coveredthemucous membrane in a singlelayer and was cylindrical, ferruterous. In the basal part, the superficial epithelium kernel had settled and in theapical part there weredrops of a mucoid secretion. The muscular cover presented three layers of fibres intertwining the flat, muscular layers.

The patho morphological analysis of the second and the third group of rats that were fed cadmium and lead showed changes in the histo structure of the internal organs and morphofunctional changes presenting ashaemorrhages and giperemiya, dystrophic processes in the liver, violation of permeability of vessels with perivascular haemorrhages in the liver and lungs. The liver was flabby, with icteric shades, and hadhaemorrhages under the capsule. The rats given a dose of 25 mg/kg of lead showed well expressed granular dystrophies, necrobiosis of separate hepatocytes, haemorrhage in sine, signs of regeneration of single hepatocytes and histiolimphocytologic infiltration of portal paths in the liver vacuoles. The frame structure was broken in segments and the sinusoids hadexpanded. Rats given a dose of 1.5 mg/kg of cadmium presented hydropic dystrophy, which is characterised by emergence of a vacuole filled with cytoplasmic liquid. Theparenchymatous cages wereincreased in volume and the cytoplasm was filled with the vacuoles containing a transparent liquid. The mechanism of development of hydropic dystrophy is difficult and reflects the preventionof water and electrolytic and proteinaceous exchange, leading to change incolloidal and osmotic pressure in a cell. This plays a large role in the preventionof permeability of cell membranes, which is followed by their disintegration. It leads to acidulation of the cytoplasm and the activation of hydrolytic enzymes of lysosomes thatbreak intramolecular links with water. The samples showedproteinaceous liver dystrophy of hepatocytes, single necrobiosis and signs of cell regeneration. However, these changes had a compensatory and adaptive character, were reversible and disappeared several days after introductionof theenterosorbentIngo2.

The histologicalanalysisof the mucous membrane of the gullet of the ratsinthe second group and third group that had received lead and cadmium showed strong puffiness. In the epithelium of the horn layer, the horn layer remained only in certain places, but was visible. After reception of theenterosorbentIngo2, the mucous membrane of theepithelium wasless subject, and irreversible destructive changes in the gullet of the rats were noted. The morphological changes had a compensatory and adaptive character and were completely reversible.

Analysis of the mucous membrane of the stomach revealed that certain partswere hyperemic, bulked up, showed catarrhal inflammation,haemorrhages and necrosis. In thestomach, insignificant puffiness of the mucous membrane and violation of integrity of the epithelium, which in certain sites had come under the influence theenterosorbentIngo2showed complete recovery. Minor changes in the histostructurewerecompletely reversed and hada compensatory and adaptive character.

Results of the histological research of the rats' lungs after consumption of cadmium and lead showed morphological changes in the rats in the second and third group. At sharp poisoning of the animals, symptoms of exhaustion werefound. In places,atelektaz of the pulmonary fabric, alternating with sites of swelling of the pulmonary fabric,was visible as werehyperaemia of the vessels anddevelopment of stagnation in the pulmonary fabric. Interlobular and interalveolar partitions had becomeexpanded. Alveoliwerefilled with air and aliquid containing an insignificant amount of albumen and cellular elements (Figure 2).

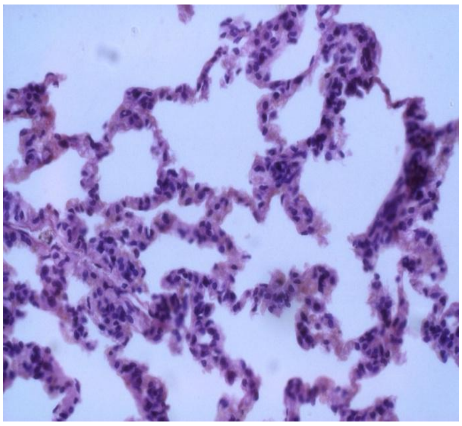
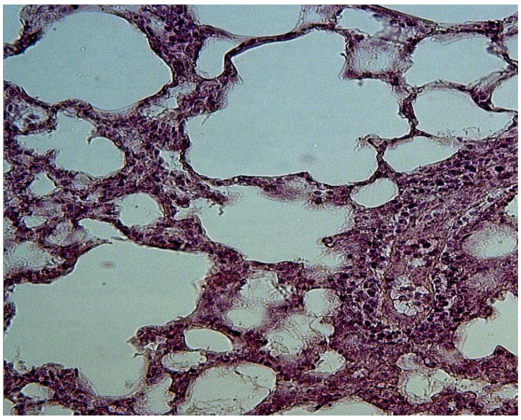

**Figure 1**. The rat lung cells were normal.
**Figure 2**. Interlobular and interalveolarpartitions wereincreased.
Hematoxylin - eozin. Uv.Kh 210.Hematoxylin - eozin. Uv.Kh the 400

The poisoning of the rats with lead and cadmium wascarriedinto the hepatotoxic substances, as usual presented by liver failure due to the presence of morphological substrates leading to fatty dystrophia and necrosis of the hepatocytes.

The histological analysisof the organs of the rats in the fourth group and the fifth group after poisoning with lead and cadmium as well asthe use of anenterosorbent did not show strong pathomorphologic changes in the structure of the organs. After reception of theenterosorbent, the rat stomach cells looked completely repaired. In the liver, hepatocytes in a condition of moderate granular or focal fatty dystrophia showedthe following: the frame structure of the lobes of the liver wsa retained, the venous sine wasslightly expanded, the hepatocytes were slightlyfilled with rather turbid cytoplasm, the cores were retained and their contours weremaleficiated. In separate lobes, groups of cells in which cytoplasmic fatty drops of various sizeswere found.

## CONCLUSION

Histological research into the internalorgans of rats indicatedthat consumption of the heavy metals lead and cadmium caused morphological changes in theliver, lungs, stomach and gullet of the animals. However, it was possible to correct these changes with the use of the enterosorbentIngo2within a month. The enterosorbentwasnot only effectively occluded by lead and cadmium, but it deliveredvitamins and minerals to the rats that were capable of rendering antagonistic action on the heavy metals and to increase nonspecific resistance of therats. The antagonistic influence of the heavy metals, at which absorption R lead remained invariable,was shown, with the absorption of cadmium significantly decreased. Comapredwith other known medicines such as activated coal, enterosorbentswork as vegetable cellulose, which has no injuring action, having the property of universal absorption.

This researchestablished that feeding rats lead and cadmium leads to strong destructive actions on their kidneys, but the damagewas reducedafter correction by treating the rats with the enterosorbentIngo2. The enterosorbent reduced dystrophic processes and increased compensatory-adaptive reactions. This research allowed the following conclusions to bedrawn:

1. Experimental introductionof lead and cadmium in rats of the second and third groups caused noticeable deviations from the norm, leading to destructive changes in the internal organsof the rats.The structure of the organs wascharacterisedas necrobioticdue tochanges in dystrophy, necrobiosis of separate hepatocytes, haemorrhage, hypostases and inflammatory processes.
2. Addition of heavy metals to a diet led to destructive changes to the organs of the rats. Use of theenterosorbentIngo2did not show special changes of a destructive character in two of the groups. Insignificant changes in the gisto structure werecompletely reversible and showed acompensatory-adaptive character.
3. It wasestablished that the enterosorbentIngo2hadthe property of universal absorption, had antioxidant properties, increased the organs'resilience to infectionsand adverse ecological factors and played an important role in correcting adverse change in the organs.

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