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# RESEARCH OF MEDICAL AND BIOLOGICAL INDICATORS OF EGGPLANT POWDER

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**Abstract**

The aim of the work is to study the medical and biological properties of eggplant powders.

Eggplant food powder is a raw material, an important characteristic of which is its chemical composition, in particular dietary fibers (pectin and fiber). Eggplant powders obtained by infrared drying of raw materials with subsequent grinding to 0.41/0.43 mm were used for the research.

The low degree of esterification gives the powders increased sorption and detoxification properties for a number of heavy metal cations. It has been established that the ability of eggplant powder to bind heavy metals reaches 40–50 %, a detoxification effect occurs, exogenous and endogenous poisons are adsorbed, and the putrefactive intestinal microflora decreases. It was established

that the binding effect is influenced by the amount of protopectin and the pH of the medium, which is determined by the content of organic acids in eggplant powders. The obtained results confirm the complex-forming ability of the powders.

Adding eggplant powder to the diet of rats reduces cholesterol by an average of 12 %. 10 % content of eggplant powder in the diet reduces the content of lipoproteins in the blood (up to 3.2 %), cholesterol (up to 1.9 %).

Medical and biological studies establish the positive effect of raw materials on the animal body and determine the expediency of using a functional ingredient. In general, eggplant powder can be used as an effective supplement to reduce cholesterol and lipoproteins, which does not affect the main physiological systems of the body.

The prospect of further research is an in-depth study of the chemical composition of raw materials, the development of recipes for dishes using eggplant powders.

**Keywords:** eggplant powder, cholesterol, medical and biological research, complex-forming ability, biological value.

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## 1. Introduction

Saving resources is the main task of a modern manufacturer. The production of food powders allows to use raw materials by maximum, preserve the nutritional value and expand the range of dishes by making products throughout the year. Rapid development of industry, environmental pollution and as a consequence of climate change, irrational use of raw materials lead to a decrease in quality and safe food. As a result, the cost of raw materials and energy resources require a revision of the requirements for quality and safety of products [1, 2]. Also there is a need to develop resource-saving technologies. In view of this, the vast majority of scientific developments are aimed at the development of resource-saving technologies and the search for new types of raw materials, which had little research [3, 4]. Production of food powders from vegetable raw materials, gives the chance to save resources, provides high-grade and rational food, allows to use natural resources rationally and to save essential substances as much as possible. Food plant powders act as:

− source of biologically active substances in dishes [5, 6];

− component of dry seasonings [7];

− the main raw material for semi-finished dry dishes (jelly, soups, etc.) [8].

It is known that powdered raw materials have a number of advantages, the main of which is the ability to rapidly recover in liquids. Hydrated puree has properties that are not inferior to the raw material [9, 10].

However, the most important things for each type of raw material is quality and safety. The vast majority of scientific work is aimed at studying the technology and processes that occur during the drying of raw materials into powders [11, 12]. The emphasis is only on obtaining good organoleptic and chemical parameters.

Much of the works is aimed at studying the physicochemical composition, microbiological contamination and the content of toxic substances [12–14].

All these studies are very important, but there is a need to determine the medical and biological properties. Medical and biological research allows to establish the effect of raw materials on the body, to analyze and establish the feasibility of using a functional ingredient.

## 2. Materials and Methods

The aim of the work is the analysis of complexing properties and the study of the biological value of eggplant powders. To achieve this goal the following tasks were set:

1) research of complexing ability;

2) study of biological value by medical and biological method in rats.

The subjects of this study were selected complexing ability and medical and biological properties of eggplant powders.

Methods for determining the complexing ability. The binding capacity of the powders was determined by a standard method, namely: 50 $cm^3$ of warm (45–50 °C) distilled water was added to a portion of 1 g. of eggplant powder, stirred and left for 10 minutes for hydration. To the resulting mixture was added 1 $cm^3$ of 0.1 M salt solution of the test metal, stirred on a magnetic stirrer,

filtered through a folded filter. The content of ions of the studied toxic metals was determined in the filtrate by the method of calibration graph [5]. The amount of heavy metals sorbed by eggplant powders was determined as the difference between the masses of heavy metals before application and the amount found in the filtrate, respectively (**Fig. 1)**.

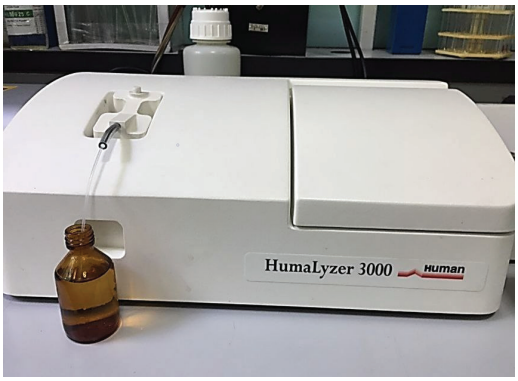


**Fig. 1.** Biochemical analyzer HumaLyzer 3000 (Germany)

The biological value of eggplant food powder was carried out by medical and biological method on young rats that are still growing.

During the experiment, 4 groups of animals were used who received:

1) vivarium diet (control group);

2) vivarium diet with eggplant powder;

3) vivarium diet with boiled eggplant;

4) vivarium diet and products with the addition of eggplant powder.

The duration of the experiment was 28 days. The diet was balanced in minerals and vitamins, caloric content was 440 kcal/100 g of diet. Throughout the period of the experiment, the general condition of the animals was observed, recording their mobility, changes in wool cover, feed consumption, and body weight dynamics. Each group consisted of 10 individuals.

## 3. Results and discussion

### 3. 1. Research of complexing ability

Eggplant food powder is a non-traditional raw material, an important characteristic of which is its chemical composition and safety. According to the principles of functional nutrition in the daily diet should be products with a high content of undigested carbohydrates, which are able to form in the digestive system insoluble complexes (pectinates and pectates), which are not absorbed and excreted from the body. That is, the low degree of esterification gives the powders increased sorption and detoxification properties in relation to a number of heavy metal cations.

Dietary fiber of eggplant is represented by pectin and fiber. Pectins are methyl esters of polygalacturonic acids. Protopectins are water-insoluble pectin complexes with cellulose and hemicellulose. During the drying of eggplants at a temperature not exceeding 60 ºC, there is a partial conversion of protopectin into pectin. Pectic substances have a pronounced biological effect. Under their influence there is a detoxifying effect, exogenous and endogenous poisons are adsorbed, putrefactive intestinal microflora decreases. One of the important properties of pectin substances is their complexing property, which is based on the interaction of the pectin molecule with heavy metal ions.

For the study used eggplant powders obtained by infrared drying of raw materials followed by grinding in a laboratory mill, followed by sieving it through sieves with holes of 0.41/0.43 mm.

Experiments have shown that the ability to bind heavy metals with eggplant powder reaches 40–50 %. It was found that the binding effect is influenced by the amount of protopectin and the pH of the medium, which is due to the content of organic acids in eggplant powders (given in **Table 1**). Pure apple pectin was used for control.

**Table 1**

Binding of heavy metal ions with eggplant powder (% of the amount of metals introduced)

| Metal | pH-binding | Apple pectin | Eggplant powder |
|---|---|---|---|
| Lead | 3.5–5.6 | 60 | 50 |
| Copper | 4.0–6.0 | 55 | 35 |
| Zinc | 3.5–6.0 | 67 | 39 |
| Nickel | 4.0–6.5 | 60 | 50 |
| Zirconium | 2.0–3.5 | 53 | 44 |

From the data of **Table 1** it is seen that the complexing ability of powders of eggplant is quite high. This is due to the content of pectins and fiber in the powders. Pectins with heavy metal ions form an insoluble complex, which is excreted from the human body.

The obtained results confirm the high complexing ability of powders. In view of this, it is advisable to use powders in the production of preventive and radioprotective products.

### 3. 2. Research of biological value

Throughout the experiment, the general condition of the animals, behavior, growth and weight were carefully checked. According to the results of the study, the subjects were lively, had a smooth coat, ate food well. However, the amount of food consumed was different due to different appetites and different biological value of rations. Due to this, the rate of weight gain in rats was different. The maximum values were in the fourth group, which used pate (5, 6) with the addition of eggplant powder (47.8±2.8 g), and the lowest at the end of the experiment in animals of the first (control) group – 44.0±2.7 g. It is possible to assume that the increase in body weight was due to the anabolic efficiency of the protein, as evidenced by the lack of adrenal fat in animals.

The established coefficient of protein efficiency in the studied groups of animals was 2.5; 2.6; 2.68; 2.85, respectively (given in **Table 2**).

The biological value of the protein component of the products under the influence of fiber and pectin in the studied rats was slightly reduced: digestion of protein products decreased by 1–1.8 %, the real biological value – by 3–4 %.

The next stage of the study was to determine the biochemical parameters of blood and internal organs of experimental animals.

Analysis of blood composition suggests that cholesterol (19.9 %) and glucose (12.1 %) decreased significantly (given in **Table 3**). Hemoglobin in animals of the fourth group was higher than control by 7.6 %.

**Table 2**

Growth and weight of experimental rats

| Indicators | Group of animals | | | |
|---|---|---|---|---|
| | Control (1 group) | (Group 2) Experiment | Experiment (Group 3) | Experiment (4 groups) |
| Mass of the consumed forage, g | 291.4±50 | 297.1±6.4 | 298.8±4,0 | 304±6.2 |
| Mass of protein consumed, g | 27±0.6 | 28.6±0.3 | 28.8±0.4 | 29.6±0.3 |
| Weight gain, g | 44.0±2.7 | 45.1±2.9 | 46.0±3.0 | 47.8±2.8 |
| Protein efficiency factor | 2.5 | 2.6 | 2.68 | 2.85 |

**Table 3**

Biochemical parameters of the blood of white rats

| Indicators | Control (1 group) | Experiment (Group 2) | Experiment (Group 3) | Experiment (4 groups) |
|---|---|---|---|---|
| Hemoglobin, % | 13.1±0.3 | 14.0±0.1 | 13.9±0.2 | 14.1±0.1 |
| Total protein, % | 6.6±0.2 | 6.7±0.3 | 6.6±0.4 | 6.4±0.2 |
| Albumin, % | 3.5±0.3 | 3.7±0.3 | 3.6±0.2 | 3.8±0.2 |
| Globulin, % | 2.9±0.2 | 3.3±0.2 | 3.1±0.3 | 3.5±0.3 |
| Cholesterol, % | 104.8±6.8 | 95.7±3.2 | 94.5±4.7 | 83.9±8.2 |
| Glucose, % | 110.7±5.4 | 99.2±6.0 | 98.3±7.9 | 97.3±6.3 |

These data show the results of biochemical parameters indicate a positive effect on the body as a whole as eggplant powders and products using them.

The influence of powders and products with their addition on metabolic processes in the body of the studied animals has been experimentally studied. Powders are characterized by the content of fiber, which affects the state of motor function of the digestive system, and the course of lipid metabolism. It was found that the addition to the diet of eggplant powder reduces cholesterol in rats by an average of 12 %. The experimental group, which received in the diet up to 10 % of eggplant powders, had, compared with the control group, reduced blood lipoproteins (up to 3.2 %), and reduced cholesterol (up to 1.9 %).

Morphological examinations of the organs revealed a decrease in degenerative changes in the heart muscle, a decrease in cholesterol in the aorta, coronary vessels of the heart.

## 4. Conclusions

The introduction of eggplant powder in the diet of laboratory animals does not lead to any statistically significant changes in morphometry, metabolism and general functional status compared with the control group. It was found that the weight gain of the experimental groups increased more significantly compared to intact animals of the control group. It was studied that in the blood of animals of the control group the level of cholesterol is higher than in the experimental groups.

On the basis of the conducted researches it is possible to draw a conclusion that introduction into structure of vivarny rations of eggplant powder did not cause at experimental animals of negative functional changes which would be caused by action of this food additive. Given the above, eggplant powder is safe and can be used for its intended purpose as an effective supplement that helps reduce cholesterol and lipoprotein levels and does not affect the basic physiological systems of the body.

## Conflict of Interest

The authors declare that there is no conflict of interest in relation to this paper, as well as the published research results, including the financial aspects of conducting the research, obtaining and using its results, as well as any non-financial personal relationships.

**References**

[1] Burgain, J., Petit, J., Scher, J., Rasch, R., Bhandari, B., Gaiani, C. (2017). Surface chemistry and microscopy of food powders. Progress in Surface Science, 92 (4), 409–429. doi: https://doi.org/10.1016/j.progsurf.2017.07.002

[2] Dag, D., Singh, R. K., Kong, F. (2020). Developments in Radio Frequency Pasteurization of Food Powders. Food Reviews International, 38 (6), 1197–1214. doi: https://doi.org/10.1080/87559129.2020.1775641

[3] Dzyundzya, O., Burak, V., Averchev, A., Novikova, N., Ryapolova, I., Antonenko, A. et. al. (2018). Obtaining the powder-like raw materials with the further research into properties of eggplant powders. Eastern-European Journal of Enterprise Technologies, 5 (11 (95)), 14–20. doi: https://doi.org/10.15587/1729-4061.2018.143407

[4] Fitzpatrick, J. J., van Lauwe, A., Coursol, M., O'Brien, A., Fitzpatrick, K. L., Ji, J., Miao, S. (2016). Investigation of the rehydration behaviour of food powders by comparing the behaviour of twelve powders with different properties. Powder Technology, 297, 340–348. doi: https://doi.org/10.1016/j.powtec.2016.04.036

[5] Kostenko, E. E., Butenko, E. N., Bondarenko, M. A. (2020). Investigation into complexation of Pb(II), Hg(II) and Cd(II) with ethyl maltol by complexometric indicator method. Voprosy Khimii i Khimicheskoi Tekhnologii, 5, 30–35. doi: https://doi.org/10.32434/0321-4095-2020-132-5-30-35

[6] Kublìnskaya, I. A., Kravchenko, M. F., Lesiyshina, J. O. (2018). Vitamin activity of Flammulina velutipes powder. Young Scientist, 7, 173–177. Available at: http://molodyvcheny.in.ua/files/journal/2018/7/38.pdf

[7] Mitchell, W. R., Forny, L., Althaus, T., Dopfer, D., Niederreiter, G., Palzer, S. (2017). Compaction of food powders: The influence of material properties and process parameters on product structure, strength, and dissolution. Chemical Engineering Science, 167, 29–41. doi: https://doi.org/10.1016/j.ces.2017.03.056

[8] Martins, A. N. A., Pasquali, M. A. de B., Schnorr, C. E., Martins, J. J. A., de Araújo, G. T., Rocha, A. P. T. (2019). Development and characterization of blends formulated with banana peel and banana pulp for the production of blends powders rich in antioxidant properties. Journal of Food Science and Technology, 56 (12), 5289–5297. doi: https://doi.org/10.1007/s13197-019-03999-w

[9] Pogozhikh, M., Pavliuk, I., Borysova, A., Dyakov, A., Zatula, A. (2016). Usage of microscopic method to analyze dispersion of food powders. Prohresyvni tekhnika ta tekhnolohiyi kharchovykh vyrobnytstv restorannoho hospodarstva i torhivli, 2 (24), 352–360. Available at: http://elib.hduht.edu.ua/handle/123456789/1190

[10] Petrova, Zh., Snezhkin, Yu. (2018). Complexing Properties of Functional Powders. Yaderna ta radiatsiyna bezpeka, 2 (78), 59–64. doi: https://doi.org/10.32918/nrs.2018.2(78).10

[11] Rifna, E. J., Singh, S. K., Chakraborty, S., Dwivedi, M. (2019). Effect of thermal and non-thermal techniques for microbial safety in food powder: Recent advances. Food Research International, 126, 108654. doi: https://doi.org/10.1016/j.foodres.2019.108654

[12] Son, Y.-J., Lee, J.-C., Hwang, I.-K., Nho, C. W., Kim, S.-H. (2019). Physicochemical properties of mealworm (Tenebrio molitor) powders manufactured by different industrial processes. LWT, 116, 108514. doi: https://doi.org/10.1016/j.lwt.2019.108514

[13] Snegkin, Y., Petrova, Z., Pazyuk, V., Dub, V. (2016). Creating new thermotehnologi obtaining quality folate containing functional powders. Prohresyvni tekhnika ta tekhnolohiyi kharchovykh vyrobnytstv restorannoho hospodarstva i torhivli, 1 (23), 80–89. Available at: https://repo.btu.kharkov.ua//handle/123456789/1101

[14] Vos, B., Crowley, S. V., O'Sullivan, J., Evans-Hurson, R., McSweeney, S., Krüse, J. et. al. (2016). New insights into the mechanism of rehydration of milk protein concentrate powders determined by Broadband Acoustic Resonance Dissolution Spectroscopy (BARDS). Food Hydrocolloids, 61, 933–945. doi: https://doi.org/10.1016/j.foodhyd.2016.04.031

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