REPORT

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# Nutritional and biological value of natural-bio shoots mung bean "Mungoltin". Food and biological values

Javokhir B. Khayitov*, Guli I. Shaikhova, Dilshod D. Achilov, Munira J. Allaeva

Tashkent Medical Academy, 100109, Uzbekistan, Tashkent, Farabi 2

*Corresponding author:
javohirhayitov@mail.ru

## Abastract

Based on the results of our own research, examination of scientific dossier materials and reference literature data, it was established that dry powder Mungoltin made from the shoots of mung beans produced by Oriona-Scorpion LLC (Uzbekistan) contains a sufficient amount of protein, minerals, vitamins and dietary fiber, does not have a negative impact on the health status of experimental animals and does not result in functional and material cumulation. Acute systemic toxicity testing with intragastric administration of Mungoltin was carried out in 18 adult white male rats. Animals were divided into 4 groups. The animals of the first group received a nutrition dose of 5000 mg/kg; the white rats of the second group were administered with a dose of 7500 mg/kg, and the rodents in the third group were given a dose of 10000 mg/kg, respectively. The animals in group 4 (the reference group) received distilled water.

Upon a prolonged intragastric exposure to Mungoltin, no changes in biochemical parameters were detected. The activity indicators of alkaline phosphatase, trans-aminase enzymes and total protein in the blood serum did not differ significantly from those found in the reference group. Therefore, using Mungoltin will not cause a cytotoxic effect in relation to normal highly proliferating cells in an organism.

The results of histomorphological studies of tissues of internal organs upon intragastric administration of Mungoltin within 30 days confirm the absence of toxic effects. According to toxicity parameters under the conditions of the above acute experiments, Mungoltin can be attributed to class 5 practically as a non-toxic substance.

## Keywords

Natural-bio-shoots mung bean Mungoltin; Cereal rice, Nutritional and biological value, Comparative assessment, Toxicology

## Imprint

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The problems of maintaining and strengthening human health, increasing human life expectancy have always been found and remain on the agenda among the most important and pressing issues in medicine and biology. Currently, the factor of healthy nutrition is recognized as one of the key components in the context of the WHO general strategy, according to which 60% of the causes of mortality are directly related to nutrition problems [13–17]. In addition, it is shown that 80% of adverse environmental factors affect the human body through food and water. It is the nutrients that are transformed during the digestion process into structural and energy substrates, provide for the physical and mental performance and finally determine the duration and quality of life. At the same time, significant changes in the lifestyle of people in recent decades have caused changes in the specific features of diseases, the predominance of growth in nutritional-dependent, i.e. food related diseases. Nutrition is a powerful lever for the implementation of the demographic policy of every state, the purpose of which is to maintain the health of the nation [3, 4, 18].

The basis of all life on the Earth is protein. Various forms of proteins take part in all processes occurring in living organisms. In the human body, proteins are responsible for constructing muscles, ligaments, tendons, all organs and glands, hair, nails; proteins are an integral part of all biological fluids and bones. Enzymes and hormones which catalyze and regulate all processes in the body are also proteins [5]. Lack of protein in a diet entails a delay in the overall development of children, their intelligence, and a decrease in immunity. A person with a weakened immune system does not resist infectious diseases, reduces the quality of life and, as a result, it shortens the life span [19].

One of the real possibilities of filling the deficiency of protein, minerals and vitamins is the use of nutritional food Mungoltin made from natural shoots of

mung beans, produced by ORION-SCORPIO LLC. In the Republic of Uzbekistan; unfortunately, the Mungoltin powder made from the sprouts of the sprouted mung beans cannot be found in food industries, despite the high protein content therein and its excellent functional characteristics [17].

Mung beans are an excellent source of protein and high energy. The Mungoltin powder from sprinkled mung beans comes directly from the nutrient-rich mung bean sprouts, containing a large amount of vitamins, minerals, antioxidants and enzymes. It is known that the mung beans are considered to be a valuable source of vitamin A, E, as well as many rare B vitamins. It is also a low glycemic product. During the first few days of germination, the sprout is saturated with potential energy: it is the source of life necessary for the seed growth. The sprout grows and ripens, and concentrated energy increases. The mung beans germinate over a short period of time up to 3.8 cm and can be harvested at the proper time, when they reach the maximum level of their nutritional value. At this point, in the sprout mung bean vitamins and minerals, as well as important phyto-chemical elements, are of the highest efficacy. After young shoots reach this optimal level of their biological development, they are harvested and dried at low temperatures for 8 hours. Drying at low temperatures is extremely important: living enzymes in the sprouts remain alive. At the end of the drying process, the sprouts are carefully crushed into a fine powder. The applicable specifications TU-6425280147-01: 2015 approved by the Ministry of Health of the Republic of Uzbekistan and an applicable international standard have been developed and introduced for this product [17].

As we have already noted, in most papers it is shown that Mungoltin made from the bio-shoots of mung beans is a unique source of high-quality protein. Its average content therein is 12%. The biological value of Mungoltin made from the natural bio-shoots of mung beans is twice as high as that of other plant proteins, and approaches that of the animal-type proteins.

Rice groats have been used by humans for a long time, and it remains a must in every kitchen. Rice groats of white color with a yellowish tint contain about a third of gluten. Nutritional and energetic value of bio-shoots of mung beans and rice groats differs. Therefore, their separate study [9] is reasonable.

**The aim of this work** is to study the nutritional and biological value of Mungoltin made from natural bio-shoots of mung beans in order to find the most rational ways to use them in human nutrition.

**Materials and research methods.** The materials for the study cover natural product Mungoltin made from bio-shoots of mung beans as compared with rice groats.

Our studies used the following testing methods: organoleptic, physic-chemical, microbiological testing. In the study of the natural Mungoltin made from bio-shoots of mung beans, we have applied the reference data on the chemical composition of rice groats widely used by the population.

Our studies were conducted at the Department of Hygiene of Children, Adolescents and Food Hygiene at the Tashkent Medical Academy (TMA), Inter-University Research Laboratory (IRL) at TMA and the Test Center of the Institute of Plant Substances named after Academician S.A. Yunusova of the Republic of Uzbekistan.

With the physical characteristics of the studied samples, Mungoltin produced from bio-shoots of mung beans and rice groats, the following indicators were studied:

– humidity, acidity, gluten (15113.4-91, 15113.5-91, 202239-91).

The chemical characteristics of the samples were determined by the following indicators:

– crude protein - by the Kjeldahl method (interstate standard 0846-91);
– total lipids - by the Rushkovsky method (interstate standard 0846-91) with the Soxhlet equipment;
– ash - after burning in a muffle furnace (according to the procedure by A.P. Ermakov, 1972);

Our experimental studies of possible toxic properties consisted of the following stages: the study of the general toxic effect produced Mungoltin made from bio-shoots of mung beans with an assessment of the possible irritating effect on the mucous membranes, as well as a possible cumulative effect thereof; the study of possible allergenic activity and effects made on the central nervous system (CNS) [5, 6, 7].

For the experiment, aqueous solutions (50%) in volumes of 0.3–5 ml per animal were prepared from samples of the natural bio-shoots of mung beans.

The rodents received the same dose in mg per kg of body weight as the object of study within the hours of their observation (16-20 hours). The animals were fed 3 hours after taking the dose. The diet was balanced in protein, fat and carbohydrate, scheduled for laboratory animals.

The effect by Mungoltin from bio-shoots of mung beans and that by rice cereal produced on the central nervous system was evaluated by motor activity, with testing "the number of crossed squares" and assessing the "mink" reflex.

Acute experiments for assessing toxicology with intragastric administration of Mungoltin were carried out in 18 adult white male rats. The animals were divided into 4 groups. The animals of the first group received a dose of 5000 mg/kg; the white rats of the second group were fed with a dose of 7500 mg/kg, and the rodents of the third group were given a dose of 10000 mg/kg. The animals of group 4 (the reference group) received distilled water.

The white rats received 5000, 7500 and 10000 mg/kg per body weight. The animals were fed 3 hours after dosing. The diet was balanced in protein, fat and carbohydrate content, according to a special diet for laboratory animals.

Under the experimental conditions, the acute toxicity of the studied bio-shoots was assessed in 24 white outbred rats with a single intragastric administration of each form of the substance at doses of 5000, 7500 and 10000 mg/kg, respectively. The introduction of the mung bean shoots at higher doses was technically impossible due to the physiologically limited amount of the substance administration into the stomach of the rats.

The maximum tested dose of the substance in experimental animals was 13 times higher than the recommended technological dose, and the reference animals received an equivalent amount of distilled water.

The effect of mung-bean-seedlings-based product Mungoltin on the mucous membranes of the eyes was tested in 2 rabbits. A single inoculation of 0.05 ml of an aqueous suspension of the powder into the conjunctival sac of the left eye of the rabbits was carried out, the right eye served as the reference.

The ability to cumulate the food additive was studied by the Lim subchronic toxicity method under the conditions of multiple intragastric administration to white rats. The experiments were conducted in white rats weighing 158.8 g. Mungoltin was given intragastrically daily for 30 days at an initial dose of 100 mg per kg, followed by an increase of 1.5 times every 5 days. The selected dose approximately corresponds to the average consumption of the mixture in one serving of powder. The reference animals were injected with distilled water in an equivalent volume. In the course of the studies, such indicators of the functional state of animals as survival, general condition, animal activity, dynamics of body weight, morphological composition of peripheral blood and biochemical blood parameters were monitored. [8]

The allergenic effect of the test powder was evaluated by a single intradermal injection of 0.02 ml of solutions of each pharmacological form diluted with physiological saline solution with a concentration of 50% using a tuberculin syringe into the outer surface of the guinea pig ear (6 experimental guinea pigs in the group and 6 in the reference one). The animals were injected with 0.02 ml of the physiological saline for comparison. Sensitization was assessed 12–14 days after the injection of the solution.

All survived animals were decapitated at the end of the study and properly disposed after pathomorphological studies. No organ or tissue has been used for other purposes.

All data obtained during the study was subjected to statistical processing with a Pentium-IV personal computer using the Microsoft OfficeExcel-2003 software package, including the use of built-in statistical processing functions. We used methods of variational parametric and nonparametric statistics, with the calculation of the arithmetic mean of the studied indicator (M), standard deviation (G), standard error of the mean (m), relative values (frequency,%). The statistical significance of the measurements, when comparing the average values, was determined by the Student criterion (t), with the calculation of the probability of error (P) when checking the normality of the distribution (by the excess criterion) and the equality of the general variances (F – Fisher's test). For statistically significant changes, the confidence level was taken to be $P < 0.05$ [2].

## Research results and discussion

We have studied the comparative assessment of the nutritional and biological value of rice cereals and natural bio-shoots of mung beans. Natural bio-shoots of mung beans are intended for the food purposes and are obtained, as indicated above, by grinding mung beans.

To conduct our research, we selected a batch of Mungoltin made from bio-shoots of mung beans and rice cereals, organoleptic, and physical & chemical tests were carried out. A comparison was made with rice cereal.

Organoleptic indicators and such significant physico-chemical parameters as moisture, fat, protein, fiber, acidity, ash, amount and quality of gluten, whiteness, grinding size, drop number, infection, contamination and content of metallomagnetic impurities were determined.

The results obtained by testing of organoleptic and physical & chemical characteristics are listed in Tables 1 and 2 herein.

Table 1

Organoleptic indicators of the quality of flour

| The name of indicators | Tested types of flour | |
|---|---|---|
| | Mungoltin made from bio-shoots of mung beans | Rice groats |
| Color | Beige colour | Creamy white |
| Smell | Bean characteristic, odor-free | Peculiar to rice cereal, without extraneous odors, not musty, not moldy |
| Taste | Inherent, without specific bean smack, bitterness, sour and other extraneous smacks | Peculiar to rice cereal, without extraneous flavors, not sour, not bitter |
| Mineral impurities | When masticating, the bio shoots of mung beans Mungoltin, moistened with water, no crunch detected | When chewing rice flour moistened with water, there was no crunch |

Table 2

Physical & chemical quality indicators of flour grades

| The name of indicators | Grade of flour | |
|---|---|---|
| | Bio-shoots of mung beans Mungoltin | Rice groats |
| Moisture content, % | 6,4±0,51 | 9,8±1,02 |
| Fat, %, per dry substance | 8,0±0,91 | 1,57±0,3 |
| Dry Ash Content | 3,43±0,35 | 0,66±0,08 |
| Crude fiber, in %, referred to dry matter | 8,2±0,84 | 0,29±0,03 |
| Crude protein, % dry matter | 12,0±2,03 | 6,92±0,72 |
| Fineness of grinding, %:<br>the residue on a sieve of silk fabric according to interstate standard 4403;<br>passage through a sieve from silk fabric in accordance with interstate standard 4403 | <br>2±0,21 (No. 25)<br><br>70±5,44 (No.35) | <br>3±0,29 (No. 43)<br><br>– |
| Acidity, °H | 20,0±2,35 | 2,5±0,19 |
| Metallomagnetic impurity, mg in 1 kg | Traces | Traces |
| Pest infestation | Not detected | |
| Pest pollution | Not detected | |

The organoleptic characteristics of Mungoltin made from bio-shoots of mung beans are slightly different from those in rice groats, but we have not revealed any negative properties in Mungoltin made from bio-shoots of mung beans.

According to the studied physical and chemical parameters, the above product shows more favorable properties. The powder has a finer grinding, shows a higher ash content, contains more crude fiber and crude protein than rice groats, and it does not demonstrate a greater acidity than rice groats.

As can be seen from the data in Table 3, an analysis of changes in the rats' body mass shows that throughout the experiment, animals of both groups added weight and the degree of increase in body weight in the experimental: the animals do not differ from the reference. That is, the dynamics of the body weight of animals treated with wheat shoot powder during the entire experiment has no differences with the reference. It is found that the relative mass of the internal organs of the animals of the experimental group differs little from that of the intact group of animals (Table 3 herein).

Table 3

Indicators of the mass of the internal organs of animals treated with Mungoltin under experimental conditions

| Rat groups | Liver | Kidneys | Spleen | Heart | Adrenal glands | Lungs |
|---|---|---|---|---|---|---|
| Reference | 5,79 ± 0,5 | 1,35 ± 0,5 | 0,65 ± 0.1 | 0,70 ± 0,01 | 0,017 ± 0,001 | 1,3 ± 0,1 |
| Mungoltin | 5,71 ± 0,4 | 1,20 ± 0.6 | 0,59 ± 0,1 | 0,72 ± 0,1 | 0.01 ± 0,001 | 1,25 ± 0,05 |

**The study of the cytotoxic activity of Mungoltin.** For this purpose, samples of rat red bone marrow cells were cultivated.

The obtained rat bone marrow cell samples were divided into 5 groups:

- group 1 to estimate an effect produced by Mungoltin at a dose of 50 mg/10•$10^6$ cells for 60 minutes;
- group II to assess an effect made by Mungoltin at a dose of 25 mg/10•$10^6$ cells for 60 minutes;
- group III to estimate an effect produced by Mungoltin at a dose of 10 mg/10•$10^6$ cells for 60 minutes;
- group IV to assess an effect made by Mungoltin at a dose of 5 mg/10•$10^6$ cells for 60 minutes;
- group V to represent cells without Mungoltin exposure (the reference sample).

The results of assessing the effects made by Mungoltin on the viability of rat red bone marrow cells are presented in Table 4 herein.

Table 4

Cytotoxic activity of Mungoltin against rat red bone marrow cells in vitro

| No. | Group | Rat Red Bone Marrow Cells | | | | |
|---|---|---|---|---|---|---|
| | | Number of examined cells $10^7$ ml | dead | | living | |
| | | | abs | % | abs | % |
| 1 | Mungoltin dose, 50 mg/10•$10^6$ cells | 1,6 | 5,1x105 | 31,0 | 1,1x106 | 69,0 |
| 2 | Mungoltin dose, 25 mg/10•$10^6$ cells | 5,0 | 1,4x106 | 28,0 | 3,6x106 | 72,0 |
| 3 | Mungoltin dose, 10 mg/10•$10^6$ cells | 9,4 | 6,0x106 | 63,9 | 3,4x106 | 36,1 |
| 4 | Mungoltin dose, 5 mg/10•$10^6$ cells | 0,98 | 2,6x105 | 26,0 | 7,2x105 | 74,0 |
| 5 | Reference | 1,1 | 2,6x105 | 23,6 | 8,4x105 | 76,4 |

Our studies have shown that Mungoltin at doses of 50 mg/10•$10^6$, 25 mg/10•$10^6$, 10 mg/10•$10^6$ and 5 mg/10•$10^6$ does not significantly affect the viability of rat red bone marrow cells in vitro. Mungoltin at its highest dose of 50 mg/10•$10^6$ cells, prepared as semi-finished ice-cream-type product has led to death of 31.0 % of the lymphoid cells, while the similar indicator in the reference group has been recorded to reach 23.6 %, i.e. the resulting difference in the number of dead cells when using the Mungoltin food supplement compared with the reference has been found to be within the statistical error.

Our macroscopic examinations of the internal organs in the rats have shown no change therein. The animals are neat in appearance, the coat is shiny, and there are no alopecia signs. The visible mucous membranes are pale pink, shiny, smooth. The mammary glands in the female rats show no abnormalities on palpation. The genitals in the male rats are found to be properly developed. The tails are noted to be somewhat brownish in color. The alveolar and bronchial system in the lungs has the normal regular structure. Plethora has been estimated as moderate. The blood vessels of the lungs have been found to be moderately full-blooded. The alveoles are filled with air. Edema or inflammation of the lung tissue has not been revealed. The size of the heart is within its normal limits. There is a small amount of blood found in the chambers of the heart. The cardiac muscle is dense and brown in color. The stomach and the small intestine are found to be without any pronounced changes. The stomach is filled with a small amount of solid food. The mucous membrane is shiny, folded and somewhat pink in color. The mucosa of the small intestine is shiny, smooth and pink in color. The size and the shape of the liver show no differences from the reference. The surface of the liver is smooth. The capsule of the liver is thin and transparent. The lobular structure of the liver is preserved. The kidneys are of their normal size and shape, brown in color, dense, with a distinct cortical and medullary substance in the cross-section.

Thus, pathomorphological studies confirm the harmlessness of dry powder Mungoltin from the shoots of mung beans.

## Conclusion

The results of our studies allow us to discuss a number of important medical and hygienic aspects related to the study of the nutritional value of dry powder Mungoltin made from the shoots of mung beans and rice grits. Consequently, as a result of the assessment of the organoleptic, physical & chemical and nutritional value, it can be concluded that Mungoltin in the form of the powder made from the shoots of mung beans, containing ample proteins, lipids, minerals, vitamins and dietary fiber, represents a valuable complex of unique essential nutritional factors. Mungoltin made from shoots of mung beans is a natural food product. Mungoltin prepared as a drink enhances the performance of the immune system, improves metabolism, and also increases the nutritional and biological value of the product as a nutritional supplement. Thus, the comparative analysis of the results of the study of dry powder Mungoltin made from the shoots of mung beans as against rice groats reveals significant differences therein.

Based on the results of our own research, our review of scientific data and the relevant reference literature, it has been found that dry powder Mungoltin made from the shoots of mung beans, produced by ORIONA-SCORPION LLC (Uzbekistan), does not adversely affect the health of experimental animals and does not result in functional or material cumulation. According to the tested toxicity parameters under the conditions of acute experiments, Mungoltin can be attributed to class 5, and it can be considered practically as a non-toxic substance.

With prolonged intragastric administration of Mungoltin no changes in the tested biochemical pa-

rameters have been detected. The activity indicators of alkaline phosphatase, trans-aminase enzymes and total protein in the blood serum have shown no significant differences from the reference values.

The results of studying of possible cytotoxic effect in vitro show that Mungoltin at its doses of 50 mg/10•$10^6$, 25 mg/10•$10^6$, 10 mg/10•$10^6$ and 5 mg/10•$10^6$ does not significantly affect the viability of red cells rat bone marrow in vitro.

Therefore, the use of Mungoltin is free of any cytotoxic effects in relation to normal highly proliferating body cells.

The results of our histomorphological studies of tissues of the internal organs with intragastric administration of Mungoltin within 30 days confirm the absence of toxic effects.

Thus, the conducted toxicological studies allow us to draw a conclusion about the biomedical safety of dry powder Mungoltin made from the shoots of mung beans, produced by ORIONA-SCORPION LLC.

## Recommendations

Using of Mungoltin made from mung bean bioshoots as a product for the population and as an organic, natural, energy- and protein-containing drink improves the performance of the digestive system, removes toxins and harmful substances from the body and strengthens the immune system.

## Statement on ethical issues

Research involving people and/or animals is in full compliance with current national and international ethical standards.

## Conflict of interest

None declared.

## Author contributions

The authors read the ICMJE criteria for authorship and approved the final manuscript.

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