RESEARCH OF THE PHYTOESTROGENS CONTENT IN SOYBEAN AND CHICKPEA FLOUR

1. Introduction

Currently, scientists around the world are actively discussing, possibly, the toxic effects of soybean and chickpeas in post-puberty and pregnancy due to the content of phytoestrogens in their composition. At the same time, they are necessary for people of reproductive age and during menopause [1]. Phytoestrogens are a group of non-steroidal, plant-derived substances which molecular weight is similar to the molecular structure of estrogen. They belong to the class of flavonoids contained in plant products, and soybean and chickpeas are leaders in its content [2]. Phytoestrogens are in the composition of chickpea and soybean in significant quantities, from 18 to 562 mg/100 g [3]. During the study of the structure and biological effect of phytoestrogen, two main groups of active substances are isolated – isoflavonoids and lignans [4]. Isoflavonoids are divided into daidzein, daidzin, formononetin, genistein, biochanin. The greatest attention of scientists studying the effect of soybean and chickpea on endocrine states is devoted to the study of isoflavonoids [5]. The relevance of the studies is associated with the ambiguous attitude of many scientists about the dangers and benefits of leguminous phytoestrogens/isoflavonoids [6]. The products of the processing of leguminous grains, such as germinated grain and flour from it, have not been studied at all. Let’s consider it relevant to conduct this research complex, where the object of research is the Krasnokutsky 195 chickpea variety, the Almaz soybean variety, and the 2018 harvest from the Agrotek collection nursery (Kyiv, Ukraine). The aim of research is studying the content of phytoestrogens and isoflavonoids in grains and flour of soybean and chickpea.

2. Methods of research

The study of the total content of phytoestrogens in native grain and soybean and chickpea flour is determined by the method of differential spectrophotometry [7]. The dependence of the change in isoflavonoids of soybean and chickpea flour, made by different technologies, is carried out by spectrophotometry using a Lambda 35 UV/VIS spectrophotometer (USA). The method used is based on the complexation reaction of isoflavonoids, which results in a shift of the absorption band, according to the peak of which it is possible to classify the content (presence) of the investigated isoflavonoids.

3. Research results and discussion

The study of the total content of phytoestrogens in native grain and flour of soybean and chickpea obtained by different technologies is shown in Table 1.
It is established that native soybean and chickpea grains are carriers of 36.8 and 22.3 % phytoestrogens. During germination, drying and grinding of legumes, the content of phytoestrogens decreases to 15.6 % in soybean flour and 13.3 % in chickpea flour. It is established that the use of KI as a medium for germinating soybean grains and NaHSeO$_3$ as a medium for germinating chickpea grains reduces the content of phytoestrogens by 2.7 and 1.6 %, respectively.

The dependence of the change in the isoflavonoids of legumes made using different technologies is shown in Fig. 1.

It is established that all the experimental samples have an absorption peak at $\lambda = 400$ nm, which corresponds to the content of daidzin isoflavonoids in them. Samples of flour from germinated soybean and chickpea grains in solutions of mineral salts have an absorption peak at $\lambda = 225$ nm, which corresponds to the content of isoflavonoids in daidzein. It is established that the germination of legumes in solutions of mineral salts does not affect the content of biochanin and formononetin. In samples with chickpea flour sprouted in a NaHSeO$_3$ solution, an increase in genistein content by 60 % relative to the control is observed.

The research results will be useful for merchandisers and technologists of the food industry, working on the development of culinary dishes and diets for people with special dietary nutrition.

### 4. Conclusions

It is found that native soybean and chickpea grains are carriers of 36.8 and 22.3 % phytoestrogens. During germination, drying and grinding of legumes, the content of phytoestrogens decreases to 15.6 % in soybean flour and 13.3 % in chickpea flour. The use of KI as a medium for germinating soybean grains, and NaHSeO$_3$ as a medium for germinating chickpea grains, reduces the content of phytoestrogens by 2.7 and 1.6 %, respectively.

When determining the content of isoflavonoids, it is found that all the experimental samples have an absorption peak at $\lambda = 400$ nm, which corresponds to the content of isoflavonoids in daidzin. Samples of flour from germinated soybean and chickpea grains in solutions of mineral salts have an absorption peak at $\lambda = 225$ nm, which corresponds to the content of isoflavonoids in daidzein. It is established that the germination of legumes in solutions of mineral salts does not affect the content of biochanin and formononetin. In samples with chickpea flour sprouted in a NaHSeO$_3$ solution, an increase in genistein content by 60 % relative to the control is observed.

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### Table 1

| No. | Sample                  | The total content of phytoestrogens, % |
|-----|-------------------------|----------------------------------------|
| 1   | Native soybean grain    | 36.8 ± 0.5                             |
| 2   | Native chickpea grain   | 22.3 ± 0.4                             |
| 3   | Control, soybean flour from grains germinated in an aqueous solution | 15.6 ± 0.5                             |
| 4   | Experience, soybean flour from grains germinated in a KI solution | 13.3 ± 0.5                             |
| 5   | Control, chickpea flour from grains germinated in an aqueous solution | 12.9 ± 0.5                             |
| 6   | Experience, chickpea flour from grains germinated in a NaHSeO$_3$ solution | 11.3 ± 0.5                             |
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