

RESEARCH OF INFLUENCE OF BIOLOGICAL ACTIVATION ON THE VITAMIN COMPLEX OF GRAIN CEREAL CULTURES

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We offered to hydrothermal treatment processing grain of cereal cultures - wheat, bare grain oats, triticale, which promotes increase in its nutritional value, in particular increase in amount of vitamins, by biological activation. . In the course of the offered grain preparation contents of anti-mineral substance of phytin significantly decrease, the content of vitamins of antioxidants, of vitamins of group B, of inositol considerably grows.

Keywords: *biological activation, germinated grain, vitamins, wheat, bare grain oats, triticale.*

1.Introduction.

Sprouting grains, as a method for biological activation, used to increase the nutritional value of grain and other of raw materials.

Germinated grain of wheat that contains plant protein, it is recommend to include in a diet for the purpose of the general strengthening of an organism and, in particular, enhance or restore of sexual activity [1], reduction to risk of emergence and development of oncological diseases [2], enrichment of an organism of children of biologically active substances [3]. The consumption of sprouted grains improves reproductive function [4]. Important question is the research of influence of reasonable parameters of germination process on change of content of a vitamin complex of the main grain crops - wheat, oats, triticale.

2. Analysis of literary data and problem definition. Germinated grain has high nutrition value. Scientists investigated that, total content of antioxidants in germinated grain are higher at 3-10 times (depending on culture) compared with native grain. Regular consumption of germinated grain stimulates a metabolism,

blood formation, increases immunity, compensates vitamin and mineral deficiency, normalizes acid-base balance, promotes cleaning of an organism of slags, effective digestion, raises a potentiality, slows down processes of aging [5].

In domestic and foreign scientific literature it is noted that during germination of grain increased the content of vitamins [6]. Scientists note that the content of B group vitamins, in particular, B₁, B₂, B₅, B₆ at 5-10 times higher in wheat sprouted grain than in mature. Also during germination of grain wheat vitamin C is synthesized [7]. It is established that after biological activation of grain wheat during the 24 hours the content of vitamins B₂ and B₆ increases by 26 and 65%, the content of vitamin E increased in 6,5 times, the amount of nicotinic acid (PP) increased by 1,3 times [8 9]. Scientists noted that the maximum increase in contents of folic acid by 3,6 times in germinated grain of wheat and 1,7 - 3,8 times in rye is recorded for the fifth time of germination, the quantity of carotinoids is the highest for the seventh day of germination [10, 11]. During of germination of such valuable grain crops as triticale and oats authors did not investigate accumulation of vitamins.

It is known that a phytic acid forms insoluble calcium salts that are not digested by the digestive juice [12]. Therefore, the presence of phytin in foods is not desirable. The scientists developed methods of phytin selection from grain raw materials and waste of its redoing [13, 14]. However, the degree of hydrolysis of phytin in the course of biological activation of grain authors is not installed. The accumulation of an inositol in the soaking and sprouting grains also not investigated.

Insufficient study of influence of biological activation at the concrete reasonable modes of grain of valuable cereal cultures of wheat, bare grain oats and triticale on change of content of all main vitamins and extent of hydrolysis of phytin proves need of carrying out researches for this direction.

3.The aim and tasks of the study.

The aim of this work is establishment impact the biological activation of grain cereal crops wheat, oats and triticale by hydrothermal processing of the change content of essential vitamins and degree of hydrolysis phytin.

For achievement of a goal the following tasks were solved:

- define indicators the physiological values of grain: energy and the ability to germination, the viability of the grain and water sensitivity;
- investigate the degree of hydrolysis phytin and the accumulation of inositol in the process of the biological activation grain;
- investigate the influence of the biological activation of grain on change of content vitamins, which have an antioxidant properties – of tocopherol, ascorbic acid, vitamin P, of vitamins group B and niacin.

4. Materials and methods of a research of influence biological activation of grain wheat, triticale, oats are depending on change of content vitamins.

For researches used samples of grain wheat, triticale and bare grain oats, respectively, grades Myronivska 137, Alkid, Solomon.

Indicators of physiologic value of grain defined according to techniques [15].

Phytin determined by extraction it from grain 1-% solution of nitric acid and further sedimentation by 25-% solution of ammonia. The besieged phytin was filtered and dried up in a drying cabinet at 80 °C for 10 hours [13]. The inositol was determined by method of a highly effective liquid chromatography, which included the freeze-drying and milling of the sample, extraction of 0,5 M hydrochloric acid, a decantation, filtering of a dekantat under pressure and actually a chromatography on a chromatography of PERCIN ELMER. Definitions carried out with use of the ultraviolet detector ($\lambda=325$ nm).

Definition of vitamin C was carried out by a titration method [16]. From grain vitamin C was extracted 2-% HCl solution. Contents were maintained during 10 minutes, filtered. The received extracts titrated by solution of sodium 2,6-dichlorophenolindophenolate to the appearance of weakly pink color. For definition of vitamin P to 1 g of a sample added 40 ml of 2% KOH solution and heated on the boiling water bath with the return refrigerator of 15 minutes. The received extract was cooled, filtered. Optical density measured of the solution on the photocolormeter at a wavelength about 500 nm in cuvette with a layer thickness of 5 mm. Control solution - distilled water [16]. Definition of vitamin E is based on formation of quinone during oxidation of molecules tocopherol, extractable from studied sample,

by chlorine iron. There is a recovery of chlorine iron to chlorous which quantity is defined behind intensity of a coloring during addition of orthophenanthroline [16].

For determination choline, sample hydrolyzed in the presence of 20% HNO₃ on the boiling water bath. To the filtrate, neutralized 33% alkaline solution (pH 10), was added 2% solution of chromthiocyanate salt and left for 18 hours in the refrigerator. The precipitate, that formed, was filtered, washed with n-propanol at 0°C, was dissolved in acetone. The resulting solution is calorimetry on the FEC-56M, ($\lambda = 510-540$ nm). Control solution was acetone [16].

Vitamin B₁ is determined fluorometric [17]. The method is based on the oxidation of thiamine into red blood salt in alkaline in tiohrom, extraction of the latter in an organic solvent, measuring the fluorescence intensity at spectrofluorimeter (wavelength of excitation - 360 nm and absorption - 430 nm). Vitamin B₂ determined by the method fluorescence using riboflavin-connecting apoprotein. The fluorescence intensity measured on spectrofluorimeter (wavelength of excitation - 465 nm and absorption - 525 nm) [18]. For determination of vitamin B₆ the sample extracted in the presence 2 N the sulfuric acid in the boiling water bath for 15 minutes. A solution was cooled and then added 1 ml 4 M sodium acetate, filtered. In test tubes is placed 0,1 ml filtrate, add 4.9 ml 0,2 N HCl and 0,4 ml of isopropanol. Cool, add 0,8 ml potassium permanganate, through 50 seconds added 0,2 ml solution of hydrogen peroxide. The intensity of fluorescence was determined on spectrofluorometer (wavelength of excitation - 354 nm and absorption – 442 nm). Definition of vitamin PP is based on the reaction that occurs in two stages: a) the interaction of pyridine ring of nicotinic acid with bromicrodan; b) formation of the painted derivative glutaconic aldehyde. The intensity of color compound that was formed directly proportional to the mass fraction of vitamin PP, which is determined calorimetric [16].

5. The research results change of the content of the main vitamins in the biological activation of grain wheat, triticale and bare grain oats.

We asked to hydrothermal treatment regime - cold conditioning of grain for temperatures 12 - 16 °C within 28 - 30 hours. Under these conditions, humidity of

grain increases about 30 - 35%, which leads to activation of the enzyme complex, lower grain density and increase its specific volume. As a result of the intensification of enzymatic processes is partial hydrolysis of carbohydrates and proteins, change conformation of protein macromolecules, activation of the synthesis of vitamins and vitamin-like substances.

For efficiency of biological process of activation and creation of optimum conditions of its carrying out indicators of physiologic value of grain are important: energy and ability of germination, viability of grain and sensibility to water.

We investigated indicators of physiologic value of grain (tab. 1.).

Table 1.

Indicators of physiological value of grain cereal cultures s

Indicators	Grain culture		
	Wheat	Bare grain oats	Triticale
Number of grains germinated in 3 days, pieces.	486	482	498
Energy of germination, %	97,2	96,4	99,6
Average square deviation	0,85	1,13	0,98
Coefficient of a variation, %	0,89	1,16	1,02
Amount of the grains which sprouted in the 5th days, pieces.	495	490	100
Ability of germination, %	99,0	98,0	100
Average square deviation	0,28	0,42	0,28
Coefficient of a variation, %	0,29	–	0,29
Viability, %	100,0	98,5	100
Average square deviation	0	2,12	0,71
Coefficient of a variation, %	-	2,29	0,72

The conducted researches show, these consignments of grain are excellent quality, because values of energy germination and ability of germination exceed 95%; the viability of the embryo, the potential germination capacity of grain to not less than 90%.

Researches of phytin hydrolysis were conducted at different temperatures: 16 and 22°C. Change of phytin amount determined after soaking and sprouting grains for 30 hours (tab. 2).

Table 2.

Effect of grain germination on the degree of phytin hydrolysis

Indicator	Grain of wheat			Grain of triticale			Grain of oats		
	Native	Germinated at temperature		Native	Germinated at temperature		Native	Germinated at temperature	
		16°C	22°C		16°C	22°C		16°C	22°C
Dry substances (DS), %	86	63,5	61,8	88,31	65,18	64,0	85,64	60,12	58,6
Phytin, % to DS	0,856	0,31	0,36	0,84	0,40	0,45	0,91	0,395	0,44
Phytin, % of initial quantity	100	36,21	42,06	100	47,62	52,57	100	43,41	51,4

The conducted researches showed that during germination of grain is a significant phytin hydrolysis. And at the lower temperatures hydrolysis actively.

Inositol, vitamin-like substance B₈, contained in plants in the form of isomers and their methylated derivatives, among which myo-inositol. At grain germination calcium-magnesium salt of inozytphosphoric acid - phytin - decomposes on an inositol and a free orthophosphoric acid. So the next step of our research was to determine of change of quantity in the course of biological activation of grain of wheat, triticale and bare grain oats, results are shown in Table 3.

Table 3.

Effect of temperature conditions for germination synthesis of inositol in grain

Sample	Sample inositol content in the grain, mg%		
	Wheat	Triticale	Oats
Native grain	5,21	5,04	6,48
Germinated at a temperature of 16°C	24,73	20,24	28,56
Germinated at a temperature of 22°C	22,12	18,51	27,00

It was established that during germination is an active synthesis of an inositol, at the lowest temperature as a result of more active hydrolysis of phytin, the bigger quantity of an inositol is formed.

Important task of preparation of raw materials is preservation and the maximum increase in content of vitamins. The change of vitamins content was investigated in the process of biological activation of grain; vitamins exhibit antioxidant properties - tocopherol, ascorbic acid, vitamin P (tab. 4).

Table 4.

The content of vitamins C, E, and P in grain

Grain culture	Content of vitamin P, mg%	Content of vitamin E, mg%	Content of vitamin C, mg%
Native grain			
Wheat	3,9 ± 0,25	0,34 ± 0,02	2,6 ± 0,20
Oat	3,4 ± 0,25	0,21 ± 0,02	1,2 ± 0,20
Triticale	4,5 ± 0,25	1,00 ± 0,02	2,3 ± 0,20
Grain after hydrothermal treatment			
Wheat	9,3 ± 0,25	10,73 ± 0,02	5,7 ± 0,20
Oat	7,9 ± 0,25	9,26 ± 0,02	3,8 ± 0,20
Triticale	9,2 ± 0,25	11,65 ± 0,02	4,1 ± 0,20

Found, that in biologically activated grain the amount of vitamin C increases in 2 - 3 times, a routine – 2- 2,5 times, significantly increases the content of tocopherols.

The complex of vitamins of group B is a valuable component of peripheral parts of grain. Changes of content of vitamins of group B and to a niacin in grain of wheat, triticale and bare grain oats in the course of a hydrothermal treatment are investigated (tab. 5.).

Table 5.

The content of vitamins of group B and niacin in grain

Grain culture	Content of vitamin, mg%				
	B ₁	B ₂	PP	B ₄	B ₆
Native grain					
Wheat	0,22 ± 0,01	0,12 ± 0,02	3,67 ± 0,12	92,0 ± 0,20	0,51 ± 0,02
Oat	0,20 ± 0,01	0,13 ± 0,02	3,45 ± 0,12	98,0 ± 0,20	0,44 ± 0,02

Triticale	0,29± 0,01	0,12± 0,02	3,8± 0,12	110,0± 0,20	0,65± 0,02
Grain after biological activation					
Wheat	0,35± 0,01	0,34± 0,02	4,33± 0,12	152,0± 0,20	0,68± 0,02
Oat	0,31± 0,01	0,39± 0,02	4,10± 0,12	145,0± 0,20	0,38± 0,02
Triticale	0,89± 0,01	0,16± 0,02	4,5± 0,12	175,0± 0,20	0,57± 0,02

Found that biologically activated grain number thiamine and riboflavin increases by 2 – 2,5 times, compared to native grain; content of nicotinic acid and choline increased by 1,5 - 2 times.

6. Discussion of research results of changes in the content of main vitamins in the biological activation of grain.

The conducted researches showed that during the biological activation grain cereals is a significant phytin hydrolysis, these results are consistent with practical data known from the work of G. Sripriya et al [5] with colleagues who say that soaking and sprouting help reduce anti-food substances in grains and seeds. But unlike existing data, our researches show the degree of hydrolysis of phytin anti-mineral substances during germination grain of perspective cereal cultures of wheat, triticale and oats, which are important for increasing its nutritional value.

And it is investigated that at the lowest temperatures hydrolysis occurs more actively. Thus, germination temperature for 16°C promoted reduce the number of phytin in wheat, triticale and oats, respectively 63,8%, 52,4% and 55,6%, and at a temperature of 22°C much less - respectively 58%, 47,43% and 48,6%.

The received results correlate with theoretical data, known from works of scientists who say that under the action of the enzyme phytase, that is activated in germinating grain, inozytphosphoric acid contained in a grain in the form of phytin, decomposes into inositol and free orthophosphoric acid [13]. But, unlike existing data, which only note the inositol is formed of phytin at germination of grain, our results demonstrate increasing the nutritional value of grain raw material due to a significant increase of inositol, which is required for normal growth and development of young organism; helps prevent disease alopecia.

Important, from the point of view of increase the nutritional value, are the results of research content in main vitamins in biologically activated grain of cereal cultures. These data are consistent with researches of a number of scientists [6-10], but the value of our results is due to the definition of a full complex of vitamins in wheat, triticale and oats for the concrete technological parameters of its processing that enables the development of perspective technology of preparation of grain.

Conclusions. We offered the hydrothermal treatment regime - cold conditioning of grain, which promotes increase of its nutritional value.

Biological activation of grain crops of wheat, triticale, bare grain oats gives a raw material for producing health foods with a high content of B vitamins, niacin, and those that exhibit antioxidant properties E and C, substances with P-vitamin activity. The proposed method of preparation of grain raw materials allows to minimize of anti-mineral substance of phytin.

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