THE INFLUENCE OF GERMINATION ON THE BIOLOGICAL AND NUTRITIVE POTENTIAL OF WHEAT SEEDS

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Abstract

In our studies we analysed the reaction at germination of the wheat, species Triticum aestivum (types Arieşan and Dropia), We have germinated the seeds of these cereals different. We have germinated the seeds of these cereals at tempetures (10, 15, 20 degrees C) and we took samples at different times (at 2, 3, 4, 6, 8 days), which we dried and rended them in many types of flour. Those were analysed by biochemical methods to determine the contain of proteins, amino acids, bioelements (Ca, Fe) but we also made some biological test: the content of amino acids, the chemical score, the index of essential amino acids (EAAI), the proteic efficiency (PER). The growth of the content of essentials amino acids by germination it is reflected positively on the biological qualities of the proteins and on their nutritive efficiency. Because from the chemical analyses made we saw that the biochimical transformations during the proces of germination make the content of metalic ionic to rise, we considered that is necesary to verified if those conclusions obtained „in vitro" – on the young bodys. One can demonstrate that the administration of germinated whreat at childreen determined the increase of the calcemy and sideremy value. The germination favours the biosynthesis of the cell and grows of the young tissues. Germinated seeds are ideal for feeding children, ill people or athletes, old people.

Keywords: *Germination of the wheat; growth of the content of essentials amino acids; chemical score; EAAI; PER; nutritive efficiency; calcemy; sideremy.*

Introduction

Health – the optimum harmonization of the biorhythms of human microcosm with macrocosm biorhythms – is sustained by the *nutrition* process, which ensures a permanent exchange of information, energy and substance between the two systems – by means of nourishment.

Current nutrition is shaped by a hedonistic approach and is based on elaborately prepared food (fast-food type), concentrated food with high energetic density, preserved and refined, but rich in preserves and chemical residues, bearing the imprint of an intensely chemical agriculture. These alimentary products with a low nutritive density – because of their deficiency in: biocatalysers, vitamins, bio-ions, fibres and other biologically active compounds – have become, according to an impressive number of scientists, an ethiopathogenic factor of many diseases. (1)

Modern nutrition trends towards food rich in biologically active compounds have directed nutritionists' attention towards the so-called *functional foods* (2). The following foods are counted among them: foods based on vegetables and fruit, products obtained from ocean fish and barm, products obtained from germinated cereals and cereal germs, products resulted from milk fermentation, foods high in fibre and pectin – rich in biologically active substances, especially enzymes, vitamins, bio-ions, and which have known a remarkable evolution especially in industrialised countries.(3,4)

Currently, the development of an increasing variety of products based on *germinated seeds* can be observed throughout many countries, these products being obtained from wheat, barley, maize, sorghum, soya, peas, beans, buckwheat, oat. (5,6) A trend towards an increasing variety of products derived from germinated seeds can also be observed: proteic and vitaminised cereal extracts. (6,8)

During the germination of seeds takes place a dynamic of the metabolical processes caused by the progressive release of preexistent synthetised enzyms „de novo", it produces gibberellin, plant hormones that migrate in the aleuronic which it stimulate to synthesize hydrolytic enzymes and which through their action cause major changes at the level of phisical structure and of the biochemical content of the major constituents with a macromolecular structure: starch, hemicellulose, proteins or even cellulose, that normally is not so available during the digestive process (4,6) The proteolityc enzymes which are synthetised during the process of germination infer changes of the structure of the proteins which can be easyer metabolised by the digestive proteases, forming free aminoacids (cysteine, tryptophan, tyrosine) as well as the increase in content of limiting aminoacids (lysine and treonine) that have positive effects on revitalising the human body (8).

During the process of germination there are many amounts of bioelements Ca, Fe, Zn, Mg, Fe under the action of fitasis that synthethises

and activates at germination. Many studies have been done so far that pinpointed the increse in content of mineral substances of cereal seeds or the ones of vegetables and thus showed that they are good resources of Ca, Fe, Zn.(7)

The biological tests on lab animals such as rats as well as those on human subjects pinpointed the fact that under controlled conditions of germination of the eatable seeds of cereals, vegetables one can obtain products with extremely high nutrient potential that can be used at obtaining food. (8)

Starting from the teoretical considerations about the improvment of the nutritional qualities of the seeds through germination method, in this article we aimed to demonstrate that the germination creates a notable acumulation of biological and active compounds. In this way it leads to an important increase of the nutritive value of the germinated seeds, because of the greater biodisponibility of the nutritive compounds, and of the increase in amino acids, bioelements (Ca and Fe) and of other biological active substances.

Experimental

In our studies we analysed the reaction at germination of the wheat, species Triticum aestivum (types Arieşan and Dropia), which have good germinative properties (the germinative energy is about 92% and the power of germination is about 98%) (1). We have germinated the seeds of these cereals differentWe have germinated the seeds of these cereals at tempetures (10, 15, 20 degrees C) and we took samples at different times (at 2, 3, 4, 6, 8 days), which we dried and rended them in many types of flour. Those were analysed by biochemical methods to determine the contain of proteins, amino acids, bioelements (Ca, Fe) but we also made some biological tests.

1. The evaluation of qualities of proteins and their nutritive potential

1.1. The Determination of the amino acids

We analizates the seeds of wheat: germinated and not (witness) from species Triticum aestivum, type Arieşan, of whom seeds have been germinated for three days at temperature of 15°C. The analize of amino acids was made by a chromatography of ionic change with derivatization post-column with ninhydrine and spectrophotometric detection, using an amino acid Analyser tip Carlo Elba (1).

1.2. The chemical score

The chemical score of the qualities „in vitro" needs the knowledge of composition from the amino acid and the protein standard, that is protein FAO; which can be appreciated by a the chemical score, using the following formula: We have to mentionate that the chemical score is lesser than 100, with that the protein is capable to favor the grouth (the protean metabolism) (1).

$$\text{Chemical score} = \frac{\text{Limitated amino acid from the protein which is analizated (mg/gN)}}{\text{The concentration of the same amino acid from the standard protein (mg/gN)}} \times 100$$

1.3. The essentials amino acids score (EAAI)

In 1951 Oser proposed that at the determination of the quality of one protein „in vitro" to be taken into consideration all the essentials amino acids, their concentration being reported to the concentration of the same amino acids from the referance protein (FAO). One can notice in this way the chemicals scores of all amino acids. We can calculate with this information the EAAI (1)..

$$EAAI = \sqrt{I_1 \cdot I_2 \cdot \ldots \cdot I_8}$$

1.4. The determination of the Protein efficiency ratio (PER)

The biological value of proteins is determinated „in vivo" by PER. The biological test of one nutritive value of germinated wheat, that is PER, which lays emphasis of the way how this product satisfies the nutritive needs of the young body. In the experiment we used white mice, race Wistar.

At the final of the test it was obtain the PER (Protein efficiency ratio) using the following formula (1):

$$PER = \frac{\text{the rear in weigh of animals, in grams}}{\text{the real quantity of proteins with were consumated , in grams}}$$

2. The determination of bioions

The measure of the ionic calcium, which was liberated by germination from the phytate under action of phytase, it was obtained with

the potentiometrical method. The ionic Fe (II) were determined by titrimetrical method (1).

2.1. The determination of the calcemy and of sideremy on the volunteers subjects

This test was made in 21 days, on 21 children (boys and girls of 7 years old). Those children were administrated germinated wheat, species Triticum aestivum, type Arieşan (at tempreture of 15°C for 3 days) in the shape of flakes made by Granovit. It was determinated the calcemy and sideremy of the volunteers before and after eating the flakes. (1) All the children had the initials values of calcemy and sideremy normal, that is ionic Ca: 4,5 - 5,5 mEq/l; serical Fe: girls 80-110 γ% and boys: 90-120 γ%. 10 children had the calcemy and sideremy values at the inferior limits of normal.

Results and Discussion

1. The evaluation of the byologic quality of the proteins and their nutritional potential

1.1. The content of amino acids

The germinated cereals are a valuable source of vegetable proteins, especially that unlike ungerminated seeds they contain a greater content of natural aminoacids that are found in a balanced and naturally harmonized proportion that favours celular biosynthesis and the growths of younger tissues. The results regarding the evolution of amino acids during germination at species Triticum aestivum type Arieşan are presented in table number 1.

One can notice a rise in content of all essential aminoacids especially the limited ones especially lysine that rises 57,6% and threonine whose content rises with 31,8%, the aspartic acid registering the most spectacular leap to 129% to enhance the growth of the future plant. We also present in the table below the variation in content of the essential amino acids.

Table 1: The influence of germination over the content of amino acids at species triticum aestivum (g/100 grams of protein)

Nr. crt.	Aminoacid	Witness g/100g prot.	Germinated g/100g prot.	Seed varatio n (%)
1	Lysine	2,88	4,54	57,6
2	Methionine	1,07	1,40	18,6
3	Histidine	2,28	2,83	24,1
4	Arginine	4,6	5,01	8,9
5	Aspartic acid	6,22	14,25	129
6	Threonine	2,92	3,85	31,8
7	Serine	4,35	4,67	7,3
8	Glutamic acid	26,12	20,28	23
9	Proline	7,19	5,36	26
10	Glycine	6,33	7,01	10,7
11	Alanine	3,03	3,7	21
12	Cysteine	2,01	2,73	36,5
13	Valine	4,15	4,75	14,4
14	Isoleucine	3,15	3,85	22,2
15	Leucine	6,01	6,70	11,4
16	Tyrosine	1,77	2,00	12,9
17	Phenylalanine	3,33	3,70	11,1
18	Tryptophan	0,88	1,24	40,9

1.2. The influence of germination denoted by the chemical score

The nutrient quality of the proteins dependent by their compositions of essential amino acids and of the best assimilation of the body is pinpointed by thze chemical indicator of the germinated grains. to demonstrate the enhancement of the nutritional values of cereals it has been calculated the chemical score of limited amino acids such as lysine and threonine at wheat.

The chemical score of the cereal seeds germinated at temperatures of 15°C the duration of germination being of three days for the essential amino acids for lysine and threonine is presented in table 2.

From the information above one can observe that germination leedsto a better enhancement of nutritional values of cereals as a result of the growth of lysine and threonine, the aminoacids that were limiting in the witness seed.

Table 2: The influence of germination denoted by the chemical indicator species type amino acid witness germinated seed

Specia	Soiul	Aminoacid	IC (%) Martor	IC (%) Germinat
Triticum aestivum	Arieşan	Lysine	52,3	82,5
		Threonine	71,2	96,2

1.3. The influence of germination upon the index of essential amino acids (EAAI)

The enhancement through germination of the content of amino acids especially of the essential ones as it is shown in table 3.13 with 157,5% at species Triticum aestivum and 111,5% is positively reflected over the quality of proteins, of their biological quality and of the nutritional value. These represent a strong argument in favour of bringing germinated seeds in our daily diet.

Table 3: The influence of germination as shown by the index of essential aminoacids

Nr. crt.	Cereal	EAAI Witness	EAAI Germinated
1	Triticum aestivum (type Arieşan)	45,51	117,28

1.4. Determining the coefficient of proteic efficiency (PER)

The coefficient of proteic efficiency, PER determined by a standard procedure offers representative value regarding the quality of the proteins of that food, the forming of proteins being in a close relation with the gain in weight. The result of the biological testing of the nutrient value of wheat grains from species Triticum aestivum, type Ariesan germinated at temperature of 15°c , during three days can be observed in table nr 4.

Table 4: The influence of germination of PER

Produs	PER
Wheat flour type 1310	1,25
Germinated wheat	2,07

Taking into consideration that wheat is a vegetable proteic source of second class, the increase of the coefficient of proteic efficiency through germination demonstrates the superior capacity of germinated wheat to cover the demanded nutritional requirements for upbringing young organisms.

2. The influence of germination on the content of bioelements from the seeds of the cereals

In the investigations made on the nutrisional transformations that take place in the germinated seeds, one can notice the evolution of some bioelements on way of these methods, analysing the varation at germination of the content of ionic calcium and iron (II). The ionic forms of these bioelements are well asimilation by the human body.

2.1. The assimilable calcium

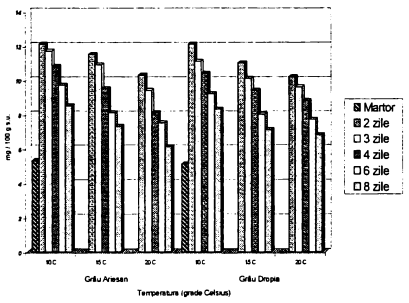

Fig. 1: The evolution of the content of iron at Triticum aestivum during germination

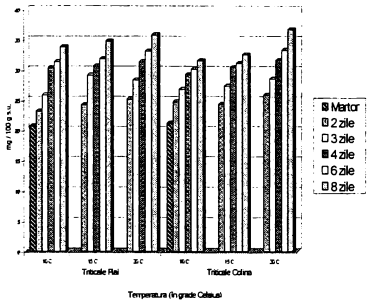

Fig. 2: The evolution of the content of Ca at spieces Triticum aestivum during germination

The results about the influence of the germination on the variation of the content of calcium assimilable to the specie Triticum aestivum, types Arieşan and Dropia are presented in fig 1.

One can notice a relatively increase of the content of Ca^{2+} starting with the second day until eight day.

2.2. The assimilable iron

The information about the influence of germination on the variation of the content of assimilable iron (Fe^{2+}), prove a remarkable increase after two days, from the beginning of the germination, then the gradual decrease until eight day, problable because of the implication of iron in the synthesis of many enzymes.

2.3. The influece of the diet with germinated wheat the calcemy and sederemy at volunteers subjects

Because from the chemical analyses made we saw that the biochimical transformations during the proces of germination make the content of metalic ionic to rise, we considered that is necesary to verified if those conclusions obtained „in vitro" – on the young bodys.

In fig. 3 and 4 are presented the variation of the calcemy and sideremy at the 21 chidreen: 9 boys (B_1-B_9) and 12 girls (F_1-F_{12}) of 7 years old. After 21 days of administration of the germinated wheat (flakes made by Granovit) we can observe a rise of values of seric calcium and iron which get to the average of the normal interval. We can observe that the closer the initial value is to the inferior limit of normality, the bigger is the increase. There were the level of the initial concentration was close by the normal average value, the rise was neglected.

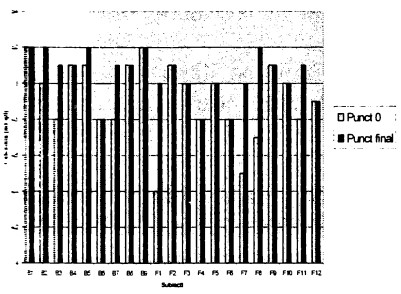

Fig 3: The influence of the diete with germinated wheat on calcemy variation at children.

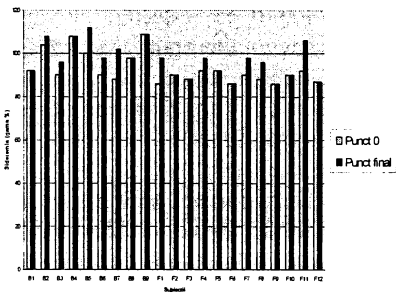

Fig. 4: The influence of diet with germinated wheat on sederemy variation at children

One can demonstrate that the administration of germinated whreat at children determined the increase of the calcemy and sideremy value (1).

It was also remarcable the disponibility of the childreen to eat the germinated cereals, proving in this way the facility influence of the alimentar behavior at that age (the childreen been less afected by preconceived ideas and less afected by wrong alimentary habitudes). They represents the future of the world and they have to be protecded by wrong steps that the grown-up made).

In conclusion, the biological active compuonds of germinated wheat imbed with the mecanisms of ionic homeostasys, the administration of wheat under this form doesn't go to an incontrollable grouth from ionic calcium and iron.

Conclusion

By germination there are realised big quantites of bioelements, the most important of them being calcium and iron (in active forms). The acumulation of the active form of calcium starts with the second day from the beginning of the germination until eight day. The iron presents a special evolution at germination, that so it grows after the second day and then it declines gradually until eight day.

The germinated cereals are a valuable source of the vegetable proteins, with a greater content of natural amino acids than non-germinated seeds. This method favours the biosynthesis of the cell and grows of the young tissues. The growth of the content of essentials amino acids by germination it is reflected positively on the biological qualities of the proteins and on their nutritive efficiency.

Germinated seeds are ideal for feeding children, ill people or athletes, old people. They are working in therapies for treating heart diseaseas, gastro-intestinal injuries, old age problems, mineral disequilibrium, imunodeficiencies.

The inportant problem at the beginning of the third milenium – because of the demographical rise – *the assurance of food* will lead the humanity to a common destiny on this unique planet, respectively to the implementation of the security plan of alimantation, which has to assure to the people a suitable food from point of view of quality. The food must be less technologically processed and more rich in biologicallz active compounds, more sanogeneses – therefore more closer to nature and in harmony with nature.

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