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The appreciation and determination the chemical composition of the tubercles at some potato grades

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Abstract

In the diet strategy both on the global level as well as in our country the potato is considered to be one of the most important cultivated grades. It is a complex food stuff with dietary properties being rich in vitamins and mineral salts. The great diversity of the products obtained from the potatoes ensures the superior valorifying of the entire production and the rhythmical supplying for the population during the entire year. The consumers' request for the potatoes varies from one country to another and even from one area to another. In the last years in the national data base of grades there has been subscribed as a total figure over 30 local or foreign grades from which due to a natural selection imposed by the producer and consumer's markets there have been noticed as to be detached by far from the others three grades accepted and agreeable for everyone. According to these there have been taken for analysis the following grades of potatoes: Ostara for the early and summer using, Kondor for the summer and autumn using, Désirée and Santé for the autumn and winter using.

Taking into account the data obtained by using the Stohmann method on the four grades of potatoes studied we can conclude that the starch and dry substance values differ from one grade to another.

Keywords: chemical composition, tubercles, starch

1. Introduction

The The potato which has an old and glorious history originates in Central and Southern America where along with the corn has been one of the basic food stuff feeding and sustaining the amazing and flourishing civilization of the native Indians ensuring the glory of the Inca Empire.

After it arrived in Europe, the old continent of differences on one hand consumed by wars and poverty on the other full of glory being the old home of culture and science, the potato became known quite late.

At its introduction for culture and harvest an important role was played by the French pharmacist Antoine-Augustin Parmentier (1737 – 1813), who while being prisoner in Prussia during the 7 years war (1756 – 1763), succeeded in surviving there only due to the potatoes.

The potato first appeared in our country in Transylvania being brought from Germany in the period 1676- 1705. In the kingdoms of Moldavia and Muntenia it was later introduced: at the end of the XVIIIth century and the beginning of the XIXth. With a tradition of over 200 years it rapidly became in many areas a strategic product for the existence of the population. The potato became a well appreciated food on everybody's daily diet no matter what their social rank was.

Romania occupies the third place in Europe and the ninth place at the global level regarding its surface cultivated with potatoes cultures. In our country over

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97% of the potatoes cultivated surfaces belong to the private sector of the economy; 58% belong to the individual producers and only 2.6% of the area belongs to the commercial companies and research labs.

In the diet strategy both on the global level as well as in our country the potato is considered to be one of the most important cultivated grades. It is a complex food stuff with dietary properties being rich in vitamins and mineral salts.

Due to the relative low costs of production and the high quantities obtained the average consumption on inhabitant in different countries (taking into account the area, economic condition and diet tradition) varies between 38 kg/year (Italy) and 152 kg/year (Ireland), the average consumption on the global level being of 28 kg, in Europe between 60 - 70 kg, and in Romania approximately 75 - 80 kg/year.

The dry substance quantity produced on the unit of surface area for the potatoes is of cca. 7 -8 t/ha. The protein production on ha in the case of potatoes is twice bigger than that of wheat, 1.3 bigger than that of barley and 1.1 bigger than that of corn. The high quality proteins content allows that the consuming of 200g of boiled potatoes daily to ensure 16-18% of the daily necessary of proteins of a human being. The presence of the essential amino acids in the potato makes it comparable with the meat or the eggs. Besides these, the potato contains all the important vitamins in quantities larger than those found in rice or white bread.

Table 1 presents the using of the potatoes production for different purposes on the global level:

Table 1. The mean of using the potatoes production on the global level

Mean of using	Quantity (mil.tons)	% of the total sum
Diet	126	45
Fodder	88	31
Seeds	39	13
Starch	6	2

The diversity of the products that can be obtained from the potatoes ensures the superior using of the entire production and the rhythmical supplying of the population during the entire year.

In the industrial field, the potatoes are used in alcohol, starch and glucose production. From 1000kg of potatoes there can be obtained 56-132l of alcohol, 140kg of starch, 240-260kg of chips or 700 - 750 kg of pommes-frites. From the starch there can be realized over 700 derivates used in the food, pharmaceutical, textile or paperboard industry.

2. Materials and method

In the case of the potato duet o the vegetative multiplication and viral degeneration the assembly „grade-seed" has a contribution of over 75% for the final production in comparison with other species. For to respond to all producer's requests a potato grade must have the following traits: to ensure a constant production of 30-50t/ha, to prove resistance to diseases and pestilence, to be able to be mechanically ploughed and treated, to show a good response to storage and to have good diet traits and to be applicable in different fields of industry. There has to be mentioned the fact that there isn't a perfect grade and for this the cultivation techniques must allow „the grade's expressing" as close as possible to its genetic potential and sometimes also to correct some of the grade's deficiencies.

One of the effects of the market economy with a long term functioning in the western European countries is the imposing of the dominant principle of choosing a grade according to the real possibilities of using the production. There are companies that produce seed potatoes for the Mediterranean area, or that produce potatoes for the early consumption in the northern countries or that produce potatoes for a certain type of industry (for creating chips, pommes-frites or starch). The potatoes grades cultivated in our country are in a continuous dynamic. Every year new grades are authorized for subscribing for cultivation in the Official list of grades (hybrids) for the agricultural plants or on the contrary the unusable grades are eliminated due to their unagricultural behaviour.In the last years in the national data base of grades there has been subscribed as a total figure over 30 local or foreign grades from which due to a natural selection imposed by the producer and consumer's markets there have been noticed as to be detached by far from the others three grades accepted and agreeable for everyone. According to these there have been taken for analysis the following grades of potatoes: Ostara for the early and summer using, Kondor for the summer and autumn using, Désirée and Santé for the autumn and winter using.

The quality of the potatoes destined for consumption and the chemical composition of the tubercles. The quality term at the potatoes destined for consumption is a complex notion that gathers besides the appearance and commercial presentation a series of internal and external; properties that determine its dietary traits and its availability for industrial processing in different food products. As a consequence the quality of the potatoes destined for consumption is defined according to the destination of the production.When establishing the quality of the potatoes destined for consumption there must be taken into account the consumers' tastes, request and preferences regarding: the size and form of the tubercles, the depth of the cavities, the colour of the cover and middle, the external appearance (healthy, unharmed and clean tubercles), the dietary quality etc. of course these preferences change quite often and it's really hard for the cultivators to permanently satisfy them.The consumers' requests regarding the potatoes destined for consumption vary from one country to another and even from one area to another. In our country duet o the high consumption of potatoes in fresh state there are still preferred the tubercles with the reddish cover (pink), of oval form, medium to big size, yellow middle and floury texture. Regarding the potatoes destined to industrial processing in different food products an important role is played by the starch content and its quality (the size of the starch grains, their ration) and the reducing sugars' content.

The dietary quality of the potatoes.

Several researches underlined the existent relation between the chemical composition of the potato expressed through its floury degree that is determined by the starch content and the taste, colour and humidity of the boiled tubercle as well as by the presence of nitrous substances, of vitamins or fats. These components differ according to the cultivated grade, the degree of maturity of tubercles at harvest and the environment conditions in which the tubercles developed. At a tubercle there is appreciated the dietary quality through its boiled middle texture expressed by the rigidity of the pulp, the consistency, the adherence, viscosity, elasticity each of these traits being determined by special measurements.

The disintegration of some tissues during boiling is duet o the breaking of the cells and generally is admitted the hypothesis that this phenomena is caused by the pressure exerted upon the cell walls by the starch (the main component of the dry substance) during its passing from the grain to the gelatin state. If the inflating is high (this can reach 4% of the initial volume) or if the cell walls are fragile they can break releasing the gel in the middle of the tissue that in this way becomes sticky. In tis process an important role is played by the cell membranes (whose contribution is more difficult to prove) as well as by the calcium content. Sometimes the disintegration phenomenon of the cells is not manifested even though the inflating of the starch takes place (tubercles of different ages with variable elasticity of the cell walls, starch grains of different sizes).

The chemical composition of the tubercles.

The potato tubercle is a vegetative organ which when found in fresh state is very rich in water. The water represents ¾ of the tubercle weight. In the tubercle there can also be found high quantities of glucides (carbon hydrates or non nitrous extracts), a small percent of proteins (nitrous compounds) and very few fats (lipids). Each of these chemical components of the tubercle show minimum and maximum values that depend on the cultivated soil land on the conditions and technology of cultivation applied. The fresh tubercles have the following average distribution of the chemical components:

Table 2. The chemical composition of the potato tubercles

Componets	Average values%	Minimum values%	Maximum values %
Water	77,5	63	86
Dry substance	22,5	13	36
Total sum of glucides	19,4*	13	30
Protides	2,0	0,7	4,6
Lipids	0,1	0,02	0,96
Ash	1,0	0,4	1,9

* out of which: 0.6 % (0.2 – 3.5) unextractable (fibers) containing cellulose, hemi cellulose, pectic substances, suberins and lignins.

The glucides are synthesized in high quantities in the potato plants through the photosynthesis process. They represent the main source of energy for the breathing processes and are found at the origin of formation of numerous glucidic and non glucidic cell components. The glucides represent an important part of the dry substance the later being made of starch.

The determination of the starch content of the studied grades. By the starch value of the potatoes we understand their content in starch and fermentation glucides. The physical methods for the determination of the potatoes starch value are base don the determination of their specific weight, for their specific weight depends on the starch content varying in direct ratio with this.

Taking into account the water specific weight 1 and that of the anhydrous starch from potatoes 1.65, we may conclude that the average weight of potatoes will be between these two limits. When it will be closer to the value of 1.65 the starch content is higher and the other way around. The research has shown that there is a constant difference between the dry substance content and the starch content this difference value being of 5.752. Thus it's enough for the specific weight to be determined for to know the dry substance content out of which deducting 5.752 we can find the starch content of the potatoes. By the specific weight or density (d) we understand the ratio between the weight and volume of the products that have to be expressed in an unitary system g/ml, kg/l.

Table 3. The glucidic composition of the tubercle

Glucidic components	Average values		The gap of vealues% in S.U.
	% of dry substance	% of raw substance	
Starch	70	15,7	60-80
Saccharose	0,5-1,0	0,1-0,2	0,25-1,5
Glocose and fructose (reducing sugar)	0,5-2,0	0,07-0,45	0,25-3,0
Raw cellulose	2,0-4,0	-	1,0-10,0
Pectines	2,5	-	-

* the values are for the tubercles harvested at maturity. The soluble sugars content depends on the degree of maturity of the tubercle and on the storage conditions.

3. Results and Discussion

The researches have shown that between the dry substance content and the starch content there is a constant difference of 5.752. So there is enough to determine the specific weight for to know the dry substance content from which deducting the constant, the starch value of the potato grades can be found. By the specific weight or density (d) we understand the ratio between the weight and volume of the products that have to be expressed in an unitary system g/ml, kg/l. In table 4 there are presented the results obtained after the application of the Stohmann method of determination of starch content and dry substance content at the potatoes grades studied.

Table 4. The evolution of the strach and dry substance content depending on the density at the potatoes grades studied

Soil	Group of maturity	Shape of tubercles	Quality class	Starch %	Dry substance %
Ostara	Half early	Oval	B	16.0	21.8
Kondor	Early	Oval long	A	21.1	26.9
Santé	Half late	Oval round	B	13.9	19.7
Désirée	Half late	Oval long	B	17.6	23.4

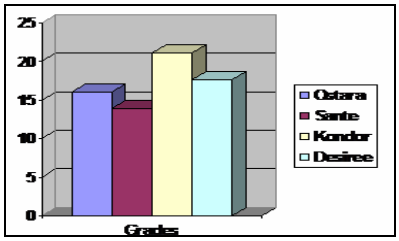

Figure 1. Starch content

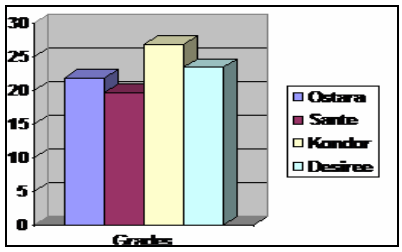

Figure 2. Dry substance content

4. Conclusion

Taking into account the data obtained by using the Stohmann method on the four grades of potatoes studied we can conclude that the starch and dry substance values differ from one grade to another. The starch and dry substance percent from the tubercles is influenced besides the genetic determination by the environmental and technological conditions.

Following the results obtain we can notice that the grades Ostara, Désirée and Santé can be grouped as belonging to the quality B class for they present a starch content below 19%, being destined to the consumption while the Kondor grade due to its higher starch content (21.1%) is also destined to the consumption but mostly to the industrial processing.

5. References

1. Draica C., *Cartoful în România*, vol .IX, nr. 3, Braşov, **1999**, 12-17;
2. Casañas, R., González, M., Rodríguez, E., Marrero, A. & Díaz, C., Chemometric studies of chemical compounds in five cultivars of potatoes from Tenerife, *J. agric. Fd Chem.*, **2002**, 50, 2076–2082;
3. Vito Buono, Annalisa Paradiso, Francesco Serio, Maria Gonnella, Laura De Gara, Pietro Santamaria,

Tuber quality and nutritional components of "early" potato subjected to chemical haulm desiccation, *Journal of Food Composition and Analysis,* **2009**, 22(6), 556-562, doi:10.1016/j.jfca.2009.01.001;
4. Amany M.M. Basuny, Dalia M.M. Mostafa and Arafat M. Shaker, Relationship Between Chemical Composition and Sensory Evaluation of Potato Chips Made from Six Potato Varieties with Emphasis on the Quality of Fried Sunflower Oil, *World Journal of Dairy & Food Sciences*, **2009**, 4(2), 193-200, ISSN 1817-308X;
5. A. Kita, The influence of potato chemical composition on crisp texture, *Food Chemistry*, **2002**, 76(2), 173-179, doi:10.1016/S0308-8146(01)00260-6;
6. Gravoueille J.M., *Les sucres de la pomme de terre*, La pomme de Terre Francaise, **1993**, 447;
7. Draica C. şi col., *Strategia culturii cartofului în România şi programul naţional de producere a cartofului. Cartoful în România,* **1996**, 6(1);
8. Joseph H. Schwartz, Reba B. Greenspun, William L. Porter, Chemical composition of potatoes. V. Further studies on the relationship of organic acid concentrations to specific gravity and storage time, *American Journal of Potato Research*, **1966**, 43(10), 361-366, DOI 10.1007/BF02862483; ISSN 1099-209X (Print) 1874-9380 (Online);
9. S. Pal, A. Bhattacharya, A. Konar, D. Mazumdar, A. K. Das, Chemical Composition of Potato at Harvest and After Cold Storage, *International Journal of Vegetable Science*, 2008, 14(2), 162 – 176, 10.1080/19315260801934779;
10. Ianoşi I.S., *Bazele cultivării cartofului pentru consum*, Editura Phoenix, Braşov, **2002**;
11. Camelia Moldovan, Cutrubiniş Mihalis, Rodica Georgescu, Nicoleta Hădărugă,Delia Dumbravă, Boltea Florin, Mărioara Drugă, Mihai Drugă, Cătălina Avrămoni, Researches concerning hunting out of irradiated food by physical-chemical methods, *Journal of Agroalimentary Processes and Technologies*, **2008**, 14(2), 455-462;