

POTATO AS A GLOBAL PLANT – NUTRITIONAL, DIETARY AND MEDICINAL VALUES

Key words: potato, nutritional, dietary and medicinal values, production, consumption, crop acreage

Potato – plant of Poland, Europe and the whole Glob

Potato (*Solanum tuberosum* L.) belongs to the Solanaceae family. It is one of the most important edible plants, universally planted in moderate climate, more rarely in the warm one. An edible part of potato is a tuber. It is known as *potato* – in English, *papa* – in Spanish, *kartofiel* – in Russian, *kartoffel* – in German, *pommes de terre* – in French (Birecki 1958, Ceglarek and Zarzecka 2003).

When nomenclature of potato in our country is concerned, probably any other crop plant in Poland had not have so many literary, dialectic, regional or folk names in the past and nowadays. Among them, two groups should be mentioned: 1/ regional, folk general names – 21, 2/ regional, folk names of varieties of this plant – 130. In the first group, the most common are: *bandura* – borderland dialect from Lviv and around, *kartofel*, *kartofla* – germ. – mainly Silesian language, but also all around the country, *pyra* – Poznań dialect, *grula*, *krapel* – highland dialect (Eastern Podhale), *bulwa*, *gulba* – Kashubian language, *kompera* – Lemko language, *perka*, *pyrka*, *pyraki*, *perzaki* – previous names derived from the country name – Peru, from where potato originates, *rzepa* from Orawa – Western Podhale, *bałabaje*, *bałabony* – most common in Eastern Poland. The second group of numerous potato names contains forms originating from foreign and native proper names or from the appearance of tuber, especially shape, size or skin and flesh colour. The most common are: *amerykany*, *moskale*, *olendry*, *galicyjki*, *krakusy* – names given from origin, *jakubki*, *janki*, *świętojanki* – were ripening early and were called by first names, *bałaburki*, *buraszki*, *burki* – originating from gray colour of tuber, *dudnice*, *gałuchy*, *gały* – because of tuber shape, *bielasy*, *bieluchy*, *rychlaki* – from flesh colour, and many others with unclear origin (Tomczak 2001, Zalewski 2008).

Worthy of notice is the fact that potato has its memorials. In Poland there are two monuments of potato, in Besiekierz near to Koszalin and in Poznań,

at Łęgi Dębińskie. On the 25 May 2008, the monument of potato was unveiled in a Slovenian town Šenčur near to Kranj. Monuments of potatoes are also located in a Croatian town Ananova and at church wall in an Austrian town Prinzendorf. A large monument of this plant is also at the Potato Museum in Idaho, USA.

A bit of potato history

Potato originates from South America, area of Peru, Chile, Bolivia and Ecuador today. The tracks of potato intentional cultivation date back to 4,000 BC. The potato was introduced to Europe in the middle of the XVIth century in two alternative ways. The first one was the Spanish trace, when about 1565 the potato was brought from Peru by Spanish caravels. The second one was the English trace – leading from Chile to England, where potato reached about 1585. Blandish tubers did not suit to contemporary gourmets' taste at once. First nation who appreciated them were the Irish. At the very beginning potato was an unusual plant specimen and was grown mainly in botanical gardens (Ratuszniak 1992). Then, it was regarded as a healing, ornamental and garden plant. Healing values of potato were discovered by monks who were cultivating potatoes in monastic gardens in Spain, Belgium, and then near Padua, Vienna and Wroclaw. It was also an exotic ornamental plant in times when gerberas and roses were unknown. The king of France Louis XVI appeared with a flower of potato pinned to his tailcoat during royal court balls, whereas the Queen Maria Antoinette was still sticking a potato flower into her hair at the end of the XVIIIth century. At that time a bouquet of potato flowers given to a beloved woman had the same symbolic meaning as seven red roses later. This plant served aesthetic functions because it was cultivated for its flowers (Leszczyński 2007).

First contacts of Europeans with potato as an edible plant were not successful. Green fruits, leaves and stalks were tasted. Only after 200 years culinary values of underground tubers were appreciated, at the same time way to introduce them to cultivation was difficult. Bitterish taste of tubers, due to a significant content of glycoalkaloid – solanine, stood in the way of their popularization. Moreover, the fact that potato was not mentioned in the Bible was an argument against its cultivation. Initially potato was a delicacy served only at royal and magnate courts, often rationed. In the XVIIIth century, countries applied various methods of popularization of potato cultivation amongst farmers in order to prevent famine. King of Prussia Frederick II appreciated the values of this plant, thus he used army to enforce peasants to grow potatoes. In Russia, Tsar Peter I and then Nicholas I, who was even more resolute, popularised potato cultivation by exiling the

insubordinates to Siberia. It enhanced the willingness to grow potatoes, and today “kartoszki” are the main component of a diet of most Russians. Also in France people’s distrust towards potato cultivation was similar, but the methods of overcoming it were different. Louis XVI and his adviser Parmentier, a pharmacist (inventor of new varieties), ordered to plant potatoes in royal demesnes and other gardens and to protect crops by army. Guards were supposed not to be very eager in their duties. Seeing the crops being watched by the guards, peasants were taking them for something valuable. At nights they were stealing potatoes, ate them and then planted them on their land. In this way, in the XVIIIth century potato cultivation gradually became common in the entire Europe. In some countries, expansion of this plant was very rapid, among others in Ireland potato became the main source of food. Great potato blight (1844-1851) led to famine and death of about one million of Irishmen and then to the mass emigration of that nation to the USA (Birecki 1958, Karczmarczyk 1999, Leszczyński 2007).

The potato was brought to Poland by King Jan III Sobieski in 1683, when he was coming back from the Battle of Vienna. Potatoes were a gift for queen Maria Casimiere and then became a specimen of royal botanical gardens. On a larger scale potato cultivation was started no sooner than at the end of the XVIIIth century. Over time in Poland and across Europe potato was subject to a metamorphosis from a luxury vegetable of magnates to staple food of poor people. It was also widely used to obtain starch, as distilling material as well as feedstuff (Chotkowski 1990, Leszczyński 1994a, 2007). Therefore the history of potato was full of ups and downs. For many years potato has had a bad reputation and was called the “devil’s apple”. Because being grown underground, potato tubers were believed to be poisonous. It resulted probably from the fact that our progenitors tasted green berries of potato which contained poisonous solanine. Other time, the potato rescued millions of people from threat of starvation. It had been a dish of the greatest kings and poor peasants, and thus it has been referred to as: “delicacy of kings and paupers” (Hobhouse 2001, Ratuszniak 1992, Zarzecka and Baranowska 2003).

2008 – International Year of the Potato

The General Assembly of the United Nations approved the resolution A/RES/60/191 on 22 December 2005, laying down year 2008 as the International Year of the Potato. But why was staple potato chosen? Initiative came from the government of Peru, which emphasised economical importance of the potato in providing food security and alleviating poverty worldwide.

The aim of this decision was:

- to emphasise the important role of the potato in providing world food security,
- to raise awareness of the importance of the potato and its cultivation,
- to increase the yield of potato production, which is grown also on less fertile soil,
- to popularize increasing world consumption of potato as a nutritionally valuable and healthy food product,
- to promote knowledge and information exchange and permanent international cooperation between all organizations operating on the potato market,
- to achieve a higher level of applying a balanced method to manage natural resources.

The International Year of the Potato was the reason for many international and national conferences and symposia held in the USA, Egypt, Kenya, Brazil, Pakistan, Austria, Spain, India, New Zealand, Poland, among others.

The strategy of celebration of the International Year of the Potato included exchange of information, conducting researches on potato, as well as aid in constructing programs and projects supporting the sector of potato production. In our country, many conferences took place as well: *i.e.* 5th Scientific Conference “Food and industrial potato and its processing” titled “Potato processing as a factor of growth and streamlining of its production” on 12-15 May 2008 in Szklarska Poręba, and “Potato in scientific researches and practice” on 5 November 2008 in Cracow (Leszczyński 2008, International Year of the Potato http://www.unic.un.org.pl/rok_ziemniaka/index.php).

Potato – an important plant worldwide

At the turn of the XIXth and XXth centuries potato spread over all continents. In 2007 its annual production amounted to 325 million tons (Tab. 1), and increased over the 10 last years by 4.5% (Leszczyński 2008). Over the years 1991-2007, a tendency was observed for decreasing crop of potato in developed countries and for increasing potato crops in developing countries. Global potato consumption and specific for selected European countries were depicted in Tab. 2 and 3, whereas crop yield was shown in Tab. 4 (International Year of the Potato <http://www.potato2008.org/>, Rynek ziemniaka 2008).

Tab. 1. World potato production in 2007.

Continent	Crop million tons	Yield tons/hectare
Asia/Oceania	137	15.7
Europe	130	17.4
North America	25	41.2
Africa	17	10.8
South America	16	16.3
World	325	16.8

Tab. 2. Potato consumption in kg/per capita/year in 2005.

Continent	Consumption kg/per capita/year
Asia/Oceania	23.9
Europe	87.8
North America	60.0
Africa	13.9
South America	20.7
World	31.3

Tab. 3. Potato consumption in selected countries in 2005.

Country	Consumption kg/per capita/year
Belarus	181
Ukraine	136
Russia	131
Poland (2007)	120
Lithuania	116
Latvia	114
United Kingdom	102
USA	54
Europe	96
World	31

Poland is one of the world greatest potato producers. Greater crop acreage of potato is only in China, Russia, Ukraine and India, whereas in terms of production Poland is at the seventh place worldwide and is holding a leading position in consumption per capita (Leszczyński 2008).

Tab. 4. Potato yield in selected countries in 2007.

Country	Yield tonnes/hectare
New Zealand	50.2
Netherlands	44.7
USA	44.6
Germany, Belgium	42.3
Japan	31.9
Egypt	24.8
Morocco	24.2
Poland	20.7
Pakistan	19.9
China	14.4
Ukraine	13.1
Russia	12.9
Peru	12.6
Bolivia	5.5
Nigeria	3.1
Europe	17.4
World	16.8

Potato is a plant of a great economical importance, mainly due to versatile utilisation of tubers. Its crops are intended for: direct human consumption, food processing (fried, frozen, dried, sterilised, semi-finished products), industrial processing (starch and distilling industry), feedstuff, and seeds (Lisińska 2004, Prośba-Białczyk 2008, Zarzecka 2006, Zgórska 2005). The usage of tubers for consumption has the greatest significance worldwide (app. 60%), in the Member States of the European Union (51%), and also in Poland (more than 34%) (Zarzecka and Wszyński 2006, Rynek ziemniaka 2008). Crop yield and quality depend on properties of cultivars (Lisińska 2006, Roztropowicz 1989, Zimnoch-Guzowska and Flis 2006), agrotechnical factors (Gruczek 2004, Krzysztofik 2008, Leszczyński 2002, Sawicka 2000, Zarzecka 2006) as well as weather conditions during plant vegetation (Leszczyński 1994b, Mazurczyk and Lis 2001). Tab. 5 depicts the effect of means of weed control using herbicides on potato tubers crop. Careful mechanical and chemical control eliminating weeds may increase the yield by 15-30% (Gruczek 2004, Zarzecka 2006)

Tab. 5. Potato tubers crop yield – average from years 2002-2004 (own studies and calculations).

Means of weed control	Tuber crop yield t·ha ⁻¹	Increase in crop yield in comparison to object 1	
		t·ha ⁻¹	%
1. Control object – mechanical cultivation	28.44 a	-	-
2. Plateen 41,5 WG	30.89 b	2.45	8.6
3. Plateen 41,5 WG + Fusilade Forte 150 EC	32.71 bc	4.27	15.0
4. Plateen 41,5 WG + Fusilade Forte 150 EC + adjuvant Atpolan 80 EC	34.00 c	5.56	19.5
Average	31.51	4.09	14.4

Values marked with the same letters are not significantly different at the level $p=0.05$

Potato cultivars

In 2008 in Poland there were registered 138 potato cultivars, including 80 cultivars grown in our country and 58 abroad. Out of the cultivars listed in the State Register, 104 were edible and 34 were starch cultivars (Lista odmian roślin rolniczych 2008). It should be emphasised that Polish cultivars equal in many respects the foreign ones and may compete with them. Moreover every region of Poland has its own name for the grey tuber (Nowacki 2004).

Tab. 6. Potato cultivars.

Cultivars	35 years ago	Nowadays
Number of cultivars in the register	35	138
Number of foreign cultivars	2	58
Edible cultivars	15	104
High starch cultivars	13	34
Multifunctional cultivars	7	-

Chemical composition and nutritional value

The potato is the world's fourth most imported food crop, following maize, wheat and rice. It should become one of the main nutritional components, since it is a rich source of energy and valuable food. Experts of the Food and Agriculture Organisation of the United Nations called people's attention to nutritional and wholesome properties of potato, for its proteins are very valuable and one middle-sized potato covers half the daily requirement for vitamin C and one-fifth of the requirement for potassium (Ceglarek and Zarzecka 2003, Leszczyński 1994a, 2000, Zarzecka and Gugafa 2008).

Tab. 7. Average nutritional value per 100 g of fresh potato tuber.

Components	
Energy: 87 kcal	Zinc 0.1 mg
Protein: 2 g	Copper 0.08 mg
Carbohydrate: 19g	Selenium 1µg
Fat: 0.1g	Nickel
Dietary fibre: 3.1g	Cobalt
Potassium 450 mg	Boron
Phosphorus 60 mg	Vitamin C 14 mg
Magnesium 22 mg	Vitamin B1 0.12 mg
Calcium 5 mg	Vitamin B2 0.04 mg
Sodium 2 mg	Vitamin B6 0..3 mg
Iron 0.5 mg	Nicotinic acid (niacin) 1.2 mg
	Folic acid 23 µg

Potato – a vegetable of the XXIst century – nutritional and dietetic values

Potatoes almost passed into oblivion in many houses. Quite a lot of people have regarded them as an outdated and ordinary vegetable. Rice, grits and pasta took over. Today they are returning on our tables with a great style, because:

- they are easily digestible and low calorific. The calorific value of potato is low and is comparable with the calorific value of apple or milk and is 4-5 times lower than that of wheat roll, hence the opinion that potatoes are fattening is completely unfounded unless we are pouring thick sauce or fat on them,
- protein of tubers has a high biological value – comparable to that of soy proteins or only slightly lower than that of egg proteins. It is very rich in exogenous amino acids, which are not synthesised by human organism,
- their dietary fibre is valuable as it improves digestion and development of proper gut microflora,
- potato tuber contains the entire Mendeleev's table – including both macro- and microelements. Especially valuable are: calcium, magnesium – they have a base-forming activity, their presence in the diet neutralises the acidifying activity of meat and cereals,
- potatoes are a rich reservoir of vitamins B1, B2, B6, PP, folic acid, nicotinic acid and especially valuable vitamin C. The intake of 200-300g of potatoes covers about 60% of organism requirement for this

vitamin (Karczmarczyk 1999, Leszczyński 2000, 2008, Lisińska 2006, Zarzecka 2006).

Some of vitamin C benefits to our organism:

- improves immunity of organism,
- has antibacterial properties,
- inhibits the formation of carcinogenic substances in the stomach,
- eases wounds healing,
- inhibits bruises,
- participates in red blood cells formation.

Culinary value of tubers is also of great significance:

- neutral odour and good flavour, they harmonise well with other products,
- their flouriness and viscosity classify them to different dishes ,
- flesh has various colours – white, creamy to yellow (the latter one contains carotenoids – antioxidant compounds).
- It is worth knowing that potatoes:
 - the less processed they are, the healthier and more valuable they remain,
 - just after harvesting they contain the largest amount of vitamin C – almost as much as lemon,
 - when cooked in large volume of water, they lose a number of vitamins, especially vit., C,
 - what is more, loss of vitamins is larger when the area exposed to temperature is larger, that is way we do not cut potatoes into small pieces before cooking,
 - tubers should be peeled as thinly as possible, because plenty of nutritional compounds are contained under the skin (Zawistowska 1983, Sikora *et al.* 2008).

It is worth reminding that that centuries ago the father of contemporary medicine – Hippocrates wrote, that “Let food be medicine”. Today, when it is known that most of diseases are induced by improper nutrition, prophetic words of the great physician may be assessed (Wiackowski 2001). Moreover, according to dieticians “potato is one of the best designed products by nature, it grows in perfect package and well stored remains fresh for a very long time” (Zawistowska 1983).

Healing power of tuber

The intake of potatoes is recommended for people suffering from hyperacidity, because they possess base-forming properties. Potato juice relieves stomach pains. In former medicine, many diseases were cured by potatoes. For example: burned skin was treated with a compress of raw grated potatoes, mist of boiling potatoes was inhaled to cure respiratory tract infections, raw potato juice was used to cure gastric and duodenal ulcers. Vitamins contained in tubers have been shown to destroy fungi and bacteria, prevent dilation of blood vessels. Furthermore, potatoes improve oxygen supply to brain, lower blood pressure, support the curing of allergies. A diet rich in potato starch lowers the risk of colon cancer and decreases the number of white blood cells. In one word: the more potatoes, the less diseases (Kaszak 1991, Karczmarczyk 1999, Nowiński 1970).

Potatoes – it is a great chapter of the Polish cuisine

Potatoes are consumed mainly unprocessed in Poland, boiled in water or steamed. In western countries, about 30-50% of potatoes are consumed in processed form, just to compare: in our country about 12% (Rynek ziemniaka 2008). The most frequently prepared dishes are: potatoes from water, potatoes with butter and dill, puree, potato pancakes, different types of potato dumplings, cutlets and noodles, potato soup, potato salads, various potato pies, French fries, chips, and fried potatoes (Zawistowska 1983). In terms of the number of recipes for potato dishes Poland is holding a leading position worldwide.

A national organisation „Association of Polish Potato” has been established in 2002 and has been integrating potato trade society. Furthermore, annual potato feasts are organised in almost every district e.g.: Dni Pyrlandii (Days of the Potato-land), Święto Pieczonego Ziemniaka (the Feast of Roasted Potato), Święto Ziemniaka (the Feast of Potato), and other regional feasts, e.g. Dokopiny, Pokopki. Potato has also been a subject to artists and writers, the latter being, among others, Adam Mickiewicz, Eliza Orzeszkowa, and Henryk Sienkiewicz. In turn, Julian Ursyn Niemcewicz in his „Podróżach historycznych po ziemiach polskich” („Historical travels around Polish potatoes”) wrote: „It should be confessed that, next to baptism, potatoes are the greatest kindness lent by the Heavens. We should owe America more gratitude for them than for ores of gold and silver, for fatal greed and tools”.

Summary

Potato is a plant of high economical importance due to the extensive utilization of tubers. It is mainly an edible plant with high nutritional, dietetic and wholesome values. Moreover, tubers are valuable materials for food and industrial processing as well as good feedstuff.

Potato cultivation plays an important role in agricultural production and has a key position in crop rotation, since it favourably influences soil fertility or yield of subsequent plants.

Abstract

The manuscript addressed an overview of potato nomenclature – from international names of the species, through national, folk, regional to cultivar names. It additionally outlined the history of potato incorporation to the European continent as well as its cultivation, production crop yield and consumption at a global, European and national level. Issues concerning the economic importance of potato, its chemical composition, nutritional, consumption, dietetic and health-promoting values were discussed as well.

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The article is a record of Author's lecture given during the Science Day on 7 March 2008, at State School of Higher Vocational Education in Biala Podlaska.