Reducing sugars, vitamin C and phenol compounds in potato tubers of various cultivars in Poland

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Introduction

The development of potato processing in the world and Poland places an obligation of high quality on potato producers. Potatoes for direct consumption as well as processing for foods should have suitable morphological traits and chemical composition. The latter one determines a flesh colour and susceptibility to darkening of cooked tubers and fried products. As the researches have showed [2,3,5] reducing sugars and phenol compounds contents are of the greatest weight in this respect. Vitamin C is another considerable component of a tuber.

A belief is held that most of this vitamin in a Polishman`s diet comes from a potato. A cultivar decides about a tuber chemical composition, yet the effect of the environmental and agrotechnical factors is also important [1,4]. On the other hand, new cultivars of higher utility parameters have been introduced and the old ones withdrawn. Hence, a necessity to carry out studies on a wide range of varieties cultivated in the same climatic, soil and agrotechnical conditions.

Materials and methods

The studies were based on the results of a field experiment conducted in 3 years` cycles on the soil developed from high loamy sand. The soil showed a medium to high phosphorus content, a high potassium content, whereas its reaction was from light acid to neutral.

The potatoes were fertilized with manure in dose of 250 dt ha^{-1} and mineral fertilizers in amounts of: 100 kgN, 100 kg P_2O_5, 150 kg K_2O ha^{-1}.

The seeding material of the tested varieties was at the degree of superelite.

The experiment comprised 34 following Polish cultivars: Aster, Atol, Beryl, Bliza, Bogna, Brda, Bronka, Bryza, Bzura, Certa, Ceza, Cisa, Dryf, Duet, Elida, Elipsa, Fala, Fauna, Fregata, Frezja, Heban, Irys, Ja•min, Lotos, Mila, Orlik, Perkoz, Pilica, Pola, Ronda, Ruta, Sokó•, Stobrawa, Tarpan and 3 Dutch ones: Diamant, Eskort and Premieur.

All earliness groups were used in the experiment.

The analyses on the fresh material of 50 tubers from each potato cultivar were made immediately after the harvest. Reducing sugars were determined by the colorimetric method with the dinitrosalicylic acid (DNS). Vitamin C was established by means of Tillman`s method and phenol compounds after Mopson and Swain`s method. Each analysis was repeated three times for each variation. The content of a particular tuber component was in g/100g fresh matter (reducing sugars) and in mg/100 g f.m. (vitamin C and phenol compounds)

The results obtained were statistically worked out by means of the analyses of variance while their verification was made according to Tukey`s test.

Results

Reducing sugars content

In the potato tubers examined reducing sugars changed from 0,22 to 0,48 g in 100 g of fresh mass (Tab.1). The influence of a cultivar factor was on the order of the effect of weather conditions in the experimental years. Analysis on the reducing sugars content in the tubers regarding a connection with a cultivar earliness did not show any significant dependence. In each earliness group there appear some varieties with medium or high content of this component. Only in a group of very early and early cultivars a reducing sugars content was placed at the lower levels compared to the other groups. In a 3 years` cycle only five cultivars i.e. Irys, Jasmin, Lotos, Perkoz and Ceza did not exceed a boundary of 0,3 mg reducing sugars content that determines the bulbs usability for chips production. In the tubers of the other cultivars the compounds content did not surpass 0,5 mg boundary value required for French fries production.

Comparing the reducing sugars content in the Polish and Dutch tubers from the same earliness groups and cultivated in the identical conditions it was found out that the tubers of Dutch cvs Diamant and Premieur demonstrated a greater deal of this content as against analogical Polish varieties.

Tab.1: Content of reducing sugars, vitamin C and phenol compounds in tubers of various potato cvs grown in Poland.

earliness group varieties	vitamin C mg/100g f.m.		phenol comp. mg/100g f.m.		red. sugars g/100g f.m.	
	sphere	**middle**	**sphere**	**middle**	**sphere**	**middle**
very early						
Aster	18,6 -23,9	21	25,8 - 34,6	31	0,22 - 0,35	0,29
Frezja	15,8 - 16,9	16,2	23,5 - 26,4	24,5	0,28 - 0,33	0,3
Irys	14,0 - 16,8	15,8	20,3 - 27,2	24,2	0,25 - 0,30	0,28
Orlik	17,6 - 20,1	18,6	20,2 - 23,4	22,3	0,29 - 0,35	0,32
Ruta	15,3 - 16,5	16	21,3 - 24,5	23,6	0,25 - 0,32	0,3
early						
Duet	14,2 - 16,8	15,5	30,4 - 35,3	33,2	0,33 - 0,35	0,34
Elipsa	14,6 - 16,9	16	23,5 - 26,3	24	0,33 - 0,35	0,34
Jasmin	13,7 - 15,8	14,8	25,5 - 30,2	27,2	0,25 - 0,30	0,28
Lotos	18,2 - 23,7	19,6	30,0 - 42,5	34,2	0,26 - 0,30	0,28
Perkoz	18,3 - 21,1	19,5	23,6 - 28,2	25,7	0,23 - 0,27	0,26
Premieur	13,2 - 14,8	14	21,2 - 26,0	23,4	0,34 - 0,40	0,36
middle early						
Beryl	18,2 - 18,7	18,4	30,7 - 37,2	33	0,29 - 0,38	0,35
Bliza	16,0 - 18,5	17,6	35,8 - 43,0	38,2	0,33 - 0,37	0,34
Elida	14,0 - 18,8	15,9	32,2 - 38,1	34	0,33 - 0,35	0,34
Fauna	18,5 - 22,5	20,2	34,5 - 42,1	38,3	0,33 - 0,43	0,37
Mila	19,8 - 24,1	20	32,5 - 39,5	36	0,28 - 0,43	0,39
Pola	18,5 - 21,2	19,7	16,5 - 20,3	18,3	0,28 - 0,44	0,36
Ronda	17,2 - 19,7	18,8	37,9 - 45,2	42,3	0,29 - 0,40	0,38
Eskort	15,4 - 18,5	17,2	21,3 - 27,4	25,2	0,26 - 0,36	0,29

middle late						
Atol	18,2 - 19,7	18,7	34,8 - 43,2	37,5	0,24 - 0,32	0,29
Bogna	13,4 - 16,7	15,8	33,5 - 38,2	36,3	0,28 - 0,35	0,31
Brda	18,3 - 21,2	19,6	36,4 - 42,8	40	0,42 - 0,45	0,43
Bryza	19,4 - 23,5	21,6	38,3 - 45,0	42,2	0,29 - 0,45	0,41
Certa	17,4 - 21,1	18,9	37,2 - 44,5	40	0,25 - 0,35	0,29
Cisa	19,8 - 25,7	22,8	35,7 - 45,0	37,8	0,32 - 0,37	0,35
Fala	25,2 - 26,9	26,1	30,8 - 36,4	34	0,36 - 0,48	0,43
Foka	18,5 - 21,4	20,4	30,7 - 37,8	33	0,26 - 0,32	0,28
Sokós	20,3 - 25,5	23,9	23,4 - 27,6	25,3	0,26 - 0,42	0,35
Diamant	18,8 - 22,6	20,5	32,0 - 38,6	36,3	0,36 - 0,46	0,43
late						
Bronka	15,4 - 18,3	16,8	24,6 - 33,5	30,5	0,29 - 0,39	0,37
Bzura	18,5 - 23,5	21,5	33,2 - 38,8	35,4	0,29 - 0,36	0,33
Ceza	17,1 - 22,4	20,3	28,5 - 36,8	33,4	0,26 - 0,29	0,28
Dryf	17,8 - 23,7	19,9	40,3 - 45,2	42,2	0,41 - 0,43	0,42
Heban	13,2 - 16,8	15,2	38,6 - 45,8	42	0,22 - 0,35	0,29
Pilica	15,2 - 19,7	16,7	34,0 - 42,8	37,5	0,31 - 0,40	0,39
Stobrawa	13,2 - 18,5	16	34,1 - 42,6	38	0,33 - 0,45	0,4
Tarpan	16,0 - 22,5	20,6	24,5 - 32,8	28,2	0,31 - 0,40	0,37
$LSD_{0.05}$		1,88		6,1		0,07

Vitamin C

In the 37 potato cvs cultivated in the same climatic and soil conditions this vitamin occurred in concentration 13,2-23,5 mg in 100g of fresh mass tubers (Tab.1). The analysis of results did not demonstrate any significant differences in the component content conditioned by a vegetative period length of a cultivar. Only in the tubers from of medium and late varieties groups there were recorded a significant higher content of vitamin C. The tubers of Fala cv had the highest vit. C content (25,2-26,9 mg), while the lower contents were noted for the tubers of the Dutch early Premieur cv.

Phenol compounds

Their content in the tubers under investigation ranged from 24,5 - 45,8 mg in 100 g of fresh mass (Tab.1). The greatest number of phenol compounds was noted in the tubers of the following cultivars: Ronda, Bryza, Heban, Certa and Brda numbered among medium late and late ones. In comparison with these cultivars the tubers of early and medium early cvs contained significantly less number of phenol compounds.

Conclusions

1. The reducing sugars content in the tubers examined did not exceed 0,5 g in 100 g of fresh mass permissible for French fries production and in the tubers of Irys, Jasmin, Lotos, Perkoz and Ceza 0,3 g permissible for chips.

2. The tubers under investigation showed a low/medium vitamin C content and its greater concentration was recorded in the tubers of Fala and Sokól cvs, while in the tubers of a Dutch Premieur one -very low concentration.

3. Phenol compounds content was placed at the medium and high level. The tubers of the late cultivars showed a higher accumulation of these compounds as compared to the very early and early varieties.

4. The tubers of Premieur and Eskort cvs contained less amount of vitamin and phenol compounds, whereas Diamant and Premieur more reducing sugars than tubers of the Polish varieties numbered among the same earliness groups.

Literature

1. Mazurczyk W., 1988, Sklad chemiczzny dojrzalych bulw 43 odmian ziemniaka. *Biul. Inst. Ziemnia*. 37, 11-20
2. Mopson L. W., Swain T., Tamelin A.W., 1963, Influence of wariety, cultural conditions and temperature of storage on enzymic browning of potato tubers *J. Sci. Fd. Agric*. 14,673-684
3. Roztropowicz S., Zgórska K., 1984 Uprawa odmian ziemniaka do przetwórstwa przemyslowego PWRiL, Poznan
4. Roztropowicz S., 1988, Srodowiskowe, odmianowe i nawozowe zródla zmiennosci skladu chemicznego bulw ziemniaka. Fragmenta Agronomika.
5. Zgórska K., 1979, Czynniki warunkujace cechy jakosci ziemniaka jadalnego. Ziemniak *The Potato*, 183-206