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Minerals and Amino Acids in Peach (Prunus persica L.) Cultivars and Hybrids Belonging to World Germoplasm Collection in the Conditions of West Romania

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Abstract

In this study carried out, the nutritional profile of 19 peach cultivars and hybrids from west side of Romania in terms of selected amino acids, macro and microelements content. Amino acids (arginine, lysine, alanine, phenylalanine, tyrosine, serine and glycine) were detected and quantified using DIONEX ICS-3000 system, while the macroelements (K, Ca, Mg) and microelements (Fe, Cu, Zn, Mn) were determined by atomic absorption spectroscopy (Varian 220 AAS equipment). The obtained results showed major differences in content of individual aminoacids in peach fruits. Alanine, responsible for the sweet taste of fruit, but also lysine and arginine are found in higher quantities. The cultivars 'JULY ELBERTA' and HB4/81 presented higher arginine content, 'MARQUEEN' and IFF853 lysine and 'MARIANA' variety has alanine and phenylalanine more than other cultivars. The macro and microelements profile depended on cultivar and increased in following order: K>Mg>Ca>Fe>Zn>Cu>Mn.

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Keywords: peach; amino acids; macro and microelements

1. Introduction

The peach (*Prunus persica* L.) is a fruit tree species cultivated in most countries in Europe, but the big production of about 4 million tons is produced in several countries, such as: Italy, Spain, Greece, France. On the Asian continent but also in the world, the supremacy is holding by China.

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Romania represents the northern efficient culture area, being favourable for this tree culture (Grădinaru, 2002). High demand for these fruit is determined by its quality and technological characteristics, such us: pulp fineness, specific flavor, richness in sugar content, acidity and other useful substances for human body.

Bioactive compounds with significant antioxidant activity were found in high concentration during early stage of peach development (Lombardo, 2011). The peach are considered among the first 3-5 fruit species regarding flavor and complex chemical composition, comprising: 10.0-21.5% dry matter, 5-12% total sugar, 0.4-1.3% protein, 0.2-0.7% pectin, 0.6-0,86% minerals (K, P, Mg, Ca, Na, Mn, Fe, Cu, Zn) and vitamin C, B1, B2, B6, E (Iordanescu et Micu, 2012).

Antioxidant activity, high content of polyphenols and their positive effect on health has been studied by Gasparotto et al. (2014), Raseira et al. (2014), Campbell et al. (2013), Montevecchi et al. (2012). Fresh peaches fruit stimulates gastric secretion, facilitates digestion, being indicated in acute infection diseases, blood pressure and arteriosclerosis, reduce blood cholesterol content and is used in the prophylaxis of cardiovascular and renal diseases and anemia. Peaches fruit are appreciated by consumers, both for fresh consumption and industrialized for jam, compotes, nectar, as frozen fruits, liqueurs, spirits and others.

The chemical composition of fruits determined their nutritional value. Amino acids are important compounds for the taste of fruits. Amino acids can be tasteless (arginine, asparagine, isoleucine, threonine, valine, lysine, serine), bitter (leucine, tyrosine, phenylalanine, tryptophan,) or sweet (proline, alanine) (Sochor, 2011).

The purpose of this paper is to evaluate the nutritional significance of some peach varieties less cultivated in Romania on the basis of selected amino acids, microelements (Mn, Cu, Fe and Zn) and macroelements (K, Ca and Mg) content.

2. Research methods

2.1. Plant material

Peach fruits were harvested from 19 cultivars and hybrids maintained in a collection orchard of the Didactic Station Timisoara (210°13`E longitude, 45045` N latitude) of Banat's University of Agricultural Sciences and Veterinary Medicine ``King Michel I of Romania`` from Timisoara. The studied fruits belong to the harvest from 2013. The sample characteristics are presented in table 1.

Table 1. Peach characteristics

Sample	Genotype	Characteristics
1	SUN HUI HUN	cultivar
2	IFF 926	hybrid
3	POLI	cultivar
4	START	cultivar
5	GOLD DUST	cultivar
6	PIROS MAGDALENA	cultivar
7	EUREKA	cultivar
8	GIALA DI ROMA	cultivar
9	HB-18-9	hybrid
10	SPRINGOLD	cultivar
11	P5	hybrid
12	P1	hybrid
13	YINQING	cultivar
14	JULYELBERTA	cultivar
15	90004061	hybrid
16	MARQUEEN	cultivar
17	HB4/81	hybrid
18	MARIANNA	cultivar
19	IFF 853	hybrid

2.2. Analysis of macro and microelements

Samples of 3 g of blended apricots were burned 8 h at 550°C in furnace (Nabertherm B150, Lilienthal, Germany). The ash was dissolved in HCl 20% and was brought to 20 ml in a volumetric flask. The macroelements (K, Ca, Mg) and microelements (Fe, Cu, Zn and Mn) were determined by AAS (Varian 220 FAA equipment). Mix standard

solutions (ICP Multielement Standard solution IV CertiPUR) were purchased from Merck. All chemicals and solvents used in this study were of analytical grades. The results were expressed as related to the fresh weight (FW) basis. Each value is the mean of three (n=3) independent determinations.

2.3. Analysis of amino acids

Sample sizes of 0.5 g were hydrolyzed in 10 mL 6-N hydrochloric acid for 24 h at 110 °C. The sample is filtered through the filter Milipore 0.2 μm, diluted sample compared 1:10 with HCl 0.1N and injected into the chromatograph. Chromatographic conditions: Column chromatography AMINOPAC PA10 (2x250 mm, P/N 055406), Precolumn AMINOPAC PA10 (2x50 mm, P/N 055407), gradient: water/NaOH 250 mM/sodium acetate 1 M, flow rate of mobile phase: 0.25 mL/min, Reference electrode: pH/Ag/AgCl, temperature of column 30°C.

3. Results and Discussions

3.1. Amino acids content

The experimental results regarding amino acids content are presented in table 2.

Table 2. The amino acids composition of peach cultivars and hybrids (g/1000 g FW)

Sample	Arg	Lys	Ala	Phe	Tyr	Ser	Gly
1	0.07	0.07	0.05	0.12	0.06	0.11	0.20
2	0.15	0.22	0.07	0.14	0.08	0.12	0.04
3	0.97	0.90	0.47	0.10	0.06	0.05	0.03
4	0.78	0.52	0.16	0.10	0.21	0.08	0.20
5	0.99	0.33	0.53	0.03	0.11	0.13	0.20
6	1.02	0.88	0.26	0.08	0.12	0.11	0.22
7	0.55	0.58	0.66	0.38	0.28	0.20	0.29
8	1.08	0.89	0.46	0.27	0.16	0.13	0.21
9	0.87	0.74	0.14	0.06	0.11	0.10	0.26
10	1.03	0.52	0.18	0.10	0.13	0.09	0.24
11	0.59	0.78	0.16	0.44	0.10	0.08	0.35
12	0.78	0.66	0.18	0.27	0.22	0.12	0.30
13	0.91	0.41	0.28	0.20	0.06	0.11	0.21
14	1.27	0.64	0.26	0.30	0.12	0.03	0.03
15	0.99	0.37	0.21	0.61	0.16	0.07	0.06
16	0.96	1.19	0.24	0.28	0.11	0.12	0.16
17	1.33	0.85	0.20	0.22	0.06	0.13	0.39
18	0.90	0.86	0.46	0.62	0.01	0.14	0.49

Amino acids occur in fruits in free form, or more commonly bound in proteins and non-protein compounds (Sochor, 2011). Amino acids are also important for the taste of fruits. They increase the taste of other compounds and they have their own tastes ranging from tasteless (arginine, asparagine, isoleucine, lysine, serine, threonine, valine) to bitter (leucine, phenylalanine, tryptophan, tyrosine) and sweet (proline, alanine) (Sochor, 2011).

Arginine (Arg) is an essential amino acid like lysine usually accompanying the protamines and histones of polypeptide chain but is also found in others proteins. In free form, arginine is found as an intermediate produce of various metabolic pathways and metabolic sequences such as, for example ureogenetic cycle and creatinine hiosintesa (Cojocaru and Sandu, 2004).

The arginine content in studied cultivars was registered between 0.07g/1000 g FW sample, in SUN HUI HUN cultivar and 1.33 g/1000g FW sample in HB4/81 hybrid. The cultivar JULY ELBERTA presented also higher arginine content (1.27 g/1000g FW sample).

Lysine (Lys) is an essential amino acid with content in native proteine which varies greatly depending on the source and the biological role they play. Lysine is taken by food and near tryptophan, histidina and vitamin A is considered growth factor, being very important in the diets of children. The lack of lysine in cereals, for example, made inoperative protein synthesis, even if others amino acids are presented (Cojocaru and Sandu 2004). The content of lysine in peach samples studied varies within wide limits between 0.07 g/1000g FW sample SUN HUI HUN cultivar and 1.22 g/1000g FW sample in IFF 853 hybrid.

α-Alanine (Ala) is an non-essential amino acid very spread in most vegetal protein. Thanks to its hydrocarbon moiety to give hydrophobic interaction, α-alanine plays an important role in the structural organization of the protein (Cojocaru and Sandu 2004). The content of alanine in studied sample varies between 0.05 g/1000g FW sample in SUN HUI HUN cultivar and 0.66 g/1000g FW sample in EUREKA cultivar. Alanine, responsible for the sweet taste of fruit, is found in large quantity in: POLI, GOLD DUST, EUREKA and MARIANNA cultivars.

Phenylalanine (Phe) is an essential amino acid present in almost all natural protein. The MARIANA cultivar is characterized by great content in phenylalanine (0.62 g/1000g FW sample) near P1 hybrid (0.44 g/1000g FW sample). The small content in phenylalanine was found in SUN HUI HUN cultivar.

Tyirosine (Tyr) is an essential amino acid found in some protein with vegetal origin, while animal protein contains moderate amounts of this amino acid. Its phenolic group confers s tyrosine an acidic character. The EUREKA cultivar and P1 hybrid presents maximum values of tyrosine content (0.28 and 0.22 g/1000g FW sample).

Serine (Ser) is a non essential amino acid very spread in nature. Serine is found in majority of glycoproteine which serves to bind the residues of polypeptide by oligosaccharide chains. Content of serine in studied cultivars varies between 0.08 g/1000g FW sample P5 hybrid and 0.20 g/1000g FW sample in PIROS MAGDALENA cultivar. The great content of glycine (Gly) was registered in MARIANNA cultivar (0.49 g/1000g FW sample). Comparable values in amino acids content was reported by Hye Ryun et al. (2014).

3.2. Macro and microelements content

The experimental results regarding macro and microelements content are presented in tables 3-4.

Table 3. Macroelements composition (mean ± SD, n=3) of peach cultivars and hybrids (mg/100 g FW)

Sample	K	Ca	Mg
1	101.6±0.5	10.0±0.7	5.66±1.5
2	103.0±0.1	9.78±1.1	5.54±0.5
3	98.0±0.3	10.5±2.5	6.00±2.6
4	104.0±0.2	11.0±5.0	4.90±4.5
5	99.0±0.07	9.55±3.5	5.28±0.7
6	98.2±0.10	9.33±2.3	4.64±4.3
7	103.0±1.3	10.7±1.3	4.80±3.2
8	97.0±1.5	10.35±0.5	4.78±0.5
9	102.0±2.4	9.65±0.7	4.64±0.7
10	106.0±1.3	9.80±1.5	4.66±1.1
11	102.6±3.4	10.20±0.2	5.86±5.5
12	104.0±2.1	9.95±1.2	5.64±0.2
13	102.8±4.5	11.31±0.5	6.82±2.4
14	105.2±3.4	9.76±4.5	5.90±1.3
15	100.0±5.0	9.63±3.3	5.92±8.2
16	105.2±0.5	9.81±0.7	5.50±2.2
17	99.4±0.6	9.54±1.1	5.88±3.5
18	100.0±3.6	9.90±2.2	6.44±0.5
19	97.6±4.5	9.21±0.6	6.00±1.0

Table 4. Microelements composition (mean ± SD, n=3) of peach cultivars and hybrids (mg/100 g FW)

Sample	Zn	Fe	Cu	Mn
1	0.28±0.2	0.344±0.8	0.013±0.6	0.020±0.2
2	0.22±0.4	0.272±2.4	0.026±1.2	0.034±1.0
3	0.26±2.3	0.250±1.2	0.025±4.5	0.032±5.6
4	0.27±1.2	0.370±3.6	0.021±2.4	0.026±2.5
5	0.41±5.6	0.400±5.6	0.015±2.4	0.020±2.4
6	1.84±3.4	0.430±0.8	0.019±0.8	0.028±6.7
7	1.80±0.5	0.392±3.6	0.014±4.5	0.029±0.7
8	0.40±1.1	0.350±7.2	0.025±1.3	0.034±1.0
9	0.26±0.5	0.368±4.5	0.017±2.2	0.027±4.5
10	0.20±2.5	0.396±3.4	0.020±0.8	0.031±1.0
11	0.32±5.6	0.390±2.5	0.021±1.2	0.035±0.5
12	0.24±4.5	0.420±0.5	0.018±2.5	0.022±2.5
13	0.19±1.2	0.420±1.2	0.030±2.4	0.027±0.9
14	0.24±0.9	0.480±0.7	0.024±0.5	0.025±0.4
15	0.30±2.4	0.300±5.6	0.038±1.0	0.031±1.1
16	0.17±1.2	0.360±2.6	0.014±0.6	0.022±2.5
17	0.19±0.6	0.280±9.0	0.027±1.0	0.026±6.5
18	0.16±2.4	0.288±2.5	0.030±0.6	0.021±0.5
19	0.17±5.6	0.374±0.8	0.017±5.4	0.035±1.1

The macro and microelements profile depended on cultivar and increased in order: K>Mg>Ca>Fe>Zn>Cu>Mn.

The macroelements (K, Ca, Mg) are indispensable for plant methabolism, participating in the aminoacid and proteine synthesis. Trace elements in plant nutrition decreases their growth and development.

In the analyzed peach cultivars and hybrids, K content varies between 97.0 mg/100g FW in GIALA DI ROMA cultivar and 106.0 mg/100 g FW value found in SPRINGOLD cultivar. Hussain et al. (2010) reported 490-520mg/100g DW in different cultivars. Similar values were reported by Gogoasa (2003) in different fruits.

Ca content was found in lower values in IFF 853 hybrid, while the highest value was obtained for YINQING cultivar (11.31 mg/100 g FW).

Regarding Mg content, YINQING cultivar had the highest content (6.82 mg/100g FW) and PIROS MAGDALENA and HB 18-9 presented the lower Mg content (4.64 mg/100 g FW).

The microelements are essential components of enzyme systems. Location has been reported to influence the mineral element compositions of plants Soetan et al. (2010).

In terms of microelements content, iron represents the principal element in the analyzed samples. Fe content varies between 0.250 mg/100g FW in POLI cultivar and 0.480 mg/100 g FW in JULY ELBERTA cultivar. Hussain, 2010 reported that the Fe level in apricots varies between 1.4-2.4 mg/100 g DW depending on cultivar.

The highest Zn content was recorded in PIROS MAGDALENA and EUREKA cultivars (1.84, respectively 1.80 mg/100 g FW). Cu and Mn were detected in lower quantity in peach cultivars and hybrids. Cu content ranged between 0.013 in SUN HUI HUN cultivar and 0.038 mg/100 g FW in 90004061. Mn content was detected between 0.02 mg/100 g FW in SUN HUI HUN and 0.035 mg/100 g FW in P5.

4. Conclusions and Recommendations

The cultivars and hybrids derived from different areas in the world grown in Romanian soil and climate conditions are significant sources of amino acids, macro and microelements.

The higher arginine content was registered on the JULY ELBERTA cultivar and HB4/81 hybrid.

The higher alanine content (responsible for sweet taste of fruits) was registered on the EUREKA, GOLD DUST

and POLI cultivars and the lowest alanine content was registered on SUN HUI HUN cultivar and IFF 926 hybrid. The MARIANNA cultivar has alanine and phenylalanine more than other cultivars.

Most balanced in terms of content in macronutrients were: SPRINGOLD, EUREKA and STAR cultivars (for K and Mg content) and YINQING and MARIANNA (for Mg and Ca content). The lowest content in macronutrients was registered in fruits of hybrids: IFF926, HB4/81 and the cultivar PIROS MAGDALENA.

The macro and microelements profile depended on cultivar and increased in order: K>Mg>Ca>Fe>Zn>Cu >Mn.

The best results were obtained by EUREKA, GOLD DUST and POLI cultivars.

The nutritional and commercial potential of peach fruits in combination with the favorable climatic conditions recommend widespread cultivation of these trees in the western part of Romania.

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