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THE EVALUATION OF VITAMIN C CONTENT IN FRUITS OF VEGETABLE PEPPER AND TOMATO

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Abstract

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In our research were evaluated sixteen varieties of vegetable pepper in technical ripe and twenty-eight tomato varieties in content of vitamin C in mg.kg^{-1}. The experimental works were made on the open field and in the laboratories of the Research Institute of Vegetables in Nové Zámky, Slovak Republic. The trials have been made in years 2005, 2006 and 2007.

The average vitamin C content of fruits in the technical maturity of all sixteen pepper varieties evaluated in 2005 was 1 813.06 mg.kg^{-1}. In the year of 2006, the average content of vitamin C was 1 909.43 mg.kg^{-1} and in the third experimental year 2 392.49 mg.kg^{-1}. When analyzing the variance of vitamin C, varieties are the sources of the significant variability (F = 2.08). Years as factors of variability are highly significant different (F = 28.78).

The mean vitamin C content in tomato fruits in the year 2005 was 317.63 mg.kg^{-1}, in 2006 the mean value of vitamin C was 345.09 mg.kg^{-1} and in 2007 the average content was 316.14 mg.kg^{-1}. The tomato varieties and years were the source of the variability factors and highly significant different (F = 6.85, F = 16.27) by the Fisher test.

vegetable pepper; tomato, vitamin C

Peppers and tomatoes are the fruit bearing vegetables. They form a relatively large group of vegetables that can be grown in our southern areas of Slovakia in field and in protected conditions as well. The vegetables in total including arable land and home gardens are currently growing at an area about 28 000 ha (Jureková et al., 2005). This area is 18 percent of peppers and tomatoes.

Peppers and tomatoes grown in field conditions are mostly harvested for direct consumption in the technical maturity. In our research we focused on vitamin C content as a sign of fruit quality in the technical maturity. Vitamin C, which occurs in vegetable fruits as ascorbic acid, has a significant presence in human nutrition. It positively affects the human body resistance to diseases of the immunity weakening.

MATERIAL AND METHODS

The biological materials and climatic data

The level of vitamin C in fruits of vegetable pepper (*Capsicum annuum* L.) and tomato (*Lycopersicon esculentum* Mill.) in the technical maturity was assessing. The crops were grown in field conditions and harvested in the technical maturity. There were used sixteen varieties of peppers (Tab. IV) and twenty-eight cultivars of tomatoes (Tab. V). Monitored varieties were selected from the collections of genetic resources of the Research Institute of Vegetables. The analysis of vegetables phenological relationships were made in Nové Zámky, which is located in Danubian Lowland, represented by the climate station Hurbanovo (altitude: 115 m, latitude: 47°52′, longitude: 18°12′. Average temperature, rainfall and sunshine during the growing season for years 2005, 2006 and 2007 are presented in tables I, II and III.

I: *Year 2005*

Month	June	July	August	September	The mean of the growing season
Rainfall (mm)	54	63	90	45	63
Temperature (°C)	19.1	21.1	19.0	16.9	19
Sunshine (h)	274	231	199	184	222

II: *Year 2006*

Month	June	July	August	September	The mean of the growing season
Rainfall (mm)	49	25	86	26	46.5
Temperature (°C)	19.9	24.0	18.3	17.7	20.0
Sunshine (h)	184	274	357	239	263.5

III: *Year 2007*

Month	June	July	August	September	The mean of the growing season
Rainfall (mm)	57	26	95	75	63.25
Temperature (°C)	22.0	23.1	21.6	13.8	20.0
Sunshine (h)	278	328	255	184	261.25

Method of assessment of vitamin C

The vitamin C content was provided according to Whatman paper chromatography method in vegetable pepper and tomato fruits, grown in field conditions (Hegedüsová, Musilová, Jomová, Hegedüs, Bystrická; 2007). The results represent averages of ten fruits from each variety in $mg.kg^{-1}$ of fresh matter.

Establishment of trial

Experimental plots were established on land of Research Institute of Vegetables in Nové Zámky, Slovak Republic. Seeds of pepper and tomato varieties were sown in a protected area for seedlings growing. Experiments were based on a sandy loam soil. There were used conventional cultivation methods and treatment against diseases and pests in accordance with applicable methodology for plant protection (Valšíková et al., 1996). The evaluation examined qualitative character in period of three experimental years from 2005 to 2007.

Planting spacing and size of experimental area

Vegetable pepper

The seedlings were planted in the space 0.60 × 0.30 m in triplicate. One repetition was planted for 20 plants and together for 60 plants per variety. The area for one variety was 10.80 m^2. The total area of the experiment in the field of pepper varieties was 172.80 m^2 per year.

Tomato

Tomato transplants were planted in plots to double rows. Space of planting was 1.30 + 0.40 × 0.40 m in triplicate. In one repetition was planted 20 plants. Total for one variety, there were 60 plants. The area for one variety as experimental field was 5.1 × 4 m = 20.40 m^2. The total area for tomato field experiment was in all three experimental years of 571.20 m^2.

RESULTS AND DISCUSSION

Vegetable pepper

The highest vitamin C content of fruit in the year 2005 had a variety Bohatýr (2 090.90 $mg.kg^{-1}$) and the lowest variety Dolmy (1 417.60 $mg.kg^{-1}$). The average vitamin C content of fruits in the technical maturity of all sixteen varieties in 2005 was 1 813.06 $mg.kg^{-1}$.

In 2006, the highest vitamin C content of fruits have had the variety Podarok Moldavy (2 421.70 $mg.kg^{-1}$) and the lowest variety Bohatýr (1 411.30 $mg.kg^{-1}$). In the year of 2006, the average content of vitamin C was 1 909.43 $mg.kg^{-1}$. In 2007 there was a high content of vitamin C in fruits of variety Čerešňová (2 885.80 $mg.kg^{-1}$). The lowest content was found in the variety Lastočka (2 033.60 $mg.kg^{-1}$). The average vitamin C content was in the third experimental year 2 392.49 $mg.kg^{-1}$, (Tab. VI). Valšíková, Minárová, Pauková (1984) find the average vitamin C content in green fruits in the evaluated range 962.00 $mg.kg^{-1}$. In our research was the range of Vitamin C content in fruits of the technical maturity considerably higher. Valšíková (1986, 1989) has noticed the average value of Vitamin C content in green pepper fruits as 1 829.60 $mg.kg^{-1}$, which is comparable to the value of our measured results. Valšíková, Králová (1999) published the mean values of vitamin C in assortment of technical ripe peppers for the years from 1996 to 1998. While in 1996 it was 1 781.30 $mg.kg^{-1}$,

IV: *Biological material of vegetable peppers*

No.	Name of variety	Origin	Year of registration in Slovakia
1.	Aurea	Slovakia	2003
2.	Bohatýr	Czech	Unregistered
3.	Botond	Hungary	Unregistered
4.	Čerešňová	Czech	1976
5.	Dolmy	The Netherlands	1994
6.	Evita	Hungary	2000
7.	Fok	Slovakia	Unregistered
8.	Jova	Czech	1989
9.	Kecskeszarv	Hungary	2001
10.	Kozí roh	Slovakia	Unregistered
11.	Lastočka	Moldavia	Unregistered
12.	Malá štipľavá	Slovakia	Unregistered
13.	Podarok Moldavy	Moldavia	Unregistered
14.	Srbská	Serbia	Unregistered
15.	Táltos	Hungary	1996
16.	Tuba	Hungary	1998

in 1997 it was 1 723.40 mg.kg^{-1} and in 1998, the value of Vitamin C content was 1 785.50 mg.kg^{-1}. These values are comparable to our results for years 2005, 2006 and 2007. Kopec (1998) provides the technical maturity of the fruit content of vitamin C in value of 1 200 mg.kg^{-1}, which is lower than our values. Pokluda (2004) gives the average content of vitamin C in fruits of pepper in the technical maturity of 1690 mg.kg^{-1}, which is comparable with values in our experiments.

During followed years was generally found a high content of vitamin C in the samples of tested cultivars. The high coefficient of variation occurred in varieties Kozí roh and Bohatýr (Tab. VI). When analyzing the variance of vitamin C for sixteen cultivars and years 2005, 2006 and 2007, varieties are the sources of the variability. The factor is demonstrably statistically different (F = 2.08) as a genuine expression of the diversity characteristic of the variety. Years as factors of variability of the character are highly significant different (F = 28.78), finding that results from the Fisher test results (Tab VIII).

Tomato

Vitamin C content in 2005 ranged from 202.60 mg.kg^{-1} (Denár variety) up to 371.20 mg.kg^{-1} (Ruslan variety). The average vitamin C content was 317.63 mg.kg^{-1}. In 2006, the highest vitamin C content was found in the variety Tondino Cherry (404.10 mg.kg^{-1}) and lowest in variety Green Husk Tomatillo (211.00 mg.kg^{-1}). The mean value of vitamin C in tomato fruits in the year 2006 was 345.09 mg.kg^{-1}. In 2007, the highest content of vitamin C found in a variety Tondino Cherry (374.60 mg.kg^{-1}). The lowest content was in variety Green Husk Tomatillo (221.00 mg.kg^{-1}). The average content in tomato fruits was 316.14 mg.kg^{-1}, (Tab. VII).

V: *Biological material of tomatoes*

No.	Name of variety	Origin	Year of registration in Slovakia
1.	Alie Parusa	Moldavia	Unregistered
2.	Balada	Slovakia	Unregistered
3.	Červená hruštička	Slovakia	Unregistered
4.	Dar	Slovakia	Unregistered
5.	Denár	Czech	1988
6.	Diana	Czech	1994
7.	Dikal Roza	Serbia	Unregistered
8.	Flamenko	Serbia	Unregistered
9.	Green Husk Tomatillo	The Netherlands	Unregistered
10.	Chocolate	The Netherlands	Unregistered
11.	Krona	The Netherlands	Unregistered
12.	Kubok Moldavy	Moldavia	Unregistered
13.	Mariošky	Moldavia	Unregistered
14.	Nadežda	Moldavia	Unregistered
15.	Nota	Slovakia	Unregistered
16.	Novinka	Slovakia	Unregistered
17.	Očarovanie	Slovakia	Unregistered
18.	Odriad	Moldavia	Unregistered
19.	Oniks	Moldavia	Unregistered
20.	Oranžové plochoguľovité	Slovakia	Unregistered
21.	Potok	Slovakia	Unregistered
22.	Rif	Slovakia	Unregistered
23.	Robura	Slovakia	1989
24.	Ruslan	Moldavia	Unregistered
25.	Sojuz F1	Moldavia	Unregistered
26.	Sultán	The Netherlands	2001
27.	Tondino Cherry	Serbia	Unregistered
28.	Venec	Slovakia	Unregistered

Content of vitamin C in mg.kg^{-1} at varieties in 2005, 2006 and 2007 was statistically evaluated. The results showed genetic diversity of varieties. The analysis of variance measured vitamin C content in fruits of 28 tomatoes varieties showed the variability of varieties and years. The varieties and years are the source of the variability factors statistically highly significant different (F = 6.85, F = 16.27) by the Fisher test (Tab. IX).

VI: *Average content of vitamin C pepper fruits (mg.kg^{-1})*

No.	Variety	2005	2006	2007	Average	S_x	V_k
1.	Aurea	1 745.40	2 133.00	2 687.50	2 188.63	386.62	17.66
2.	Bohatýr	2 090.90	1 411.30	2 651.30	2 051.17	507.01	24.71
3.	Botond	1 940.30	1 956.60	2 330.50	2 075.80	180.22	8.68
4.	Čerešňová	2 064.30	2 245.30	2 885.80	2 398.47	352.43	14.69
5.	Dolmy	1 417.60	1 971.70	2 243.00	1 877.43	343.50	18.29
6.	Evita	1 958.00	1 587.70	2 403.20	1 982.97	333.39	16.81
7.	Fok	1 816.20	2 293.40	2 139.10	2 082.90	198.83	9.54
8.	Jova	1 683.30	1 571.70	2 243.30	1 832.77	293.84	16.03
9.	Kecskeszarv	1 851.70	1 924.50	2 544.60	2 106.93	310.90	14.75
10.	Kozí roh	1 515.00	1 571.70	2 582.40	1 889.70	490.35	25.94
11.	Lastočka	1 771.90	1 988.70	2 033.60	1 931.40	114.26	5.92
12.	Malá štipľavá	1 943.00	2 117.00	2 452.50	2 170.83	211.45	9.74
13.	Podarok Moldavy	2 037.70	2 421.70	2 565.60	2 341.67	222.82	9.51
14.	Srbská	1 754.00	1 852.40	2 120.20	1 908.87	154.74	8.10
15.	Táltos	1 461.80	1 547.60	2 042.10	1 683.83	255.74	15.18
16.	Tuba	1 958.00	1 956.60	2 355.20	1 985.57	39.98	2.01
	Average	1 813.06	1 909.43	2 392.49	-	-	-

Sx – standard deviation, Vk – coefficient of variation

VII: *Average content of vitamin C in tomato fruits (mg.kg^{-1})*

No.	Variety	2005	2006	2007	Average	S_x	V_k
1.	Alie Parusa	357.10	352.40	335.50	348.47	9.09	2.60
2.	Balada	297.50	343.00	321.00	320.50	18.57	5.79
3.	Červená hruštička	324.20	371.20	350.00	351.47	19.91	5.66
4.	Dar	333.60	322.50	302.10	319.40	13.04	4.08
5.	Denár	202.60	356.90	320.50	293.33	65.85	22.45
6.	Diana	296.20	310.10	291.00	299.10	8.06	2.69
7.	Dikal Roza	351.60	357.10	325.20	344.63	13.92	4.04
8.	Flamenko	328.90	357.10	311.17	332.39	18.91	5.68
9.	Green Husk Tomatillo	218.00	211.00	221.00	216.67	4.18	1.93
10.	Chocolate	344.10	371.20	366.40	360.57	11.80	3.27
11.	Krona F1	305.40	305.54	265.40	292.11	18.88	6.46
12.	Kubok Moldavy	287.90	352.40	322.70	321.00	26.95	8.21
13.	Mariošky	361.80	361.80	306.60	343.40	26.02	7.58
14.	Nadežda	351.10	352.40	311.20	338.23	19.12	5.65
15.	Nota	351.10	352.40	311.20	338.23	19.12	5.65
16.	Novinka	319.50	352.40	324.20	332.03	14.53	4.37
17.	Očarovanie	357.10	371.20	347.70	358.66	9.66	2.69
18.	Odriad	341.20	341.20	320.10	334.17	9.94	2.97
19.	Oniks	300.70	357.10	327.60	328.47	23.03	7.01
20.	Oranžové plochoguľovité	311.50	361.80	321.80	331.70	21.69	6.54
21.	Potok	351.90	380.60	365.60	366.03	11.72	3.20
22.	Rif	310.10	310.10	271.00	300.07	20.87	6.95
23.	Robura	287.50	352.40	304.30	314.73	27.50	8.73
24.	Ruslan	371.20	371.20	352.20	364.87	8.95	2.45
25.	Sojuz F1	289.70	289.70	259.00	279.30	14.35	5.13
26.	Sultán	272.50	341.20	320.40	311.37	28.76	9.23
27.	Tondino Cherry	352.40	404.10	374.60	377.03	21.78	5.61
28.	Venec	317.50	352.40	302.50	324.13	20.90	6.44
	Average	317.64	345.09	316.14	-	-	-

Sx – standard deviation, Vk – coefficient of variation

VIII: *Mathematical – statistical evaluation of vitamin C in fruits of vegetable pepper by analysis of variance*

Source of variability	MS	Variance	f	F real	F tab. by 005 p	F tab. by 001 vp	Sx
Varieties	1 558 162.7	103 877.516	15	2.08561	2.01	2.7	p
Years	2 866 939.8	1 433 469.89	2	28.78062	3.32	5.39	vp
Residues	1 494 203.1	49 806.7694	30				
Total	5 919 305.6		47				

MS – sum of squares, f – degree of freedom, F-Fisher-Snedecor test (F- test), p – significant difference, vp – highly significant difference, Sx – standard deviation

IX: *Mathematical – statistical evaluation of vitamin C in fruits of tomato by analysis of variance*

Source of variability	MS	Variance	f	F real	F tab. by 005 p	F tab. by 001 vp	Sx
Varieties	85 341.77	3 160.806	27	6.85668	vp	1.67	2.09
Years	15 003.01	7 501.506	2	16.2729	vp	3.15	4.98
Residues	24 893.04	460.9822	54				
Total	125 237.8		83				

MS – sum of squares, f – degree of freedom, F-Fisher-Snedecor test (F- test), p – significant difference, vp – highly significant difference, Sx – standard deviation

SUMMARY

For assessment of vitamin C in fruits of vegetable peppers in the technical maturity and tomato were made field trials in the years 2005, 2006 and 2007 at the Research Institute of vegetables in Nové Zámky, Slovak Republic. The trials were included sixteen varieties of sweet peppers and twenty-eight varieties of tomatoes.

Vegetable pepper

The highest content of vitamin C in 2005 had a variety Čerešňová (2 090.90 mg.kg^{-1}) and the lowest variety Dolmy (1 417.60 mg.kg^{-1}). The average vitamin C content of fruit in the technical maturity of cultivars evaluated in 2005 was 1 813.06 mg.kg^{-1}. In the year 2006, the highest vitamin C content was found in variety Podarok Moldavy (2 421.70 mg.kg^{-1}) and the lowest in variety Bohatýr (1 411.30 mg.kg^{-1}). The average content of vitamin C was 1 909.43 mg.kg^{-1}. In the year 2007 there was a high content of vitamin C in fruits in a variety of technical maturity in Čerešňová cultivar (2 885.80 mg.kg^{-1}) and lowest in Lastočka (2 033.60 mg.kg^{-1}). The mean vitamin C content in the year 2007 was 2 392.49 mg.kg^{-1}. The high coefficient of variation occurred at varieties Kozí roh and Bohatýr. When analyzing the variance of vitamin C in fruits of technical maturity for sixteen varieties of sweet peppers for the years 2005, 2006 and 2007, are varieties measured feature set as the source of the variability factor demonstrably statistically different (F = 2.08) as a genuine expression of the diversity characteristic of the variety. Years as factors of variability of the character are highly significant difference (F = 28.78).

Tomato

The content of vitamin C in 2005 ranged from 202.60 mg.kg^{-1} (Denár) to 371.20 mg.kg^{-1} (Ruslan). The average vitamin C content in 2005 was 317.63 mg.kg^{-1}. In the year 2006, the highest value of Vitamin C had the variety Tondino Cherry (404.10 mg.kg^{-1}) and lowest the variety Green Husk Tomatillo (211.00 mg.kg^{-1}). The average value of vitamin C in tomato fruits was 345.09 mg.kg^{-1}. In the year 2007, the highest content of vitamin C was found in a variety Tondino Cherry (374.60 mg.kg^{-1}). The lowest content had the variety Green Husk Tomatillo (221.00 mg.kg^{-1}). The average content in tomato fruits was 316.14 mg.kg^{-1}. When analyzing the variance of the measured vitamin C content in twenty-eight varieties of tomatoes for the years 2005, 2006 and 2007, show the variety as a factor in resource variability statistically highly significant difference (F = 6.85). Even years as factors of variability are statistically highly significant (F = 16.27).

SÚHRN

Hodnotenie obsahu vitamínu C v plodoch zeleninovej papriky a rajčiaka

Pre hodnotenie obsahu vitamínu C v plodoch papriky zeleninovej v technickej zrelosti a rajčiaka jedlého sa založili poľné pokusy v rokoch 2005, 2006 a 2007 vo Výskumnom ústave zeleninárskom v Nových Zámkoch. Do pokusov bolo zaradených 16 odrôd papriky zeleninovej a 28 odrôd rajčiakov.

Zeleninová paprika

Najvyšší obsah vitamínu C v roku 2005 mala odroda Bohatýr (2 090.90 mg.kg^{-1}) a najnižší odroda Dolmy (1 417.60 mg.kg^{-1}). Priemerný obsah vitamínu C v plodoch v technickej zrelosti hodnotených odrôd v roku 2005 bol 1 813.06 mg.kg^{-1}. V roku 2006 mala najvyšší obsah vitamínu C v plodoch odroda Podarok Moldavy (2 421,70 mg.kg^{-1}) a najnižší odroda Bohatýr (1 411,30 mg.kg^{-1}). Priemerný obsah vitamínu C bol 1 909,43 mg.kg^{-1}. V roku 2007 sa zistil najvyšší obsah vitamínu C v plodoch v technickej zrelosti pri odrode Čerešňová (2 885,80 mg.kg^{-1}) a najnižší pri odrode Lastočka (2 033,60 mg.kg^{-1}). Priemerný obsah vitamínu C bol v treťom pokusnom roku 2 392,49 mg.kg^{-1}. Vysoký variačný koeficient sa vyskytol pri odrode Kozí roh a Bohatýr. Pri analýze rozptylu obsahu vitamínu C v plodoch technickej zrelosti pri 16 odrodách zeleninovej papriky za obdobie rokov 2005, 2006 a 2007 sú odrody hodnotené uvedeným znakom ako faktor zdroja premenlivosti štatisticky preukazne rozdielne (F = 2.08), čo je výrazom skutočnej rozdielnosti charakteristickej pre danú odrodu. Roky ako faktory zdroja premenlivosti daného znaku sú vysoko preukazne rozdielne (F = 28.78).

Rajčiak

Obsah vitamínu C sa v roku 2005 pohyboval od 202.60 mg.kg^{-1} (odroda Denár) do 371.20 mg.kg^{-1} (odroda Ruslan). Priemerný obsah vitamínu C v roku 2005 bol 317.63 mg.kg^{-1}. V roku 2006 bol najvyšší pri odrode Tondino Cherry (404.10 mg.kg^{-1}) a najnižší pri odrode Green Husk Tomatillo (211.00 mg.kg^{-1}). Priemerná hodnota vitamínu C v plodoch rajčiaka jedlého v roku 2006 bola 345.09 mg.kg^{-1}. V roku 2007 bol najvyšší obsah vitamínu C zistený pri odrode Tondino Cherry (374.60 mg.kg^{-1}). Najnižší obsah mala odroda Green Husk Tomatillo (221.00 mg.kg^{-1}). Priemerný obsah v plodoch rajčiaka jedlého poľného bol 316.14 mg.kg^{-1}. Pri analýze variancie nameraného obsahu vitamínu C pri 28 odrodách rajčiakov za obdobie rokov 2005, 2006 a 2007 sa prejavili odrody ako faktor zdroja premenlivosti štatisticky vysoko preukazne rozdielne (F = 6.85). Aj roky, ako faktory zdroja premenlivosti daného znaku sú štatisticky vysoko preukazné (F = 16.27).

paprika zeleninová, rajčiak, vitamín C

REFERENCES

HEGEDŰSOVÁ, A., MUSILOVÁ, J., JOMOVÁ, K., HEGEDŰS, O., BYSTRICKÁ, J. 2007: Laboratórne experimenty z organickej chémie a biochémie pre špecializáciu Chémia životného prostredia. Nitra, UKF, 2007. s. 86, ISBN 978-80-8094-211-3.

JUREKOVÁ, Z. A KOL., 2005: Slovenské záhradníctvo, trendy vedy, praxe a vysokoškolského vzdelávania. SPU Nitra, 216 s., ISBN 80-8069-629-2.

KOPEC, K., 1998: Tabulky nutričních hodnot ovoce a zeleniny. ÚZPI Praha, 72 s., ISBN 80-86153-64-9.

POKLUDA, R., 2004: Content of Selected Nutritional Element in Fruits of Several Pepper Cultivars. In: Annales universitatis Marie Curie-Sklodowska, Lublin, Poľsko, 14: 37–43.

VALŠÍKOVÁ, M., 1986: Vitamínová hodnota zeleninovej papriky. In: Zahradnictví, 13 (3): 219–224.

VALŠÍKOVÁ, M., 1989: Hodnotenie kvalitatívnych znakov sortimentu zeleninovej papriky a rajčiakov. In: Zahradnictví, ÚVTIZ Praha, 16 (2): 151–160.

VALŠÍKOVÁ, M. a kol., 1996: Produkčné systémy vybraných druhov zelenín I. časť. Nové Zámky, Výskumný ústav zelenín a špeciálnych plodín, 201 s.

VALŠÍKOVÁ, M., KRÁLOVÁ, J., 1999: Hodnotenie domáceho a svetového sortimentu poľnej papriky. In: Vedecké a výskumné práce, VÚZ Nové Zámky, 10: 113–123.

VALŠÍKOVÁ, M., MINÁROVÁ, E., PAUKOVÁ, B., 1984: Obsah vitamínu C v sortimente zeleninovej papriky po pozberovej úprave. In: Zahradnictví, ÚVTIZ, Praha, 11: (1): 53–59.

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