

# GENERAL ISSUES CONCERNING ON THE CONTENT OF ASCORBIC ACID IN FRESH HORTICULTURAL PRODUCTS

## ASPECTE GENERALE PRIVIND CONȚINUTUL ÎN ACID ASCORBIC LA PRODUSELE HORTICOLE PROASPETE

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**Abstract.** Ascorbic acid also called vitamin C or antiscorbutic vitamin, is synthesized by vegetal organism, animal organism (except human, primates, rat) and some microorganisms, using glucose or galactose as precursors. Accumulation of vitamin C is a specific process for every horticultural product. In some species there is a decrease in content with the evolution of the ripening process, in others can be found an increasing amount of tissue ascorbic acid as sequence of the baking phases. The stability of ascorbic acid in tissues is influenced by the presence of the ascorbatoxidase enzyme that catalyzes its oxidation reaction. During maturation of horticultural products the content of vitamin C decreases (apples, plums), while the tomatoes or melons content grows. During storage, most species tend to lower their ascorbic acid content; as far as acid products goes, the process in their case is lower than the case of those with higher pH.

**Key words:** vitamin C, synthesis, stability

**Rezumat.** Acidul ascorbic denumit și vitamina C sau vitamină antiscorbutică, este sintetizat de organisme vegetale, organismele animale (cu excepția omului, primatelor, șobolanului) și de unele microorganisme, folosind ca precursori glucoza sau galactoză. Acumularea vitaminei C este un proces specific fiecărui produs horticol. La unele specii are loc o diminuare a conținutului odată cu evoluția procesului de maturare, la altele se poate constata o creștere a cantității de acid ascorbic din țesuturi pe măsura succesiunii fazelor de coacere. Stabilitatea acidului ascorbic în țesuturi este influențată de prezența enzimei ascorbatoxidaza, care catalizează reacția de oxidare a acestuia. În timpul maturării unor produse horticole conținutul de vitamina C scade (mere, prune), în timp ce la tomate sau pepene galben crește. Pe parcursul perioadei de păstrare, majoritatea speciilor au tendința de a-și diminua conținutul de acid ascorbic, la produsele acide procesul fiind mai lent spre deosebire de cele cu pH mai ridicat.

**Cuvinte cheie:** vitamina C, sinteză, stabilitate

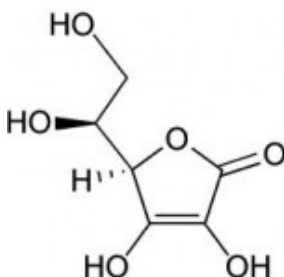
## INTRODUCTION

Ascorbic acid is an organic acid with antioxidizing properties, it is soluble in water and encountered under the form of bright yellowish white powders or crystals. L enantiomer of ascorbic acid is known under the name of vitamin C (fig. 1).

L – ascorbic acid is the main vitamin synthesized by plants having an important role in the synthesis of unsaturated fat acids, the degradation of some amino acids, the sugar metabolism etc. (wikipedia.org).

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**Fig. 1** - Chemical formula of vitamin C

## MATERIAL AND METHOD

Besides the study of specialized literature represented by scientific work, treatises, and books, I consulted various websites of foreign non-governmental agencies dealing with research in the public nutrition field.

## RESULTS AND DISCUSSIONS

The vitamin C content of foods is considered by many specialists as the best criterion when appreciating their quality. Some authors showed a parallelism between the vitamin C content and the taste of some vegetal origin foods. (Cuciureanu Rodica, 2002)

The vitamin C content of horticultural products is influenced by:

- species/assortment/variety
- soil conditions,
- climate where they developed.

Ascorbic acid may be found in the regions of active growth of vegetal tissues being synthesized by chloroplasts. In seeds it appears only after germination. The synthesis process is proportional to the intensity of breathing and the activity of oxidizing enzymes (peroxidase, catalase, ascorbinoxidase).

They noticed that the more flavored fruit species, where anaerobic processes are more important, have a lower content of ascorbic acid.

The use of fertilizers determines the increase of the ascorbic acid content in the horticultural products, but there are also substances diminishing this content (compounds containing copper, herbicides like caprometrin).

*Dynamics during the storage period* – the trend of most species is to diminish the ascorbic acid content. There are also cases where during storage the vitamin C content increases (tomatoes, onion, potatoes) due to the appearance of new tissues (stems) (Beceanu D. et. al., 2011).

The ascorbic acid content of some vegetables and fruits are given in the table 1.

The horticultural products having the highest content in ascorbic acid for 100g of product are the green walnuts (1000-1800mg/100g), rosehip (120-800mg), red peppers (250-300mg), blackcurrant (140-300mg), spinach (225mg), horseradish (200mg), and the lowest content may be found in: cucumbers (5mg), eggplant (2mg), fig (2mg).

Table 1

**Ascorbic acid content in some vegetables and fruits in mg/100g**  
(after G. Neamtu, 1996)

Product	Content mg/100g	Product	Content mg/100g	Product	Content mg/100g
cranberries	8-10	green beans	7-14	watermelons	7
gooseberries	30-50	strawberry	28-45	melons	20
pineapple	40	grapefruit	40	peaches	10-19
pepper	80	quince	10-38	oranges	40-80
red peppers	250-300	horseradish	200	plums	7-14
green peppers	100-200	lemons	30-78	radishes	20
cucumbers	5	orache	140-150	salad	10-50
apricots	7-20	tangerines	30-45	beet	5-10
potatoes	15-22	mango	20	sugar beet	30-40
strawberries	25-120	green peas	25-35	fig	2
Sea Buckthorn	2500	rosehip	120-800	grapes	6-10
onion	60	apple	6	spinach	225
cherries	16	dill	50-150	scotch kale	50
horns	50-60	carrot	5-10	celery	10
redcurrant	30-70	blackberry	5-8	nettles	100
white currants	5-6	green walnuts (shells)	1000-1800	fresh tomatoes	18-45
blackcurrant	140-300	parsnip	40	eggplant	2
cauliflower	70	parsley	150	sour cherry	12
courgettes	26-30	pears	4-10	raspberry	28-45

*Factors of influence* are:

- species and variety (intensity of metabolism, product pH);
- storage temperature;
- atmospheric composition;
- storage period.

a. In more acid products, the decrease of the ascorbic content acid is slower whereas those having a less acid pH have a faster decrease.

In tomatoes having a red pigmentation on more than 10-15% of their surface as they grow the red coloration extends on 80-90% of their surface and the ascorbic acid content of tomatoes rises to about 24.0 mg/100g.

In case of marrows, the accumulation of ascorbic acid occurs in the phase when the marrow is in bloom and the values are 40mg/100mg. as marrows mature, the ascorbic acid content decreases on average to 23mg/100g and then to 15mg/100g, when they reach the size characteristic to the species.

For the melons in their ripening period the ascorbic acid content is below 28mg/100g, and when they are ready for consumption it increases to 31mg/100g.

In the ripening period of Jonathan apples, they found a content of 10.2mg ascorbic acid, and then during 18 day period when they get ripened for consumption the ascorbic acid content decreased to 7.9mg/10g.

For deep purple Italian plums, the ascorbic acid content was 6.7mg/100g in the ripening period, and the presence of some compounds as vitamin P or tanoid

substances with a protective role delayed the speed of degradation of ascorbic acid.

b. The lower storage temperature for capsicums determined the decrease from 1.5% daily losses of ascorbic acid (20-22°C) to only 0.8% every day at 10°C.

The rate of daily losses is very high for lettuce (almost 20% even when refrigerated). Reduced losses are registered by carrots, onion, cabbage (0.08 – 0.18%).

There are also situations when the ascorbic acid content increases during storage. Onions and potatoes register a slight increase of the ascorbic acid content at the end of the storage period following the start of sprouting phenomenon.

By keeping vegetables and fruit for several days at room temperature, which is a common practice in the normal circuit of these products from producer to consumer, there is a significant decrease of vitamin C content (table 2).

*Table 2*

**The decrease in vitamin C content of vegetables acquired through trade "retail"**  
(after Cuciureanu Rodica)

Vegetables	mg vitamin C (%)		Losses (%)
	harvest	bought at market	
peas	154	56	64
potatoes	<b>112</b>	<b>8</b>	<b>93</b>
tomatoes	<b>250</b>	<b>250</b>	<b>0</b>
beans	136	40	70,5
onion	128	75	41,5
asparagus	364	146	32,5
cucumbers	220	68	69
spinach	414	134	68

The structural particularities of every horticultural product influence the decrease of vitamin C content; if products have a relatively thick skin preventing the diffusion of oxygen towards the inside, the destruction of vitamin C occurs at a slower rate (Cuciureanu Rodica, 2010)

According to Inoue K et al. (1988), some vegetables cultivated in hydroponic solution, in which they added 1-2g/l sodium ascorbate, significantly increased their ascorbic acid content within  $14 \pm 2$  hours.

Researches carried out on the storage of vegetables in a controlled atmosphere showed that in these conditions the ascorbic acid content maintained a high level as compared to the ones determined in the products kept in normal frigorific conditions (Burzo I., 2001).

The controlled atmosphere inhibits the fast degradation of vitamin C in apricots, peaches and grapes. In apples and pears there was no difference and in case of plums the normal atmosphere better preserved the ascorbic acid content.

Table 3

**Change in ascorbic acid content during storage of vegetables and fruits**  
(after I. Burzo)

Species	Storage Conditions	Storage period, days	Vitamin C content, mg/100g	Species	Storage Conditions	Storage period, days	Vitamin C content, mg/100g
Apples	-	0	7,84	Plums	-	0	3,46
	10°C	200	5,70		0°C	40	2,75
	5%CO <sub>2</sub> 3%O <sub>2</sub> , 0°C	200	6,53		5%CO <sub>2</sub> 3%O <sub>2</sub> , 0°C	40	2,42
Apricots	-	0	9,69	Grapes	-	0	4,95
	0°C	30	5,00		0°C	120	3,20
	5%CO <sub>2</sub> 3%O <sub>2</sub> , 0°C	30	6,32		5%CO <sub>2</sub> 3%O <sub>2</sub> , 0°C	120	2,83
Pears	-	0	7,71	Sour cherry	-	0	5,43
	0°C	120	5,21		0°C	10	4,75
	5%CO <sub>2</sub> 3%O <sub>2</sub> , 0°C	150	4,48		5%CO <sub>2</sub> 3%O <sub>2</sub> , 0°C	15	3,75

During the storage period, a continuous diminution of the ascorbic acid quantity occurs in the vegetables and fruits harvested at their maturity and the intensity of decrease of this content depend on species, variety and temperature (table 3).

A diet rich in foods containing vitamin C keeps the body healthy, especially the bones, skin and teeth ([www.ziare.com](http://www.ziare.com)).

When natural vitamin C is found in the natural food matrix, for example in fruits, due to the matrix effect, it has the highest biological value synergizing with other components of the food matrix, namely bioflavonoids. In contrast with this, for example, highly purified synthesis vitamins intentionally introduced as E numbers do not have the same biological activity ([www.remediu.ro](http://www.remediu.ro)).

**The main properties** of vitamin C are:

- ~ Occurs in the redox phenomena, the most powerful antioxidant;
- ~ Is anti-infective, tonic, antitoxic;
- ~ Involved in iron uptake by the body;
- ~ Prevents and cures scurvy;
- ~ Increases the resistance of blood vessels;
- ~ Contribute to the formation of red blood cells, teeth and bones;
- ~ Serves to regulate blood sugar and cholesterol;
- ~ Interfere with proper functioning of tissues and various organs;
- ~ Is effective in reducing the rate of opacification of the lens;
- ~ Intervenes in the metabolism of carotenes;
- ~ Protects folic acid;
- ~ Ensures cohesion protein cells, thus increasing life expectancy;
- ~ Decreases incidence of clots in blood vessels;

~ Is allergic activities ([www.tratamente-naturiste.ro](http://www.tratamente-naturiste.ro)).

For a healthy adult, the recommended daily intake is 60÷90 mg/day, and for children the intake is 1.5÷2 mg/kg of body weight/day.

The intake of vitamin C must be increased for the workers working in environments with lead, benzene or varnishes, athletes during their training sessions (up to 200 mg/day) as well as for the people working under stress conditions (Guilland J.C., 1992).

At the same time, a higher intake is necessary in the pathological cases having an increased metabolism, in infectious diseases, tuberculosis, gastric ulcer and duodenal ulcer (<http://www.tratamente-naturiste.ro>).

## CONCLUSIONS

The lowest amount of vitamin C is found in eggplant (2mg), cucumbers (5mg) and in greater quantities in red peppers (250-300mg) and walnut (bark) (1000-1800mg). These high values are influenced by the presence of anthocyanins (fruit and vegetables are more colored with the increasing of vitamin C content), the pH (at the horticultural products with a low pH, the content of ascorbic acid is high) and storage conditions (temperature, atmospheric composition).

During storage of some vegetables (potatoes, onions), the vitamin C content increases due to the emergence of new tissue (corners and stems).

Sick people, those who work in polluted environments, athletes, requires additional intake of vitamin C for proper functioning of the body.

Biological value of vitamin C in fruits and vegetables that are fresh, is more easily assimilated by the human body, compared with vitamin C obtained by synthesis.

## REFERENCES

1. Beceanu D., Anghel Roxana, Filimon R., 2011 – *Materii prime horticole mai importante pentru industria alimentară*. Editura Pim, Iasi
2. Beceanu D., 2009 – *Tehnologia prelucrării legumelor și fructelor*. Editura Ion Ionescu de la Brad, Iași
3. Burzo I., Gherghi A., Miruna Bibicu, Liana Mărgineanu, Liliana Bădulescu, 2001 – *Biochimia și fiziologia legumelor și fructelor*. Editura Academiei Române, București
4. Cuciureanu Rodica, 2010 – *Igiena alimentului*. Editura Performantica, Iași
5. Cuciureanu Rodica, 2002 – *Elemente de igiena mediului și a alimentației*. Editura Junimea, Iași
6. Guilland J.C., Leque B., 1992 – *Les vitamines*. Editura TEC&DOC, Paris
7. \*\*\* <http://www.tratamente-naturiste.ro/multivitamine-suplimente-naturale/acid-ascorbic.htm>
8. \*\*\* 2011 - <http://www.remediu.ro/articole/articol/206/aditivii-alimentari-sntos>
9. \*\*\* <http://www.ziare.com/articole/vitamina+c+beneficii>
10. \*\*\* [http://ro.wikipedia.org/wiki/Acid\\_ascorbic](http://ro.wikipedia.org/wiki/Acid_ascorbic)