

Content and dynamics of accumulation of ascorbic acid in fruits of *Rosa canina* L.

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SUMMARY

When studying the content and dynamics of the accumulation of ascorbic acid in the fruits of *Rosa canina*, it was found that the Nakhchivan population is characterized by a high content of ascorbic acid. The amount of ascorbic acid depends on the species, the place of growth, the height of the area, the mechanical composition of the soil, the climatic conditions of the growing season and the age of the plants. The greatest amount of ascorbic acid accumulates in the fruits of 4-5-year-old stems in the phase of technical maturity.

Key words: content, dynamics, vitamin C, *Rosa* L.

RESUME

The study of contents and dynamics of ascorbic acid accumulation in fruits of *Rosa canina* established that the Nakhchivan population is characterized by the high content of ascorbic acid. The quantity of ascorbic acid depends on specific characteristics, habitat, altitude, the mechanical compositions of soil, climatic conditions and age of plants. The greatest amount of ascorbic acid collects in fruits stalk 4-5 years, in a phase of a technical maturity.

Keywords: contents, dynamics, vitamin C, *Rosa* L.

Introduction

Rosehip is of great importance in human life. They are used as raw materials for the manufacture of medicines, wines, essential oils, vitamins, vinegar, tanning extract, water infusions, etc. The healing properties of rose hips have been known for a long time. Rosehip flowers and fruits were used as early as the 16th and 17th centuries. as a remedy for scurvy and other diseases. Rosehip seed oil was used to treat burns, catarrhal inflammation of the mucous membranes of the throat, and colds. The wide and almost universal use of rose hips as a medicine, which began in the 16th century, was scientifically explained only in the 20th century, when it became clear that rose hips are a natural concentrate of multivitamins [1].

Among all fruit and berry plants, rose hips are a record carrier of vitamin C [2, 3]. Ascorbic acid in rose hips is 10 times more than in currants, 50 times more than lemon, 100 times more than apples [4, 5, 6, 7]. For the first time, the high content of vitamin C (ascorbic acid) in rose hips was indicated in 1931 by Galn [8], S. Tillmans and others [7], who obtained a crystalline preparation of ascorbic acid from the fruit. In 1934 N.N. Ivanov et al. [9] also isolated pure vitamin C from rose hips.

Further research showed that the fruits of some species of rose hips, widespread in Ukraine, Russia, Central Asia, belonging to the section *Cinnamomeae* DC (rose cinnamon, river needle, river Dauraskaya, river Webba, river Fedchenko, river Begger, river Albert, river wrinkled, etc.) are the richest in vitamin C [10–18]. For example, the content of ascorbic acid in the river. cinnamon and p. Begger reaches 14000 and 19000 mg% (respectively) on the dry weight of the fruit pulp [19]. Places of growth and soil and climatic conditions of plants greatly affect the content of ascorbic acid in fruits. For example, the concentration of vitamin C in fruits *R. cinnamomea* L growing in different places varies from 1444 mg% to 2038 mg%; fruits of the species *R. pendulina* L. grown from seeds in the Botanical Garden of Lviv State University, accumulates 2551 mg%, and in subalpine meadows 2889 mg% of vitamin C. In 37 samples of this species collected from different growing areas, the content of ascorbic acid ranges from 900 to 2800 mg% [1] ...

A large amplitude of fluctuations in the content of vitamin C, in our opinion, depends not only on the species and geographical location of growth, but also on the time of collection of fruits, fixation of the material, as well as the research method. Many authors do not indicate the time of collection, the place of growth, the state of the fruits and show the content of ascorbic acid in the fruit pulp of the rose hips as a percentage, excluding

seeds, etc.

The data available in the literature on the content and dynamics of the accumulation of ascorbic acid in rose hips are contradictory [20, 21, 12, 15, 22, 23]. From the foregoing it follows that a lot has been done to study vitamin C, especially in the content and accumulation of this vitamin in rose hips. But there are still many questions not covered in the literature, for the solution of which further research work is required. For example, the study of ascorbic acid in rose hips depending on the ripening phase of the fruit, the age of the stems, the location of the branches on the stem, soil, meteorological conditions of the year, etc. determining the time of collection of rose hips. The quality and quantity of harvested fruits depends on this. *Rosa canina*.

Materials and methods

The object of the study was fruits of the species *Rosa canina*, the most widespread and having a large operational reserve.

Samples for analysis were taken from 20–25 plants from all expositions. Fruits were selected according to their standard size, shape, color, not mechanically damaged by pests and diseases. The dynamics of the accumulation of ascorbic acid was studied on the same plants at the same time of day. In order to determine the change in the quantitative content of vitamin C, the fruits were collected in four phases: ovaries, in immature, but fully formed, reaching about half of their characteristic size, green, colored and ripe fruits. Ripe fruits were examined at various stages of ripening - technically mature, biologically mature and overripe. The content of ascorbic acid was determined in freshly collected materials. The preparation of raw materials for analysis was carried out according to generally accepted methods [26]. The content of ascorbic acid was determined by the photolorimetric method,

The research material was rose hips. *Rosa canina* collected in 2010–2011 in the villages Tananam, Karabaglar, Buzgov, Bichenak, Nasyrvaz, from five districts of the Nakhchivan Autonomous Republic (Sharur, Kengerlinsky, Shahbuz, Julfiysk, Ordubad), for the dynamics of vitamin C accumulation, the fruits from the Shamdin tract, the Kengerlinsky region and the floodplains of the Kuyuk river were studied. The climate of the Nakhchivan Autonomous Republic is moderately continental, with an average temperature in July from +12 to +20 °C, in January from 4 to 8 °C, in general it is characterized by an abundance of warmth and dryness. Average annual precipitation in the lowlands is 300–500 mm, in the mountains 600–800 mm (Physical geography of Azerbaijan - 19).

Results and discussion

The results of an analysis carried out in 2010 showed that, depending on the place of growth, the content of ascorbic acid in fruits *R. canina* ranges from 701 mg% to 987 mg% on wet weight, and in 2011 from 765 to 968 mg%. The content of ascorbic acid in fruits also depends on the individual state of the plants. For example, in the collected samples from the vicinity of Tananam, Sharur region, growing under the same conditions, the content of ascorbic acid in fruits varies from 765 to 991 mg%.

The table shows that the content of ascorbic acid in fruits increases with increasing altitude. Fruits growing at an altitude of 650 m above sea level (v. Karabaglar), contain 701 mg%, and the fruits growing at an altitude of 1600 m above sea level. (v. Bichenak) - 916 mg% ascorbic acid. Obviously, as you climb the mountains, the increase in the content of vitamin C is influenced by a decrease in temperature and an increase in ultraviolet radiation, since there is more radiation in the mountains than in the lowlands.

It is known that different parts of fruits differ in the content of ascorbic acid [28, 29]. Our studies in rose hips have shown that ascorbic acid is unevenly distributed.

When recalculating the weight ratios of various parts to the total weight of the fetus, it turns out that the main amount of vitamin C is concentrated in the pulp - the main part of the fetus. A similar distribution of ascorbic acid in fruits is observed in almost all fruit and berry plants [30]. The largest amount of ascorbic acid is also found in the juice, and the smallest in the seeds. As you know, different parts of the same plant differ both in the content of water, minerals, and in the content of organic substances. It depends on age, lighting of plants, microclimate and

other factors. Our studies on the content of ascorbic acid in rose hips showed that the content of ascorbic acid in fruits has a certain dependence on the age of the stems of rose hips (Table 3). The table shows that the smallest amount of vitamin C was noted in fruits collected from 2-year-old stems, and then it gradually increases, and starting from 5 years there is a slight decrease. An increase in the content of ascorbic acid in 6-year-old stems was very rarely noted. However, 6-year-old trunks bear little fruit, remain in the thickets a little, so they are not significant. Thus, it was found that a greater accumulation of ascorbic acid in fruits *R. canina* advances in 4–5-year-old trunks. The study of yield, average weight of fruits and content of ascorbic acid shows that they all depend on the age of the stems. At 4-5 years of age, the trunks in *R. canina* has high fruiting and greater accumulation of ascorbic acid, and natural death of stems occurs at the age of 5-6 years.

In the course of work 2009–2011 analyzes were also carried out on fruits collected from lateral shoots branched into the lower, middle and upper parts of the stems *R. canina*, aged 3-5 years. The data are shown in table. 4.

Table 1

Change in the content of ascorbic acid in fruits *R. canina* L. depending on location growth (mg% wet weight)

Время сбора	Количество образцов, шт.	Место произрастания	Колебания количества витамина С
07.IX.2010	5	С. Тананам, Шарурского района	765–991
10. IX.2011	6	«-----» «-----»	817–985
10. IX.2010	6	С. Карабаглар, Кенгерлинского района	701–989
15. IX.2011	5	«-----» «-----»	768–835
12. IX.2010	6	С. Ашагы – Бузгов, Нахчыванского района	817–1031
11. IX.2011	6	«-----» «-----»	801–987
14. IX.2010	6	С. Бичанак, Шахбузского района	916–1102
13. IX.2011	6	«-----» «-----»	967–1135
13. IX.2010	5	С. Бадамлы, Шахбузского района	835–957
15. IX.2011	5	«-----» «-----»	857–969
08. IX.2010	4	С. Газанчы, Джулфинского района	957–1058
14. IX.2011	5	«-----» «-----»	968–1101
16. IX.2010	6	С. Насирваз, Ордубадского района	987–1125
17. IX.2011	5	«-----» «-----»	965–1102

table 2

Distribution of ascorbic acid in individual parts of rose hips

Анализируемая часть плода	Содержание, мг % на сырой вес
Мякоть	985.7
Сок	843.6
Семена	87.5

Table 3

The content of ascorbic acid in fruits *R. canina* depending on the age of the stems

Ярус	Урочища Шамдин		Пойма р. Кюкючай
	2010 г.	2011 г.	2010 г.
Нижний	835	846	902
Средний	917	927	1031
Верхний	733	755	883

Table 4

The content of ascorbic acid in fruits *R. canina* depending on the location of the branches in stem, mg% wet weight

Возраст стволиков	Урочища Шамдин		Пойма реки. Кюкючай
	2010 г.	2011 г.	2010 г.
2	789	802	931
3	896	917	1062
4	935	965	1135
5	909	903	1062
6	–	–	1035

As can be seen from the data, the highest vitamin C content is observed in fruits collected from the middle branches, then from the lower branches and the least from the upper branches. To establish the influence of the mechanical composition of the soil on the accumulation of ascorbic acid, analyzes were made of fruit samples collected in 2011 from the floodplain of the river. Jagrichaya. The results of the analyzes are presented in table. 5. As you can see from the table. 5, the highest content of ascorbic acid in fruits is observed in rose hips growing on fresh loamy soils, somewhat less on sandy loamy soils and the least on sandy soils. Analysis data of vitamin C content in ripe fruits *R. canina* collected from sample plots Shamdin tract, are given in table. 6. A high content of ascorbic acid was observed in 2010 (985 mg%), 2009 (869 mg%), and the lowest - in 2011 (765 mg%). These years are characterized by meteorological conditions as dry. During May and June, the relative humidity was 30%, precipitation in 2009 - 65 mm, and in 2011 - 145 mm. The average monthly temperature in May 2009 was + 16.3 -C, and in 2011 + 9.9-C, May 2009 was dry and hot, and May 2011 was dry and cold. The spring-summer period of 2011 compared to 2009 was unfavorable, which explains the slightly lower content of vitamin C in rose hips in 2011.

Table 5

The content of ascorbic acid in fruits *R. canina* depending on texture soil (mg% on dry weight of pulp)

Механический состав почвы	Количество анализов	Содержание аскорбиновой кислоты (мг%)		
		Максимальное	Минимальное	Среднее
Свежая суглинистая	7	985	691	
Супесчаная	9	765	459	
Песчаная	7	717	403	

Table 6

Influence of climatic conditions on the accumulation of ascorbic acid in rose hips

Годы	Содержание, мг %
2009	869
2010	985
2011	765

Table 7

Change in the content of ascorbic acid in fruits *R. canina*, during the growth and development of the fetus (mg% wet weight)

Стадия развития	Содержание
Завязь (через 15 дней)	317
Плоды зеленые, вполне сформированные (25.VII.2010)	538
Плоды желто-зеленые (04.VIII.2010)	749
Плоды желто-красные (15.VIII.2010)	857
Плоды красные 25.VIII.2010	917
Плоды красные 05.IX.2010	924
Плоды красные 15. IX.2010	910
Плоды красные (перезрелые) 15.X. 2010	865

Table 8

Daily change in the content of ascorbic acid in rose hips

Время взятия проб, ч	Содержание, мг % на сырой вес
7	557
10	785
13	859
16	840
19	660

We also carried out an analysis to study the dynamics of the accumulation of ascorbic acid in fruits of the species *R. canina*, as the fetus grows and develops. The analysis results are presented in table.7.

As you can see from the table. 7, as the fruits ripen, the content of vitamin C continuously increases, reaching a maximum in the phase of fully mature (but not overripe) fruits, which is fully consistent with the data of previous researchers [12, 15, 19].

Studies of changes in the content of ascorbic acid during the day have shown that it is subject to significant fluctuations. The analysis results are shown in table. 8. The table shows that the formation and accumulation of ascorbic acid in rose hips are subject to a certain pattern. The amount of ascorbic acid increases from 7 o'clock in the morning and reaches a maximum at 13 o'clock. In the afternoon, the amount of ascorbic acid gradually decreases.

conclusions

1. It was found that the fruits of the species *Rosa canina* L. Nakhchivan population, characterized by high the content of ascorbic acid, its content during the growing season depends on the place of growth, the height of the area and climatic conditions.

2. Ascorbic acid is unevenly distributed in certain parts of the fetus. The greatest the amount accumulates in the pulp of the fruit - 985.7 mg%, and the smallest in the seeds - 87.5 mg%.

3. It was revealed that the age of plants and individual trunks, as well as the position of the fetus on the lateral branches. The greatest amount of ascorbic acid is accumulated in the fruits of 4-5-year-old middle tier stems.

4. As the fruit grows and develops, the content of ascorbic acid changes. Big the amount accumulates during the period of technical maturity and lasts until the biological maturity of the fruits, while in overripe fruits the content decreases slightly.

5. It was found that the content of ascorbic acid in rose hips during the day undergoes a certain change. Starting from the morning hours, the content of ascorbic acid increases, and at 1 pm it reaches a maximum of 859 mg% (wet weight), and by noon it gradually decreases and at 7 pm it reaches 660 mg%.

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