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Accumulation of vitamin C and sugars in wild rose hips of Karaganda region

The study of wild fruit plant populations has a great potential in the selection of species and forms promising in terms of a number of economically valuable traits for introduction and industrial cultivation. Local species are more resistant to local climatic conditions and composition of pathogens. The aim of the study was to evaluate the accumulation of sugars and vitamin C in fruits of 3 wild rose hips collected in Karaganda region. The quantitative accumulation of vitamin C varied from 0.87 to 1.85 %, the sum of sugars from 6.8 to 15.8 %. Analysis of fruits for accumulation of sugars and vitamin C showed that *Rosa majalis* from the Nura River floodplain, *Rosa spinosissima* from Komissarovka tract, *Rosa acicularis* from the vicinity of Karagaily settlement are promising for selection in the introduction experiment.

Keywords: plants of *Rosa* genus, fruits, Karaganda region, vitamin C, sugars, quantitative accumulation.

Introduction

One of the most important factors ensuring harmonious development of the human body is nutrition. According to WHO experts [1], human health is determined by heredity by 10–15 %, by ecology by 10–20 %, and by 55–70 % by lifestyle, the most important component of which is nutrition.

The problem of preserving the genetic potential of fruit and berry plants, its practical introduction into culture, and its use in modern breeding is one of the basic foundations in the creation of new varieties, forms, and hybrids [2]. The need to study the genetic potential of wild fruit and berry plants and attract their gene pool into culture is explained by the potential for obtaining more resistant forms to local climatic conditions, diseases and pests [3, 4].

In Karaganda oblast, representatives of the genera rosehip (*Rosa*: *R.majalis*, *R.acicularis*, *R.spinossissima*), which can serve as valuable food and vitamin plants, are of interest for the introduction of wild species into culture [5].

The purpose of this study was to determine the accumulation of sugars and vitamin C in the fruits of wild rose hips of the flora of Central Kazakhstan for the selection of species and populations suitable for introduction according to this set of traits.

Experimental

Fruit sampling was conducted in August — September 2024 from different natural populations, at full ripeness.

The quantitative accumulation of sugars was evaluated on a refractometer [6], the content of vitamin C — by the method of potentialmetric titration [7]. The exact weight ~ 3.00 g of raw material is thoroughly grinded in a mortar with distilled water (100 ml), infused for 10 minutes, then the mixture is stirred and filtered. 10 ml of the obtained filtrate is transferred into a 100 ml beaker, 1-2 drops of phenolphthalein are added and titrated with standardized NaOH solution until the appearance of a pale pink color, stable for 30 seconds and in the presence of a pH meter to determine the end point of titration, which is within 8.5 pH. Each measurement is carried out 3 times.

Calculate the mass of ascorbic acid using the following formula:

$$m(C_6H_8O_6), g = \frac{C(NaOH) \cdot V(NaOH) \cdot M_{equiv.}(C_6H_8O_6) \cdot V_k}{1000 \cdot V_{al}}$$

Calculate the ascorbic acid concentration using the following formula:

$$\omega(C_6H_8O_6), \% = \frac{m(C_6H_8O_6) \cdot 100}{m \text{ plant material}}$$

The obtained data were analyzed using the application software package Statistica 6.1 and Microsoft Office Excel 2007.

Results and Discussion

The diversity of natural reliefs, significant amplitude of temperatures, precipitation and humidity determined the diversity of vegetation of Central Kazakhstan. Thus, more than 1250 species of vascular plants belonging to 434 genera and 99 families grow on its territory [8]. As the preliminary analysis showed, the flora of Central Kazakhstan contains a significant number of species of economic value, including wild fruit plants. This group is represented by 31 species belonging to 14 genera and 7 families.

A review of species distribution over the territory of Central Kazakhstan shows their unevenness. Most species are confined to the northern, northwestern and central parts, characterized by higher annual precipitation, moderate summer temperatures and the presence of coniferous, mixed island forests and numerous shrub thickets. The southern, southwestern areas are characterized by extremely arid conditions, poor soils and high summer temperatures. Fruit crops in these habitats are mainly concentrated along river valleys, in the vicinity of springs. All described species are well adapted to the conditions of Central Kazakhstan and can be used for introduction into culture as fruit crops.

It is known that the chemical composition of wild fruits depends on many factors, including soil and climatic conditions of the place of growth, composition and structure of soil under plant thickets, moisture availability, water quality, presence of microorganisms and other factors [8].

We found 3 species of rose hips in natural conditions.

Rosa spinosissima L. Habitat: interfold hollow; soils — meadow, dark chestnut. Communities — briar-briar-grass communities. *Rosa spinosissima* grows in small colonies, area 40x15 m. Shrub shape — oval, age — 8–12 years, height — 112,5±12,2 cm, diameter — 137,4±9,8 cm. Condition — average, winter hardiness — without damage, bark color — brown, length of annual shoots — 6.4±0.8 cm. Shoot-forming ability — medium, growth force — medium, vigor — medium. Degree of fruiting — medium. Yield — 0.5 kg per bush. The color of the upper side of the leaves is green. Shirredness — high. Fruit shape — oval. Hypanthium color — black, taste — sweet, slightly astringent. Pests and diseases — not identified.

Rosa acicularis Lindl. Habitats: under mixed forest canopy; soils — forest chernozem. Communities are boneset-grass, briar-grass, briar. *Rosa acicularis* grows in small patches, area 53x50 m. Shape of the bush — spreading, age — 10–14 years, height — 134,67±5,01 cm, diameter — 103,3±3,6 cm. Condition — average, winter hardiness — very weak damage, bark color — light gray, length of annual shoots — 9.7±1.8 cm. Shoot-forming ability — satisfactory, growth strength — average, vigor — average. Degree of fruiting — weak. Yield — 0.24 kg per bush. Coloring of the upper side of leaves — green. Foliage — moderate. Pests and diseases — chlorosis 25–40 %.

Rosa majalis Hermm. Habitats: mixed forest edge; under mixed forest canopy, soils — dark chestnut. Communities of thavolgovo-briar-briar-grass, briar-briar, briar-briar-honeysuckle. Rosehip grows in groups, area 77x120 m. Shape of the bush — spreading, age — 12–17 years, height — 142,3±5,45 cm, diameter — 100,3±3,79 cm. Condition — poor, winter hardiness — medium damage, bark color — light gray, length of annual shoots — 8,4±0,55 cm. Shoot-forming ability — poor, growth force — average, obliquity — average. Degree of fruiting — weak. Yield — 0.05 kg / bush. Coloring of the upper side of the leaves — light green. Fertility — high. Pests and diseases — not identified.

The results showed that phytochemical parameters can vary significantly among species under natural conditions.

The quantitative accumulation of vitamin C ranged from 0.87 to 1.85 %, and the sum of sugars — from 6.8 to 15.8 %. Thus, among representatives of the genus *Rosa* L., the best indicators of quantitative vitamin C content were observed for May rosehip in the floodplain of the Nura River — 1.85 %, the minimum — for prickly rosehip from the Komissarovka tract (Fig. 1).

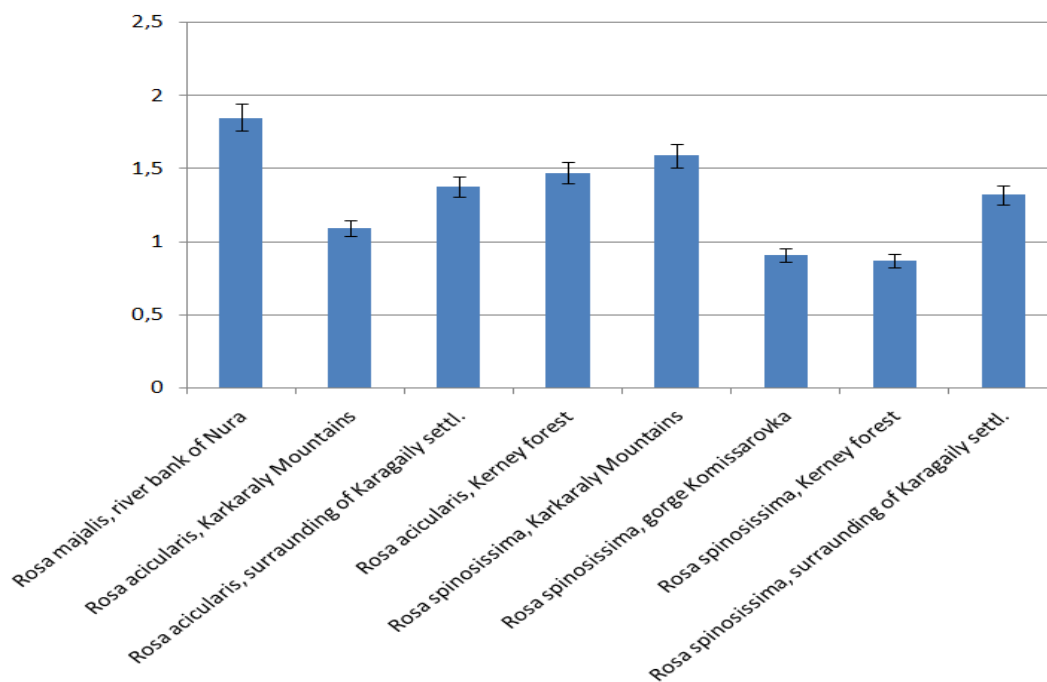


Figure 1: Quantitative accumulation of vitamin C in rose hips depending on species and place of growth

Fruit flavor depends on the sum of free sugars and acidity. For rose hips, the maximum accumulation of sugars was detected for prickly thorn from Komissarovka tract (15.8 %) and Karagaily settlement (14.8 %), and the minimum — for needle thorn from Karkaraly mountains (Fig. 2).

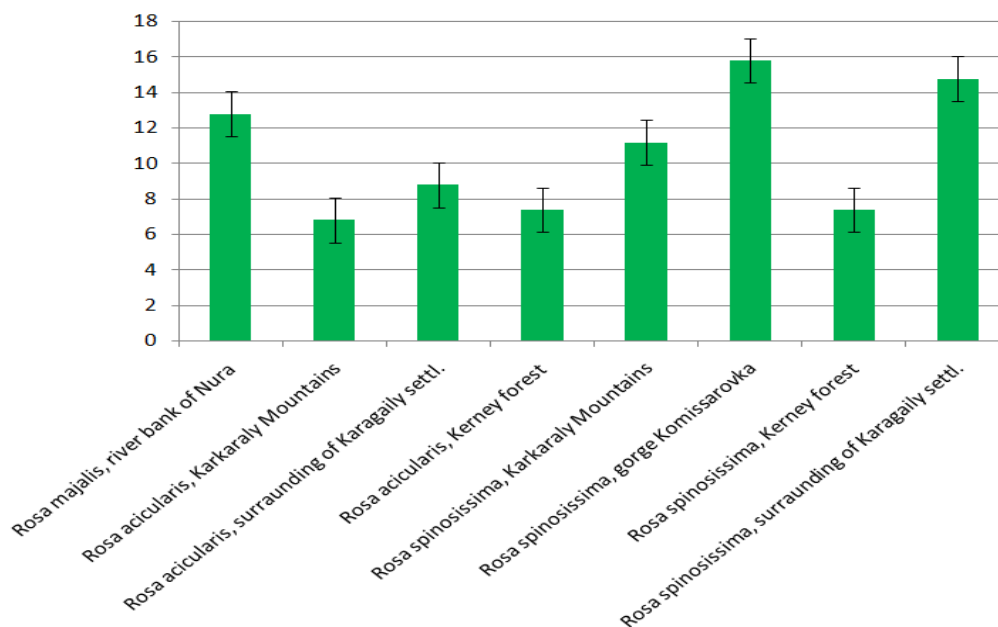


Figure 2: Quantitative accumulation of the sum of free sugars in rosehip fruits depending on species and place of growth

The obtained data allow selecting promising species and specimens with the best biochemical parameters for the introduction experiment.

Conclusion

Thus, on the territory of Karaganda oblast (Central Kazakhstan) a number of populations with 3 species of rose hips were found. Analysis of fruits for accumulation of sugars and vitamin C showed that *Rosa majalis* from the Nura River floodplain, *Rosa spinosissima* from the Komissarovka tract, *Rosa acicularis* from the vicinity of Karagaily settlement are promising for selection in the introduction experiment.

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References

- 1 Гусейнова Б.М. Особенности экстракции нутриентов из плодов рябины, терна и шиповника / Б.М. Гусейнова, М.Д. Мукайлов // Изв. ТСХА. — 2018. — Вып. 1. — С. 109–117. DOI: 10.26897/0021-342X-2018-1-109-117
- 2 Титок В.В. Роль ботанических садов и дендрариев в сохранении, изучении и устойчивом использовании разнообразия растительного мира / В.В. Титок, И.К. Володько, Л.В. Гончарова // Центральный ботанический сад Национальной академии наук Беларуси: структура, достижения, перспективы. — Минск, 2017. — С. 4–10.
- 3 Смыков А.В. Перспективы селекционно-генетических исследований плодовых культур / А.В. Смыков // Plant Biology and Horticulture: theory, innovation. — 2020. — № 2(155). — С. 112–129.
- 4 Nocker S. Breeding better cultivars, faster: applications of new technologies for the rapid deployment of superior horticultural tree crops / S. Nocker, S.E. Gardiner // Horticulture Research. — 2014. — Vol. 1. — 8 p.
- 5 Байтулин И.О. Создание лесного питомника и технология выращивания посадочного материала / И.О. Байтулин. — Костанай: Костанай-Полиграфия, 2009. — 48 с.
- 6 Колодезная В.С. Пищевая химия / В.С. Колодезная. — СПб., 1999. — 140 с.
- 7 Новрузов А.Р. Содержание и динамика накопления аскорбиновой кислоты в плодах *Rosa canina* L. / А.Р. Новрузов // Химия растительного сырья. — 2014. — № 3. — С. 221–226.
- 8 Флора Казахстана. — Т. 1–9. — Алма-Ата: Наука, 1956–1966.

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Қарағанды облысындағы жабайы итмұрында С витамині мен қанттың жинақталуы

Жабайы жеміс өсімдіктерінің популяциясын зерттеу интродукциялық және өнеркәсіптік өсіру үшін бірқатар экономикалық құнды белгілер бойынша перспективалы түрлер мен формаларды таңдауда үлкен мүмкіндіктерге ие. Жергілікті түрлер жергілікті климаттық жағдайларға және патогендік құрамға төзімдірек. Зерттеудің мақсаты Қарағанды облысынан жиналған 3 жабайы итмұрынның жемістерінде қант пен С витаминінің жинақталуын бағалау. С витаминінің сандық жинақталуы 0,87-ден 1,85 %-ға дейін, қант мөлшері 6,8-ден 15,8 %-ға дейін өзгерді. Қант пен С витаминінің жинақталуына жемістерді талдау көрсеткендей, Нұра өзенінің жағалауынан жиналған *Rosa majalis*, Комиссаров шатқалынан жиналған *Rosa spinosissima*, Қарағайлы ауылының маңынан жиналған *Rosa acicularis* интродукциялық тәжірибеде іріктеу үшін перспективалы екенін көрсетті.

Кілт сөздер: *Rosa* тұқымдас өсімдіктер, жемістер, Қарағанды облысы, С витамині, қант, сандық жинақтау.

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Накопление витамина С и сахаров в дикорастущих шиповниках Карагандинской области

Изучение популяций дикорастущих плодовых растений имеет большой потенциал в отборе перспективных по ряду хозяйственно-ценных признаков видов и форм для интродукции и промышленного выращивания. Местные виды являются более устойчивыми к местным климатическим условиям и составу патогенов. Цель исследования — оценить накопление сахаров и витамина С в плодах 3-х диких

шиповников, собранных на территории Карагандинской области. Количественное накопление витамина С варьировало от 0,87 до 1,85 %, сумма сахаров — от 6,8 до 15,8 %. Анализ плодов на накопление сахаров и витамина С показал, что перспективными для отбора в интродукционный эксперимент являются *Rosa majalis* из поймы р. Нура, *Rosa spinosissima* из урочища Комиссаровка, *Rosa acicularis* из окрестностей поселка Карагайлы.

Ключевые слова: растения рода *Rosa*, плоды, Карагандинская область, витамин С, сахар, количественное накопление.

References

- 1 Guseynova, B.M., & Mukailov, M.D. (2018). Osobennosti ekstraktsii nutrientov iz plodov riabiny, terna i shipovnika [Features of nutrient extraction from the fruits of mountain ash, sloe and rosehip]. *Izvestiia Timiriazevskoi selskokhoziaistvennoi akademii — Bulletin of Timiryazev Agricultural Academy*, 1, 109–117. DOI: 10.26897/0021-342X-2018-1-109-117 [in Russian].
- 2 Titok, V.V., Volodko, I.K., & Goncharova, L.V. (2017). Rol botanicheskikh sadov i dendrariiev v sokhranении, izuchenii i ustoichivom ispolzovanii raznoobraziia rastitelnogo mira [The role of botanical gardens and arboretums in the conservation, study and sustainable use of plant diversity]. *Tsentralnyi botanicheskii sad Natsionalnoi akademii nauk Belarusi: struktura, dostizheniia, perspektivy — Central Botanical Garden of the National Academy of Sciences of Belarus: structure, achievements, prospects*. Minsk, 4–10 [in Russian].
- 3 Smykov, A.V. (2020). Perspektivy selektsionno-geneticheskikh issledovaniy plodovykh kultur [Prospects of breeding and genetic research of fruit crops]. *Plant Biology and Horticulture: theory, innovation*, 2(155); 112–129 [in Russian].
- 4 Nocker, S., & Gardiner, S.E. (2014). Breeding better cultivars, faster: applications of new technologies for the rapid deployment of superior horticultural tree crops. *Horticulture Research*, 1, 8.
- 5 Baitulin, I.O. (2009). *Sozdanie lesnogo pitomnika i tekhnologiya vyrashchivaniia posadochnogo materiala [Creation of a forest nursery and technology of growing planting material]*. Kostanai: Kostanai–Poligrafiiia [in Russian].
- 6 Kolodyaznaya, V.S. (1999). *Pishchevaia khimiia [Food chemistry]*. Saint-Petersburg [in Russian].
- 7 Novruzov, A.R. (2014). Soderzhanie i dinamika nakopleniia askorbinovoi kisloty v plodakh *Rosa canina* L. [Content and dynamics of ascorbic acid accumulation in the fruits of *Rosa canina* L.]. *Khimiia rastitelnogo syria — Chemistry of plant raw materials*, 3, 221–226 [in Russian].
- 8 (1956–1966). *Flora Kazakhstana [Flora of Kazakhstan]*. Alma-Ata: Nauka [in Russian].

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