Aegyptus et Pannonia VII.

Acta Symposii anno 2021

BUDAPEST

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Editor: Hedvig Győry

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Contents

Plants and Health Conference 2021, and the Proceedings

Dr. Hedvig Győry PhD

HEFT AEC president

In 2021, the HEFS Ancient Egyptian Committee, in partnership with the HNM Semmelweis Museum of Medical History, organised an international conference entitled "*Plants and Health from Ancient Egypt to the Present Day*". The three-day conference focused on topics related to the application of plant material in medicine, but also included other topics connected to the use of plants in any practical or theoretical area of human life. We planned four sections with the following keywords:

History of healing and nutrition from the time of ancient Egypt to the present day
Which plants were used for healing, how, where, by whom and when, which plants were used to maintain health, or prevent disease in different parts of the world; what did people eat in everyday life, what were the festive foods/drinks, what were the expected results; and what are the related issues raised by ethnographic research.

Medicines and pharmaceutical science in historical periods in the light of sources
Who, how and why recorded knowledge of medicine in each period; what principles were used to treat patients or maintain health; what were/are the popular explanations of these issues or principles.

Herbal medicine and contemporary medicine
According to our current knowledge, what can we assess about the active ingredients of a given plant, the mechanism of action and its intensity, and what biochemical relationships can be discerned from their interactions.

Religious views and beliefs about plants
By whom, where, when, and what special magical properties have been attributed to plants, what is the role of plants in the social context, how is it explained, and how have plants been incorporated into everyday life/celebrations or healing practices

The conference was held between 14 and 16 October 2021 with 40 presentations. Due to the COVID pandemic, circumstances did not allow for a face-to-face meeting, so the event was entirely online. However, the possibilities offered by the Internet also allowed for smaller group discussions. The topics presented included the appearance and use of plants in different times and places, from ancient Egypt to contemporary Europe. They were divided into thematic and language (English and Hungarian) sessions, led by recognised scholars. After the lectures, it was possible to discuss the issues raised in front of the general public, and topics of narrower interest could be further discussed in separate rooms created within the Zoom system. Valuable contacts were made and new research ideas were generated. A small exhibition was also organised by the HNM Semmelweis Museum of Medical History for the occasion, as we had hoped until the last minute that the pandemic situation would change. However, it was only available to personal visitors.

During the conference it was possible to learn about new methods, we exchanged ideas and heard about research results and ongoing projects. A significant part of the presentations were given in English, the other part in Hungarian, but the papers included in the proceedings are all in English. The first part of the proceedings, as a result of the presentations and discussions, is published in this volume; the other part can be read in the next volume of the Aegyptus et Pannonia series.

Although not all the presentations are published, most of the aspects we covered are included in the volumes. The programme covered a wider range of topics: We were able to learn about plant finds from recent Egyptian archaeological excavations, the identification and use of plants in textual sources, religious connotations, and even the possibility of reconstructing perfumes. We could also look at the trade in plants between the Hittite Empire and Egypt, and learn which plants were used by the Copts in the Middle Ages. The latest research on Roman herbaria was discussed, and hitherto unknown ancient Egyptian texts were presented. Other presentations were devoted to the reproduction of some medicines based on ancient recipes. In one of the lectures we saw on video the process of preparation and examination of an ancient Egyptian medicine. Several papers dealt with temporal and spatial changes in the everyday and liturgical use and interpretation of a given plant, e.g. pomegranate in Greece. In India, Soma. In Hungary, thorn apple. In Estonia, pelargonium. In Finland and the Arctic, roseroot. And in the Arabian desert of Egypt, the apple of Sodom. The role of plants in religious ceremonies and concepts was also discussed, as well as the variety and significance of the scent they produce.

The lectures presented a wide range of the application of herbs in ancient and medieval medical methodology, with the help of Egyptian, Greek, Anatolian, and Hungarian herbariums. The conference participants were the first to hear that many ancient Egyptian medicines can still be found in the medieval Welsh medicinal knowledge. We also learned that a significant part of Dioscorides' usage of herbs could also be observed in Anatolian folk medicine. Lectures were given on the wide range of magical effects attributed to plants, spanning from antiquity to the Renaissance, in terms of iatromagic, iatromathematics, and iatromythology.

In separate sections, the participants were introduced to Hungarian ethnobotanical research, where, in addition to the methods of the way of collecting ethnobotanical data throughout Transylvania, the lecturers presented both the botanical aspects and the therapeutic potential of the plants included in the various Hungarian medicinal herbariums and pharmacopeias. In addition to the knowledge of plants preserved in the Hungarian witch-trial documents of the 15th to 19th centuries, the possibilities of historical and folk use against various diseases – such as tuberculosis and cholera – were also presented, and in connection with diabetes and surgery we also visited India and China. We got again an idea of how wound care has changed over the centuries, how plants have influenced the toolkit of surgeons, and which plants are still used in modern wound management. In connection with the Székesfehérvár Pharmacy Museum, an overview of the museum's extensive educational activities was presented in addition to its history. We have got acquanted also with the the most important medical tariff book of Hungary in the 18th century and the drawer labels of five apothecary furniture of the same period.

The approach to the flora of ancient Egypt is also diverse, and the study of the Ancient Near Eastern relations encompasses several scientific fields, such as Assyriology, Hittiteology and Biblical studies. The classical Greco-Roman world is also included in the next volume to facilitate comparison. In addition to history, interdisciplinarity also extends to other branches of the humanities, such as – among others – archaeology, history, linguistics, ethnography, philology, the history of religion and magic or iatromathematics.

In recent decades, the development of the sciences has moved in the direction of interdisciplinary cooperation, not only between related sciences, but also between seemingly distant branches of science. In addition to textual and material sources, the results and methods of the natural sciences are of fundamental importance for a more precise understanding of the past. The role of analyses and investigation of the various materials is thus becoming increasingly important, complementing traditional descriptive studies. As we also wanted to play a role in this process, several areas of natural science, such as archaeobotany, phytogenetics, types of data investigation and plant breeding, or various facets of medicine and medical history are also represented in the proceedings.

In this volume, we publish 11 studies that approach the world of plants from different perspectives within the broad framework of the conference. The focus is on ancient Egypt, but the articles also look at other areas. In addition to the data found in the articles and the results obtained, the methodological and theoretical approaches raise many new ideas, give exciting results and draw attention to various possibilities. For example, the multifaceted role of medicinal plants in the museum world or their application from the perspective of medical history and ethnomedicine.

With this volume, we hope to arouse interest in the unique world of the past, especially Egypt, to bring closer the world of nature and its possible effects on human life, and to encourage the birth of further results that will make the ancient Egyptian world better known and our own world better understood.

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Rhodiola Rosea L. (roseroot) its Cultural history and pharmacological effects

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Abstract

Rhodiola rosea (*Crassulaceae*), is a perennial plant native to Europe and Asia, growing typically on the plateaus or stony slopes of the mountains above the Arctic Circle. The plant with yellow flowers and succulent leaves has a brown-red rhizome and root system that has an intense rose scent. This rhizome contains biologically active compounds with different chemical characteristics. Its first written record dates back to 77 BC. The Greek physician Dioscorides described the use of "*rhodia radix*" as a medicine in his *De Materia Medica*.

Traditional medicine used it to increase general fitness and endurance, to overcome insomnia, depression, anaemia, impotence, gastro-intestinal disorders, inflammation, central nervous system problems, headaches, and colds. Its adaptogenic activity has been known for centuries, but it was only at the end of the 20th century that its antioxidant effect was confirmed in animal and human clinical experiments by identifying the molecular groups responsible for the effect: the rhizome of the roseroot contains phenylpropanoid molecules (rosin, rosarin, salidroside and rosavin components).

In order to meet the world's increased demand for plant material, instead of exterminating the wild growing stock, it was necessary to solve the problem of cultivating the plant in controlled conditions. This problem was solved by several teams worldwide, e.g. in Mikkeli, Finland. Nowadays the *Rhodiola rosea* rhizome is grown under commercial cultivation from the Urals to Alaska, including areas like Canada, the Norwegian, Danish, and Austrian Alps.

During the investigation of the plant chemistry of the rhizomes grown in Mikkeli, Finland we found that depending on the place of origin, the total rosavin content varies from 4.6 mg/g to 8.2 mg/g, the bitter value 5000 to 15000, and determined the two main components of their essential oil, myrtenol (14-35%) and geraniol (18-62%) ratio. Rhizomes of Finnish and Komi origin contain also 5-8% campesterol and 25-35% sitosterol phytosterol components, which shows the good quality of the species and explains why its fragrance is similar to that of the rose.

Keywords: roseroot, Rhodiola rosea, adaptogen, medicinal plant, rosavin, salidroside, essential oil, GC/MS, SPME-GC/MS, cultivation

Introduction

In recent decades, researchers often find new sources in the field of traditional medicine and folk medicine while searching for bioactive substances. Old writings and oral tradition often contain medical knowledge based on experience, which, – when examined by modern methods, by medicine based on natural science, and after appropriate tests, experiments and control procedures – can be exploited even more effectively. One such source of materia medica is *Rhodiola rosea*, which we also researched.[1]

It is an adaptogenic plant that grows wild, and is native to the sandy plateaux and stony slopes of the high mountains of the countries around the North Pole and the tundra. It belongs to the *Crassulaceae* family, with the vernacular name of roseroot or golden root.[2] The wild roseroot is a perennial herbaceous plant with a bushy structure, a thick rose scented rhizome and a thin root system, growing to a height of 5-40 cm and up to 70 cm in its cultivated form. The Swedish doctor-botanist Carl von Linné classified and systematized it botanically in 1725, reclassifying this species from the *Sedum* genus to the *Rhodiola* genus, and after further classification attempts, this was finally approved in 1963. Today it is considered the type species of the genus.[3] The name *rosea* refers to the rose scent of the root. Several other species of the genus have compounds that can be used in medicine, but they show significant differences.[4]

1 See *Rhodiola rosea* Rose Root in PFAF Plant Database: (https://pfaf.org/user/Plant.aspx?LatinName=Rhodiola+rosea), or Windston – Maimes 2020, 220-225.

2 Its other Hungarian names are also mirror translations, referring to its similarity to other members of the family: *fragrant stonecrop, yellow stonecrop*, and the name *arctic root*, which refers to its typical place of production.

3 Hegi 1963, 99-102.

4 Brown et alii 2002, 40-52, table 2.

The plant developed its special properties in order to be able to survive in extremely unfavorable conditions in its homeland, the Altai region. Reports on the meteorological conditions in Kazakhstan[5] show that there are typically large fluctuations in air temperature during the day, even dropping below 0 °C, paralleled by intense solar radiation, strong and persistent cold winds, and even in summer it can snow or freeze to ice. In winter heavy snow storms are usual, and the soil covering the ground provides a bare, thin, rough frame work for plants, extremely poor in nutrients, and cold.

Roseroot breeds on rocky ledges and crevices of mountains, on peaty stream banks and in the tundra. It is a component of several plant communities. Its green leaves can be eaten as a salad, although they taste bitter. Its root system has long been used as a medicinal plant in Scandinavia, Russia (mainly Siberia) and China, and in recent decades, it has become popular in many parts of the world due to its adaptogenic nature.

Figure 1. Flowering *Rhodiola rosea.* Photo by Bertalan Galambosi

5 Khapilina et alii 2016, 2.

Ancient knowledge

It appears first in the fourth book of Dioscorides' *Materia medica* (4-45), where it is presented as a geospecific medicine: "*Rhodia radix grows in Macedonia, similar to costus [1-15] but lighter and uneven, making a scent when bruised similar to that of roses. It is useful for those aggrieved with headaches, bruised and applied with a little rosaceum [1-53] and applied moist to the forehead and temples. It is also called rhodida*."[6]

His first sentence indicates an ostensible contradiction since Macedonia was an integral part of the Roman Empire in the region of the Mediterranean Sea, a well-known landscape of Europe even at that time. That is why one would think that the vegetation there did not hide any special features, the appearance of which needs an explanation. Looking at other parts of the work, however, it is obvious that here we encounter the author's usual method; he uses the possibility of comparison with lesser-known plants. It is surprising, however, that he mentions the roseroot in such a southern area, since according to our current knowledge, it is native to a much more northern area, within Europe, in the territory of the Scandinavian states, the northern part of Great Britain, The British Isles, Iceland, Greenland and other arctic islands.[7] However, scattered about at an approx. altitude of 1500-3000 m, its variants or subspecies can also be found[8] in the high alpine zone of Europe[9] (Alps,[10] Pyrenees, Carpathians,[11] Caucasus[12] and Rhodopes[13]), so Dioscorides, given the location, can either mention it as one of the rare plant drugs of the Macedonian mountain peaks or as a commercial commodity whose route led here. Its rarity is clearly shown by the fact that it is not mentioned in any book of Galen,[14] the most frequently cited ancient physician of the following centuries.

Dioscorides talks exclusively about the root and names its most characteristic property, the scent of roses. Based on this, the identification is clear. He compares its appearance to *costos*. Pliny (NH XXV, 12) writes about

6 Wellmann 1906, vol. 2, 203. Translation by Tess Anne Osbaldeston 2000, 587.

7 Brown et alii 2002.

8 For distribution by country, see Brown et alii 2002, table 1.

9 In the *Androsacetalia vandellii (Silikat-Felsspalten-Gesellschaften) Androsacion vandellii (Besonnte Silikat-Felsspalten-Gesellschaften), Asplenion serpentini (Serpentin-Felsspalten-Gesellschaften)* and *Asarinion procumbentis* form a plant community. See Oberdorfer et alii 2001, 482.

10 György et alii 2014.

11 Szontagh 1864, 269-283; Dascaliuc 2009.

12 Hegi 1923, 99-102.

13 Rila, Pirin and Stara Planina mountains, cf. Valev 1970.

14 Durling 2018, 262 not mentioned either *rhodia* or *rhodiola*.

its root (*costus amari radix*)[15] that "*The root and leaf are highly valued in India. The root of the costus is burning, the smell is special, the shrub is otherwise useless. On the island of Patale, right at the mouth of the Indus, there are two forms: black and what is considered better, white. The price is 5 denars per pound*." Dioscorides (1.15) lists three forms: the best is the Arabian, which is fragrant and has white flowers, then the Indian, which is black and smooth, and finally the Syrian, which is waxy in colour, dark and pungent in smell. However, this characterization and the ancient term "*with a special smell*" do not really fit the plants now called *Costus*, so many researchers believe that the ancient *costos* was not the modern *Costus (Arabicus / speciosus*), but a different plant, and they were swapped sometimes in later centuries. The names of *Amomum hirsutum* and *Saussurea costus [Mabberley]* have been suggested,[16] or identification with *Saussurea lappa*, which is also an essential component of modern oriental perfumes.[17] Whatever Dioscorides compared it to, he seems to have known it only as a medicine, since he gives no description of the plant, and is only dealing with the root.

He mentions two areas of its use: headaches and wound healing. In both cases, he recommends applying the mixture of roseroot and rose oil externally.[18] Applying it to the forehead and temples was certainly used to treat headaches; he does not specifically address bruises. This brief description suggests that Dioscorides had minimal knowledge and had only encountered or heard of the medicinal root. The reason for this was perhaps that he was unable to collect more knowledge from the Macedonians – and that they also obtained it in this condensed form, via the mountainous or long-distance trade.

Recently, it has been possible to identify the supposed route of distribution of *Rhodiola rosea* through phytogenetic research. It has been established that it probably reached Europe from its homeland, the Qinghai Plateau (QTP) in Tibet, during the Pleistocene, where it continued its journey in

15 *radix et folium Indis in maximo pretio. Radix costi gustu fervens, odore eximia, frutice alias inutili. Primo statim introitu amnis Indi in Patale insula duo eius genera: nigrum et, quod melius, candicans. Pretium in libras 5 VS*.

16 Osbaldeston 2000, 21 (Jaquin, in London).

17 Clay – Hubbard 1977, 205: *Costaceae* (*Costus* Family): *Saussurea lappa*, refering to a certain Fée.

18 *rosaceum*: Diocorides I.53 (Wellmann 1906, vol. 1, 49) describes its production in detail. So we know that in its usual form contained *Juncus odoratus*, oil and honey in addition to rose petals, but Dioscorides also gives another option, albeit without a recipe, where *calamus, aspalathus* and possibly even *anchusa* are the ingredients. He suggests a variety of uses, including headaches, and it is also recommended as a poultice and as a purgative – the latter presumably also applied to wounds.

two branches: the Scandinavian[19] and the Alpine[20] regions. Between the Alps and the Carpathians[21] – significant differences and a unique genetic pattern have been preserved in the Eastern Carpathians. The Macedonian highlands fit into the migration route in the European Alpine System (EAS).[22]

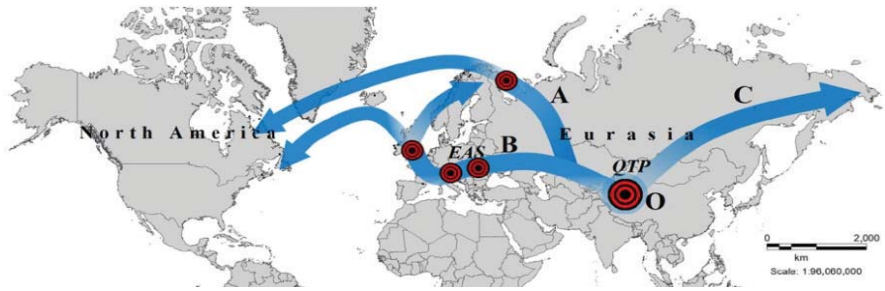

Figure 2. The supposed route of distribution of *Rhodiola rosea* through phytogenetic research by György et alii 2018, fig. 7.

Centuries of the Middle Ages and ethnomedicine

According to our knowledge, it was mentioned for the first time in medieval European sources in 1542, under the name *rhodia* in Leonhart Fuchs' book first published in Latin, and later in German.[23] He found it cultivated in many German gardens at that time. The herb is illustrated only in a 1543 manual from Ulm[24] – perhaps by his own hand, because the specimen planted in his garden in Tübingen produced flowers only in this second year. He could see it first at that time, and compared it to that of the *Sedum reflexum*. Hieronymus Bock also mentions the *rhodiola* in his herbarium[25] as an antidote for headaches. Other German authors reported that it was used as a remedy for pain, headache, scurvy, and as an anti-inflammatory.[26] We found no trace of the bruise-treatment mentioned by Dioscorides.

In South Tirol, it was believed that its concoction, mixed with milk,

19 György et alii 2013.

20 György et alii 2014.

21 György et alii 2015.

22 György et alii 2018, fig. 7.

23 Fuchs 1542, 664, and its German translation, Fuchs 1543, Cap. CCLXXIII. „*Nunc in multis Germaniae hortis plantatur.*" / „*würt aber yetz und bey uns auch in gärten gepflantzt*. "

24 Fuchs 1543, 662.

25 Bock 1546 and 1551.

26 Hoppe 1975, 986-7.

promoted pregnancy.[27] At the beginning of the 20th century, [28] it was used as a painkiller and cooling agent for headaches or as a substitute for "Chinese root", and although at that time there was no knowledge of its regular cultivation anywhere, Hegi recorded it with reference to Theodor Zwinger (III.)[29] that due to its pleasant smell, it was planted in the 17th century into all Italian, French, Dutch and English pleasure gardens (Lustgarten).

In Norway, it had more than 50 different vernacular names, and there is an abundant folk tradition associated with the plant, which Torbjørn Alm describes using literature from earlier in the millennium and material collected during his own ethnobotanical interviews.[30] Its earliest names appear in the diaries written during the Danish-Norwegian King Christian IV's voyage to the north in 1599 – the first known description of the roseroot form is in Paulli's Danish herbarium (1648) and was included in specialist books as a mirror translation. In the 19th century, it was – rightly – considered as an effective medicine for scurvy, due to its high vitamin C content, especially for cattle, which were also fed with fresh shoots and roots of the plant; that is why the word calf could be included in its several names. Based on this, Gunnerus called it "*Radix Scorbuticis salutaris*" in 1766.[31]

As an excellent hair strengthener/hair growth agent, it was used to wash hair with preference, while it was planted on the roofs of houses because the power to ward off evil / appease Thor's anger was attributed to it, a property which also provided protection from fire.

This custom can be documented as early as the 13th century and is considered a Central European adoption. The Sami people of Finnmark used the water of the roseroot to treat the eyes and drank its decoction as a treatment for urinary disorders. Kirkevoll[32] knew that it was used very commonly for wounds in SE-Norway, while in the West in the 17th century, it was used with oats as a poultice for sprained and swollen limbs.

In the Faröe Islands, *Rhodiola rosea* was used as a hair wash and as a wound salve. In Iceland, a decoction of the root was used to wash the head to relieve headaches,[33] and the dried root mixed with butter was applied to treat old wounds.[34] Attested by an 18th-century Norwegian scholar, the Eskimos of

27 Alm 2004, based on Marzell 1979.

28 Hegi 1923, 526-528, no. 1386.

29 Zwinger 1696, 868-859 and fig. Cap. XXXV: Rosenwurg, Radic Rhodia.

30 Alm 1996; Alm 2004, based on Hansen et alii 1985.

31 Gunnerus 1766; Galambosi et alii 2010, 162.

32 Kirkevoll 1940.

33 Alm 2004, 337-338: based on Nordhagen 1934.

34 Alm 2004, 338: based on Hallgrimson 1964; Mohr 1786.

Greenland consumed both the root system,[35] and the shoots and leaves,[36] fried and boiled, while the North American Nunivak on the islands and in Alaska make tea from its flowers.[37] It was applied externally especially for the treatment of burn wounds, internally to treat pneumonia and urinary problems, and it was also considered suitable for pain relief.[38]

According to tradition, Viking warriors used roseroot to increase their strength.[39]

Apart from these references, it is recorded that the Laps, during their long and arduous journeys, consumed the decoction of the rhizome to increase their endurance and to strengthen themselves physically and mentally, and when this decoction was not available, they chewed the dried root – thus the active ingredient was perfectly dissolved with the saliva. It has been used in traditional medicine for centuries also in other areas of Scandinavia, as well as in Siberia. In general, it is used to strengthen physical and mental fitness, and to increase endurance in the tasks to be performed. In Siberian Russian folk medicine, it was considered as an aphrodisiac, and long life was expected by applying it. It was used to strengthen the heart and to treat wind chills, but it was also used against flu and colds.[40] The Komis living in the Taiga near the Ural mountains attributed to it such a magical power that it was thought to be visible only to those „*whose blood shows a resemblance*" to it.[41] Young Siberians drank the alcoholic extract in the morning for 3 weeks before marriage in order to beget healthy and preferably male children. In their family tradition, the knowledge of the site, the time of collection, and the method of extraction were secret.[42]

Roseroot has long been used in the Far East. The first Chinese records of it were made in the "*Four Medical Dictionary*" written around 800 AD, during the Qing Dynasty in Tibet. According to this, his tea was a general tonic given to soldiers; it filled them with energy and vitality.[43] The Chinese emperors themselves regularly purchased the drug to increase their endurance/stamina and satisfy their sexual desires. Its extract was considered highly effective. In

35 Lagerberg et alii 1955; Galambosi 2006, 224-225.

36 Alm 2004, 338: based on Birket-Smith 1928, Egede 1741, Høygaard 1941, Hughes 1960, Schübeler 1888.

37 Alm 2004, 338: based on Griffin 2001.

38 Ryvarden 1993; Galambosi 2006, 224-225.

39 Magnusson 1992.

40 https://premiumvitamin.hu/2017/10/24/az-egyik-legosibb-gyogynoveny-rhodiola-rosea/ .

41 Galambosi et alii 2010, 163.

42 Saratikov – Krasnov 1987a.

43 In a 2011 investigation, also examining its military use, it was established that it has „evident role in ameliorating symptoms of de-adaptation" to high altitude. (Shi et alii 2011)

Central Asia, drinking *R. rosea* tea was the most effective treatment for colds and flu during the harsh cold winter. In Mongolia, the use of the extract is also prescribed for tuberculosis and cancer.[44]

It is also widely used in modern natural medicine. It is recommended to strengthen physical abilities, treat anemia, impotence, depression and gastrointestinal problems, fight various infections, and improve symptoms caused by diseases of the central nervous system. Based on experiences, it also stimulates cognitive abilities, reduces the symptoms of altitude sickness, slows the rate of memory loss and senility, and helps with learning and memorization.

Beginnings of scientific knowledge

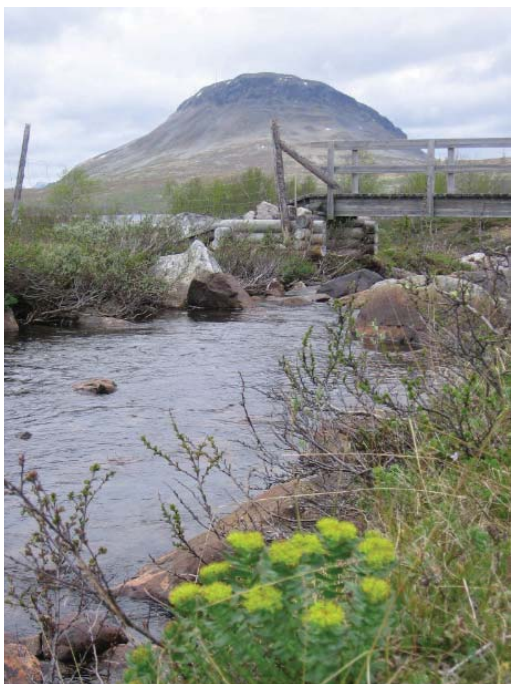

Figure 3. Rhodiola rosea in Kilpisjärvi II. Photo by Bertalan Galambosi

The scientific research of the plant began with Linné's taxonomy, certainly based on the work of Dioscorides, although Linné only refers in his taxonomic work[45] to his two earlier works, Flora Lapponica (Fl. Lapp)[46] and Flora Suecica (Suec).[47] However, in the introduction to his book, he lists Dioscorides as one of the main sources, and in addition, he calls himself a follower of Dioscorides in the full title of his own book, which he also titled Materia Medica.

He names Lapland and other mountainous regions as the place of occurrence of the plant. He says that it is perennial, and easily maintains itself when planted in gardens. He notes that

44 Khaidaev – Menshikova 1978.

45 Linnaeus 1749, 168, no. 477: in chapter Classis XXIII, Dioeciae.

46 Linnaeus 1737, 304, no. 378; Linnaeus 1754, 182-187.

47 Linnaeus 1745, 303, no. 831.

its sap is reddish and sticky and has a rose-like scent. He says it is a popular plant and exceptionally effective.

As a medical use, Linné mentions the treatment of hernia, leucorrhæa, cephalgia and hysteria, namely using the root, and he refers to the work of Caspar(d) Bauhin / Casparus Bauhinus, *Pinax theatri botanici* (1623),[48] which refers to the already mentioned Dioscorides' description, but expanded it by saying that the colour of the flower is sometimes pale, other times reddish – that is to say, several *Rhodiola* species and variants were probably named this way at that time. The list relating to its effects summarizes the experiences of traditional medicine.

Linné already described it as part of the Lappish flora in 1737, and there he also recorded a folk tradition according to which the plant was associated with the Biblical Sarah and Hagar. Here he writes that the male and female plants can be distinguished, highlighting the rose-scent of the root and the pale-yellow colour of the flower compared to the usual *Telephium genus*. He describes it as abundant in vast areas in the mountains.

Figure 4. Male and female flowers of Rhodiola rosea. Photo by Bertalan Galambosi

48 Bauhin 1673, 286.

However, research on roseroot only began in 1931 in Russian nutritional research, or as part of Dr. Brechman's investigations. Its botanical definition took place in 1961 when the Russian botanist identified the golden root with *Rhodiola rosea* in the Altai Mountains of Southern Siberia.[49] Its adaptogenicity was settled in 1968 by Israel Brekhman and Dardymov,[50] though after WW II, the Soviet Union secretly used the alcoholic extract of the golden root, which only the chosen one: astronauts, elite athletes, Olympians, and leading statesmen could access.[51]

Its alcohol-based extract, *Rhodiola Extract Liquid*, was only registered as an official medicine in 1975. It is thanks to Professor F. Sandberg, one of the leaders of the Swedish Medicinal Plant Research Institute, that it was in the same year, 1975, that it became known in Europe, as he had translated the Russian publications up to 1975 into Swedish and English: [52] more than 180 pharmaceutical, phytochemical, animal and human clinical research results. This made it possible for the European scientific world to learn about the herb *Rhodiola rosea L.* and its extremely wide application. Since 1969, the 46% ethyl alcohol extract of the rhizome (Rhodiola Extract Liquid) [53] has been marketed as a medicine in the Soviet Union, which contains salidroside, rosin, rosavin, and rosarin phenylpropanoid molecules in the prescribed amount. Initially, only the amount of salidroside (rhodioloside) was determined, attributing to this the special effect of the rhizome. However, in order to meet the growing demand, *Rhodiola* preparations were also prepared by extracting other *Rhodiola* species, following this standard, and their medicinal effects were variable. It became clear that additional ingredients, unknown at the time/unexplored in their effects, also played an important role in the special adaptogenic effect of *Rhodiola rosea*. In 1986, Dubichev and his colleagues discovered that rosavin, rosin, and rosarin are the specific cinnamyl alcohol-vicianosides in this variety, the collective name of which became the rosavins.[54]

Following on from its use in the Soviet Union, it became a medical product for antifatigue in Sweden (1985, Textbook of Phytomedicine for Pharmacists) due to its stimulating effect.[55] Since 1989, according to the

49 Krylov 1969, 264; Brown et alii 2002.

50 Brekhman – Dardymov 1968.

51 Vastag 2007.

52 Sandberg 1998.

53 The officially defined scope of its use: stimulant for asthenia (fatigue), for somatic and infectious illnesses, in psychiatric and neurological conditions, and for healthy individuals to relieve fatigue and to increase attention span, memory, and work productivity. (Brown et alii 2002)

54 The publication appeared only later: Dubichev et alii 1991. Confirmation of its species-specific presence from an independent source: Ganzera et alii 2001.

55 Sandberg – Bohlin 1993, 131; Brown et alii 2002.

prescription of the Soviet Pharmacopoeia,[56] *Rhodiola rosea* extract must contain at least 3% rosavins and 0.8-1% salidroside, since the ratio of the components in the naturally occurring rhizome is also 3:1. However, the effect of *Rhodiola rosea* preparations is also influenced by the other components, and the determination of these components, the identification of their effects or the search for their mechanism of action still requires further investigation.

The research on the wild plants themselves is also an important and wide-ranging task since the studies so far show that there is greater genetic diversity even at the species level, and although there are fewer genetic variations within individual plant populations, this diversity can also result in significant differences in the chemical components in plants from different areas.[57] Given that the production has been mostly based on the collection of wild plants, different trends may prevail in the effect of the preparations, depending on the place of origin, and the variation in the source of the raw materials, so it has become important to study wild populations and to establish the cultivation of a high-quality, stable form, so that it will be possible to study this important aspect of the selection. Similar to the Finnish material,[58] the material collected in the Norwegian Finmark showed significant compositional differences, for example, when examined with ISSR markers:[59]

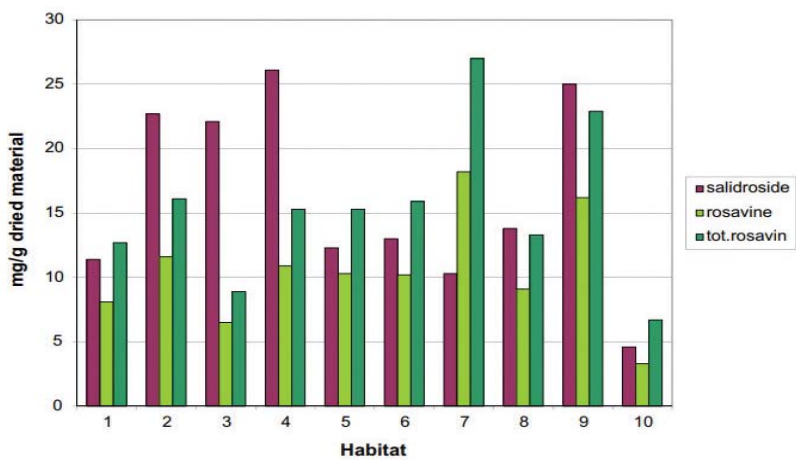

Figure 5. Salidroside, rosavin and total rosavins content of the 10 studies North-Norvegian habitats by György et alii 2013, 365, figure 3.

56 Russian National Pharmacopoeia. Moscow, Russia: The Russian Federation Ministry of Health and Medical Industry 1989.

57 In the case of glycosides, it was shown that molecular variations have no effect on the content, it is only influenced by environmental factors. This is the explanation e.g. for the 3 ecotypes separated in the Ural and Altai regions of Kazakhstan.

58 Fjelldal et alii 2010, 35.

59 György et alii 2013, fig. 3.

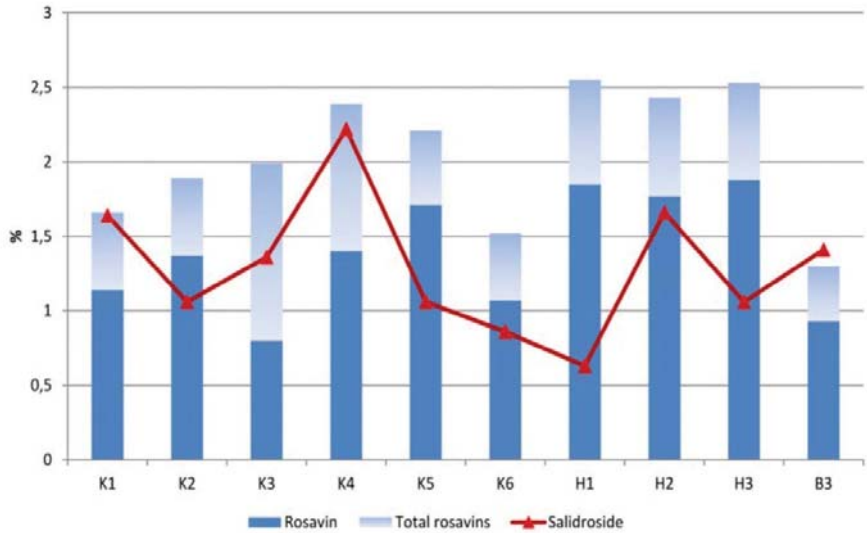

Figure 6. Contents of the studied compounds in the rhizomes of 6 years old plants, originated from different places of Kilpsijärvi, 2009 by Galambosi-Galambosi 2015, 14, figure 6)

In the populations studied in nearby Finland (Kilpisjärvi region), the same materials also show significant fluctuations.[60]

Cultivation

Although the research on the *Rhodiola rosea L.* has not yet been completed despite numerous tests, its positive values are obvious. Thus, in addition to its uses in folk and natural medicine, the pharmaceutical industry is also employing it in increasing quantities, in a similar way to the importance given to other new medicinal plant species which have been identified across the world. However, in order to satisfy the increasing demand for the plant, wild stock is being collected on an industrial scale, which in many places threatens the natural balance and the survival of the species.[61] It should be possible to

60 Galambosi – Galambosi 2015.

61 Brinckmann et alii 2021. In Bulgária e.g. it was listed among the critically endangered species in 2011 (Meshinev 2011), and its collection was already banned in 2002 (Appendix 3 of the Biodiversity Act, 2002). Roseroot was also put on the Red List in Kazakhstan (Khapilina et alii 2016, plates also in English). Separated by countries (see Kubentayev et alii 2021, 2.) In a Polish survey, the yield of components of various sizes of the fresh root system was compared, concentrating especially on the polyphenols (Adamczak et alii 2014).

avoid this by providing a new plant source, namely by producing plants under cultivation.[62]

Biomass assessment plays an important role in the selection of the most suitable subjects for breeding, which is one of the main goals of preparatory research for industrial production. One side of this is the chemical analysis of the components of the individual plants,[63] the other is the promotion of optimal yield, which requires very accurate assessment of the characteristics of each population. In connection with this research, it was established in some *R. rosea* coenopopulations in Altai that significant differences can be observed between female and male plants.[64] The multidirectional difference suggests that in some cases, in addition to genetic and environmental effects, gender can also be a significant factor. Calculating the amount that meets the needs also involves the further destruction of plant species that are now on the verge of extinction in many places, so it even became necessary to develop new methods for calculating the biomass.[65]

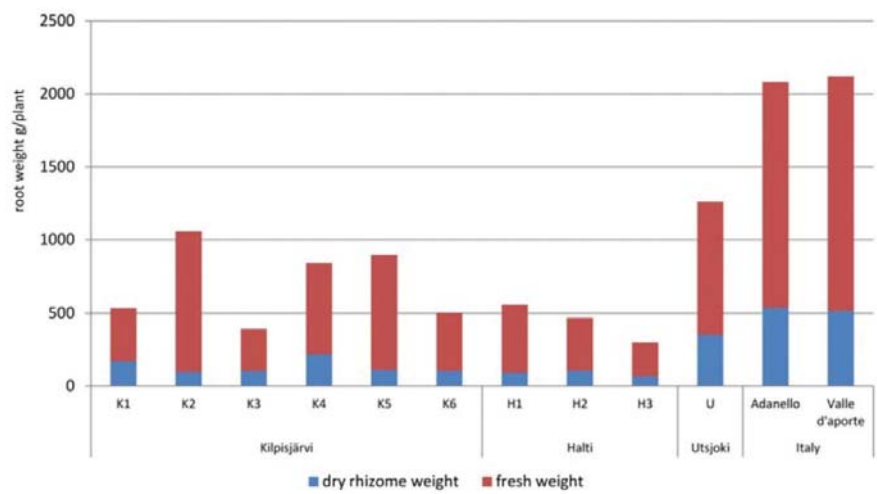

Figure 7. Average root weight of 10 years old cultivated *Rhodiola rosea* accessions in 2012, Mikkeli (n=1) by Galambosi-Galambosi 2015, 12, figure 5.

62 Another possibility has arisen, it can be theoretically solved by the artificial production of the main active ingredient – Mirmazloum et alii 2019: the biotransformation of the alcoholic glucoside precursor of cinnamyl. Also the search for a new way has begun, for e.g. Martínez et alii 2020, who try to regenerate hair roots by inoculating *R. rhizogenes*, instead of plundering nature.

63 E.g. for survey of Finnish population see Galambosi – Galambosi 2015, fig. 5: presentation of the measurement results of 10-year-old samples.

64 Prokopyev et alii 2021.

65 Bozhilova 2019a.

It has also become important to solve its propagation in large quantities,[66] since the plant is destroyed by the use of the rhizome, and a large number of seeds or seedlings are needed to replace them, and acclimatization is also a task to be solved for them when transplanting.[67]

The plant has developed its special materials and way of life to withstand special, oxygen-poor, cold conditions, but its agricultural cultivation must be solved in less extreme conditions, i.e., the cultivation of *Rhodiola rosea* was/is needed in a way that can support a large mass, clearly visible, uniform, and, especially important, in a place that can be cultivated with machines. Most importantly, it must be established in a way that ensures that the plant would not loose its effectiveness in the new cultivation conditions but would even increase it.

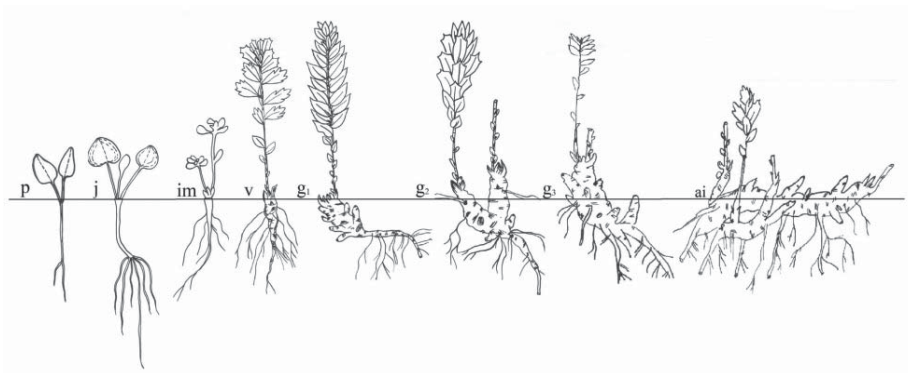

Figure 8. Growing phases of *Rhodiola rosea* plants by Kubentayev et alii 2021. j: juvenile, im: immature, v: virginile, g1: young generative, g2: mature generative, g3: old generative, ai: ageing individuals

Experiments were started in China, the Soviet Union[68] and other places,[69] and also in Mikkeli, Southern Finland in 1994, and by 2002, we succeeded in solving the main problems inherent in cultivating the plant.[70] The work was divided into 2 phases: 1) between 1994-1998, biological

66 solved by cloning, reducing the seed yield to 1 year, e.g. Erst et alii 2018. in vitro cultivation e.g. In Bulgaria: Tasheva – Kosturkova 2012. Also In Kazakhstan, the method of micropropagation and in vitro cultivation is applied, with the further development of a procedure patented in 1981; in the future, plants grown in vitro are also considered as a source material for re-introduction. Now any of its organs can be cloned. Khapilina et alii 2016.

67 Tasheva – Kosturkova 2010, 209-110.

68 E.g. Kim 1976; Kozłowskj – Szczyglewska 2001; Nukhimovskii et alii 1987.

69 E.g. in Alberta, Canada: Kwesi 2004; in Europe: Galambosi 2015.

70 Galambosi 2006.

reproduction, growth, the amount of biomass, and the characteristics of the root and rootstock were studied, 2) between 1998-2002 practical small-scale and then medium-scale cultivation experiments were carried out to establish production methods, how to keep weeds away, and how to assist fertilization, seed production and harvesting. The results were published in a series of articles in academic journals.[71] Based on the experiments, although it is drought tolerant, it requires relatively wet weather with evenly distributed rainfall, cool temperatures, loose and deep, 6-7 Ph clay/sandy and loamy soil, and a sunny location for good yields. Interestingly, it does not like stony soil in agricultural cultivation, although it usually occurs in such places in its natural environment.

The 5-year-old plants are best suited for harvesting, as by aging dead parts are created and their quality is lower. [72] Little is known about its nutrient requirements, but the plants appreciated the cow manure (Biolan composted cow manure) used in the experiment, although the dry matter content of the rhizome hardly changed. NPK = 50-50-75 kg/ha proved to be ideal.[73] It happened once before planting.

The reproduction by root division proved to be faster than when it sprouted from a seed, and it also developed faster than in its natural environment.[74] At the same time, seed or seedling reproduction yielded equally good quality results.[75] According to the literature, the most favorable germination

71 Dragland – Galambosi 1996; Galambosi et alii 2003; Galambosi 2004.

72 Galambosi et alii 2010, 167.

73 Galambosi 2006, 227-228, table 1.

74 Galambosi 2006, 229-231, table 2.

75 Galambosi Barents 7.

value is reached at 2-4 °C,[76] but a simple natural winter hibernation in Mikkeli yielded better results. Russian research has shown that the seed retains its ability to germinate for 10 years. The seedlings produced a significantly better crop after 12 months of pre-cultivation than those planted after 5 months. Optimal row or root distance proved to be 40x40 cm. There are several options for keeping weeds at bay, but there is currently no herbicide being used. In addition to weeding, the black plastic mulch spreading method was tried, which resulted in an increase in crop yield. The “potato ridge” technique proved to be also suitable for keeping weeds at bay. There were hardly any pathogens during the 10-year experimental period. The seed is extremely tiny, and the flower produces it in large quantities. It can be collected annually.

Figure 10. *Rhodiola rosea* after flowering. Photo by Bertalan Galambosi.

Based on Russian studies, it is also known that the size of the plant increases under agricultural conditions.[77] It is advisable to harvest the root in autumn.[78]

76 Revina et alii 1976.

77 Bozhilova 2019b.

78 Galambosi et alii, Barents 1.

Strong pickers/shakers are required as it is 15-20 cm deep. After harvesting, it is important to slice and wash and then dry the rhizome. The rhizome and hairy roots are both important products – according to the measurements, the flavonoid value of the roots is more than double than that of the rhizome, but manual and mechanical slicing or the length of the period before drying significantly affects the value of the main active components, probably due to auto-fermentation.[79] The active ingredients can be extracted from both fresh and dried raw materials with good results.[80] Cooling and freezing and then thawing after slicing seemed to increase the total rosavin content.[81]

All of this clearly shows that agricultural production is time-, labor- and cost-intensive, and a new plantation needs to be established every year. The Mikkeli experiment resulted in the establishment of a plantation, thus in addition to the Russian alcoholic extract, an alcoholic extract (Dynaforce) and capsules are now also produced in Finland.[82]

Medical use

Beside agricultural research, pharmaceutical analyses and other investigations also continued. Based on scientific research, it was established that roseroot is an extremely versatile plant,[83] as summarized by Suzan Tireki, "*Rhodiola rosea* increases the resilience of the body to stress-factors by impacting the axis of hypothalamic-pituitary-adrenal and protects against mental and physical exhaustion due to stress. Military people and athletes use(d) this adaptogenic herb to boost their stress resistance and combat fatigue".[84] Its main known effects

- treat the symptoms of stress comprehensively and can prevent chronic stress or complications.[85] It is also antihypoxic.
- relieve depression by improving the mood;[86] – Its presumed mechanism of action on the central nervous system is described by Brown and his colleagues.[87]

79 Galambosi et alii, Barents 4.

80 Siivari, Barents 5.

81 Galambosi et alii, Barents 3.

82 It can also be purchased in Hungary, as well as the Norway Odin-Roseroot capsule.

83 Saratikov 1974.

84 Tireki 2021, 849.

85 Anghelescu et alii 2018; Darbinyan et alii 2000a; Furmanowa 1995, 412-26; Brown et alii 2002.

86 Konstantinos – Heun 2020, 1-11.

87 Brown et alii 2002, Diagram 1: stimulates NE, DA, 5-HT, and Ach neuronal systems plus emotional calming with its antioxidant effect.

- increase endurance and physical performance[88] in such a way that, after extreme exertion, the normal state is restored much sooner than the natural duration would do, based on the measurement of blood pressure and pulse,[89]
- results in enhanced thyroid function but does not cause hyperthyroidism,[90] while the thymus and adrenal glands continue to function well, without the involution occurring with aging, and hypertrophy usual at other psychostimulants respectively.
- inhibit the division of cancerous tissues,[91] while increased the effect of antioxidant and anticancer drugs[92], thus it can both enhance tumor inhibition by chemotherapeutic drugs while alleviating dangerous side effects,[93] and increase indices of DNA repair in bone marrow cells.[94]
- protect the functioning of blood circulation.[95] This anti-arrhythmic effect is related to the mu-opiate receptors of the myocardial heart muscle,[96] as demonstrated by naloxone injection experiments.[97] It ameliorates the strength of heart muscle contractility, and improves the functions of the sympathetic and parasympathetic systems.[98] It was also observed that they „improve the progress of atherosclerosis by regulation of lipid metabolism, restoring of the antioxidant capacities, and attenuation of pro-inflammatory cytokines and chemcytokines release, and improving the endothelial dysfunction indicated by nitric oxide system”. [99]
- improves sexual function, has sexual stimulating effects[100]
- has a beneficial effect on concentration and memory,[101]
- has an immunity enhancing effect, and the ability to cause weight loss has

88 Lee et alii 2009.

89 Saratikov – Krasnov 1987b; Ishaque et alii 2021.

90 Maslova et alii 1994.

91 Agnieszka et alii 2006.

92 Udintsev et alii 1991; Udintsev et alii 1992.

93 Salikhova and colleagues found that in mice injected with cyclophosphamide, RRRE (minimum 0.8 percent salidroside and 3 percent rosavins) had antimutagenic effects.

94 Salikhova et alii 1997.

95 Maslova et alii 2004.

96 Maimeskulova et alii 1997.

97 Maimeskulova et alii 1997.

98 Baranov 1994.

99 Zhou et alii 2018.

100 Saratikov – Krasnov 1987a, 216-27; Saratikov – Krasnov 1987b; Gerasimova 1970, 46-48 and 83; Saratikov – Krasnov 1987c.

101 Olsson alii 2009.

also been mentioned lately [102]

In an article published in Kazakhstan, its use in rehabilitation is emphasized: after operations, injuries, and after serious infectious diseases, when it can be used as a general tonic, as well as in sports medicine and geriatrics.[103]

There are, however, some contraindications: *R. rosea* should be taken early in the day due to its invigorating effect – its regular consumption can interfere with sleep or cause vivid dreams (not nightmares), and it can be toxic when consumed in large quantities.

No interactions with other drugs have been recorded, but the data is limited, thus it requires further investigation.

Figure 11. 5 year old cultivated roots of *Rhodiola rosea* in Mikkeli. Photo by Bertalan Galambosi

Chemical composition

Studies in recent decades have revealed more than 140 compounds in roseroot.[104] The Browns[105] classified the most important into 5 groups:

102 Colitti 2014.

103 Khapilina et alii 2016, 2.

104 Panossian – Wikman 2010.

105 Brown et alii 2002.

- Phenylethanol derivatives: salidroside (rhodioloside), tyrosol;
- Flavanoids: rhodiolin, rhodione, rhodiosin, acetylrodalgin, tricin;
- Monoterpernes: rosiridol, rosaridin;
- Triterpenes: daucosterol, beta-sitosterol;
- Phenolic acids: chlorogenic and hydroxycinnamic, gallic acids.

Other identified compounds from *Rhodiola rosea* plants growing in different places are also known with tested effects.[106] So, many phenols (e.g. quercetin, kaempferol, proanthrocyanidins),[107] other phenolic acids, terpenoids, flavones and flavonoids, alkaloids, anthraquinones and lotaustralin.[108]

Basically, the most important among them are salidroside[109] and phenylpropanoids: rosavin, rosin, rosarin (which are specifically characteristic of the *R. rosea* species).[110] In addition to them, tyrosol and cinnamic alcohol are considered to contribute to the adaptogen effects.[111] Recently, in order to increase their amount in vitro experiments were carried out.[112]

The essence of the adaptogenic effect is the non-specific enhancement of resistance to psychological or physical stress. Adaptogens are different natural substances that partially modify the body's reactions to various stress effects through their impact on the adrenal glands: The external and internal conditions of the human body are constantly changing. It is possible to increase our ability, to adapt to changes by using adaptogenic herbs. The mechanism of the adaptogenic effect is not yet fully clarified, it seems to be at least partially based on adenosine triphosphate (ATP), which reduces stress (see Diagram 2).[113]

In the case of roseroot, it seems that the phenylpropanoid components are responsible for the adaptogenic effect, the qualitative and quantitative analysis of which is determined by the HPLC method. The ratio of the various rosarin components and salidrosin in the 46% ethyl alcohol solutions available in pharmacies is 3:1, because this is the average natural ratio of the components found in the Russian tundra.

The adaptogenic activity of the plant is analogous to the activity of *Panax ginseng* and *Echinaceae purpurea* extract. Furmanova and her colleagues identified a very strong antioxidant activity when examining the

106 E.g. Kuryanov et alii 1991; Ming et alii 2005.

107 Yousef et alii 2006.

108 Yurdanur et alii 2004.

109 Bozhilova 2011; Mao et alii 2007.

110 Evstavieva et alii 2010.

111 Brown et alii 2002.

112 Javid et alii 2020. For earlier experiments see Bozhilova et alii 2008.

113 Brown et alii 2002.

dihydroxyphenol content of the rhizome,[114] and the immunostimulating and muscle strength-enhancing effect of the plant rhizome, tissue culture, and callus samples was also determined.[115]

Most recently, Colitti summarized the effects of these compounds, supported by numerous studies. Roseroot thus is:

Figure 12. Seed capsules of *Rhodiola rosea*. Photo by Bertalan Galambosi.

- antioxidant[116]
- anticancer[117]
- antidepressant[118]
- neuroprotective[119]
- cardioprotective[120]
- liver protector[121]
- immune stimulant[122]
- normalizes the physiological effect and protects against stress,[123]
- can balance the blood sugar level of diabetics and activate the lipolytic process[124]
- reduces atherosclerotic plaque formation[125]
- mobilizes the lipids of adipose tissues into the natural fat-burning processes and
- has a direct effect on "sympathetic tone and hypothalamic norepineph-

114 Furmanova et alii 1995.
115 Tasheva – Kosturkova 2012.
116 Chen et alii 2009; Calcabrini et alii 2010; Mao et alii 2010.
117 Hu et alii 2010; Sun et alii 2012.
118 Darbinyan et alii 2007; Ross 2014,
119 Yu et alii 2010; Zhong et alii 2014; Limanaqi et alii 2020.
120 Wu et alii 2009; Cheng et alii 2012.
121 Song et alii 2003; Wu YL et alii 2009.
122 Skopńska – Rózewska 2008; Siwicki et alii 2012; Mishra et alii 2012.
123 De Bock et alii 2004; Olsson alii 2009.
124 Lee et alii 2011.
125 Zhang et alii 2012.

rine secretion",[126] therefore it has been suggested that it can also contribute to weight loss.

One of the reasons for all these diverse effects may be the strong antioxidant capacity of *Rhodiola rosea* rhizome, which is due to its composition rich in phenolic components.

Phytochemical and mass spectrometric analysis of the essential oil test

The pleasant smell of the rhizome also indicates that it is rich in aromatic oils, but just like the other active ingredient content varies in different geographical areas, [127] the amount and proportions of the essential oils vary from area to area.[128] The individual populations retain their morphological characters and their internal content for a long time, even in a refined form.

During the phytochemical examination of the root system of *Rhodiola rosea* from Mikkeli, Finland, we identified the biologically active components of the essential oils and phytosterol components of the root system using the mass spectrometric GC/MS, SPME-GC/MS method.[129] The tests have been carried out since 2000 at the Semmelweis University, Institute of Pharmacognosy, using an AGILENT type mass spectrometer. During the phytochemical examination of the rhizome, we determined that, depending on the place of origin, the total rosavin content varies between 4.6 mg/g and 8.2 mg/g. The bitter value also varied between 5000-15000.

The distinctive scent reminiscent of roses, gives the roseroot its appellation. Although we know about 200 varieties and cultivars of roses, only four of them have a strong enough fragrance to make rose oil or rose water out of them: *Rosa damascena Mill., Rosa gallica L., Rosa moschata Herrm* and *Rosa centifolia L.* During previous studies, we analyzed the essential oil content of several types of roses,[130] and after comparing our own results with the literature, we came to the conclusion that, although the composition of the rose fragrance varies depending on the cultivation period and storage, the colour of the petals also fundamentally influences the fragrance-groups. Rose

126 Verpeut et alii 2013; Abidoff 1997; Ramazanov et alii 1999.

127 Galambosi et alii 2010, 166-167.

128 Based on the dendrogram, Wikipedia: rosavin, rosarin, and rosin at their highest concentration, according to many tests, can be found only in *R. rosea* of Russian origin; the main component of the essential oil from *Rhodiola* growing in Bulgaria are geraniol and myrtenol; in China the main components are geraniol and 1-octanol; in India the main component is phenethyl alcohol. Cinnamyl alcohol was discovered only in the sample from Bulgaria.

129 Héthelyi et alii 2005; Héthelyi et alii 2007.

130 Héthelyi et alii 2005; Szabó – Héthelyi 2008; Héthelyi et alii 2010a; Héthelyi et alii 2010b; Héthelyi – Rosival 2012.

oil is made from the *R. Damascus* variety,[131] whose blackish-purple petals make the strongest composition among those which we examined.

In analysis similar to that used on roses, we performed gas chromatography (GC) and mass spectrometry (GC/MS) SPME-GC/MS analysis of the rhizome and root essential oil of *R. rosea*, and after analyzing several *Rhodiola rosea* root essential oil samples, it became clear that the two main components of the essential oil are myrtenol and geraniol.[132] In addition to these typical components, the samples contained pinene, octane, cumin alcohol, cumin aldehyde, perilla alcohol and perilla aldehydes in a few %.[133] Rhizomes of Finnish and Komi origin contain 5-8% Campesterol and 25-35% Sitosterol phytosterol components. The ratio of the two main components of their essential oil, myrtenol (14-35%) and geraniol (18-62%), also varied. We found that the same components are characteristic of the Arab Damascus Rose oil, which has a strong sexual arousal effect. This composition also explains why the fragrant *R. rosea* root system was used as an aphrodisiac: its essential oil has a sexual arousal effect.

Conclusion

Rhodiola rosea, belonging to the *Crassulaceae* family, is a characteristic plant of the cool arctic and subarctic climates of the northern hemisphere, but it can also be found in the southern high mountains of Europe. Its characteristic rose scented root system was typically used in European traditional medical practice to increase general health and endurance or as an aphrodisiac. Its medicinal effect has been known since ancient times, but it was only proved at the end of the 20th century that it contains biologically active components of a polyphenolic nature, to which it owes its strong adaptogenic and antioxidant effects.

Both animal and human clinical experiments confirm the presence, structure and strong adaptogenic effect of its especially characteristic polypropylene components (rosin, rosarin and rosavin) and salidroside molecules, but the studies have also shown that the chemical composition of the plant's materials varies in specimens from individual areas and populations, and may even differ between the two sexes.

The tests have therefore proved that it is a particularly effective plant, so it is no wonder that it is harvested in industrial quantities in nature. However, on the one hand, this endangers the survival of the plant species, and on the other hand, it provides raw material with unevenly active ingredients. Thus, for industrial use the cultivation of the wild plant must be resolved, and it is

131 Tucker – Maciarelo 1988; Falsetto 2008.

132 Héthelyi et alii 2005.

133 Héthelyi et alii 2007.

cultivated already in Mikkeli, Finland and in several other places.

During our investigation, we determined the composition of the essential oil and phytosterol components of the Mikkeli *Rhodiola rosea* rhizomes, a field hardly dealt with before, finding as main components the myrtenol and geraniol, with less campesterol and sitosterol, which explain – besides the many favorable physiological effets – the aphrodisiac property of the fragrance.

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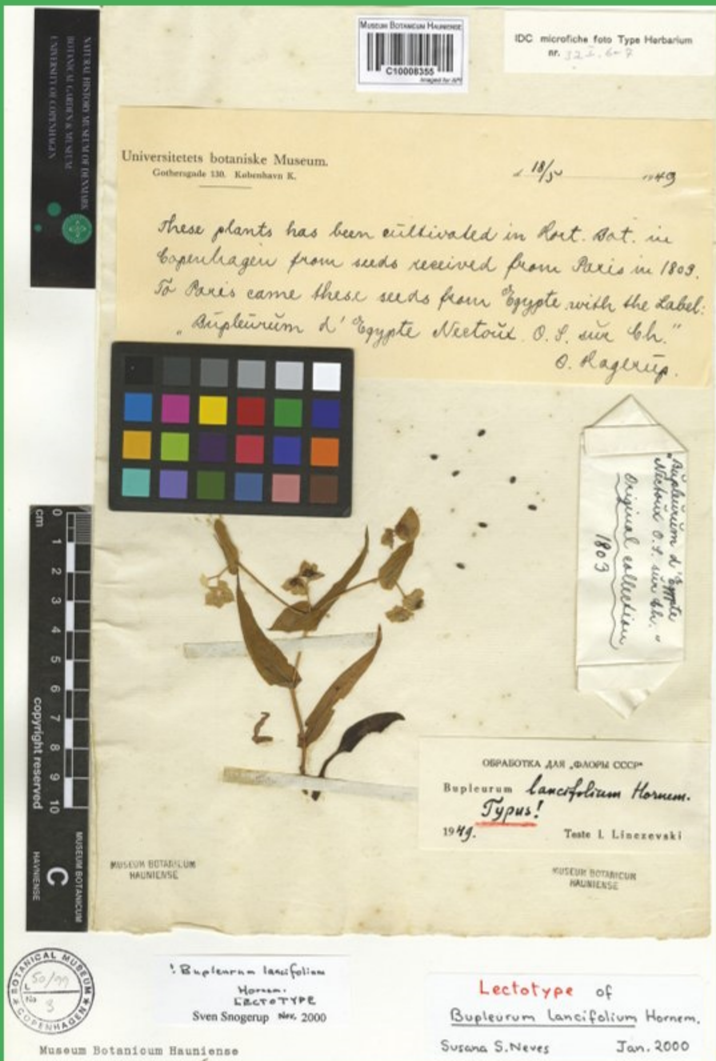

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IDC microfiche foto Type Herbarium
nr.
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18/5 1949
These plants has been cultivated in Hort. Bot. in Copenhagen from seeds received from Paris in 1809.
To Paris came these seeds from Egypte with the Label:
„Buplevrum d'Egypte Nectoux O. S. sur Ch."
O. Hagerup.
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ОБРАБОТКА ДЛЯ „ФЛОРЫ СССР"
Bupleurum lancifolium Hornem.
Typus!
1949.
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! Bupleurum lancifolium Hornem.
LECTOTYPE
Sven Snogerup Nov. 2000
Lectotype of
Bupleurum lancifolium Hornem.
Susana S. Neves Jan. 2000
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