https://doi.org/10.22364/iarb.2023.07

TYPICAL BERRIES OF THE HEMIBOREAL ZONE: TRADITIONAL USE AND THE POTENTIAL FOR CULTIVATION – A SHORT REVIEW

Laura Āboliņa[1,2*], Anita Osvalde[1]

[1] University of Latvia, Institute of Biology, Laboratory of Plant Mineral Nutrition, O. Vācieša street 4, Riga

[2] Latvia University of Life Sciences and Technologies, Lielā iela 2, Jelgava

[*] Corresponding author: Abolina.Laura@lu.lv

Abstract: Wild berries – bilberry, lingonberry, cranberry, and cloudberry are typical boreal forest species and have been a source of food and traditional medicine since ancient times. Based on the SCOPUS database, this review evaluates the popularity of wild berries in Latvia and the world, comparing the latest scientific research on each species. The literature highlights the global popularity of bilberry and a notable research interest on cloudberry in Latvia. The large proportion of articles in health-related fields emphasizes the importance of using wild berries for health benefits.

Keywords: boreal forests, V*accinium myrtillus, Oxycoccus palustris, Vaccinium vitis-idaea*, *Rubus chamaemorus*

Wild berries of Latvia – worldwide distribution and growth environment

Wild berry species such as wild bilberry *Vaccinium myrtillus, bog cranberry Oxycoccus palustris, lingonberry Vaccinium vitis-idaea*, and cloudberry *Rubus chamaemorus* are typical boreal forest species in the subarctic-temperate zone, however, their distribution and use differ throughout the regions of the northern hemisphere. Wild berries have been used as a source of food and medicine for thousands of years, including both berry fruits and leaves, finding use for most, if not all, parts of the plant (Vanhanen, Pesonen, 2016).

In Latvia, the most popular are wild blueberries and cranberries, although other berry species of the hemiboreal zone can also sustain good harvests. Bilberry is widely distributed throughout the northern hemisphere, the subarctic and temperate zone. France is the southern limit, where it mostly grows in the colder mountain areas. Most important factors determining distribution is mean annual temperature, soil pH and C : N ratio (Coudun, Gégout, 2007), colder regions with poor, peaty soils with pH of 4–5 are especially favorable. Cranberries are distributed mainly in the subarctic and temperate zones, particularly in bogs, tundra and boreal forests (Adamczak et al., 2009). Lingonberry distribution is similar to wild bilberries (Lee, Finn, 2012; Hirabayashi et al., 2022).

Cloudberry is naturally distributed in the arctic-subarctic regions, sustaining most abundant harvests in the Scandinavian countries, but still can be found in the northern parts of Poland (Thiem, 2003; Koczur, 2011). Overall, a similar characteristic for these wild berry species is the requirement for wet, acidic habitats that are poor in nutrients.

Yield variations of wild berry species

Current scientific literature reports on annual yield variations for all berry species included in the review (Wallenius, 1999). In general, bilberry and lingonberry yields are similar, literature reports on yield range 12–38 kg ha^{-1} for bilberry, 12–35 kg ha^{-1} for lingonberry (Turtiainen et al., 2011). Thus, average yields *can variate by more than three times from year to year (Turtiainen et al., 2011, Nestby et al., 2011). Bilberry blooms in spring, so in most cases low yields have occurred in years with spring frosts during flowering (*Nestby et al., 2011). As lingonberry usually blooms in late spring or early summer, risk for frosts is lower. However, concerns regarding climate change predict on earlier blooming for all vegetation, which can result in higher risk for frost during blooming for all berry species (Hirabayashi et al., 2022). Bog cranberry can be considered as the highest yielding berry shrub between mentioned species, with average yields reportedly ranging 92–2420 kg ha^{-1}, which can be attributed to the species sustaining large stands throughout the bog landscape (Adamczak et al., 2009). Meanwhile, the yields of *cloudberry* in the northern countries are highly variable with reported results ranging from 2 to 300 kg ha^{-1} (Kortesharju, 1984; Thiem, 2003, Li et al., 2015). Although yields in Latvia are likely not comparable to those reported in Finland or Canada (Thiem, 2003; Li et al., 2015), local businesses get by to make cloudberry liquor and wine (Ligatne winery, S. a.). It should be noted that so far data on yearly yields in Latvia is limited for all wild berry species (Bārdule et al., 2020).

Research on health benefits of various wild berry species

Current research suggests health benefits of using both leaves and fruits of mentioned berries, as well as ongoing demand for wild berry products (Ferlemi, Lamari, 2016; Vaara et al., 2013). Fruits of each species has a unique set of compounds associated with specific taste and health benefits. Leaves are gathered and even sold in pharmacies as teas or transdermal agents for a wide range of health problems (Ferlemi, Lamari, 2016; Rubine et al., 1977). Therefore, although yield variability and distribution affect availability, all wild berry species are still widely sought after on the world market.

Research on health benefits is abundant for all four berry species, however, only cranberries, bilberries and lingonberries are mentioned in Latvian traditional plant medicine books (Rubine et al., 1977; Groms, Hammermane, 1971). Scientific literature describes cloudberries as an important vitamin C source in the northern regions, using berries and leaf tea (Thiem, 2003; Nilsen, 2005). However, the lack of mentions in Latvian popular scientific literature indicate that the cloudberry has been overlooked in spite of being relatively abundant in the wild. In general, scientific research is most scarce regarding cloudberries, but in Latvia, as of August 2023, both cranberries and cloudberries have

been mentioned in 4 SCOPUS indexed articles. This contradicts the assumption that annual yield highly determines the popularity and level of knowledge about berries, regarding the high popularity of cranberry daily use.

Teas or infusions prepared from berry leaves have several common effects e.g., as diuretics, antipyretics, diaphoretics, and scurvy remedies. Bilberry leaves are also known to reduce gastrointestinal pain and are traditionally widely used against diabetes, although there is little research on this (Rubine et al., 1977; Ferlemi, Lamari, 2016). Cranberry leaves are commonly used to treat urinary tract infections and discomfort (Rubine et al., 1977). Lingonberry has similar properties regarding treating fever and urinary tract issues (Ferlemi, Lamari, 2016). Cloudberries have been shown to contain the highest amounts of ellagic acid – an antioxidant associated with anti-carcinogenic properties (Landete, 2011; Ferlemi, Lamari, 2016). Ellagic acid has also been found in cloudberry leaves (Thiem, 2003).

Cultural and scientific popularity

Although studies show great potential for wild berries to improve human health, there is evidence of decreasing demand and knowledge of non-wood forest product picking. This is due to both socio-economic and ecological reasons, as nowadays visiting forest sites is regarded mostly for recreational rather than harvesting purposes (Anderson et al., 2018; DiCori et al., 2021; Lindhagen, Hörnsten, 2000). It should be noted that fresh fruit is preferable due to evidence regarding fruit losing bioactive compounds during processing and freezing (Howard et al., 2012). Therefore, the trend of declining berry picking in the Northern Hemisphere is not encouraging. Especially since the demand for fresh berry supply had increased at least up until 2022 (Rijswick, 2022). High demand has also remained for processed berry products like liquors, wine, jam, frozen fruit, sweets and canned products. This highlights the gap between knowledge on traditional product use and the modern lifestyle. However, an interest in methods and technologies of cultivating various species has remained in the scientific community, providing theoretical and practical knowledge to the fields of food science and biochemistry.

In this literature review, the popularity of various berries was analyzed by comparing scientific research conducted on each species, as well as including current knowledge on their uses in traditional medicine in Latvia.

The SCOPUS database provides a search function for the comprehensive analysis of research documents within its repository. We performed a comparative analysis of research articles mentioning four wild berry species, conducting search for their respective Latin taxonomic names either in the article title, abstract or keywords. The inclusion of Latin taxonomic names in scientific literature is a common practice, ensuring accessibility and clarity for researchers, regardless of the diverse common names assigned to these species.

For instance, "bilberry" is frequently used interchangeably with "blueberry," even though *V. myrtillus* is the Latin nomenclature for bilberry, while "blueberry" primarily denotes the cultivated highbush blueberry *Vaccinium corymbosum* and other varieties.

Furthermore, *Vaccinium uliginosum* is also referred to as bilberry, though its distinct English common name is "bog bilberry".

Our search methodology involved specifying the inclusion of both the genus name and specific epithet within the article title, abstract, or keywords, spanning the time frame from 2000 to August 2023. The search terms for each berry species were defined as follows: "vaccinium myrtillus" for bilberry, "vaccinium vitis idaea" for lingonberry, and "rubus chamaemorus" for cloudberry. However, for cranberry, both "oxycoccus palustris" and "vaccinium oxycoccus" were specified, with the results combined, given their interchangeability in wild bog cranberry research.

Analysis revealed bilberry as the most frequently referenced berry species among the four, with mentions in 1793 SCOPUS-indexed articles (Figure 1). This aligns with its distribution throughout temperate and subarctic zone and its widespread use as a dietary supplement or additive in everyday culinary practices. Lingonberry was the second most cited species, also widely distributed in the temperate zone and containing various bioactive compounds known for their health benefits.

Interestingly, the analysis revealed unexpected differences in research popularity between cloudberry and cranberry. Despite the significantly narrower geographic distribution as compared to cranberries, we found a higher number of indexed articles on cloudberries, indicating a notable research interest in this species. This also applies to the ongoing interest, both scientific and practical, in the commercial cultivation of cloudberry (Boulanger-Pelletier, Lapointe, 2017; Rapp, Martinussen, 2002). Furthermore, even though cloudberry in the wild covers significantly less area than cloudberries, these species have the same number of indexed articles from Latvian authors.

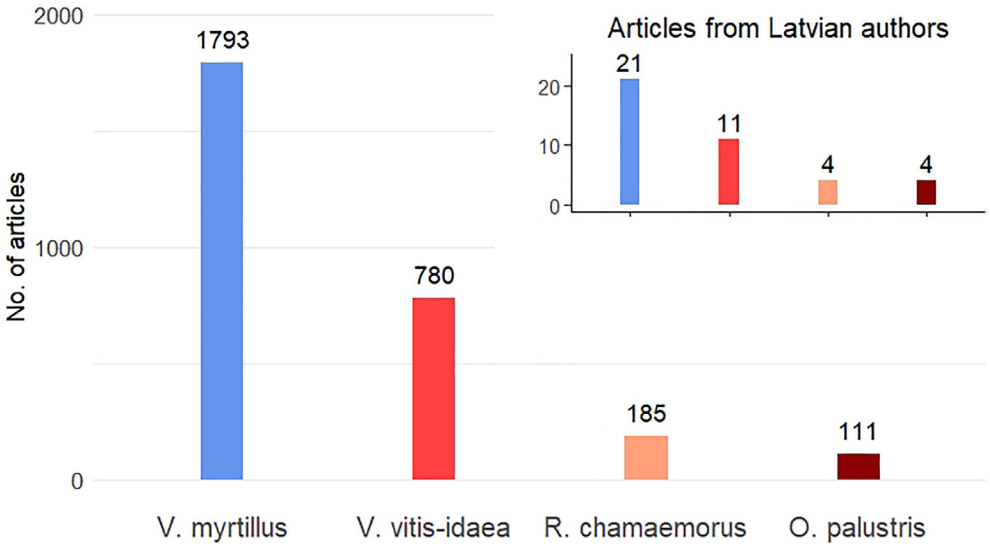

Figure 1. Comparative analysis of species name occurrence in titles, abstracts, and keywords within the SCOPUS database

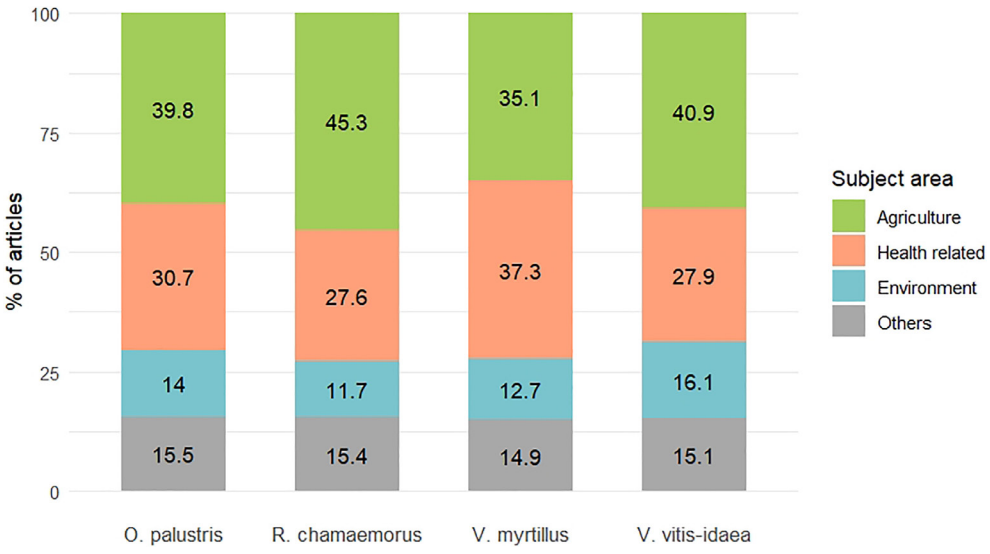

Figure 2. Comparative analysis of articles by subject area for wild berry species

The document analysis reveals that research on all species has been done primarily within the domains of agricultural and biological sciences (Figure 2). This highlights the significance of investigating wild species as a means to develop cultivars for commercial production. They are followed by research in health-related fields, including biochemistry, medicine, pharmacology, immunology, and chemistry. The third most notable subject area is environmental sciences.

In the case of cloudberries, the current focus remains on the selection of varieties for commercial cultivation purposes. Currently commercially grown cultivars include female cultivars like "Fjordgull" and "Fjellgull," male cultivars like "Apollen" and "Apolto," and the hermaphrodite variety "Nyby" (Rapp, Martinussen 2002; Uosukainen, 2010).

Conclusions

Demand for fresh produce has increased over the last decades, however, the popularity of picking wild produce has decreased. This highlights the gap between knowledge on traditional product use and the modern lifestyle. However, an interest in cultivation of species like bilberries and cranberries has remained in the scientific community, providing theoretical and practical knowledge for growers and consumers alike. Research on cloudberry cultivation is also promising, currently focusing on finding the optimal conditions for successful propagation and growing in field. Only wild bilberries, bog cranberries and lingonberries have been mentioned in Latvian traditional plant medicine books. This indicates that the cloudberry has been overlooked, considering that it is relatively abundant in Latvian bogs and forests on peatlands. Our comparative analysis of research articles mentioning wild berry species revealed bilberry as the most popular

among the scientific community globally, including Latvian authors. Interestingly, the analysis also revealed a higher number of articles mentioning cloudberries as compared to cranberries, indicating a notable research interest in the species. The high percentage of articles conducted within the subjects of health-related areas also underlines the importance and potential of wild berry use for their health promoting properties.

References

Adamczak, A., Gąbka, M., & Buchwald, W. 2009. Fruit Yield of European Cranberry (Oxycoccus palustris Pers.) in Different Plant Communities of Peatlands (Northern Wielkopolska, Poland). *Acta Agrobotanica* 62(1): 97–105.

Anderson, D., Ford, J. D., & Way, R. G. 2018. The Impacts of Climate and Social Changes on Cloudberry (Bakeapple) Picking: a Case Study from Southeastern Labrador. *Human Ecology* 46(6): 849–863. https://doi.org/10.1007/s10745-018-003

Bārdule A., Jūrmalis E., Lībiete Z., Pauliņa I., Donis J., & Treimane A. 2020. Use of retail market data to assess prices and flows of non-wood forest products in Latvia. *Silva Fennica*, 54(3): 10341. https://doi.org/10.14214/sf.10341

Boulanger-Pelletier, J., & Lapointe, L. 2017. Fertilization stimulates root production in cloudberry rhizomes transplanted in a cutover peatland. *Canadian Journal of Plant Science* 97(6): 1046–1056. https://doi.org/10.1139/cjps-2016-0235

Coudun, C., & Gégout, J. C. 2007. Quantitative prediction of the distribution and abundance of Vaccinium myrtillus with climatic and edaphic factors. *Journal of Vegetation Science* 18: 517–524. https://doi.org/10.1111/j.1654-1103.2007.tb02566.x

Di Cori, V., Franceschinis, C., Robert, N., Pettenella, D. M., & Thiene, M. 2021. Moral Foundations and Willingness to Pay for Non-Wood Forest Products: A Study in Three European Countries. *Sustainability* 13: 13445. https://doi.org/10.3390/su132313445

Ferlemi, A. V., & Lamari, F. N. 2016. Berry Leaves: An Alternative Source of Bioactive Natural Products of Nutritional and Medicinal Value. *Antioxidants* 5(2): 17.

Groms, J., & Hammermane, A. 1971. *Savvaļas ārstniecības augi*. Zvaigzne, Rīga. [In Latvian].

Hirabayashi, K., Murch, S. J., & Erland, L. A. E. 2022. Predicted impacts of climate change on wild and commercial berry habitats will have food security, conservation and agricultural implications. *Sci. Total Environ* 845, Article 157341, https://doi.org/10.1016/j.scitotenv.2022.157341

Howard, L. R., Prior, R. L., Liyanage, R., & Lay, J. O. 2012. Processing and storage effect on berry polyphenols: challenges and implications for bioactive properties. *Journal of agricultural and food chemistry* 60(27): 6678–6693.

Koczur, A. 2011. Newly Discovered Relic Population of Rubus chamaemorus L. in the Western Carpathians. *Acta Soc. Bot. Pol.* 73: 129–133.

Kortesharju, J. J. 1984. Observations on cloudberry crops in Finland. *Communicationes – Instituti Forestalis Fenniae* 120: 86–88.

Landete, J. M. 2011. Ellagitannins, ellagic acid and their derived metabolites: A review about source, metabolism, functions and health. *Food Research International* 44(5): 1150–1160, June 2011.

Lee, J., & Finn, C. E. 2012. Lingonberry (Vaccinium vitis-idaea L.) grown in the Pacific Northwest of North America: anthocyanin and free amino acid composition. *The Journal of Functional Foods* 4: 213–218.

Li, J., Percival, D., Hoyle, J., Yue, J., White, J., Head, K., & Pruski, K. 2015. Environmental Effects on Fruit Composition of Cloudberry/Bakeapple (Rubus chamaemorus L.) Grown in Southern Labrador, Canada. *Can. J. Plant Sci.* 95: 1167–1175.

Ligatnes winery, SIA. S.a. Cloudberry Wine. Accessed on: 20 August 2023. Available at: https://ligatnes-vinadaritava.lv/en/products/cloudberry-wine/

Lindhagen, A., & Hörnsten, L. 2000. Forest recreation in 1977 and 1997 in Sweden: changes in public preferences and behaviour. *Forestry* 73(2): 143–153.

Nestby, R., Percival, D., Martinussen, I., Opstad, N., & Rohloff, J. 2011. The European blueberry (Vaccinium myrtillus L.) and the potential for cultivation. *European Journal of Plant Science and Biotechnology* 5: 5–16.

Nilsen, G. S. 2005. Cloudberries – The Northern Gold. *International Journal of Fruit Science* 5(2): 45–60.

Rapp, K., & Martinussen, I. 2002. Breeding cloudberry (Rubus chamaemorus L.) for commercial use. *Acta Hortic* 585: 159–160.

Rijswick, C. 2022. The Global Berry Sector: Changes for the Better Beyond 2023. Accessed on: 10 Semptember, 2023. Available at: https://research.rabobank.com/far/en/sectors/fresh-produce/global-berry-sector-changes-for-the-better-beyond-2023.html

Rubine, H., Ozola, S., & Eniņa, V. 1977. *Ārstniecības augu sagatavošana un lietošana*. Zvaigzne, Rīga. [In Latvian].

Thiem, B. 2003. Rubus chamaemorus L.—A Boreal Plant Rich in Biologically Active Metabolites: *A Review. Biol. Lett.* 40: 3–13.

Turtiainen, M., Salo, K., & Saastamoinen, O. 2011. Variations of yield and utilization of bilberries (Vaccinium myrtillus L.) and cowberries (V. vitis-idaea L.) in Finland. *Silva Fennica* 45(2): 237–251.

Uosukainen, M. 2010. Cloudberry (Rubus chamaemorus L.) cultivar 'Nyby' – an example of domestication of wild plant species to cultivation. *IX Finnish Symposium on Plant Science*, May 17–19, Joensuu, Finland. Abstracts, 116.

Vaara, M., Saastamoinen, O., & Turtiainen, M. 2013. Changes in wild berry picking in Finland between 1997 and 2011. *Scandinavian Journal of Forest Research* 28(6): 586–595. https://doi.org/10.1080/02827581.2013.786123

Vanhanen, S., & Pesonen, P. 2016. Wild plant gathering in Stone Age Finland. *Quaternary International* 404: 43–55. https://doi.org/10.1016/j.quaint.2015.10.036

Wallenius, T. H. 1999. Yield Variations of Some Common Wild Berries in Finland in 1956–1996. *Ann. Bot. Fennici* 36: 299–314. https://doi.org/10.22364/iarb.2023.08