

JAPANESE QUINCE (*CHAENOMELES JAPONICA*) – FROM FIELD VIA LAB TO TABLE: THE ROLE OF “GREEN” TECHNOLOGIES

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Plants of *Chaenomeles* sp. are known as ornamentals worldwide. However, Japanese quince (*Chaenomeles japonica*) as a fruit crop is well known only in the Baltic countries, Ukraine, Belarus, Scandinavia, and Poland. The Japanese quince fruits are a valuable raw material for the food industry because of their nutritive value. In Latvia **breeding of *Chaenomeles japonica* as a fruit crop** was initiated in the 1950s. The first large plantations of Japanese quince were established in the 1970s, in the 1980s reaching approximately up to 300 ha. All these commercial plantations were established using seedlings, which are very heterogeneous. At the Institute of Horticulture (LatHort), breeding of Japanese quince was started in the 1990s with the aim to obtain local cultivars adapted to the Latvian climate. Only one species – *Ch. japonica* – was used in breeding, since the others are not winter hardy in the northern part of Europe. During 1998–2002, LatHort together with Swedish and Lithuanian scientists evaluated a broad range of *Chaenomeles* germplasm within the scope of the EU Project “Japanese quince (*Chaenomeles japonica*) – a New European Fruit Crop for Produce of Juice, Flavour and Fibre” (EUCHA). Later after evaluation at the LatHort three cultivars were selected and registered in Latvia: ‘Rasa’ from the Lat-

vian breeding material and ‘Darius’ and ‘Rondo’ from the EUCHA breeding programme. These cultivars are thornless, productive (4–8 kg per bush); fruits are homogenous, 40–60 g, ripen in the beginning or middle of September [1]. Since Japanese quince is relatively resistant to disease and pests, it can be grown in an environmentally friendly way, using integrated and organic growing systems.

In Latvia, Japanese quince is considered to be a **significant commercial crop** (558 ha in 2020, incl. 235 ha organic). During the last five years, the area of plantations in Latvia has increased four times showing that **cultivation of Japanese quince** becomes more popular every year. A similar trend is also observed in countries of Baltic sea region, e.g., Poland. Market demand for fruit shows an upward trend with the pointing to ecological “BIO” products, therefore popularity of organic orchards can be observed. However, the quality of the Japanese quince fruits currently available on the market is diverse, since most of the growing areas are still planted using seedling material.

In order to raise knowledge on the cultivation, storage and processing of Japanese quince, ERDF project “Environment-Friendly Cultivation of Emerging Commercial Fruit Crop Japanese Quince –



First-registered Japanese quince cultivar 'Rasa'

Chaenomeles japonica and Waste-Free Methods of Its Processing” was carried out in 2017–2020. The aim of this project was to develop environment-friendly technologies for growing, plant protection, storage and waste-free processing of Japanese quince, biosynthesis study of hydrophilic and lipophilic compounds during fruit development, an economic evaluation of production for faster development and increased export potential of the fruit and their products. Based on research results, technological solutions for the introduction of integrated and organic Japanese quince growing system have been developed. These include the correct selection of growing sites and cultivars, soil preparation, planting, fertilising, plant protection against pathogens and other harmful micro- and macro-organisms.

The demand for **Japanese quince** comes from the **processing industry** due to high acidity and fruit hardness. Japanese quince fruits are processed into juice, syrup, jams, and candied fruit. The processing of Japanese quince in Latvia can be divided into two periods with the first in the 1970s when the available products were juice and puree. The juice has found a niche use in the production of a sparkling non-alcoholic drink. Over time, this drink has gained great popularity, the demand for it is constantly growing, it is currently being exported, and various flavours have been created for it. The puree fared

worse on the market and the production decreased due to limited processing options. The second period started at the beginning of the 21st century when, simultaneously to the breeding, the first technology for production of candied Japanese quince fruit in Latvia was developed and patented by LatHort in collaboration with the Latvia University of Life Sciences and Technologies. More than ten years passed before industrial production, but candied Japanese quince fruit is currently produced by more than 15 companies, as well as exported.

LatHort has considered the application of **“zero-waste” processing technologies** in Japanese quince processing. During the production of candied fruit, two by-products are produced: cores and seeds. Considerable quantities of biologically active compounds (incl. procyanidin B1, chlorogenic acid, epicatechin) have been found in Japanese quince cores, and the organic acid content facilitates their use in the production of salty sauces. Seeds constitute 4–10% of the original weight of fresh fruit. It has been shown that the Japanese quince seeds are a source of oil rich in bioactive compounds with high potential industrial application [2]. The content and profile of organic acids in Japanese quince fruits are found to be comparable to that of lemon fruits, which are most widely used as raw material to produce acidifiers in the form of juice concentrate and powder. However, the composition and concentration of bioactive compounds in Japanese quince fruit, i.e. catechin, epicatechin, procyanidins, vitamin C, and essential amino acids are more valuable than found for lemon fruits. Since most commercial plantations due to economic reasons use seedling material, which produces uneven fruit, the part of the yield is suitable only to produce juice or puree. Therefore, the development of juice concentrate or powder can also be noted as a relevant use of Japanese quince in the “zero-waste” strategy. The development of juice concentrate production technology is being done under the project “The introduction of innovative, competitive growing technologies for Japanese quince and the extension of the range of fruit-processed products”. Economical growth can be expected for producers and processors of Japanese quince with the application of this technology in the industry.

Environment-friendly techniques in bioactive compound extraction and analytical chemistry are also becoming more and more important in parallel to the food production. Despite the relatively low oil content (10–14%) of Japanese quince seeds, affected by the harvest year and cultivar [3–5], it is possible to obtain oil by applying “green” techniques such as cold pressing and supercritical extraction using CO₂ [2, 3]. A similar content of oil can be found in grape seeds obtained mainly as a by-product during juice and wine production. Since the production of grape seed oil is commercialised, the same could be done in the case of Japanese quince seed oil, especially that it is a valuable source of α-tocopherol (vitamin E), carotenoids, phytosterols, squalene, and phenolic compounds [2]. Determination of the chemical composition of food and plant material is often associated with using several harmful solvents. Currently, the supercritical fluid chromatography (SFC) provides a meaningful advantage on the liquid chromatography (LC), due to uses low viscosity a supercritical carbon dioxide (CO₂) as the main mobile phase, which allows higher operational flow rates and rapid analysis as compared with LC. Additionally, the application of the CO₂ makes the SFC an environment-friendly method for the determination of lipophilic compounds, e.g., tocopherols [6].

Many studies in LatHort are made in close collaboration with several institutes and faculties of the Poznań University of Life Sciences, publishing results in joint articles in high quality international scientific journals. As part of the ERDF project a PhD student from the Lithuanian Agriculture and Forestry Sciences Centre worked on part of her thesis at LatHort by studying the possible use of the fruit and leaves of different Japanese quince varieties in food and beauty products.

Japanese quince is not only an interesting research subject in the field of science; interest in it for Latvian and foreign businesses has also increased. Cultivars bred in Latvia are being tested in Lithuania, Estonia, Poland, and Norway. An exclusive licensing contract has been signed with a tree nursery about the propagation of Japanese quince varieties ‘Rasa’, ‘Darius’ and ‘Rondo’ in Poland.

In general, all of these activities show that the Japanese quince has good future potential!



For the results in Japanese quince research the scientist group received the prestigious Ministry of Agriculture award “Sējējs” in 2020 (D. Segliņa and E. Kaufmane)

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