

BUCKWHEAT, AMARANTH AND OTHER PSEUDOCEREAL PLANTS

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Summary

Among the pseudocereals the three most important are the buckwheat, the amaranth and the quinoa. The pseudocereals are food products with higher protein and mineral

content, and better protein quality, than traditional cereals. The pseudocereals, which can be grown by simple methods, may be potential and perspective nutritional sources for the “starving world”. They are very good complements to the nutritional value of traditional, corn based food products.

The protein of buckwheat, amaranth and quinoa does not contain gluten therefore it can be used in the diet of patients suffering from celiac diseases. Buckwheat contains other special, “health-preserving” components (rutin, flavonoids).

In many countries of the world (USA, Latin-America, Africa, Asia, Europe) serious research work is underway on growing suitable new species, optimizing growing conditions (growing methods, machines, storage, quality-proofing, etc.) and developing suitable food producing technologies.

When developing new food products it is very important to take into account the current tastes of modern times. The wider use of pseudocereals which are rich in nutritive value will hopefully improve the food supply and health of the population.

1. Introduction

Because of their favourable characteristics (high dietary fibre, vitamin, mineral and essential amino acid content) the food industrial usage of seeds of buckwheat, which had been regarded as a “food of poor” in the past, quinoa and amaranth has come to the fore. Buckwheat- and amaranth-based food products are popular among people who consciously eat healthy food. Applying the suitable growing and producing technologies, buckwheat, amaranth and quinoa are a new potential food source for peoples of the world in countries of different climates. Using buckwheat amaranth and quinoa the nutritional value of traditional cereals (e.g. wheat, rice) can be improved.

2. Buckwheat

2.1 History and distribution

2.1.1. History

Buckwheat is probably not an ancient crop but is known to have been cultivated in China for at least 1500 years. There are references to buckwheat production in the fifth and sixth centuries AD.

The wild *Fagopyrum cymosum* from temperate Asia (northern India and China) has been held to be the ancestor of buckwheat. The common or sweet buckwheat is *Fagopyrum esculentum* Moench, a species with excellent protein quality in terms of amino acid composition.

In Asia cultivation of buckwheat is significant in India, Nepal, Bhutan, China, Mongolia, North Korea, far eastern Russia and Japan. Cultivation has spread to Europe, USA, Canada, Australia and South Africa.

In the Himalayas it has been cultivated for centuries, especially between 500 m and 4200 m above sea level, in a zone running from Pakistan to Myanmar. It is a staple food crop in this area and a mainstay of subsistence agriculture.

A second species (*F. tataricum* Gaertn.) tartary or bitter buckwheat, is cultivated in India and China in cooler and harsher conditions. Both species are adapted to cool, temperate climates, but will tolerate tropical climates at higher altitudes.

Buckwheat was introduced into Europe in the Middle Ages, probably from Siberia, reaching Germany early in the fifteenth century (J. T. Williams, 1995).

2.1.2. Distribution

In Europe there has been a degree of production in the UK, France, Germany, Switzerland, Austria, Italy, Yugoslavia, Bulgaria, Hungary, Poland and Russia. The zenith of its cultivation was reached in Europe in the seventeenth century in Germany. Later, from the end of the eighteenth century its significance gradually decreased due mainly to the lack of significant improvement in buckwheat production, compared to the steadily increasing returns per acre of other modern grain crop varieties. Because buckwheat breeding has been made difficult by a self-incompatibility system, certified varieties of buckwheat are of relatively recent origin. Another factor contributing to low returns per acre from buckwheat is its poor response to fertilizer applications and other modern cultural practices that have dramatically increased yields of other crops.

Production fell during the first half of the twentieth century, particularly in Russia and France. It was also falling in Canada until production began to increase in the 1960s as a result of export demands. Exports have steadily grown to Japan, where the flour is used in the manufacture of noodles.

In Europe a resurgence in the popularity of buckwheat occurred from the 1980s, stemming from an interest in natural foods and the high nutritional value of buckwheat grain proteins.

According to data prepared by the FAO, the world production of buckwheat varied during the 1990s between 3.8 and 2.6 million tons. Cultivation in Russia, China and Ukraine (about 2.4 million hectares) is the highest. The other major buckwheat-producing countries are USA, Canada, Brazil., Japan, India, Nepal and Bhutan.

The buckwheat plant and its grain have been used in various forms for human food, for animal feed, as a source of medicines, as green manure and for soil conservation. The flowers are visited by honey bees, and the plant is also used as an ingredient of beer.

2.2. Taxonomy, Morphology and Ecology

2.2.1. Taxonomy, Morphology

The genus *Fagopyrum* is in the herbaceous subdivision of the subfamily Polygonoideae of the family Polygonaceae. It contains 15 species distributed in temperate Eurasia. The

common sweet buckwheat is *F. esculentum* Möench. and the other species, the bitter buckwheat, is called *F. tataricum*. The taxonomy of the cultivated species is still somewhat confused. Some minor cultivated species have been described, e.g. coarse buckwheat *F. sagittatum* Gilib, and Kashmir buckwheat *F. kashmirianum* Munshi. These are morphologically different, and it is probably not justified that they belong to buckwheat cultivated genepool, although *F. kashmirianum* is similar to *F. tataricum* and *F. sagittatum* is similar to *F. esculentum*. According to Ohnishi (1983) *F. tataricum* and a *F. esculentum* were derived independently from the ancestral wild type *F. cymosum*. *F. cymosum* plants are tall and stout. The leaves are large, long-stalked and triangular. The stalked white flowers are borne on long recurved terminal and axillary cymes.

F. esculentum (see Figure1) is an erect annual attaining a height of 60-80 cm. The stem is hollow and angular, with swollen nodes, and coloration of red pink and green. The leaves are alternate, triangular, acute, and 5-10 cm long. The flower is dimorphic with either a long (3-4 mm) or a short style. It is fragrant, and may be white, pink or red. The fruit is a dry, one-seeded, three-edged nut or achene, measuring 6 mm x 3 mm. Some varieties have distinctly winged seeds. The seed colour is brown or grey and triangular in shape. *F. tataricum* is also an annual but is taller and coarser than *F. esculentum*. Its flowers are small, yellowish-green, and without fragrance. The fruit is small, ovoid, conical, brownish, grey or black in colour, with dull irregular faces on each of which is a deep furrow. For common buckwheat 1000 seed weight is 25-35 g, and for bitter buckwheat 1000 seed weight is 15-25 g. ("1000 seed weight" is a traditional term. See J.T. Williams (1995): Cereals and Pseudocereals, Chapman and & Hall, London, p. 105).



Figure 1. Common buckwheat (*Fagopyrum esculentum*)

2.2.2. Ecology

Buckwheat can tolerate poor, infertile and acidic soils, and is a potential food plant in cold deserts, although it is sensitive to frost and low temperatures when germinating and at the end of the growth season. It does not have potential for growing in semi-arid or saline areas. It thrives best on sandy, well-drained soils but can be grown in dry regions with poor soils and drainage.

Buckwheat is a short duration crop (90-100 days) so it can be grown in short summer seasons. Because of the wide ecological tolerance of buckwheat its cultivation can be readily expanded to new areas.

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Biographical Sketch

Ms. Irén Léder was born in September 1946 in Budapest, Hungary. Since 1995 she has been employed as a research scientist in the Central Food Research Institute (CFRI), in Budapest. She qualified as a food preservation engineer (University of Horticulture and Food, 1984) and worked from 1965 to 1985 in the National Institute of Food Hygiene and Nutrition, Budapest. From 1985 to 1995 she worked for the Research and Development of Flour Milling Co. Ltd., Budapest

She has worked on:

- Product development in the flour milling industry by traditional and new hydrothermal technologies which are able to conserve the nutritional value of cereals.
- Product development of flaked, puffed and extruded cereal and pseudocereal products, as well as the improvement of dehulled products (buckwheat, millet, sorghum), elaboration of cereal ready mixed flours and vitamins and mineral-enriched flours.
- Elaboration of health protecting and high nutritional value food products using different cereals and pseudocereals
- Elaboration of technologies and recipes of bio-food products using cereal basic materials grown without chemicals.
- Keeping contact with grain industrial, milling, bakery and confectionery enterprises by looking for utilization possibilities of research results and help in the realization of new product development results,

Her publications include:

Biacs P. Á., Léder I. and Lajos J. (1998). Production and use of special cereals and pseudocereals (buckwheat, amaranth) in Hungary. 16th ICC Conference, 9-12 May, Vienna. Book of Abstracts.

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