


Quinoa

Quinoa	
	
Scientific classification	
Kingdom:	Plantae
(unranked):	Angiosperms
(unranked):	Eudicots
(unranked):	Core eudicots
Order:	Caryophyllales
Family:	Amaranthaceae
Subfamily:	Chenopodioideae
Genus:	<i>Chenopodium</i>
Species:	<i>C. quinoa</i>
Binomial name	
<i>Chenopodium quinoa</i> Willd.	
Synonyms	

Quinoa (/ˈkiːnwɑː/ or /kɪˈnoʊ.ə/, Spanish: *quinua*, from Quechua: *kinwa*), a species of goosefoot (*Chenopodium*), is a grain-like crop grown primarily for its edible seeds. It is a pseudocereal rather than a true cereal, or grain, as it is not a member of the true grass family. As a chenopod, quinoa is closely related to species such as beetroots, spinach and tumbleweeds.

It has been described as relatively high in protein, lacking gluten, and tolerant of dry soil.

Overview

Quinoa (the name is derived from the Spanish spelling of the Quechua name *kinwa* or occasionally "Qin-wah") originated in the Andean region of Ecuador, Bolivia, Colombia and Peru, where it was successfully domesticated 3,000 to 4,000 years ago for human consumption, though archeological evidence shows a non-domesticated association with pastoral herding some 5,200 to 7,000 years ago.

Similar *Chenopodium* species, such as pitseed goosefoot (*Chenopodium berlandieri*) and fat hen (*Chenopodium album*), were grown and domesticated in North America as part of the Eastern Agricultural Complex before maize agriculture became popular.^[1] Fat hen, which has a widespread distribution in the Northern Hemisphere, produces edible seeds and greens much like quinoa, but in smaller quantities.

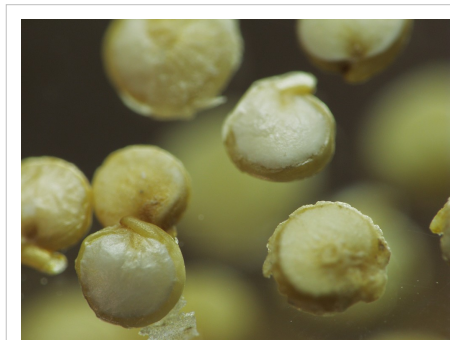
The nutrient composition is favourable compared with common cereals. Quinoa seeds contain essential amino acids like lysine and acceptable quantities of calcium, phosphorus, and iron.

After harvest, the seeds need to be processed to remove the coating containing the bitter-tasting saponins. Quinoa seeds are in general cooked the same way as rice and can be used in a wide range of dishes. Quinoa leaves are also eaten as a leaf vegetable, much like amaranth, but the commercial availability of quinoa greens is limited.



Landscape with *Chenopodium quinoa* Cachilaya
Bolivia Lake Titicaca

Biology



Quinoa seeds

Quinoa is a dicotyledonous, annual plant usually about 1–2 m high. It has broad, generally pubescent, powdery, smooth (rarely) to lobed leaves normally arranged alternately. The woody central stem is either branched or unbranched depending on the variety and may be green, red or purple. The panicles arise either from the top of the plant or from axils on the stem. The panicles have a central axis from which a secondary axis emerges either with flowers (amaranthiform), or bearing a tertiary axis carrying the flowers (glomeruliform). The green hypogynous flowers have a simple perianth and are generally bisexual and self-fertilizing. The fruits are about 2 mm in diameter and of various colours — from white to red or black depending on the

cultivar.

Natural distribution

Chenopodium quinoa is believed to have been domesticated in the Peruvian Andes from wild populations of *Chenopodium quinoa*. There are non-cultivated quinoa plants (*Chenopodium quinoa* var. *melanospermum*) which grow in the same area where it is cultivated; it is presumed that those are related to quinoa's wild predecessors, but they could be descendants of cultivated plants.



Quinoa plant before flowering

Saponin content



Red quinoa, cooked.

Quinoa in its natural state has a coating of bitter-tasting saponins, making it unpalatable. Most quinoa sold commercially in North America has been processed to remove this coating. This bitterness has beneficial effects during cultivation, as the plant is unpopular with birds and therefore requires minimal protection. Attempts to lower the saponin content of quinoa through selective breeding to produce sweeter, more palatable varieties have proven difficult due to cross pollination contamination.

The toxicity category rating of quinoa saponins treats them as mild eye and respiratory irritants and as a low gastrointestinal irritant.

The saponin is a toxic glycoside, a main contributor to its hemolytic effects when combined directly with blood cells. In South America, Quinoa saponin has many uses outside of consumption, which includes detergent for clothing and washing, and as an antiseptic for skin injuries. High levels of oxalic acid in the leaves and stems are found in all species of the *Chenopodium* genus, but are also present in the related plant families of *Polygonaceae* and *Amaranthaceae*. The risks associated with quinoa are minimal, provided it is properly prepared and leaves are not eaten to excess.

History and culture




Early history

Quinoa was first domesticated by the Andean peoples around 3000 years ago. Quinoa has been an important staple in the Andean cultures where the plant is indigenous but relatively obscure in the rest of the world. The Incas, who held the crop to be sacred, referred to quinoa as *chisaya mama* or "mother of all grains", and it was the Inca emperor who would traditionally sow the first seeds of the season using "golden implements". During the Spanish conquest of South America, the Spanish colonists scorned quinoa as "food for Indians", and even actively suppressed its

cultivation, due to its status within indigenous religious ceremonies. In fact, the conquistadores forbade quinoa cultivation for a time and the Incas were forced to grow wheat instead.

Rising popularity and crop value

World Quinoa Production (thousand metric tons)

Country	1961	1970	1980	1990	2000	2010	2011
 Peru	22.5	7.3	16.3	6.3	28.2	41.1	41.2
 Bolivia	9.2	9.7	8.9	16.1	23.8	36.1	38.3
 Ecuador	0.7	0.7	0.5	0.7	0.7	0.9	0.8
Total	32.4	17.7	25.8	23.0	52.6	78.1	80.2
Export price ^[2] USD/Kg		\$0.080	\$0.492	\$0.854	\$1.254	\$3.029	
<i>Source: Food and Agriculture Organization of the United Nations (FAO)</i>							

Quinoa has become increasingly popular in the United States, Canada, Europe, China and Japan where the crop is not typically grown, increasing crop value. Between 2006 and early 2013 quinoa crop prices have tripled. In 2011, the average crop value was \$3,115 USD per ton with some varieties selling as high as \$8,000 per ton. This compares with wheat prices of \$9 per bushel (about \$340 per ton). Since the 1970s, producers' associations and cooperatives have worked toward greater producer control of the market. The higher price fetched by quinoa does make it harder for people to purchase, but it also brings livable income for farmers, and is enabling many urban refugees to return to working the land.

The popularity of quinoa in non-indigenous regions has raised concerns over food security. Due to continued widespread poverty in regions where quinoa is produced, and because few other crops are compatible with the soil and climate in these regions, it is suggested that the inflated price of quinoa disrupts local access to food supplies. In 2013, The Guardian compared quinoa consumption to Peruvian asparagus, a popular Andean crop criticized for excessive water use, as "feeding our apparently insatiable 365-day-a-year hunger for this luxury vegetable[...]" It is also suggested that as people rise above subsistence level income, they choose higher status Western processed foods. However, anthropologist Pablo Laguna has noted that farmers tend to save quinoa for personal consumption, and consumption of the grain in nearby cities has been traditionally lower. According to Laguna, the net benefit of increased revenue for farmers outweighs the costs, saying that it is "very good news for small, indigenous farmers". The transformation of quinoa from a healthy staple food forming a significant part of the diets of farming families/communities into a product that is held to be worth too much in trade or sale to keep for oneself and one's family is an ongoing process, however. As it stands, quinoa is seen as a valuable resource that can bring in far greater amounts of cheap, low nutrient foods such as pasta and rice. A food which used to be seen as a peasant food (and which provided farming families with a very important source of nutrition) now occupies a spectrum from an everyday food of urban Bolivia's middle class to a luxury food in the Peruvian capital of Lima where "it sells at a higher per pound price than chicken, and four times as much as rice".^[3] Efforts are being made in some areas, however, to redistribute quinoa more widely and ensure that farming and poorer populations retain access and understanding about the importance of this food source. Efforts include incorporating quinoa into free school breakfasts and including it in government provisions sent to pregnant and nursing women in need.

Kosher controversy

Quinoa has become popular in the Jewish community as a substitute for the leavened grains that are forbidden during the Passover holiday. Several of the kosher certification organizations refuse to certify quinoa as being kosher for passover citing reasons including its resemblance to prohibited grains, or fear of cross-contamination of the product from nearby fields of the prohibited grain.^[4]

Nutritional value

Quinoa, uncooked

Nutritional value per 100 g (3.5 oz)	
Energy	1,539 kJ (368 kcal)
Carbohydrates	64 g
- Starch	52 g
- Dietary fibre	7 g
Fat	6 g
- polyunsaturated	3.3 g
Protein	14 g
- Tryptophan	0.167 g
- Threonine	0.421 g
- Isoleucine	0.504 g
- Leucine	0.840 g
- Lysine	0.766 g
- Methionine	0.309 g
- Cystine	0.203 g
- Phenylalanine	0.593 g
- Tyrosine	0.267 g
- Valine	0.594 g
- Arginine	1.091 g
- Histidine	0.407 g
- Alanine	0.588 g
- Aspartic acid	1.134 g
- Glutamic acid	1.865 g
- Glycine	0.694 g
- Proline	0.773 g
- Serine	0.567 g
Water	13 g
Thiamine (vit. B ₁)	0.36 mg (31%)
Riboflavin (vit. B ₂)	0.32 mg (27%)
Vitamin B ₆	0.5 mg (38%)

Folate (vit. B ₉)	184 µg (46%)
Calcium	36 mg (4%)
Iron	4.6 mg (35%)
Magnesium	197 mg (55%)
Phosphorus	457 mg (65%)
Potassium	563 mg (12%)
Zinc	3.1 mg (33%)
Percentages are roughly approximated using US recommendations for adults. Source: USDA Nutrient Database ^[5]	

Quinoa was important to the diet of pre-Columbian Andean civilizations. Today, people appreciate quinoa for its nutritional value. Quinoa has been called a superfood. Protein content is very high for a cereal/pseudo-cereal (14% by mass), yet not as high as most beans and legumes. Quinoa's protein content per 100 calories is higher than brown rice, potatoes, barley and millet, but is less than wild rice and oats. Nutritional evaluations of quinoa indicate that it is a source of complete protein. Furthermore, it is a good source of dietary fiber and phosphorus and is high in magnesium and iron. Quinoa is also a source of calcium, and thus is useful for vegans and those who are lactose intolerant. Quinoa is gluten-free and considered easy to digest. Because of all these characteristics, quinoa is being considered a possible crop in NASA's Controlled Ecological Life Support System for long-duration human occupied spaceflights.

Quinoa may be germinated in its raw form to boost its nutritional value. Germination activates its natural enzymes and multiplies its vitamin content.^[6] In fact, quinoa has a notably short germination period: Only 2–4 hours resting in a glass of clean water is enough to make it sprout and release gases, as opposed to, e.g., 12 hours with wheat. This process, besides its nutritional enhancements, softens the seeds, making them suitable to be added to salads and other cold foods.

Cultivation



Climate requirements

Quinoa is highly variable due to a high complexity of different subspecies, varieties and landraces (domesticated plants or animals adapted to the environment in which they originated). However, in general it is undemanding and altitude-hardy. It is grown from coastal regions (Chile) to over 4,000 m (13,120 ft) in the Andes near the equator. However, most of the cultivars are grown between 2,500 m and 4,000 m. Depending on the variety, Quinoa's optimal growing conditions are in cool climates with temperatures that range from 25°F/−3°C during the night, to near 95°F/35°C during the day. Some cultivars can also withstand lower temperatures without damage. Light frosts normally do not affect the plants at any stage of development, except during flowering. Mid-summer frosts during flowering, often occurring in the Andes, lead to sterilization of the pollen. Rainfall conditions are highly variable between the different cultivars, ranging from 300 to 1,000 mm during growing season. Optimal for Quinoa growth is well-distributed rainfall during early growth and development and dry conditions during seed maturation and harvesting.

Sowing

Quinoa does best in sandy, well-drained soils with a low nutrient content, moderate salinity, and a soil pH of 6 to 8.5.

The seedbed must be well prepared and drained to avoid waterlogging. Normally in the Andes, Quinoa seeds are broadcast over land and raked into the soil. Sometimes it is sown in narrow, shallow soils.

Cultivation management

Yields are maximised when 150 to 180 lb N/acre is available. The addition of phosphorus does not improve yield. In eastern North America, it is susceptible to a leaf miner that may reduce crop success; this leaf miner also affects the common weed and close relative *Chenopodium album*, but *C. album* is much more resistant.

Harvesting and handling



Camino a Puno Golpeando quinoa

Quinoa is usually harvested by hand and rarely by machine, because the extremely variable maturity periods of native Quinoas complicates mechanization. Harvest needs to be precisely timed to avoid high seed losses from shattering, and different panicles on the same plant mature at different times. The seed yield (often around 3 t/ha up to 5 t/ha) is comparable to wheat yields in the Andean areas. Handling involves threshing the seedheads and winnowing the seed to remove the husk. Before storage, the seeds need to be dried in order to avoid germination.

International Year of Quinoa

The United Nations General Assembly declared 2013 as the "International Year of Quinoa" in recognition of ancestral practices of the Andean people, who have preserved quinoa as food for present and future generations, through knowledge and practices of living in harmony with nature. The objective is to draw the world's attention to the role that quinoa plays in providing food security, nutrition and poverty eradication, in support of achieving Millennium Development Goals.

The Food and Agriculture Organization of the United Nations serves as the Secretariat of the international year. Bolivia has the presidency of the Coordination Committee, while Ecuador, Peru and Chile share the vice presidency, with the rapporteurship in the hands of Argentina and France.



Logo of International Year of Quinoa 2013


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External links

 Data related to *Chenopodium quinoa* at Wikispecies

- Quinoa (<http://www.dmoz.org/Home/Cooking/Grains/Quinoa/>) at the Open Directory Project
 - Quinoa nutrition facts and analysis (http://www.nutritionvalue.org/Quinoa,_cooked_nutritional_value.html)
 - International Year of Quinoa (2013) (<http://www.fao.org/quinoa-2013/>)
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