

QUINOA: THE NUTRITION SOURCE

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Introduction

Plants play an important role in our diet. They are healthy part of our meals, providing nutrients, vitamins, minerals, fiber and water, and the base of the entire food web! Most of the animal products that people eat were produced by farm animals that were fed plants. It means that even when you are eating meat, you are indirectly eating herbs.

A common plant life cycle begins when a plant produces a seed. A seed takes in water and nutrients from the soil to grow. Seeds are small embryonic plants enclosed in a coat, the product of the ripened ovule of flowering plants after pollination and the completion of the process of reproduction. Seeds are made of complex matrices in the outer layer and the germ, rich in minerals, vitamins, and bioactive photochemical that protect the plant's DNA from oxidative stress, thus facilitating the existence of the species.

A variety of species can provide edible seeds. Most edible seeds are angiosperms, but a few are gymnosperms. The most important seed food source is cereals, followed by legumes, and nuts. Cereals (or grains) are grass-like crops that are harvested for their dry seeds. These seeds are often ground to make flour. Cereals provide almost half of all calories

consumed in the world. Botanically, true cereals are members of the Poaceae or Grass family. Pseudocereals are cereal crops that are not members of the Poaceae or Grass Family.

Pseudocereals are plants that produce fruits or seeds which are used as grains, though botanically pseudocereals are neither grasses nor true cereals. Pseudocereals are typically high in protein and gluten-free, and are considered whole grains. Many so-called “ancient grains” are pseudocereals. Quinoa (*Chenopodium quinoa* Willd.) is one of the pseudocereals which have many health benefits. Quinoa is part of the Dicotyledoneae class, Chenopodiaceae family, *Chenopodium* genus, and quinoa species. Since the seed is too small to mill to separate the anatomical fractions, quinoa is included in the whole grain category.

At present quinoa is cultivated in 95 countries of the world. Both Bolivia and Peru are the largest exporters of quinoa accounting for 88% of worldwide production. It is one of the complete foods, because it is the richest source of good quality protein, lipid and it contains starch, minerals and vitamins such as C and E. Quinoa is also a good source of amino acids such as lysine (5.1-6.4%) and methionine (0.4-1.0%) which are deficient in other cereals and pulses. It is considered as a gluten-free grain as it contains very little or no prolamins.

Quinoa is one of the functional foods and is known to lower the risk of various diseases such as celiac disease and exerting health-promoting effects. Besides nutrients, quinoa also contains bitter and toxic compounds such as saponins. Especially, it is present on the hull part of the grain. Therefore, before using this, it must be de-hulled or polished and washed. Besides nutrients, quinoa also contains bitter and toxic compounds such as saponins. Especially, it is present on the hull part of the grain. Therefore, before using this, it must be de-hulled or polished and washed. Despite all these attributes, still quinoa has little usage as food because of the high cost of the imported grain and also there is little knowledge about its health benefits by most of the consumer.

Traditional Indian foods are very nutritious and tasty and help in effective utilization of natural resources and minimize the waste.

Commonly rice and wheat are used as traditional foods. Grains such as sorghum, maize, finger millet and many more millet family members are now using widely. The Indian traditional foods impart beneficial effects and adequate nutrition. Traditional foods helps to secure normal physiological functions in the body such as improving gastrointestinal health, enhancing the immune system, weight management, providing better skeletal health, reduce blood cholesterol level, minimize oxidative stress, reduce the risk of cardiovascular diseases, inflammatory diseases, various types of cancer, diabetes and neurodegenerative diseases (Srinivasan, 2010). Many traditional foods from coarse grains such as sorghum, maize, and millets are already popular. However, pseudo cereal like quinoa needs attention of consumers because of its superior nutritious quality in terms of protein, essential amino acids and minerals such as calcium and iron which provide itself a gluten free nutritious alternative for routine dietary alternative.

History

Quinoa has been cultivated for thousands of years in the Andean region of Bolivia and Peru. It is known by different local names, or simply quinoa or quinua (quinua is in Quechua). Quinoa plant was called “the mother grain” by the Incas and was considered a gift from their gods, used even for treating medical issues. Traditionally, quinoa seeds were roasted and cooked, added to soups, used as a cereal, and even fermented into beer or chichi (traditional drink of the Andes).

After the Spanish conquest of South America, the colonists looked down on quinoa as a peasant food or food of the Indians; consequently, quinoa has been considered a food of low social prestige. In addition, the Catholic Church actively suppressed its cultivation after discovering that quinoa was used as a sacred drink (Mudai) during indigenous religious ceremonies. Thus, quinoa remained only where Europeans could not reach and replace it with other grains.

Traditional use

Quinoa has been traditionally used by several indigenous peoples of South America, including the Quechua, Aymara, Tiahuanacota, Chibcha,

and Mapuche. The seeds have been consumed similarly to rice, prepared in soup, puffed to make breakfast cereal, or ground to flour to produce baked goods (cookies, breads, biscuits, noodles, flakes, tortillas, pancakes). Quinoa seeds can be fermented to make beer, or a traditional ceremonial alcoholic beverage from South America called “chicha”. The whole plant has also been used as a rich nutritional source to feed livestock, including cattle, pigs, and poultry. A wide variety of medicinal uses of quinoa, from the treatment of wounds and fractures to the promotion of digestive health. Quinoa has widely been considered an invigorating, wellness- promoting, and endurance-enhancing food. The mixtures of quinoa and fat, called “war balls,” were used to sustain the Incan armies as they marched over the Andes Mountains.

Nutritional Facts

Quinoa is one of the complete foods, because it is the richest source of good quality protein, lipid and it contains starch, minerals and vitamins such as C and E. It is also a good source of amino acids, lysine (5.1-6.4%) and methionine (0.4-1.0%) which are deficient in other cereals and pulses. It is considered as gluten free grain as it contains very little or no prolamin.

The exceptional nutritional value of quinoa relies on its balanced composition of high protein, amino acid profile, minerals, fibers, and minor compounds (such as antioxidants and vitamins. The proximate composition of quinoa seeds, among the macronutrients, carbohydrates can be found mostly on the perisperm of quinoa seeds, while the endosperm and embryo are richer in protein, minerals, and fats.

Protein and Amino Acid Content

The protein content of quinoa seeds ranges between 11% and 19% of total nutrients. Moreover, quinoa seeds contain all nine essential amino acids (EAA) for proper human health. FAO reported that quinoa has garnered attention as a protein source due to the high quality and balanced composition of amino acids content of its protein—superior to wheat, barley, and soybean.

Due to quinoa's high protein content and amino acid profile, quinoa

is suggested to be an alternative to dairy products. The protein and respective amino acid profile of quinoa vary significantly from cultivar and location. Quinoa can be grown on various types of soils; nevertheless, the plant responds well to nitrogen fertilization, increasing yields, and protein content of seeds. The application of organic matter is important for ~~topping~~ nutrients and promoting water use efficiency in arid regions and sandy soils, thus enhancing the seed yield.

Carbohydrate

Carbohydrate content of quinoa seeds ranges between 49% and 68% (dry matter weight). Starch is the main biopolymer constituent of plant organs, and is the most abundant carbohydrate present in the seeds. Native quinoa starch consists of uniform small granules less than 3 μm in diameter.

Quinoa shows a higher maximum viscosity, water absorption capacity, and greater swelling power compared to the starch of wheat and barley. The excellent freeze-thaw stability makes it an ideal thickener for food products where resistance to retro degradation is desired.

Due to the small-sized granules and high viscosity, quinoa starch has the potential to be used in specialized industrial applications, such as dusting starches in cosmetics and rubber type mold release agents.

Dietary fiber

Another carbohydrate group present in quinoa seeds is dietary fiber. Total dietary fibers content of quinoa seeds is close to what is found in other cereals ranging from 7.0% to 9.7%. An average of 17.2% of dietary fiber is found in quinoa harvested in the south of Italy. Although representing a high content, dietary fiber can decrease significantly after post-harvest processes to eliminate anti-nutritional micro components present in seed coats.

Fat

The fat content of quinoa seeds varies between 2 and 9.5%, which is higher than maize and other cereals but less than soybean. Quinoa oil to be rich in essential fatty acids such as oleic (19.7%–29.5%), linoleic (49.0%–56.4%), and linolenic acid (8.7%–11.7%) and the portion of (poly-)

unsaturated fatty acid accounts to 87%– 88% of total fatty acids of the seed. He concluded that quinoa may also be considered an alternative oilseed. The oil contains a high concentration of antioxidants such as α - and γ -tocopherol, which ensures quinoa oil a long shelf life due to its natural antioxidant potential at the level of cell membrane, protecting fatty acids against damage by free radicals. Quinoa have gained importance since they promote health benefits such as positive effects on the immune system, cardiovascular diseases, cell membrane function, and increased insulin sensitivity.

Micro Components

Micro constituents such as minerals and bioactive compounds are present in minor scales in quinoa seeds. Such micro constituents contribute to not only the nutritional composition of quinoa but also may be used due to their functionality. Moreover, the exceptional nutrient profile from quinoa can provide valuable therapeutic properties such as enhancing immune function, assisting in cell repair, calcium absorption and transport, participation in the metabolism of fatty acids for human health, and even preventing cancer metastasis.

Minerals

Ash content of quinoa seeds ranges from 2.4% to 4.8%. The ash contains a diversified profile of minerals including a high content of calcium, magnesium, iron, copper and zinc. Mineral concentrations seem to change drastically when quinoa is cultivated in different soil types—thus with particular mineral compositions—and fertilizer application. Mineral content of quinoa seeds is found to be at concentrations greater than most grain crops.

Betaine

Betaine is an essential osmolyte source of methyl groups and finds its source either in diet or in the oxidation of choline. Its metabolism methylates homocysteine into methionine, also producing N,N-Dimethylglycine. Mammals use betaine to assist in cell volume regulation, and as a methyl donor for the remethylation of homocysteine into methionine.

Hyper-homocysteinemia makes a person more prone to endothelial

cell injury by activating inflammation pathways and is thus a possible risk factor for coronary artery disease. For this reason, betaine consumption could prove beneficial, as it converts homocysteine into methionine. Nevertheless, urinary excretion of betaine is minimal, even following a large betaine dose. Saponin content is important in order to differentiate between 'sweet' (having saponin content of 20–40 mg g⁻¹ dry weight) and 'bitter' genotypes (>470 mg g⁻¹ dry weight). Saponins contribute the bitter taste and are mostly found in the outer seed coat. The compound is removed by post-harvest processing techniques like cold water washing, abrasion, and dehulling. In addition, Saponins extracted from quinoa seeds can be used in other industries such as cosmetics and pharmaceuticals.

Vitamins

Quinoa is also a good source of vitamins, namely riboflavin and folic acid, offering similar values of thiamine, but is a lesser source of niacin. It has been noted that the removal of the saponins (to reduce the bitter taste) does not seem to affect the vitamin content.

Health Benefits

Many compounds contained in quinoa have been described to contribute to the beneficial effects on human health. The evidence of these benefits demonstrated in both animals and humans is still limited. Some studies demonstrated the ability of quinoa to reduce serum glucose, triglycerides (TG), and total and low density Lipoproteins (LDL) cholesterol levels in male Wistar rats fed a fructose-enriched diet, inhibiting the negative effects of fructose on high density lipoproteins (HDL). These findings indicate the protective effects of quinoa against oxidative stress by increasing the antioxidant capacity and reducing the lipid peroxidation in plasma and tissues of animals.

Quinoa-enriched baby food provided sufficient protein and other essential nutritional elements capable to prevent child malnutrition. Moreover, supplementation of diet with quinoa has been demonstrated to modulate cardiovascular and metabolic parameters in both healthy.

Quinoa and diabetes

The studies show that quinoa emerges as a food of particular interest to celiac patients, as the potential cornerstone of a healthy, gluten-free diet. Including quinoa in the diet could decrease oxidative stress, improve serum lipid profile, help to control body weight and serum glucose, and decrease cardiovascular disease and type 2 diabetes risk factors; quinoa may even prove beneficial in reversing the effects of these diseases. However, until now, very few studies using quinoa or quinoa compounds in vitro, in vivo or clinical trials have taken place for determining translational applications based on strong scientific evidence.

Quinoa and Cardiovascular Disease

The effects of quinoa on the biochemical and anthropometric profile and blood pressure in humans, as parameters for measuring risk of cardiovascular diseases. Indicated that quinoa had beneficial effects since the levels of total cholesterol, triglycerides, and LDL showed reduction. It was concluded that the use of quinoa in diet can be considered beneficial in the prevention and treatment of risk factors related to cardiovascular diseases.

Conclusion

Quinoa is an edible seed that has become increasingly popular. It is loaded with many important nutrients, including fibre, protein, folate and magnesium. In the past couple of decades, quinoa's popularity has grown exponentially as the demand for easy-to-grow, nutritious, gluten free grain alternatives has soared. Not only is quinoa nutrient dense but offers health benefits too.

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