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Quinoa: The Superfood with Untapped Potential

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Quinoa (*Chenopodium quinoa* Willd.), belongs to family chenopodiaceae is a pseudo-cereal which is native to the Andean region. For many parts of the world quinoa is a new crop which has garnered substantial attention as a viable substitute for traditional cereals such as rice, wheat, and corn in the last few decades. Certainly, quinoa was one of the main food crops of the pre-Columbian civilizations of Latin America and remains an important food for the Quechuas and Aymaras settled in rural areas of the Andes, South America. In the Quechua language, quinoa is called chisiya, which means mother grain [1]

The surge in popularity is primarily due to quinoa's exceptional nutritional profile, which includes being a complete protein source, rich in fiber, gluten-free, and abundant in essential vitamins, nine essential amino acids and minerals. This trend has relegated a vast number of plants as "Neglected and Underutilized Species" (NUS). One of them is *Chennopodium quinoa*. Health benefits associated with quinoa consumption are manifold. Its low glycemic index aids in stabilizing blood sugar levels, making it a suitable food choice for individuals managing diabetes [2]. The high magnesium content and abundance of antioxidants in quinoa contribute to cardiovascular health, potentially reducing the risk of heart disease. Furthermore, the combination of protein and fiber in quinoa fosters prolonged satiety, which can be advantageous for weight management and obesity prevention. The year 2013 has been declared the International Year of Quinoa (IYQ) by the United Nations. This made it possible to recognize the importance of the biodiversity of quinoa and the high nutritional value of its seeds [3]. Two scientists at the National Aeronautics and Space Administration (NASA), USA, Dr. Greg Schlick and Dr. David L. Bubenheim, put quinoa back on the map when they concluded in their research that "quinoa has desirable food qualities for long term space missions – high protein and desirable amino acid composition". From an environmental perspective, quinoa presents several sustainable benefits. The crop is resilient and adaptable to different climates, enabling it to be cultivated in various regions worldwide. This adaptability contributes to its potential as a sustainable agricultural product. Moreover, quinoa requires less water for cultivation compared to water-intensive grains like rice, which is a critical advantage in the context of global water conservation efforts [4].

Processing of quinoa:

Removing the Saponins

Processing of quinoa includes methods like milling soaking, fermentation, and autoclave. One of the most critical steps in quinoa processing is removing the toxic compound such as saponins present on hull part of the grain, gives a bitter, soapy molecules that coat the tiny seeds [5]. These saponins act as natural pesticides for the plant but taste very unpleasant to humans. Traditionally, quinoa seeds were soaked in water and then carefully rinsed in baskets to remove as much of the saponin coating as possible.

Modern commercial processing uses abrasive mechanical scourers, rotating drums, or specialized machines to rub off the saponin layer from the seeds. By Using Abrasive mechanical scourers the saponin content was reduced by 68% [6]. The seeds may also undergo a water rinsing stage to wash away any remaining saponin residues. This desaponification process is crucial for improving quinoa's palatability.

Other Processing Steps:

After desaponification, the quinoa seeds go through drying, sieving, sorting, and polishing steps. Drying removes any residual moisture; while sieving and sorting separate out any remaining plant debris or damaged seeds. Polishing gives the seeds their

distinctive shine through gentle abrasion. For products like quinoa flour or flakes, the seeds undergo additional grinding or rolling steps. Some quinoa may also be pre-rinsed or pre-cooked before packaging for consumer convenience.

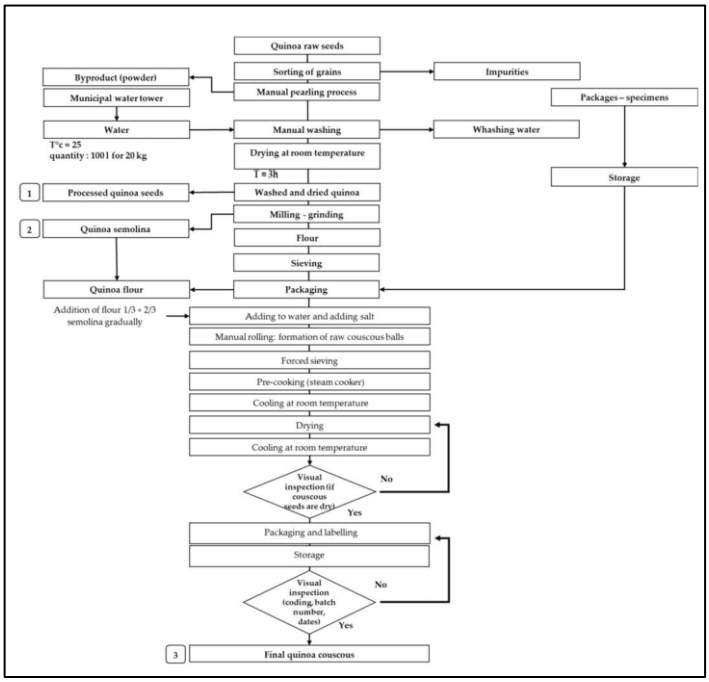

Fig.1 Processing of quinoa [6]

Nutritional value

Hailed as a super-food and an ancient "mother grain," quinoa has taken the world by storm in recent decades. But this seed from the goosefoot plant isn't just a dietary fad – it packs a staggering array of nutrients that make it one of the most nutrient-dense foods on the planet.

Quinoa is one of the few plant-based complete protein sources, containing all nine essential amino acids our bodies require [7].With around 8 grams of high-quality protein per cooked cup, quinoa is an excellent option for vegetarians, vegans and anyone looking to boost their intake of this vital macronutrient [8] What's more, quinoa is remarkably high in dietary fiber, providing over 5 grams of a healthy mix of insoluble and soluble fiber per cooked cup [9]. This fiber is critical for digestive health, blood sugar regulation and cholesterol reduction [10]. As a whole grain that is naturally gluten-free and has a low glycemic index, quinoa is an ideal choice for those with celiac disease, gluten intolerance or diabetes [7].

But where quinoa truly distinguishes itself is in its provision of essential vitamins and minerals. It is an excellent source of manganese, phosphorus, magnesium, iron, copper and zinc. One cup of cooked quinoa can supply over 25% of the recommended daily intake of important B-vitamins like folate, thiamin, riboflavin and vitamin B6 [11].

Protein per cent is one of the important parameters considered in cereals. Most of the cereal's loss considerable amount of protein during processing. Quinoa on the other hand showed increased in protein content after processing. Percent protein content of raw seed is 14.42% and processed seed showed increased protein per cent of 15.39%. Micro nutrient like Fe and Zn (mg/kg) has also increased [6]

Table. 1 Protein per cent, Iron and Zinc content of Raw, processed seed and quinoa bran. [6]

Product	Protein Content (%)	Fe (mg/kg)	Zn (mg/kg)
Raw seed	14.42%	57.35	20.54
Processed seed	15.39	61.55	22.30
Quinoa Bran	14.99	101.64	180.85

Value Added Products

Quinoa Flour

Quinoa flour is produced by grinding quinoa seeds into a fine powder. It is a versatile, gluten-free flour that can be used in baking bread, pastries, and cookies, as well as in pancakes and waffles. It can also be used as a thickener for soups and sauces.

Quinoa Pasta

Quinoa pasta is a gluten-free alternative to traditional wheat pasta. It is made by combining quinoa flour with other gluten-free flours, resulting in a nutritious and protein-rich pasta option that is suitable for people with gluten intolerance or celiac disease.

Quinoa Breakfast Cereals

Quinoa can be used to create breakfast cereals, such as puffed quinoa, quinoa flakes, or quinoa granola. These cereals can be enjoyed with milk or yogurt, providing a healthy, high-protein start to the day.

Quinoa chikki

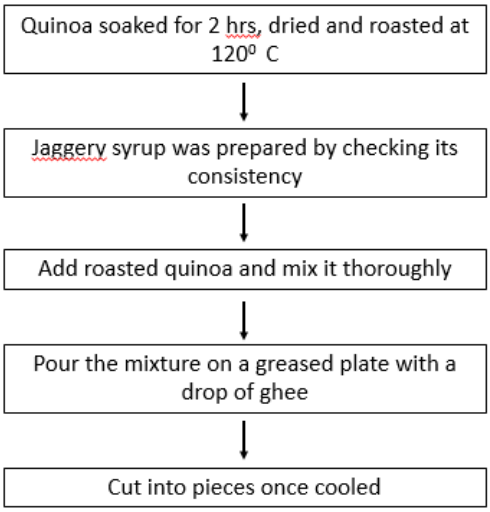

Fig. 2 Preparation of roasted quinoa chikki [13]

Roasted quinoa chikki

Fig. 3 Roasted quinoa chikki [13]

Quinoa Snacks

Quinoa can be incorporated into various snack products, such as quinoa chips, crackers, and energy bars. These snacks are often marketed as healthy alternatives to conventional snacks, offering higher nutritional value and appealing to health-conscious consumers.

Quinoa Milk

Quinoa milk is a plant-based milk alternative made by blending quinoa with water and then straining the mixture. It is a nutritious, lactose-free beverage that can be used in place of dairy milk in various recipes and as a drink.

Quinoa Baking Mixes

Quinoa baking mixes, such as those for muffins, cakes, and breads, provide a simple way for consumers to incorporate quinoa into their homemade baked goods. These mixes often include quinoa flour and other gluten-free ingredients.

Quinoa Beverages

Innovative beverages such as quinoa-based protein shakes or smoothies are becoming popular. These drinks often blend quinoa with fruits, vegetables, and other nutrient-dense ingredients, offering a quick and healthy option for on-the-go nutrition.

Quinoa-based Fermented Products

Quinoa can be used to create fermented products such as quinoa kombucha or quinoa tempeh. These products leverage the nutritional benefits of quinoa along with the health benefits of fermentation.

Quinoa Protein Powder

Quinoa protein powder is made by extracting and concentrating the protein from quinoa seeds. It is used as a supplement in smoothies, shakes, and other foods to boost protein intake, particularly for athletes and those seeking plant-based protein sources.

Conclusions

The versatile and nutrient-dense quinoa grain offers immense potential for value addition and product diversification. The awareness and demand of gluten-free products among the population has greatly raised. Quinoa has the ability to meet up the increasing demand as it has wide adaptability on extreme climate conditions like drought, resistant to pests and diseases. As consumer demand for healthier, plant-based, and sustainable food options continues to rise, quinoa value-added products present a lucrative opportunity for food manufacturers and entrepreneurs.

Leveraging quinoa's exceptional nutritional profile, which includes high-quality protein, fiber, and a range of essential vitamins and minerals, these innovative products cater to diverse dietary needs and preferences. Moreover, quinoa's adaptability to various processing techniques allows for the creation of texturally appealing and flavorful products that can compete with their conventional counterparts.

By embracing quinoa value addition, the food industry can not only tap into a rapidly growing market but also contribute to sustainable agriculture practices and support local economies in quinoa-producing regions. As research and development efforts continue to explore novel applications and

processing methods, the future of quinoa value-added products looks promising, offering a wealth of opportunities for innovation, economic growth, and improved nutritional well-being.

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