



Nutritional and Economic Aspects of Quinoa (Chenopodium Quinoa)

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Abstract

Quinoa (*Chenopodium quinoa* Willd.), is considered as pseudo-cereal it has high nutritional values due to its exceptional protein quality and broad range of vitamins, minerals and amino acid balance. The quinoa protein is rich of amino acids like lysine and methionine that are deficient in cereal proteins. Quinoa grain is used to prepare flour, soup, breakfast, cereal and alcohol, while the flour is utilized in making of biscuits, bread and processed food. Quinoa starch has some functional properties like solubility, good water-holding capacity, gelation, emulsifying, and foaming that allow diversified industrial applications. Quinoa also contains various minor components like phytosterols and flavonoids etc. Besides, it has been considered an oil crop, with an interesting proportion of omega-6 and notable vitamin-E content. Quinoa milk and related food products are becoming popular throughout the world due to its good nutritional values and medicinal qualities. Quinoa milk is high in protein, low in fat and carbohydrate and contains no cholesterol. It is an excellent food for babies, children, elderly people and pregnant and lactating women. Due to diverse use of quinoa it is utmost important to grow quinoa to meet the requirement of the daily life of world population. In this study it is emphasised on economic and nutritional aspects of quinoa.

Keywords: Economic, Nutritive Aspects, Quinoa Milk, Quinoa Protein

1. Introduction

Quinoa is considered as pseudo-cereals grains. Quinoa grains have an established excellent nutritional food quality and it is also called the mother grain. Quinoa was the major crop of the pre-Columbian cultures in Latin America. Later, after the arrival of the Spaniards, quinoa cultivation was almost eliminated and only remained in the farmer's traditions. It has broad leaf plant with starchy dicotyledonous seed and therefore not a cereal. Quinoa is used in various cereal foods and also an important ingredient source of the

functional foods.

Quinoa's ability to produce high-protein grains under ecologically extreme conditions makes it important for the diversification of future agricultural systems, especially in high-altitude area of the Himalayas and North Indian Plains. The healthy lifestyle and appropriate nutrition are stressed nowadays. New foodstuffs are still investigated with the aim to improve the diet and conduce to a better health state of the population. Quinoa has high nutritious and dietary quality meets the demands of the food industry and



consumers.

In aspects like exceptional nutritional quality, genetic variability, adaptability to adverse climate and soil conditions, and low production cost constitutes quinoa as a strategic crop with potential contributor to food security and sovereignty. The cultivation of quinoa provides an alternative for countries with limited food production. Quinoa has potential agronomic importance because it can adapt to produce high yields under adverse conditions and contribute to food security in different regions worldwide (Wilson, 1985).

Besides protein content, many studies have been made of their lipids, starch, minerals and saponins it also contains minerals and vitamins like vitamin B, vitamin C and vitamin E. In 1996, quinoa was catalogued by FAO as one of the most promising crops for the humanity, not only for its great properties and its multiple uses, and it is also considered an option to solve human nutrition problems (FAO, 2011).

2. Quinoa seed processing

The plants are threshed in stationary threshers, which may be operated by a tractor or by self-propelled motors and cleaning is done to separate soil, stones, excrement, and small and broken seeds from the seed material.

Removal of saponins, water-soluble soapy compounds in the seed hull with a bitter taste, is an obstacle for processing and consumption. Some quinoa varieties, such as Sajama, Cheweca, Kamiri, and Blanca de Juni'n, are sweet, requiring only a simple cleaning before use (Tapia et al., 1979). Saponin removal can be performed as a humid or dry process, or preferentially in combination (Jacobsen et al., 2000; Mujica, 1993). The humid method is traditionally used by peasants and housewives and entails a successive washing of the grain using friction by hand or a stone to eliminate the episperm, which is the outer layer where the saponin is located. At the industrial level, the humid method has the disadvantage of the high cost of drying the seed and the formation

of foam (Nieto and Fisher, 1993; Valdivia et al., 1997). The dry process is a polishing. First, the seeds are mechanically abraded against rough walls. The grain is then rubbed against sieves to separate the next layer, and the residues and saponin dust are eliminated (Mujica, 1993).

Value added products of quinoa

Quinoa is a highly nutritious food; the nutritional value of this grain has been compared to that of dried whole milk by the Food and Agriculture Organization (FAO) of the United Nations and found best source of nutrients. Quinoa is used to make flour, soup, breakfast cereal, and alcohol. Most quinoa sold in the United States as whole grain that is cooked separately as rice or in combination dishes such as pilaf. Quinoa flour works well as a starch extender when combined with wheat flour or grain, or corn meal, in making biscuits, bread, and processed food.

Quinoa biscuits

Quinoa biscuits are consumed directly at any time either with tea or alone. They are available in sealed polythene bags (HDPE 400 microns)/laminated packages/ hermetically sealed metal containers. The shelf life is about six months at normal retail shelf temperatures, however, should be used within a month after opening the packet. It is essential to ensure product safety. The package should provide all the nutritional information.

Quinoa bread

Quinoa bread is consumed directly at any time either with tea or alone. It is available in sealed polythene bags (HDPE 400 microns)/laminated packages. It will be fresh for 6 day's at normal retail shelf temperatures. It is essential to ensure product safety.

1. Quinoa seeds have been identified for making soups and desserts, pastries, drinks and dry snacks. Following is a brief description of traditional

- preparations that are made from quinoa in South America.
2. Quinoa soup: Not very thick cooked quinoa with meat or dried meat, tubers and vegetables.
 3. Lawa: A semi thick “Mazamorra” (porridge like preparation) with raw flour, water with lime and animal fat.
 4. P'esque: Quinoa grain cooked with water, without salt, served with either milk or grated cheese according to the availability of these additions.
 5. Kispina: Steamed buns of different shapes and sizes.
 6. Tacti o tactacho: Fried buns, a kind of doughnut made with flour and llama fat.
 7. Mucuna: Steam cooked balls made from quinoa flour with seasoning in the centre similar to tamales or humitas.
 8. Phiri: Roasted and slightly dampened rough quinoa flour.
 9. Phisara: Lightly roasted and cooked quinoa grain.
 10. Q'usa: Quinoa chicha, a macerated cold drink.
 11. El Ullphu, Ullphi: Cold drink prepared with roasted quinoa flour diluted in water with
 12. sugar added to taste.
 13. 11. Kaswira de quinua: Flattened bread fried in oil, made with katahui (lime) and white quinoa.
 14. 12. Kaswira de ajara: Flattened bread fried in oil, made with katahui (lime) and black quinoa or Ajara
 15. 13. K'api kispina: Steamed bun, made with quinoa ground in a K`ona and cooked in a clay pot, common in the feast of all Saints.

Production quinoa milk

India with the total milk production of 109 million tones is the world's highest milk-producing country for the past one decade now and accounted for about 15% of the world milk production in 2009. The importance of dairy enterprise in the national economy can be gauged from the fact that the value of output from milk group is highest among all

the agricultural commodities, accounting for nearly one fourth of the value of output from agricultural sector. Dairying is one of the most important means of providing livelihood and nutritional security to the rural masses. The livestock activities, among which dairy farming predominates, employ about 8.5 million workers in the country. Milk and milk products account for 9.2 and 12.4 percent of protein intake in rural and urban areas, respectively, which is higher than the protein intake through non-vegetarian animal products.

The increased production of milk has improved the per capita milk availability to 250 grams per day. The demand of milk and milk products in India is projected to increase to 142.9 million tones in 2015 and further to 191.3 million tones in 2020. At the existing rate of growth in milk production, in next ten years, supply will fall short of the demand.

Together with the increase in domestic demand of milk, at the international level, particularly in developing countries, the three drivers of demand population growth, urbanization and income growth are very strongly in operation. For instance, the import demand of milk and milk products has shown tremendous increase in several developing countries notably China, South Korea, Singapore, Srilanka and several other Asian countries many of whom have become buoyant economies after opening up of the world market. Thus, buoyant markets and trade liberalization have opened new vistas of international trade for the Indian dairy sector. However, for tapping the economic benefits of growing demand of milk and milk products and to compete with the traditional milk exporting countries viz; Australia and New Zealand the Indian dairy sector has to gear itself to meet the following challenges:

- Increase the milk production at the rate that is higher than the existing growth through alternative sources like quinoa milk.
- Increase the production of value added dairy products by cereal based quinoa milk.
- Provide complete food security by the

production of milk using cereal grain. Quinoa is the cheap and best healthy food. Quinoa milk and related food products are becoming popular throughout the world due to their good nutritional values and medicinal qualities. Quinoa milk is high in protein, low in fat and carbohydrate and contains no cholesterol. It is an excellent food for babies,

children, elderly people and pregnant and lactating women since it contains vegetable protein which is very nutritious and easy to digest. Besides possessing high nutritional values, quinoa milk is best for people suffering from diabetes and lactose intolerance. It can be said that quinoa be an is a valuable gift of mother nature to human beings.

Table: Nutritional composition of quinoa compared with other source

Components (%)	Quinoa	Meat	Eggs	Cheese	Cow Milk	Human Milk
Proteins	13.00	30.00	14.00	18.00	3.50	1.80
Fats	6.10	50.00	3.20	-	3.50	3.50
Carbohydrates	71.00	-	-	-	-	-
Sugar	2.9	-	-	-	4.70	7.50
Iron	5.20	2.20	3.20	-	2.50	-
Calories per 100 g	350.00	431.00	200.00	24.00	60.00	80.00

Process of manufacture the initial stage involves the cleaning, sorting of the quinoa followed by dehulling and soaking at room temperature in 0.5-1.0% sodium bicarbonate solution in 1: 3 ratio (quinoa:solution). After soaking, the weight of original quinoa becomes double, the split (dehulled beans) are ground in hot water in 1:7 ratio and filtered to get milk. The milk is then cooled to 70°C and 0.1 molar calcium sulphate /magnesium chloride or 2% citric acid solution is added with slow stirring. These chemicals precipitate/coagulate the proteins of quinoa milk. The muslin cloth containing quinoa protein is pressed in paneer making boxes for 30 to 45 mts. and then cut into pieces of approx. desired size and put in cold water for another 30 minutes. vacuum packed tofu should always be kept in the fridge and, after unpacking, immersed in water. The various products which can be manufactured are mentioned in the chart No. 1

The health claims of quinoa milk

- It's a high protein, nutrient-rich drink
- It's a low calorie drink that's better for weight loss than cows' milk
- It is a healthy alternative to cows'

milk.

Quinoa is a complete protein source (i.e. it contains all of the essential amino acids the body needs) and is high in iron, magnesium and vitamin B6, so is the milk. Quinoa milk will find fortified with calcium, vitamin D, vitamin A and vitamin E. There's one key reason for this the trendy drink is devoid of all the key nutrients found in cows' milk. With this in mind, quinoa milk in its pure, unadulterated form does not compare nutritionally to cows' milk. There's one key reason for this the trendy drink is devoid of all the key nutrients found in cows' milk.

The most popular cereal based non dairy highly nutritious milk which will help in eradication of malnutrition from India. The quinoa milk if fortified with calcium, vitamin A palmitate, vitamin D2 and D-alpha tocopherol (vitamin E). Overall quinoa milk will be better nutrient profile than cows' milk. Quinoa drink is fantastic milk alternative. It is naturally high in protein and is free from additives or preservatives. Use this milk as you would regular dairy milk. It can be used in tea and coffee.

Market potential

With the increasing health consciousness among the general people, the use of quinoa is getting acceptance in the form of high protein. Quinoa fortified wheat flour, quinoa milk,

paneer and curd etc. Being mainly the country of vegetarians, India has indeed a very great potential for quinoa products.

PROCESS FLOW CHART OF QUINOA MILK

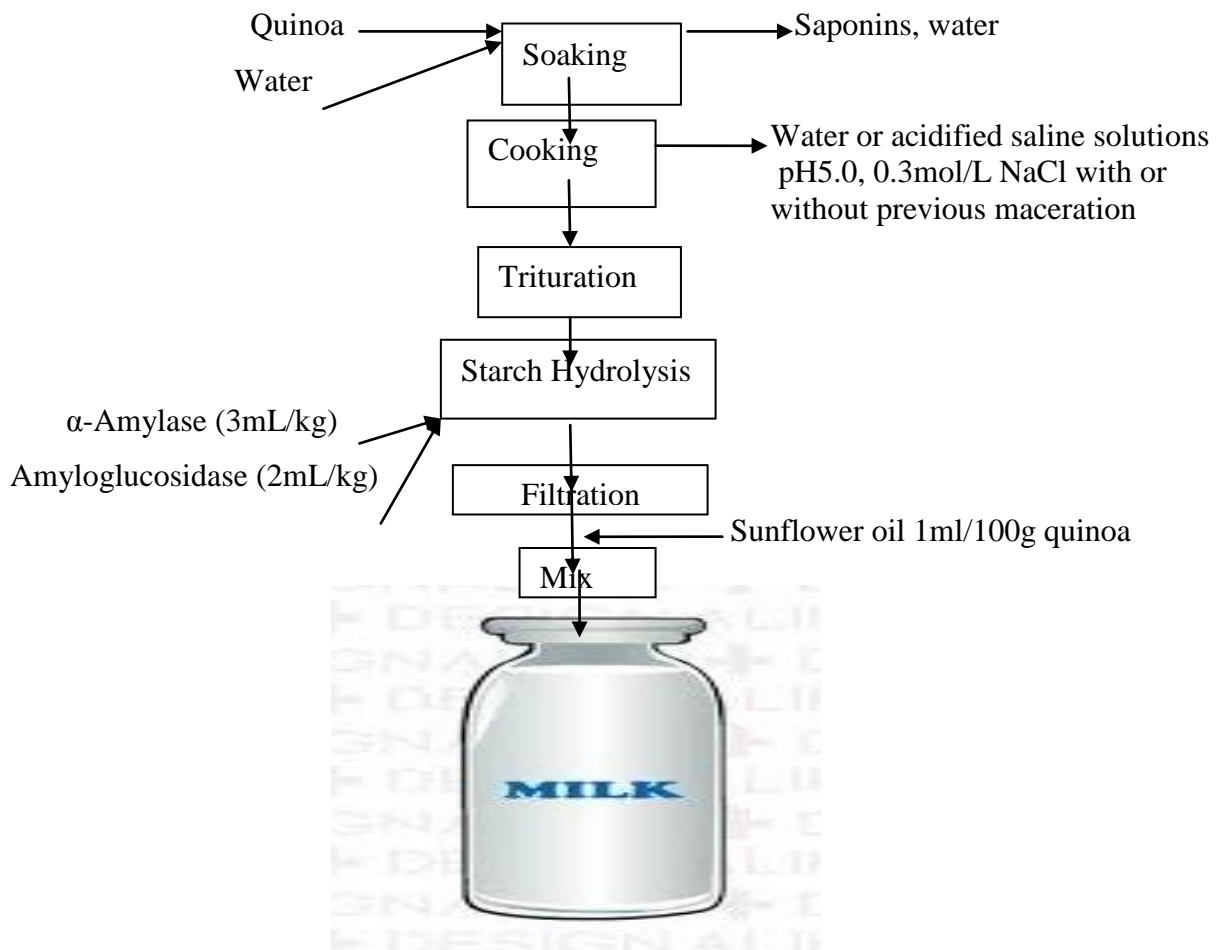


Chart No. 1

NUTRITIONAL INFORMATION OF QUINOA MILK AND OTHER MILK

Typical Values Per 100gm	Quinoa Milk	Soya	Cow Milk	Human Milk
Energy	46 Kcal/Kg	33 Kcal/Kg	62Kcal/Kg	65 Kcal/Kg
Protein	4.5g	2.8g	3.0	0.9g
Total Carbohydrates	5.0g	1.8g	4.0g	7.1g
Fat	2.8g	2.0g	4.0g	4.0g
Fibre	0.6g	1.3g	0.0g	0.0g

3. Scope of quinoa milk

To feed demand, new agricultural frontiers are being opened up in India. As Quinoa products are emerging in the food market so this study will help the entrepreneur who want to establish them self in this field. The study will provide valuable insights to the marketers of Quinoa products and will help them in formulating their promotional strategies. This study will also be useful for researchers, scholars and students who are seeking information of value added of quinoa milk products.

This report brings together modelling and analysis expertise in order to develop uniquely detailed market data. This allows domestic and foreign companies to identify the market dynamics to account for quinoa milk products sales overall and to know which categories and segments are showing growth in the coming years.

In the view of above results we can conclude that the quinoa milk market is an emerging market but still awareness level in people is low and no attempt has been made from company's or manufacturers side for increasing the awareness. The benefits of quinoa milk products have not been promoted so the usage of quinoa products by the people is low. So analysis suggests that manufacturers have to pay attention towards the advertisement and should stress on its benefits to increase the sales of products and also benefitted to the consumers.

Also the no specific brand of quinoa milk is available in Indian market. In India no research/study has been conducted on value added products based on quinoa. Therefore it is extensively important to conduct a research study from pilot plant to commercial scale. So that we can make economically quinoa milk for the benefits of Indian people. Our main objective of this research is to support the farmers to encourage for cultivation of quinoa and the production of value addition products on based on quinoa which will help to eradicate.

Products derived from quinoa and quinoa milk Quinoa milk

Quinoa milk (plain/flavored) is ready to drink and applicable to all sections of people suffering from lactose intolerance (Infants/youth/old/pregnant etc). The quinoa milk has shelf life of six months when packed in tetra packs or else for few weeks under refrigerated conditions. It has to be stored and distributed at ambient temperature. It is essential to ensure product safety.

Quinoa milk curd

Quinoa curd can be prepared by the addition of citric acid and it form.

Quinoa milk beverages (unsweetened)

A smooth and creamy non-dairy beverage made from pure quinoa and not blended with other grains. Quinoa, an ancient grain prized by the Incas, dates back to more than 5,000 years. Quinoa is the complete protein and contains essential amino acids and making it the super protein for our dietary needs.

Quinoa paneer

It is also known as quinoa curd and is a good source of protein and isoflavones. It is made by adding calcium or magnesium salts to quinoa milk, which enables the quinoa protein to coagulate to form curd. A simple and low cost technology for making quinoa paneer was developed at domestic and commercial level. When the quinoa paneer is made with calcium, calcium becomes an essential component. The softer one is used for desserts or other foods those require wetter consistency. Again it is essential to ensure product safety.

There is still a great scope in non dairy quinoa milk industry; good promotional efforts combined with effective marketing strategies can result in huge growth of quinoa based allied products. As mentioned about the potential of this industry, real efforts for

creating awareness of quinoa products among consumers will definitely prove beneficial for quinoa industry. India being an agricultural country has enormous production of quinoa and can cater to the food needs of not only to the world's second largest population but also to the whole world.

Quinoa protein concentrate

It is made wholly from defatted quinoa meal. quinoa protein is flour like product consisting of about 70% protein and is being used in a variety of meat systems, baked foods and dairy applications.

Quinoa protein isolates

It is made wholly from defatted quinoa meal and is used as an ingredient in high protein foods including dairy foods, nutritional supplements, meat systems, infant formulas, nutritional beverages, cream soups, sauces and snacks. It is also a good source of protein in milk replacers. Due to high protein content, it is highly suited for those people who have high protein needs due to growth (children), famine (acute needs) and chronic diseases (HIV/AIDS/tuberculosis).

Benefits of quinoa

Quinoa cultivation has lot of indirect benefits as increasing population in India will not meet the requirement by natural milk. It is urgent need to search alternative source to

meet the demand of milk having nutritional values comparable to natural milk which will able alleviate hunger and meet the requirement of nutritive foods.

4. Conclusion

Quinoa milk is nutritionally close to cow's milk. Quinoa is popular as a rich source of protein. Quinoa milk is promoted as healthy alternative to cow's milk for reasons including: diabetes management through its ability to control blood sugar, source of lecithin and vitamin- E and cholesterol free and safe for people with lactose intolerance or milk allergy.

As quinoa market and its product is growing in the world wide day by day. Quinoa milk and its uses are very lucrative; also it can be used as a substitute of milk products and other value added products. As today the milk products are coming with adulteration of harm full chemicals like urea in it, so the products of quinoa can prove there valuable presence in this scene. But still it's lacking because of its awareness level in public about quinoa based milk products, so it can be concluded that there is very urgent need to conduct a research study on quinoa based milk and other products for its commercialist ion in India.

In the view of above it can be concluded that the growing quinoa, will economical and nutritional beneficial to the farmers, food processor, traders and ultimately beneficial to the consumers.

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