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Quinoa: A Review on Nutritional Analysis and Its Viability As A Staple Food In India

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Abstract
Quinoa is a highly nutritiouspseudo cereal with high relevance in healthy daily lifestyle. Because of India's unique set of issues such as malnutrition, nutrition imbalance in diet, health of new born unhealthy child and lactating mothers, extreme whether events such as drought etc. Quinoa presents its claim to be adopted in the staple diet of the people of this sub-continent. This review paper analyses the nutritional properties of Chinopodium quinoa willd. and its suitability to the Indian population in their diet.

Keywords: *Quinoa, Staple diet, India, Malnutrition, Food Security, Cash Crop, Income.*

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I. Inroduction

The Quinoa food crop was grown since very long and is native to Southern American region. Back then in the region it was considered a sacred crop (Viktoria et al., 2020). Due to its balanced nutritional profile, it is being increasingly adopted in various economically developed strata of the word. It endows balanced macronutrients and micronutrients, making it almost very significant for the population that still has a significant number of undernourished and malnourished populations (Mousa et al., 2019). India houses a population, which is facing ample of issues and the root of those issues lie primarily in nutritional diet and active lifestyle. Therefore, more and more healthy food choices, which are sustainable to be grown and made affordable by the population is required to face this challenge. Also, it is quite interesting how Quinoa shows itself as one of such sources and needs to be included in the staple diet (FAO, 2017). An overview of nutrition, micronutrients, certain facts and advantages related to Quinoa and various ways to incorporate Quinoa in diet and its requirement in Indian context compiled under following heads:

NUTRITION

Nutrition is primarily classified as Macronutrients and Micronutrients. The analysis of quinoa cereal shows presence of all essential amino acids (Proteins), significantly low gluten quantity, fibre, magnesium, vitamin group-B, iron, potassium, calcium, phosphorus, lipids, vitamin-E, significantly high antioxidant compounds (Chavavan et al., 2019):
According to the analysis done on Quinoa its macronutrient and micronutrient have been explained as below:

MACRONUTRIENTS

Macronutrients are major nutrients, which are required in large quantities and provide body with energy to function physically and metabolically.
Three macronutrients are proteins, fat and carbohydrates. Authors consider Quinoa as per the macronutrients it contains.

a. Proteins

The protein is one of the very important components of our diets which help to repair and build muscles to make them strong. But due to majority population remain vegetarian with avoidance paid to eggs as well, the protein is majorly derived from cereals and legumes (Francoisetal, 2019). These sources remain inferior to meat and other nonvegetarian sources with respect to protein quantity and quality.
But when it comes to quinoa the following facts are considered:

- Gluten free, high quality and quantity protein with respect to cereals such as Barley, Oats, Maize, Wheat (Sharma et al., 2015).
- The findings of average protein content from different seed varieties form the crop varies from 7.5 % to 22.1 % (Sharma et al., 2015).

- The nutritional value of quinoa protein is comparable to milk and when cooked the protein efficiency increases (Sharma et al., 2015).
- The high protein content of quinoa comes with higher amount of lysine that in most of the cereals comes as a limiting protein. Also, threonine and methionine were found comparatively higher (Srujana et al., 2019).
- Through studies, it was found that all essential and non-essential amino acids were found in Quinoa making it a cereal with balanced amino acid profile both qualitatively and quantitatively (Barakat et al., 2017)
- Thus, it meets the guideline from FAO/WHO /UNU, 1985 recommendations of amino acid requirements for preschool, school children and adults (FAO, Report, 2011)
- The ample fulfillment of protein has therapeutic benefits such as fatty acid metabolism, gastric function promotion, cancer metastasis prevention, calcium absorption, formation of antibodies, enhances immune function (FAO, Report, 2011).

B. Carbohydrates

The most outstanding feature of Carbohydrates found in the Quinoa is that it is Gluten free which allow is to be fit even for the people who are Gluten Allergic, thus allowing them to complete their carbohydrate needs (Mustafa and Suleyman,2017).

- The high fiber content of this grain helps in slow release of energy (Mustafa and Suleyman, 2017) thus becoming ideal source of carbohydrates. Comparatively it has low number of sugars when compared to rice and wheat.
- Also, it shows suitability of its usage for mixing it with other flours such as wheat flour and make other consumables (Bhathal and Kaur, 2018).
- Fibre accounts for 6% of the grains total weight, and quinoa intake therefore promotes intestinal transit, regulates cholesterol, stimulates the development of beneficial bacterial flora and helps prevent colon cancer (FAO, Report, 2011).

C. Fats

- Quinoa is an excellent source of essential fatty acids with 2% to 9% fats contents (Sharma etal, 2015).
- It also has a low Omega-6 : Omega 3 fatty acids thus beneficial for cardiovascular health, immune system, autoimmune disease and inflammation (Srujana etal., 2019).
- Considering fatty acid profile of soybeans and maizeresembled similarity in levels of linoleic (C18:2), oleic (C18:1), and linolenic (C18:3) fatty acid as that of quinoa bran oil. Thus, it offers a blend of high protein, high fat and higher fiber contents with gluten free carbohydrates (Minocha, etal., 2017).
- The quality and quantity of lipids in quinoa made it an alternate oilseed crop (Filho, 2017).

MICRONUTRIENTS

- Numerous findings have shown that Quinoa has mineral and vitamin which makes the absorption of proteins from grains more effective and suitable, as fruits complement grains,thus making quinoa a good package for consumption. (Minocha, etal., 2017)

- The primary vitamins and minerals present are magnesium, iron, B group vitamins, Iron potassium, calcium, phosphorus, vitamin E.The outstanding quality of this grains is its high anti-oxidant nature (Filho, 2017).
- Ratio of Calcium to Magnesium is 1:3 and Calcium to Phosphorus is 1:6, which stands greater to which is recommended Ca:P ratio i.e. of 1:1.5 (Lutz and Godoy, 2017).
- High content of calcium, magnesium and zinc in quinoa than wheat, corn, rice, barley, oats, rye makes it stand out from the rest (FAO. Report, 2011).

Other facts and benefits related to quinoa:

- It has anti-oxidative, anti-hypertensive, anti-diabetic properties, hence can be used as nutraceutical and functional food ingredient (Chavan, et al., 2019).
- Effects of quinoa consumption making it suitable food source for steady uptake of it in the diet is to comparatively lower weight gain, an improved lipid profile, saponin content, potential antioxidant effects (Chavan et al., 2019).
- Quinoa has shown resistance to stress factors and is grown at high altitudes as well (Mustafa and Suleyman, 2017).

- Quinoa has shown its ability to reduce the risk of diseases such as cardiovascular diseases, type-2 diabetes, several cancers, high blood pressure, obesity and is also a good option for Gluten allergic people (Singh, et al., 2016).
- Improper food habits make metabolic processes suffer and impacts health adverselythus also leading to various other disorders (Singh et al., 2016).
- This crop is resistant to drought and has shown good growth on poorly fertilized saline soil without irrigation (Raoand Shahid, 2012).
- It is highly beneficial forconsumers who are at higher health risk group, such as children, the elderly, athletes, lactose intolerant, women prone to osteoporosis, anemic, diabetic, dyslipidemia, obesity, and celiac disease (Srujana et al., 2019).
- Studies have reported that a serving of quinoa (~40 g) meets a significant part of the daily recommendation intake for essential nutrients - mainly vitamins, minerals and essential amino acids (Barakat et al., 2017) and it even completes intake of compounds such as Phytosterols, Phytoecdysteroids, bioactive peptides etc.
- Valuable bioactive compounds exhibiting antifungal, antiviral, anticancer, hypocholesterolemic, hypoglycemic, antithrombotic, diuretic and anti-inflammatory activities have been identified (Barakat et al., 2017).
- Buckwheat and Quinoa showed the highest antioxidant potential among cereals and pseudocereals studied (Filho, 2017).
- Quinoa helps reduce LDL in the body and raise HDL due to its omega 3 and omega 6 content (FAO, 2017).

Ways to incorporate Quinoa in diet and its need in Indian context

Above we saw numerous nutritional properties and therapeutic benefits of quinoa. Here we will try to connect that how these benefits are a need for Indian population today, which is facing the numerous issues such as: Malnutrition in Children, Pregnant mothers and lactating mothers, undernourishment due to less consumption, undernourishment due to excess junk food consumption, impact on food security due to ecological imbalance, impact on nutritional security of the people (Below Poverty Line), sedentary lifestyle and food habits are causing diseases, healthy diets yet not completing nutrient requirements, unavailability of a major crop that gives monetary value same as of wheat and rice crop.

The Population of India has 21.9% people living below poverty line (Census of India, 2011). Relevant data for the population of India (specifically Children below age 5) is given as below (Aijaz, 2017) for the period of 2015-16:

Stunted	38%
Wasted	21%
Underweight	36%
Overweight	2% (for 2006)
Anemic	58%

The population of India bears the burden of 24% of world's malnourished population and 30% of world's stunted population of children under the age of 5 (Global Nutrition Report, 2018).

This problem of undernourishment is causing numerous diseases in the population affecting their quality of their life. Most of them are from the Below Poverty Line population (Global Hunger Report, 2020) which barely gets two squared meals to satisfy their hunger. Apart from this, the becoming to be parents also faces the same problem that gets intensified when it is about the mother. In a study conducted in Kolkata, West Bengal India, 28.4 % of womenwere undernourished and came from lower socio-economic status family (Malliketal, 2017). A similar study in north Karnataka show that more than 60% of women were malnourished and came from lower socio-economic strata (Xavier and Amgiasvanth, 2020).

On the contrary several studies shown that the in the urban population some undernourished were because of the reason that they didn't consume the right amount of food in right quantity and some consumed food but that was junk (Ashakiran and Deepthi, 2012).

This overfed yet undernourished population has reasons as follows to avoid junk food in staple diet. The concerns are as follows feeling of lack of energy, entails poor concentration, high cholesterol levels, different heart diseases, low nutrition value, highly addictive nature, high chemical adiitives and preservatives (Bhaskar and Monika, 2012).

Amid all this there stands problem of ecological imbalance and deterioration of soil or increasing salinity which lays its impact on food security and affects every aspect of economy and public policy (Pillay and Kumar, 2019).

Around these issues surfaces a different problem of sources of food. When it comes to diet people often ignore the fact that they are consuming less as per the nutritional dimensions are related. Protein and fiber are the most important nutrients which are falling short in diets of the people. Quinoa as per the studies stands higher than the other traditional sources of nutrition, thus helping to bridge the nutritional gap in the diet.

Also, the when it comes to the issue of farming incomes quinoa offers a wide ground to the farmers to adopt this crop as its consumption is gaining momentum in the developed world and in now in developing countries. Due to its ability to grow in drought, unfertilized saline soil, un- irrigated strata; it can be readily grown with low investment and giving room or higher returns.

Cereals stand as highest consumed food category in India (Swaminathanetal, 2012) and Quinoa being a cereal offers tremendous benefits health wise and economically. Also, in Indian context Health is given the status of greatest wealth. Thus, Quinoa production and support by government in its introduction can boost efforts of the government in many sectors.

Mediums which can introduce and enhance usage of quinoa in India:

- Introduction of quinoa in ICDS scheme of Govt. Of India.
- Procurement through FCI for sale in PDS.
- Spreading awareness in school children and Mid Day Meals Scheme.
- Popularizing it more in less aware population.
- Developing snacks to replace usage of junk foods.
- Providing quinoa based malt drinks and flour to women on Lower Socio Economic Strata.
- Utilizing large un-irrigated Indian farms to grow quinoa and targeting its exports for high value.
- Aligning health sector workers to promote the usage.
- Intensive research to identify suitable variety of quinoa and develop more other varieties by the advanced agricultural fraternity of our nation.

Apart from this there are various methods suggested citing multiple usages of quinoa, such as rice replacement, cereals (Breakfast), popcorns, flour with wheat/maize, sprouts, processed foods like breads, pasta, cookies, soup like porridge/dalia (Jancurova et al., 2009).

The beneficial effects of including quinoa or its products were evident when it was given to a sample group of students aged between 18 to 45 for 30 days and they showed the results lowered total cholesterol, lowered Triglycerides, lowered LDL, proven beneficial in preventing and managing cardiovascular disease (Machodoetal.,2012):

Above are the few methods which can be implemented to integrate Quinoa in our staple diet and enjoy the benefits altogether with the world community. This requires testing of varieties by the Indianagricultural research agencies as evident from the research done in Chile (Miranda, 2014), which reflected differences made by the varieties and strata, on which it was grown, in the yield delivered. Conscious and sustainable approach is required before starting to grow as the demand is high in developed world and could be high in India as well, so the economic benefits may compel the farmers to grow it in maximum causing same catastrophe to soil nutrition as in Bolivia (Miranda, 2014).

II. Conclusion

Quinoa is a highly nutritious pseudo cereal that has immense benefits on health and in various disorders. It can be used extensively in India by incorporating it through various agencies and government support as it will be helpful to achieve various health and nutrition targets and overall welfare of the population.

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