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Importance of Pseudo-cereals in Human Health

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Abstract

Pseudo-cereals, including amaranth, quinoa, and buckwheat, have gained increasing recognition for their exceptional nutritional value and health benefits. Unlike traditional cereals, they are rich in high-quality proteins containing essential amino acids, dietary fiber, vitamins, and minerals such as phosphorus, potassium, and magnesium. Their gluten-free nature makes them an excellent dietary option for individuals with gluten intolerance or celiac disease. Regularly consuming pseudo-cereals has been associated with improved heart health, blood sugar regulation, enhanced digestion, and stronger immunity. Additionally, they contribute to weight management due to their high fiber content and satiety effects. Pseudo-cereals play a crucial role in promoting sustainable agriculture and food security. Their versatility in culinary applications and growing demand in the health food market further emphasize their significance in modern diets.

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1. Introduction

Pseudo-cereals are those plant that produces starch-rich grains that are used in the same way as cereals excluding those plants already classified under the cereal group. They are often referred to as "under-utilized foods" or "sub-exploited foods" because these are often neglected in our dietary habits (Rodriguez et al., 2020). UNESCO placed pseudo-cereals under the important crops category due to their decreasing consumption and exploitation, besides having a high nutrient-rich profile. Some of the most common pseudo-cereals are amaranth, buckwheat, quinoa, etc. They are nutrient-dense food can help achieve various goals of the United Nations' (UN) Agenda 2030 such as SDG 2 zero hunger and SDG 1 no poverty (Graziano et al., 2022). Being gluten-free it makes a good dietary alternative for people suffering from celiac disease or having gluten intolerance. Additionally, providing protein with essential amino acids (lysine, leucine, isoleucine, tryptophan), peptides, flavonoids, fatty acids, phenolic acids, minerals, vitamins, antioxidants, unsaturated fatty acids, lignans, and dietary fiber (Pirzadah et al., 2020). Their seed can be ground into flour and made into products like pasta, noodles, and bread otherwise used as

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cereals. Their consumption has been linked to improved heart health, better blood sugar control, enhanced digestion, and overall well-being. As the demand for healthier and more sustainable food sources increases, pseudo-cereals are gaining recognition not only for their nutritional value but also for their role in food security and climate-resilient agriculture. Incorporating pseudo-cereals into daily meals can offer substantial health benefits while supporting global efforts toward healthier and more sustainable food systems.

2. Types of Pseudo-cereal

The term pseudo-cereal is combination of two words 'cereal' implying grain of grass family and 'pseudo' referring to false or fake. Hence, the name 'pseudo-cereal'. Three most common pseudo-cereal are buckwheat, quinoa, and amaranth.

2.1. Buckwheat

Commonly cultivated buckwheat species include *Fagopyrum tartaricum* and *Fagopyrum esculentum* belonging to the family Polygonaceae. It is a rich source of vitamins (thiamin, riboflavin, niacin, biotin), minerals (calcium, iron, magnesium, phosphorus, potassium, selenium, sodium), fats, protein, dietary fibers, and bioactive compounds like polyphenols, inositol, flavonoids and organic acids. The protein content of buckwheat contains twice the amount of lysine as compared to rice and wheat. Its kernel (achene) can be roasted, granulated form can be steamed, baked, or coarsely grinded for breakfast. Buckwheat-based soba noodles are quite popular in Japanese cuisine and also in Hindu tradition, such as during the period of fasting buckwheat based food is gaining popularity as consumption of cereal-based food is prohibited during those times. It can be used either with wheat flour in making bread, cakes, pancakes, etc., or in specialty pasta, ready-to-eat cereals, etc.

2.2. Amaranth

Amaranth crop originating from Mesoamerica, is a nutrient-dense food. The most common species include *Amaranthus cruentus; Amaranthus caudatus; Amaranthus hypochondriacus.* It contains a high concentration of crude protein (14-19%), with essential amino acids such as lysine (6%) and tryptophan. Along with bioactive like tocopherols, flavonoids, phytates, phenolic compounds, squalene (lower cholesterol), omega-3 and omega-6 fatty acids, vitamins (riboflavin, niacin, pantothenic acid), minerals (calcium, iron, magnesium, phosphorus, potassium) and dietary fibers. Amylopectin constitutes 69% of grain starch and is smaller in size as compared to cereal grains. However, antinutritional factors such as trypsin inhibitors occur twice the amount as in wheat. It can be used to make confectionery items, porridge, bread, pancakes, multigrain crackers, or popped, toasted, sprouted, etc.

2.3. Quinoa

Quinoa (*Chenopodium quinoa* Willd.) belonging to family Chenopodiaceae produces grain rich in protein with essential amino acids (lysine, methionine, histidine, isoleucine, cysteine), fibers, fat, minerals (potassium, phosphorus, magnesium, calcium), vitamins (riboflavin, niacin,) with phytosterols, saponins, and phtoecdysteroids, with lower carbohydrate content than cereal. Quinoa seeds contain a high content of antioxidants imparting anti-inflammatory, anti-diabetic properties. But, saponin present in the seedcoat has antinutritional properties. It can be used to make salad, patties, soups etc. Some of the important nutritional content of buckwheat amaranth and quinoa is given in Table 1.

Table 1: The major nutritional content of buckwheat, amaranth and quinoa

Parameters	Buckwheat	Amaranth	Quinoa
Protein (g)	8.8	13.2	11.9
Carbohydrate by difference (g)	62.2	68.8	69.5
Total lipid/fat (g)	2.48	6.24	6.6
Fiber, total dietary (g)	10.4	7.2	6.3
Energy (kcal)	334	378	378
Phosphorus, P (mg)	282	425	369
Potassium, K (mg)	378	396	551
Magnesium, Mg (mg)	167	233	164
Manganese, Mn (mg)	1.54	2.3	2.02
Vitamin B1, Thiamine (mg)	0.241	0.059	0.345
Vitamin B2, Riboflavin (mg)	0.16	0.175	0.316
Vitamin B3, Niacin (mg)	3.84	0.748	1.21
Vitamin B6, Pyridoxine (mg)	0.17	0.387	0.222

(Food Data Central, U.S. Department of Agriculture)

3. Health Benefits

Pseudo-cereals are highly valued for their impressive nutritional profile and numerous health benefits (Figure 1.). Their rich content of essential nutrients, fiber, and bioactive compounds contributes to overall well-being and disease prevention. Buckwheat, amaranth, and quinoa contain antioxidants such as flavonoids, and phenolics, that reduce the incidence of cardiovascular diseases, cancer, neurodegenerative disorders, diabetes etc. Pseudo-cereals have a unique amino acid profile and can be used to supplement cereals and pulses for a more balanced amino acid diet containing essential amino acids (lysine, methionine, histidine, isoleucine, cysteine, tryptophan). Its gluten-free property makes it a good choice for patients with celiac disease, and reduces constipation, bloating, improves bowel movement, and gastrointestinal health. Additionally, fiber acts as a prebiotic, nourishing beneficial gut bacteria and improving overall gut health. The low glycemic index of buckwheat along with enzyme-inhibitor, polyphenol, quercetin, and rutin (reduces insulin resistance) makes it an excellent dietary option for diabetic patients. In amaranth, high manganese level regulates the gluconeogenesis pathway and simultaneously maintains the cholesterol level of the individual, increasing muscle growth. High levels of vitamins (Thiamine, Riboflavin, Niacin, Pyridoxine) and minerals (P, K, Mg, Mn) in the pseudo-cereals imparting antimicrobial, anti-cancerous anti-anemic properties help maintain the overall health of the body. They also contribute to brain function, cognitive health, and stress management. Some studies reported that amaranth consumption lowered disease inflammation and higher calcium content increased bone density and reduced the incidence of osteoporosis. Thereby, maintaining overall bone health. Its higher folic acid content makes it a good supplement for pregnant women reducing birth defects.

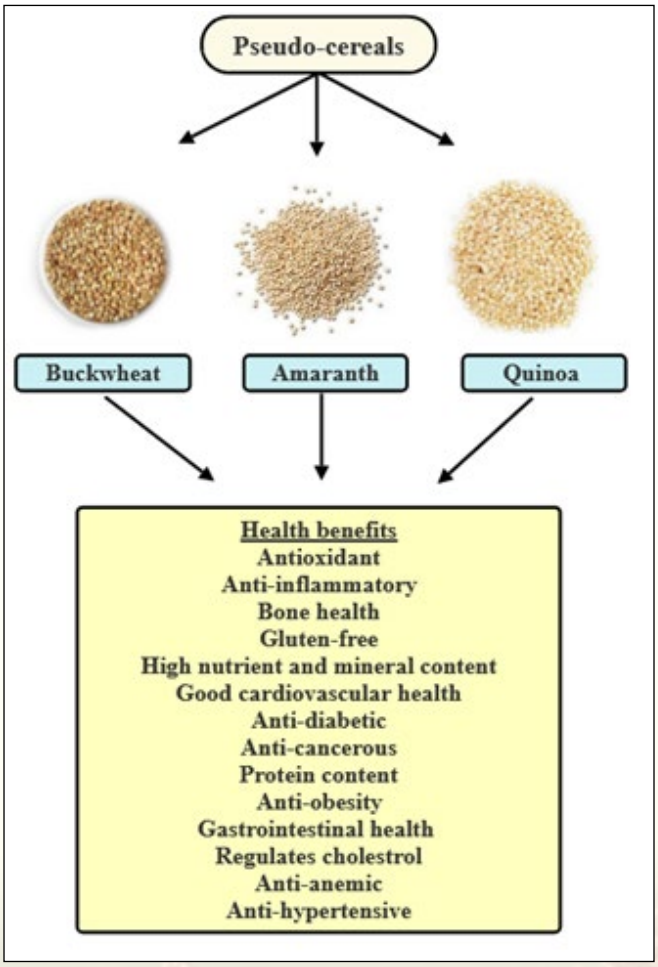

Figure 1. Health benefits of Pseudo-cereal

4. Value added Products

Pseudo-cereals can be transformed into a variety of value-added products that enhance their market potential and consumer appeal. These include gluten-free flours used for baking bread, pasta, tortillas, biscuits, porridges, and confectionary items providing nutritious alternatives for individuals with gluten intolerance (Thakur and Kumar, 2019). Additionally, pseudo-cereals are processed into breakfast cereals, snack bars, and puffed grains, offering convenient and healthy options for modern diets. Their high protein content makes them ideal for plant-based protein powders and energy drinks, catering to the growing demand for functional foods. Fermented products, such as pseudo-cereal-based probiotic drinks and beverages, further expand their usability in the health food industry. By developing innovative products, the commercial value of pseudo-cereals can be increased, making them more accessible and appealing to a wider range of consumers.

5. Constraints

Despite their numerous health benefits and nutritional advantages, pseudo-cereals face several challenges that limit their widespread use. One of the primary concerns is their relatively lower yields compared to staple grains like wheat and rice due to limited breeding efforts and the absence of high-yielding varieties. Their cultivation is often restricted to specific climatic and soil conditions, making them less adaptable to large-scale farming.

Additionally, these crops are more susceptible to pests, diseases, and environmental stresses. Harvesting can be challenging due to their small seed size, and poor post-harvest handling may lead to significant losses and reduced seed quality. Less awareness among the people regarding their nutritional benefits leads to low demand and preference. In some regions, these crops are perceived as low-status foods, discouraging both farmers from growing them and consumers from including them in their diets. Additionally, limited knowledge of how to cook and use pseudo-cereals reduces their acceptance as people tend to favor familiar ingredients. They have received limited attention in breeding programs, resulting in fewer improved varieties with traits like higher yields and disease resistance. Additionally, challenges in processing and storage, such as the need to remove anti-nutritional factors to prevent spoilage, make large-scale production and commercialization more difficult. Limited market availability, high production costs, and a lack of government support make it challenging for farmers to cultivate and sell pseudo-cereals competitively, restricting their economic viability and widespread adoption.

6. Conclusion

Pseudo-cereals play a vital role in human health due to their rich nutritional profile, including high-quality proteins, essential amino acids, dietary fiber, vitamins, and minerals. Their health benefits, such as improving heart health, regulating blood sugar levels, enhancing digestion, and supporting weight management, make them valuable additions to a balanced diet. Additionally, their gluten-free nature provides an excellent alternative for individuals with gluten intolerance or celiac disease. Despite certain challenges related to production, processing, and consumer awareness, promoting the use of pseudo-cereals through research, innovation, and education can enhance their accessibility and acceptance. By incorporating these nutrient-dense grains into daily diets, individuals can improve their overall well-being while supporting sustainable and diverse food systems.

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