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Uses of multigrain for functional ice cream cone

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Abstract
A study was conducted to understand the acceptance of blended healthy gluten-free high protein flour; we aimed to standardize an innovative, preservative-free, simple, and nutritional that is cost-effective. Grains are a staple and major part of the human diet. Multigrain products are made by combining more than two grains. They give more nutrients. They give more than regular single grain consumption and fulfill deficiencies of nutrients of other grains. The study explored Whole wheat flour, Millet, Oats, Quinoa and Amaranth. Without whole wheat flour develop an ice cream cone. Processing of grains may lead to the destruction of nutrients from grain therefore different types of grain are mixed to make multigrain food products. Bioactive compounds are fatty acids, minerals, vitamins, prebiotics, probiotics, dietary fiber, carotenoids, enzymes, antioxidants, and phytochemicals. These bioactive compounds help in the prevention of various chronic diseases as well as keep your body healthy. In this review, I discuss multigrain product and their nutrition, the product designed was multigrain flour, the effect of processing on grains and their health benefits. The study explored multigrain flour to develop an ice cream cone. The product was developed under laboratory conditions, standard steps were followed to develop the product. The Evaluation was performed on sensory attributes like Appearance, color, taste, texture, aroma, and overall acceptability of the product. In the preparation of ice-cream cones yield %, baking time, and ice cream holding time were investigated. Microbial analysis was carried out for validation of its shelf life. Our other vital focus was on the packaging and nutritional labeling.

Keywords: Multigrain, nutrition, sensory evaluation ice cream cone, etc.

Introduction

An essential component in the production and promotion of novelty-frozen desserts is the ice cream cone. We have already discussed the connection between cone batter rheology and baking performance [51]. The focusing on cone batter formulation issues as well as general core strength and quality [53]. A dry, flat waffle in the shape of a cone that allows you to hold and consume ice cream is known as an ice cream cone. Ice cream was served in dishes, cups, and other containers before the development of ice cream cones. Anyone can enjoy using an ice cream cone to serve themselves ice cream. Wafer (or cake) or molded cones and rolled sugar cones are the two varieties of ice cream cones [54].

Consumer knowledge of the relationship between health and nutrition has significantly changed recently. In addition to basic nutrition, the importance of diet has grown. In addition to satisfying hunger and supplying important nutrients, nutrition also lowers health risks promotes wellbeing, and supports the prevention of diseases linked to poor nutrition [21, 16]. A multigrain product is a combination of at least two grains. Every grain has different nutritional qualities, thus when different grains are combined, they provide more nutrients than when consumed alone. In addition to providing various phytochemicals, multigrain products also improve texture and sensory qualities [32]. Grains were once one of the most essential components of the human diet and were regarded as a staple meal. It promotes growth and gives the body the nutrition it needs for daily tasks. Today's consumers eat food to satisfy their appetites as well as to ingest more nutrients. Today's diet is highly beneficial in the battle against diseases linked to nutritional disorders. Human lifestyle is drastically changing in the twenty-first century. People are more concerned with their diets and overall health today. People are looking for food that provides more nutrients with fewer calories. Food with health advantages is produced as a result of this. Functional foods are simply those that contain food germ and bran and offer advantages to health beyond those offered by essential nutrients [42]. The bran and germ of whole grains contain significant amounts of nutrients. The removal of the germ during grain milling results in a nutritional loss.

Numerous scientific investigations revealed that including whole grains in the diet lowers the risk of coronary heart disease and some cancer kinds. Dietary fiber is crucial for slowing down the rate of glucose breakdown, reducing body absorption, and promoting balanced glucose release from carbs [95]. The urban and health-conscious consumer can choose multigrain because it contains gluten-rich, high-protein flour. When consumed in excess, gluten has negative effects on health. Consume excessive amounts of gluten, which has also affected how our brains function. Massive health deterioration due to stress, a bad lifestyle, and poor eating habits are just a few of the issues that people in today's urban environment must deal with. In addition to these issues, metabolic syndromes have been seen in several people [47, 91].

The combination of grains makes it a great option for people trying to lose weight, diabetes, vegans, and health enthusiasts. It contains antioxidants, qualifies as a functional food for diabetes, and acts as a preventive food for cancer and cardiovascular diseases [54]. Some ancient grains, such as millets, buckwheat, and amaranth, which are high in phytonutrients or micronutrients, have historically served as a staple diet in many civilizations but are currently underutilized. In addition to fagopyritols, they are abundant with polyphenols, flavonoids, dietary fiber, amino acids, and lignans as well as minerals, vitamins, and antioxidants [54, 67].

Varieties of Multigrain

Whole grains sources are as follows:

Cereals	Minor cereals	Pseudocereal
Wheat [spelled, emmer, Kamut, durum]	Millets	Amaranth
Rice [black, brown, red, and other]	Sorghum	Buckwheat
Barley [hulled and dehulled]	Teff	Tartary buckwheat
Maize or corn	Triticale	Quinoa
Rye	Canary grass	
Oats	Wild rice	

Source: [114].

Nutritional and health benefits of multigrain

We have been compelled to remain at home for the past 15 months to stop COVID from spreading. The pandemic is causing unequaled levels of fear and uncertainty. It is not surprising that multigrain has become popular in India as more and more people prioritize healthy eating and lifestyle choices because it offers a variety of advantages:

High nutritional value compared to typical cereals: Protein, a vital macronutrient for our bodies, is abundant in multigrain cereals. Consuming foods high in protein will help you fulfill, satisfied for longer, and can have a significant long-term favorable effect on your health. The range of essential nutrients that multigrain offers, such as vitamins, minerals, protein, fiber, and other healthy plant compounds.

Overall health benefits

Multigrain dietary fiber is an important element of a balanced diet since it helps to lower blood cholesterol levels. There are several health benefits associated with multigrain goods, but there are many more reasons for you to consume multigrain ready-to-eat cereals.

Delicious and nutritious: Humans eat to live and live to eat, and given our modern lifestyle, it is critical to discover solutions that please taste senses without making you feel bad, for example, is packed with the deliciousness of healthy multigrain. It features a delightful chocolaty cream within and a crunchy chocolatey cereal exterior, making it the ideal solution to those annoying hunger pains that strike at any time of day. Weight control: Multigrain cereal can help with weight management because it provides a feeling of fullness, which discourages overeating and helps limit junk food intake [133].

A multigrain product is made up of two or more grains used for product formation. Its nutritional properties are enhanced due to the variety of grains.

legumes, oilseeds, nuts, and whole grains are rich sources of sterols and stanols. They aid in the reduction of low-density lipoprotein cholesterol and serum levels in the body [59].

Ice Cream Cone

Like the Hong Kong-style bubble cone, an ice cream cone, also known as a poke (Ireland/Scotland) or a cornet (England), is a crumbly pastry in the shape of a cone made of a wafer with a texture similar to that of a waffle. Cones come in a range of shapes and sizes, including pretzel and chocolate-coated cones (coated on the inside). Informally, an ice cream cone is a cone topped with one or more scoops of ice cream. Cones can be prepared in one of two ways: baking the ingredients flat before rolling them into form (before they firm), or baking the ingredients inside a cone-shaped mold [58]. J. T. "Stubby" Parker of Fort Worth, Texas, died in 1928 and created an ice cream cone that could be stored in a grocer's freezer, with the cone and the ice cream frozen together as one item [44].

Whole wheat

The awareness in public regarding the health benefits of whole wheat (Triticum 12 aestivum L.) has increased its consumption to a large extent. Whole wheat flour has been 13 reported to be associated with a reduced risk of major chronic diseases, including cardiovascular 14 diseases, obesity, type II diabetes and cancer [22]. It is 15 mainly composed of germ, endosperm and bran. However, during the production of refined 16 flour, the germ is removed together with the brand as a byproduct of milling. The bran fraction of 17 whole wheat flour is rich in bioactive phytochemicals that confer several health benefits. 18 Phytochemicals that are mainly present in whole wheat flour include phenolics, carotenoids and 19 vitamins. Phenolics have been reported to have numerous biological effects including antioxidant 20 activity [121]. Extracts obtained from plants are rich sources of phenolic 21 compounds that can reduce oxidation of lipids and thus improve the quality of 22 foods. The use of plant extracts is therefore of increasing interest to the food industries [35].

Millets

Small-seeded grasses known as millets are frequently referred to as nutricereals. In addition to other millets, it also contains sorghum, pearl millet, tiny millet, foxtail millet, proso millet, barnyard millet, and Kodo millet. Millets provide a calming alkaline impact on the digestive tract, preserving the body's optimal pH balance, which is necessary for immunity [126]. Millets are categorized as non-allergenic because they are gluten-free [28]. Millets should be promoted as the preferred food in place of wheat and rice because of this. The cultivation and consumption of millets must be improved to lower health risks like diabetes, obesity, cardiovascular disorders, etc. Millets are resilient to climatic conditions and are rich in micronutrients, anti-oxidants, phytoconstituents, flavonoids, etc. [127]. but they are also resistant to climate change [117]. Consumers are shifting to wheat and rice due to antinutritional components in the fibrous seed coat, colorful pigments, astringent flavor, and poor keeping quality of processed millets. Another issue is that millets are difficult to digest [6]. The biological production of additional amino acids during germination was described as an increase in the protein content of millets in foxtail millet [122]. Millet protein content increased significantly as a result of the use of carbohydrates for respiration during the germination phase [67]. An increase in enzymatic activity caused an increase in total protein content in finger millet during germination. Furthermore, this study found that the time intervals for germination played a significant effect in influencing many alterations [26]. According to research findings, protein breakdown during germination was promoted by microbial enzyme activity, which led to a large incre ase in the total protein content of millets. It is important to keep in mind, though, that proteolytic activity that results in protein degradation during the germination process may also occur, which would lead to a reduction in the protein content [49]. Foxtail millet's dietary fiber changed as it germinated, and it also rose as the amount of time it had to germinate grew [122]. The explanation provided for this was that the structure of polysaccharides was altered, disrupting connections between carbohydrates and proteins, and rating in the production of a novel dietary fiber during the formation of grain cell walls. Similar findings regarding the dietary fiber content of millets during germination [40]. Millets were high in minerals such as potassium, phosphorus, and calcium, as well as micronutrients such as iron, zinc, and salt. However, the simple presence of certain elements in the diet is insufficient; the bioavailability of these minerals to the human body is essential [36]. Mineral bioavailability in millets was lowered due to the presence of phytic acid and anti-nutrients [122]. Phytic acid complexed with minerals and precipitated, limiting mineral bioavailability [75].

The fundamental physicochemical and organoleptic properties of food ingredients that benefit consumers' health are known as functional qualities [29, 125]. The many components of ready-to-eat food contribute to its texture, structure, nutritional value, nutrient bioavailability, and other qualities [29]. listed several criteria that need to be taken into account when selecting an ingredient for a portion of functional food, such as water absorption capacity, hydration (water binding), oil absorption capacity, swelling capacity, solubility, emulsifying activity, emulsion stability, foam capacity, foam stability, bulk density, gelatinization, dextrinization, denaturation, coagulation, gluten formation, aeration, elasticity, viscosity, jelling, shortening, etc.

Finger Millet (Eleusine coracana)

Millets are small-seeded grasses that are frequently referred to as dryland cereal or nutricereal. Millets are significant foods in many developing nations due to their capacity to grow in severe weather conditions such as low rainfall. Millets provide a calming alkaline effect on the digestive tract, preserving the body's optimal pH balance, which is necessary for immunity [126]. Millets are categorized as non-allergenic because they are gluten-free [28]. Millets should be promoted as the preferred food in place of wheat and rice because of this. The cultivation and consumption of millets must be improved to lower health risks like diabetes, obesity, cardiovascular disorders, etc. Millets are abundant in micronutrients, antioxidants, phytonutrients, flavonoids, and other compounds. Millet is gluten-free, making it an ideal choice for persons with celiac disease, who are frequently affected by the protein content of wheat and certain other common cereal grains. It is also beneficial to those suffering from atherosclerotic and diabetic heart disease [127].

Chemical and nutritional composition of finger millet

In terms of nutrition, finger millet is a good source of vitamins, minerals, and fiber, particularly calcium. According to reports, finger millet has a total carbohydrate content between (72 and 79.5 %) [105, 56, 62, 22]. Among the carbs, starch makes up (59.4 to 70.2 %) of the total [105, 145, 11, 94, 86]. Granules of finger millet starch have a polygonal rhombic form [63]. The finger millet starch contains (15 to 20 %) amylose and (80 to 85 %) amylopectin [147, 61]. Non-starch polysaccharides make up (20 to 30 %) of total carbohydrates in finger millet [22]. Reducing sugar is in the range of (1.2 to 1.8 %) [105], whereas finger millet has a value of 1.5 % reducing sugar and 0.03 % non-reducing sugar [94].

Protein

Protein quality is mostly determined by the essential amino acids found in it. Finger millet contains (44.7 %) essential amino acids [84] of the total amino acids, which is higher than the FAO reference protein's (33.9 %) necessary amino acids. Furthermore, the finger millet amino acid profile provides a reasonable ratio of essential to total amino acids. When compared to the FAO amino acid scoring pattern for children aged 2 to 5 years old [8], lysine was limiting, while all other amino acids scored greater than 1. Tryptophan is often the second most lacking amino acid in cereals. However, finger millet is abundant. Unlike rice, wheat, and sorghum, threonine was not inadequate [7]. Finger millet has a better balance of essential amino acids than other millets because it includes more lysine, threonine, and valine [108].

Fat

Finger millet has a crude fat level ranging from 1.3 to 1.8 % [22, 81, 79], however a higher proportion (2.1%) of crude fat [11]. The fat content of brown and white finger millet types ranged from (1.2 to 1.4 %) [120]. Oleic acid was the most abundant fatty acid in finger millet, followed by palmitic acid and linoleic acid. It also included a trace of linolenic acid. According to the fatty acid profile, saturated fatty acids account for (25.6 %) of total fatty acids, whereas unsaturated fatty acids account for (74.4 %) [130].

Mineral
The mineral makeup of millet grains varies greatly. The mineral content of various food grains is affected by genetic variables and environmental circumstances in the growing region. The total ash level of finger millet is higher than that of regularly consumed cereal grains. In finger millet, the ash level ranged from approximately (1.7 to 4.13 %) [106, 15]. The best source of calcium and iron is finger millet. Calcium deficiency, which causes bone and tooth disorders, and iron deficiency, which causes anemia, can be overcome by including finger millet in our regular diet [146].

Foxtail Millet (Setaria italica)
The second and third most significant millets crops are foxtail and finger millets, after pearl millet. In addition to Asia, Europe, North America, Australia, and North Africa, foxtail millet is also a common grain or animal feed in China, India, Korea, and Japan [14]. Foxtail millet (Setaria italica), the sixth-highest yielding grain, has been noted as a significant millet in terms of output globally [111]. It is a kind of cereal grain that is a member of the Setaria genus and the Panicoideae subfamily of the Poaceae family. Foxtail millet is among the earliest crops ever domesticated [4]. In northern China, the oldest artifacts from this period, which date from 7400 to 7935 years ago, were found. Its remains dating back 4,000 years have also been found in Europe [78]. Foxtail and finger millets are strong in nutraceutical and antioxidant characteristics and are good sources of micro and macronutrients. Protein, fat, crude fiber, iron, and other minerals and vitamins are abundant in these crops. When compared to rice, foxtail millet has about twice the amount of protein (11.2 %) and fat (4%), while finger millet has more than ten times the calcium [111]. Foxtail millet is high in nutritional components, including carbohydrates, protein, vitamins, and minerals. Because of the coarse form of foxtail millet grains, the digestible portion accounts for around 79 percent of the grain, while the remaining undigestible portion contains relatively high levels of fiber as well as various anti-nutritional components. Foxtail millet, like most millets, is high in crude fiber, which aids in digestion and induces bowel movement, resulting in a laxative effect that is useful to a healthy digestive system [19].

Composition of Foxtail Millet
Foxtail millet includes a variety of health-promoting components, making it not only a great source but also unique in the cereal category due to the specific balance of nutrients it contains. Starch, protein, dietary fibers, fat, vitamins, and minerals are the primary components of foxtail millet [151]. Both nutritional and sensory properties of foxtail millet are due to its unique composition, which includes aroma, flavor, and look.

Starch
Starch is a major carbohydrate element in foxtail millet, accounting for 61% of the dry content. It is made up of two primary molecular components, amylose, and amylopectin, in a weight ratio of 25:75, which are associated with the production and quality of foxtail millet products [142, 65]. Amylose has a linear shape with a few branches distributed along the backbone, whereas amylopectin has a much more branching structure. These starches govern biosynthesis, physical granular structure, functionality, and prospective applications. Structure. Starch is a major component of all cereals, including foxtail millet, and it is critical in determining post-processing quality. Gelatinization parameters, molecular structure, amylose and amylopectin levels, gel-forming properties, and digestibility and absorption are the starch features that determine the quality of a certain foxtail millet-based product [157].

Protein
The protein content of millet seeds accounts for a major portion of the overall dry weight of the seed, with variable biochemical compositions for different millets. Alcohol-soluble prolamines, for example, are the primary storage proteins in foxtail millet [89, 88]. To define the protein fraction in foxtail millet and determine the isoelectric points of protein components in various foxtail millet varieties. Albumin was discovered to have the largest protein proportion, followed by gliadin, globulin, glutenin, and other proteins, giving a total protein concentration of 11.54 g /100 g [77]. Prolamine, on the other hand, was the main storage protein of foxtail millet [64]. According to the latter, the prolamine percentage ranged from (41 % to 77.5 %) of total protein in different kinds of foxtail millet. The protein from foxtail millet was discovered to be high in glutamic acid, leucine, alanine, aspartic acid, and lysine. This essential amino acid composition revealed that amino acids in foxtail millet met FAO/WHO/UNU standards and were even comparable to soy protein concentrate [88].

Phytochemicals
Aside from proteins, antioxidants are the most important functional component of foxtail millet. Antioxidants have been shown to reduce the number of free radicals in our bodies. Phenolics are one of the principal antioxidants found in foxtail millet, and they work chemically by donating hydrogen atoms to electron-deficient free radicals via hydroxyl groups on benzene rings, forming a resonance-stabilized and less reactive phenoxyl radical. Phenolics derived from foxtail millet and other millets have also been found to be effective as reducing agents, singlet oxygen quenchers, and metal chelators [30].

Fat
People rely on fat for energy since it contains twice as many calories as carbohydrates. Millet fat contains around 80 percent unsaturated fatty acids. The fat content of 35 different foxtail millet types cultivated in 5 different locations in China ranged from (3.38 % to 6.49 %). Linoleic acid was discovered to be the most abundant fatty acid, followed by oleic acid, palmitic acid, stearic acid, and linolenic acid. Because there was a correlation between the fat content and the variety cultivated in different places, the study concluded that the fatty acid profile of foxtail millet might be easily modified through breeding programs. Foxtail millet is unusual among cereal grains due to the proper balance of numerous functional components. Many studies have been carried out over the years to identify, measure, analyze, and investigate the main components of foxtail millet [155].

Composite flours
Initially, the term "composite flour technology" referred to a method of combining wheat flour with cereal and bean flour to make bread and biscuits. Millets are more nutrient-dense

than other cereals, but their widespread use in a variety of cuisines has not yet materialized. They developed millet-based (48-hour germinated) composite flours, rich in nutrients, by combining millets with skimmed milk powder and vegetable powder (carrot powder, cowpea powder, pumpkin seed powder) for children aged 6-59 months. They also researched the functional properties of millet-based composite flours for the rural population as well as the macro and micronutrient contents of these flours. Making dishes from blended flours generated from blending millets with wheat, rice, and other grains could be one strategy to increase millet use. Because of their distinct functional qualities, millets affect the functional features of composite flour when mixed in different quantities with other flours. Some physicochemical and functional qualities of composite flour might alter if millets were blended in different quantities [141].

Oats

Oat (Avena sativa L.) is unique among cereal crops in that it contains several nutrients that are valuable for the human diet, animal feed, health care, and cosmetics [27, 144]. It is an annual crop that has been farmed in many regions of the world for over 2000 years [113] and is one of the oldest crops known to human civilization [71]. It appeared in cultivation thousands of years after other grains such as wheat and barley [92]. This grain is high in carbs, dietary soluble fiber, protein, lipids, phenolic compounds, vitamins, and minerals [63]. Oat has gained more attention from scientific academics and enterprises as the general public knowledge of good eating habits have grown. With the popularity of ancient grains and improved nutritional content, food-based enterprises are generating unique food products by using oats as an ancient grain in morning cereals, beverages, bread, and infant foods [24]. Although oats are primarily utilized in morning cereals and snack bars, including them in other goods would considerably benefit consumers due to their health-promoting properties [113, 97]. One of the principal components of soluble fiber is oat beta-glucan (OBG), a viscous polysaccharide composed of a linear branched chain of D-glucose monosaccharides bound by mixed (1 3) and (1 4) links. It is found in the kernel's endosperm cell wall [97]. It is thought to be the most active component in oats, with a variety of functional and nutritional features, including cholesterol reduction [148] and anti-diabetic benefits [5]. Phenolic compounds are composed of aromatic rings that contain one or more hydroxyl groups [31]. Consuming these phenolic compounds is linked to the prevention of diseases like cancer, stroke, and coronary heart disorders [128]. These phenolic compounds function as a defensive mechanism against many microorganisms. To outline the current state of scientific understanding and the possible health benefits of oats and their bioactive components, including cardiovascular illnesses, Type II diabetes, obesity, celiac disease, cancer, antioxidant activity, gut health, and antimicrobial characteristics.

Chemical and nutritional composition of oats

Carbohydrate is the primary component of oats, accounting for 58.7 g per 100 g of grain, with starch making up the majority of this carbohydrate supply. The macronutrient profile of the grain is mostly composed of proteins (14 g per 100 g oats) and relatively high amounts of dietary fiber (9 g/100 g oats). 15-20 per cent of the weight of the oat groat is made up of proteins [101].

Fiber

The dietary fiber component of cereal grains is typically classed as soluble or insoluble, based on their ability to dissolve in water, which has a significant impact on their physiological effects on human nutrition. The non-soluble fraction of cereal grains is predominantly composed of lignin, cellulose, and hemicellulose, whereas the soluble fraction is primarily composed of the nonstarchy polysaccharide fraction, of which glucan is a prominent component and is notably abundant in oats. Non-soluble fiber is often more effective as a bulking agent in human health and hence has a laxative effect, whereas water-soluble fiber may have a favorable impact on human health (further information on oats and β-glucan [70].

Protein

Because of the particular amino acid composition of the oat protein fractions-globulin, albumins, prolamin, and glutelin-oats have naturally high quantities of protein, averaging 11-15 per cent in an oat kernel with a hull [150, 39]. The primary protein storage form in oats, whereas the alcohol-soluble prolamin fraction, is a small component and accounts for 4-15 per cent of total protein content in oats. Both globulin and prolamin are present mostly in the protein bodies of the grain's endosperm and aleurone layers; however, the proportions of these two fractions vary amongst grains. For example, when compared to wheat, which contains more prolamin storage proteins and, to a lesser extent, globulins, oats have a greater globulin:prolamin ratio [123, 39].

The increased lysine content in oats leads to a better balance of essential amino acids and, as a result, a higher amino acid score for oats (protein quality). The amino acid makeup of oats and regularly eaten cereals. While the glutamine level of oat protein fractions is lower than that of other cereals, the combined glutamine-glutamic acid content, which accounts for 25 per cent of total amino acid residues, is greater. Apart from rice, oats have a higher lysine content than other cereals, averaging 4.2 per cent [102].

Vitamins

Vitamins are minor organic compounds that the body cannot synthesize and are thus essential components of the diet. Vitamins are classed as water-soluble (vitamin C water-soluble) or fat-soluble (vitamins A, D, E and K). Oats contain both water-soluble and fat-soluble vitamins.

Generally contains ascorbic acid or vitamin B12 (cobalamin). Other B vitamins, such as thiamin, riboflavin, niacin, B6, and folate, are found in large amounts. These B vitamins are essential for energy and amino acid metabolism, and they supply methyl groups as enzyme cofactors. Calculations were made using the US Department of Agriculture's nutritional database [10] and the US Food and Drug Administration's nutrition labeling requirements labeling calorie diet [9].

Minerals

Minerals are the inorganic component of micronutrients in food and can be classed as major or trace minerals based on the amount necessary for nutrition. Calcium, magnesium, potassium, phosphorus, and salt are examples of major minerals that must be consumed at levels of more than 100 per day. Iron, zinc, manganese, and copper, on the other hand, are required in levels less than 100 mg/day in the diet. Oats and other regularly consumed grains include major and minor minerals, however, the mineral levels in oats are substantially greater than in other grains [10].

Quinoa

Quinoa is a grain with high nutritional content that has been farmed in the Andean area of Bolivia and Peru for the last 5,000-7,000 years. The United Nations recognized 2013 as the International Year was Quinoa in appreciation of its tremendous potential. Quinoa has a high protein content, all necessary amino acids, unsaturated fatty acids, and a low glycemic index (GI); it also includes vitamins, minerals, and other useful substances and is naturally gluten-free. Quinoa is simple to prepare and versatile in its preparation [132, 131, 46, 145].

History of Quinoa

Quinoa has been farmed in the Andean area of Bolivia and Peru for thousands of years [59, 45]. It is recognized by many local names, as well as quinoa or quinua (quinua is a Quechua word) [145]. They referred to this plant as "the mother grain," and it was considered a gift from their gods, even being used to alleviate medical ailments. Quinoa seeds were traditionally roasted and cooked, added to soups, eaten as a cereal, and even fermented into beer or chichi (traditional drink of the Andes) [145, 32, 17]. Following the Spanish invasion of South America, colonists looked down on quinoa as a peasant or Indian cuisine; as a result, quinoa has been regarded a food of low social standing. Furthermore, after finding that quinoa was utilized as a sacred drink (Mudai) during indigenous religious rites, the Catholic Church aggressively opposed its development. As a result, quinoa persisted only where Europeans could not access it and was replaced by other cereals [145]. Quinoa is available in over 250 variants globally. Its categorization is based on plant shape or the color of the plant and color [145 59]. This grain may be planted in Europe, North America, Asia, and Africa. In Europe, the initiative "Quinoa: a Multipurpose Crop" is underway [145].

Nutritional aspect of Quinoa

Globalization and urbanization have altered food patterns and lifestyle practices among many demographic groups throughout the world. Traditional food patterns are high in complex carbs, micronutrients, fiber, and phytochemical fiber being replaced by diets high in animal fats, processed carbohydrates, and oils, which have a direct influence on the incidence of certain chronic diseases [119]. As a result, many academics focus their efforts on evaluating food or dietary components that may be beneficial to human consumption [59]. As an illustration, consider the work of the HEALTH GRAIN Consortium, HEALTH GRAIN is worth for including quinoa on its list of healthy grains [143]. Quinoa is regarded as one of the greatest sources of plant-based protein since it has protein levels that are comparable to those in milk and greater than those found in grains like wheat, rice, and maize. Due to its adaptability in supplying human needs during space missions, quinoa has also been employed by the National Aeronautics and Space Administration (NASA) [56, 145, 32, 12, 68].

Major biological macromolecules such as proteins and amino acids act as building blocks for proteins as well as catalysts for enzymatic processes, energy sources, and protein synthesis in the body [90, 72]. The important amino acid met, which is lacking in many legumes, is also abundant in quinoa [112, 119]. World Health Organization's (WHO) and the Food and Agriculture Organization's (FAO) daily recommendations for amino acids, quinoa provides adults with the following amounts of each amino acid: 180 per cent of histidine, 274 per cent of isoleucine, 338 per cent of lysine, 212 per cent of methionine + cysteine, 320 per cent of phenylalanine + tyrosine 331 per cent of threonine 228 per cent of tryptophan and 323 per cent of valine [119]. Quinoa may be used in nutritious meals and beverages for these reasons, making it a valuable source of nutrition, especially for babies and children [1]. Dietary fiber is an indigestible component of plants that is divided into two types: soluble and insoluble fibre. Soluble fiber is water soluble, quickly converted into gases and physiologically active molecules in the colon, and has prebiotic properties. Insoluble fiber is either metabolically inactive and acts as bulking material, or it is prebiotic and ferments in the large intestine. Bulking fibers absorb water and aid in defecation [46, 41]. More fiber-rich whole grains have been associated to a decreased risk of type 2 diabetes [80] and cardiovascular disease [149]. Quinoa is a fantastic source of fiber. Dietary minerals are necessary chemical elements that regulate electrolyte balance, glucose homeostasis, nerve impulse transmission, and enzyme cofactors in the body [48]. Quinoa contains calcium, magnesium, and potassium in sufficient numbers and accessible forms to support a healthy human diet. Quinoa contains 874 mg/kg of calcium (Ca) [145, 59]. Vitamins are molecules that are necessary for human health. Quinoa is high in vitamins, with 100 g containing: 0.4 mg of thiamine, 78.1mg of folic acid, 1.4 mg of vitamin C, 0.20 mg of vitamin B6, and 0.61 mg of pantothenic acid [145].

100 g of quinoa contains: 1.70 mg glucose, 0.20 mg fructose, 2.90 mg saccharose, and 1.40 mg maltose [145, 79, 135, 41]. Furthermore, research suggests that quinoa polysaccharides have antioxidant capabilities [152].

Gluten

Gluten is one of the most widely used components in food, particularly grains [140]. Gluten is created by combining glutenin and glutenin [154]. A T-cell-mediated immune response that is insufficient in celiac disease, an immunological response triggered by gluten, causes inflammation in the small intestine. Those with celiac disease must consume gluten-free grains or gluten-substituted meals [114, 98, 154, 140]. Many gluten-free meals are higher in salt and fat and poorer in vitamins and minerals (especially saturated fat). As a result, quinoa is a fantastic grain that is gluten-free and packed with vitamins and minerals, making it a potentially crucial component of any healthy, gluten-free diet [32, 11, 98, 99].

Glycemic Index (GI)

The GI assesses carbohydrates on a scale of 0 to 100 based on how they affect blood sugar levels two hours after eating. Foods with a low GI (55) cause insulin and blood sugar levels to rise gradually. Because they aid in hunger control, low GI diets have been demonstrated to improve cholesterol and glucose levels as well as weight management [134, 135]. In addition to lowering insulin resistance, low GI diets also lower the chance of developing diabetes, heart disease, and several types of cancer [118, 80, 13]. According to studies [100], people who consume more dietary fiber had lower fasting insulin levels, and eating complex carbs lengthens life expectancy [72]. Furthermore, a high GI diet raises the levels of inflammatory biomarkers. A lower inflammatory state in celiac disease patients may give certain protective mechanisms; consequently, following a low GI diet may ameliorate this condition [98].

Amaranth

Amaranthus spp.(Amaranthaceae family), also known as amaranth, consists of 60 species that can be separated into grain and vegetable amaranth based on their applications for human consumption [87] Because it does not belong to the grass family and does not contain gluten, the amaranth plant has panicle-like inflorescences and is usually described as a pseudocereal (such as quinoa). This has resulted in amaranth grain being a favorite food among celiac disease sufferers in recent years [136, 2]. Amaranth is a tropical plant that has yet to be fully discovered. Amaranth was a staple food crop in Aztec, Inca, and Mayan cultures. In addition to corn and beans, amaranth was a staple of the daily diet. The primary cultivation region was in Mexico around the year 1400; it is believed that more than 20,000 tones of amaranth were gathered for food purposes per year [139].

Amaranth is one of the rare crops whose leaves are eaten as vegetables and whole grains are eaten as cereals. In Central America, the leaf, known as blebs, is highly valued as greenery and blooms are used to color clothing [43]. However, amaranth grains have been used as human nourishment in a variety of ways. The most typical application is to crush them into flour for use in baking bread, pancakes, cereals, cakes, and other flour-based items. The grains can be popped or flocculated to make porridge, which is a cereal-like dish that is gluten-free and more healthy. Rastogi, as well as S. Amaranth grains and their products, are a rich source of bioactive chemicals with antioxidant qualities [107, 66, 103]. This non-spiniferous lipid portion of grain components, which include squalene, tocopherols, sterols, and others, have antithrombotic, antioxidant, hypocholesterolemic, antidiarrheal, antidepressant, and anticancer properties [47, 110, 25, 34, 74, 73, 69, 57, 93].

Composition of amaranth

The amaranth grain has been examined for its outstanding agricultural properties, such as its short growing period and drought resilience. Despite having various anti-nutrient components (e.g., phytic acid, oxalates, and tannins) that may impair nutrient absorption, notably its protein content, amaranth is well known for its high nutritional quality [50]. The most common cultivars are A. A. cruentus in Guatemala Mexican hypochondriacs, and A. caudatus a species found in Peru and other Andean countries. A cruentus grain, for example, has a higher protein (14.9 %), lipid (6.98 %), and fibre (4.5 %) content than other amaranth grain species and general grains like wheat (12.3 % protein, 8 % fat, and 2.3 % fibre), corn (8.9 % protein, 3.9 % fat and 2.0 % fibre), rice (7.5 % protein, 1.9 % fat and 0.9 % fibre), and oat (16.1 % protein, 6.4 % fat, and 1.9 % fibre) [116]. Amaranth protein fractions contain approximately 65 per cent albumin, 17 per cent globulin, 11 per cent prolamine and 7 per cent glutelin [25, 74, 15]. The extraction process utilized ermines the proportion of distinct fractions in the isolated protein as well as its nutritional and functional qualities [82]. The main storage proteins in amaranth are albumins and globulins [83]. Starch is the main component of the amaranth grain, ranging from (48 % to 69 %) depending on the species [51]. Amaranth grain is also high in insoluble fiber, fiberfill lignin and cellulose. The total fiber of amaranth is higher than that of a common cereal [116]. Amaranth grain is softer and thinner than wheat bran, with 16 and 9% bran and dietary fiber, respectively.

Amaranth as a food

Amaranth grain can be used whole as grain, like whole wheat flour, or blended with other grains. Wheat flour with a high amaranth protein content can be used to boost the nutritional value of finished foods like noodles, biscuits, potatoes, cassava or maize bread and cakes. Amaranth can be used to replace wheat and other grain products at amounts of up to 15 per cent, dramatically affecting the technological functional qualities of the goods. Amaranth grain starch maize could be used as a sauce thickener [109]. Various food processing technologies (for example, germination and lactic acid fermentation) have been presented as techniques to increase nutrient density while decreasing antinutrients [52].

Amaranth flour is typically combined with maize or wheat flour to create a balanced protein supply [3]. It has also been observed that the nutritional value of bread can be increased by using expanded amaranth grains (10-20 %) instead of amaranth flour [23] increasing the iron, phosphorus, calcium, magnesium, and potassium concentrations [96, 124].

Protein

Proteins in amaranth are also known for their antioxidant properties, particularly those containing sulphurfurine and methionine), aromatic (tyrosine and tryptophan) and amino acids lysine, histidine, proline, glycine, alanine and threonine [129]. Proteins carry out this activity by scavenging transition metals and/or free radicals of t Some antioxidant peptides (like fraction 11S) formed during gastrointestinal digestion of amaranth proteins [138, 37]. Amaranth peptides are produced through alcalase hydrolysis or *in vitro* digestion, and their capacity to scavenge reactive species is typically found in the human body. The protein extracted from amaranth was directly digested to produce the most potent hydrolysate, as pre-hydrolysis with alcalase was ineffective in alcalde antioxidant activity. The significance of investigating the amino acids and polyphenols derived from amaranth, as well as their stability and effectiveness in maintaining human health, is thoroughly justified [38].

Amaranth as an additive and emulsifier

Amaranth foams and emulsions prepared with protein hydrolysates have the potential for use as nutraceutical food in the prevention of chronic degenerative diseases. Furthermore, the antioxidant peptides may also be useful to prevent the generation of ROS, extending the shelf life of food products. The amaranth surfactant's properties were improved by partial hydrolysis and also demonstrated angiotensin-converting enzyme activity. In another study, the substitution of 15% of bovine protein into an emulsion-type meat product with amaranth protein concentrate, isolated from five plant genotypes, greatly affected the properties of the cooked meat emulsion and gel [129]. It has also been reported that amaranth starch has potential utility as a food thickening and a fat substitute. However, certain favorable benefits were only seen in the K112 genotype [73]. Squalene was extracted and stabilized from amaranth grains stabilized it displayed good stability for usage as a bioactive ingredient in food or as an emulsifier [137]. (0.1 to 0.3 %) of red amaranth, pigments were used during the production of pork sausage to replace NO2. The addition of the pigment greatly improved the color, and taste while significantly lowering the levels of thiobarbituric acid (TBA) and volatile basic nitrogen. It was determined that amaranth's pigments may be a suitable substitute for NO2 based mostly on the results of the general acceptability throughout 29 days of storage [156].

Conclusion

With the growing challenge of producing health-promoting food products, the food industries are focusing on less exploited ingredients. In this review the versatility and importance of Multigrain as a food source, which has pertinent levels of all the nutritional components required. And also due to its ability to produce food products with significant health-benefiting properties. Cereal grains contain a wide spectrum of nutrients that have potential benefits for human health. Compared to the major food grains cereals have a comparable nutrition profile except for a higher amount of protein, some micronutrients, and, most notably, its water-soluble fiber content in the form of β-glucan.

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