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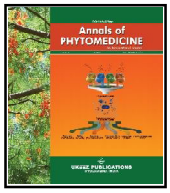

Review Article : Open Access

A study on the functional properties of multigrain for development of functional ice cream cone

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Abstract

We wanted to standardize a novel, preservative-free, uncomplicated, and nutritionally sound product that is also reasonably priced, so we ran a survey to see how well-liked blended healthy gluten-free high protein flour. A staple and significant component of human nutrition are grains. And over two grains are combined to create multigrain goods. They supply greater nutrition. They provide more than what is commonly provided by a single grain and make up for other grains' nutrient shortfalls.Whole wheat flour, millet, oats, quinoa, and amaranth were all examined in the study. Bake an ice cream cone without the use of whole wheat flour.To produce multigrain food products, different types of grains are blended together because processing grains could cause them to lose their nutritional value. Examples of bioactive substances include fatty acids, vitamins, minerals, prebiotics, probiotics, dietary fiber, carotenoids, enzymes, antioxidants, and phytochemicals. These bioactive components support the health of your body and guard against several chronic illnesses. In this review, we discuss the nutritional value of multigrain goods, how multigrain flour was created, how processing affects grains and the advantages of grains for human health. The study investigated the feasibility of making ice cream cones out of multigrain flour.

1. 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 (Huang, 1981). The focus is on cone batter formulation issues as well as general core strength and quality (Huang *et al*., 1988). 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 (Huang *et al*., 1989). 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 well-being, and supports the prevention of diseases linked to poor nutrition (Bhat *et al*., 2016; Bartlomiej *et al*., 2012). A multigrain product contains at least two grains. Because each grain has different nutritional qualities, combining them provides more nutrients than consuming them separately. Multigrain products improve texture and sensory qualities in addition to providing various phytochemicals (Cooper, 2015). In the previous, grains were recognized as a staple food and one of the most fundamental elements of the human diet. 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 (Fernandesa *et al*., 2021). The bran and germ of whole grains contain significant amounts of nutrients. The removal of the germ during grain milling results in nutritional loss. Numerous scientific research has demonstrated that including whole grains in your diet minimizes your chances of developing some types of cancer and coronary heart disease. Dietary fiber is crucial for slowing down the rate of glucose breakdown, reducing body absorption, and promoting balanced glucose release from carbs (Pande *et al*., 2017). 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 (Gorinstein *et al*., 2007; Mulloy *et al*., 2010). 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 (Hoover *et al*., 2010). Some ancient grains,

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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 (Hoover *et al*., 2010; Kouakou *et al*., 2008).

Table 1: Classification of grains

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: Saturni *et al*. (2010).

Table 2: Nutritional composition of multigrain (mg/100 g)

Composition	Protein	Fat	TDF	SDF	Carbohydrate	Energy(KJ)
Wheat	3.18	0.44	3.37	0.48	19.42	96.6
Foxtail	2.60	1.08	2.13	-	15.43	86.0
Bajra	1.96	0.54	1.49	0.23	6.18	36.9
Oats	0.59	0.47	0.50	0.19	3.43	20.4
Maize	0.44	0.19	0.61	0.05	3.24	16.7
Ragi	0.36	0.10	0.56	0.08	3.34	16.0
Jowar	0.50	0.09	0.51	0.09	3.38	16.7
Micronutrients	**Ca**	**Zn**	**Se**	**Fe**	**Mg**	**Vitamin B_6**
Wheat	11.81	0.85	14.33	1.97	37.50	78.00
Foxtail	8.00	1.28	2.67	0.70	20.20	96.00
Bajra	2.74	0.27	3.04	0.64	12.40	27.00
Oats	5.40	1.38	0.90	0.47	17.70	11.90
Maize	0.45	0.11	0.43	0.12	7.30	2.50
Ragi	18.20	0.10	1.31	0.14	6.70	14.00
Jowar	1.38	0.10	1.31	0.14	6.70	14.00

Source: Longvah *et al*., 2017; Shaheen *et al*., 2013; USDA, 1999.

2. Ice cream cone

An ice cream cone is a crumbly pastry in the shape of a cone created of a wafer with a texture akin to a waffle, much like the Hong Kong-style bubble cone. It is also referred to as a poke (Ireland/Scotland) or a cornet (England). Cones come in a wide range of sizes and shapes, featuring cones coated in chocolate or pretzels (coated on the inside). A scoop of ice cream placed on top of a cone is termed as an ice cream cone generally. Cones can be prepared in one of two ways: either baking the ingredients inside a cone-shaped mold or baking the ingredients flat before rolling them into form (before they firm) (IDFA, 2015). J. T. "Stubby" Parker, a citizen of Fort Worth, Texas, created an ice cream cone in 1928 that could be stored in a store's freezer had the cone and also the ice cream frozen like a single piece (Funderburg, 1995).

3. Millets

Small-seeded grasses known as millets are frequently referred to as nutricereals. Sorghum, pearl millet, small millet, foxtail millet, proso millet, barnyard millet, and kodo millet were also mentioned in addition to other millets. Millets provide a calming alkaline impact on the digestive tract, preserving the body's optimal pH balance, which is necessary for immunity (Singh and Sarita, 2016). Millets are categorized as non-allergenic because they are gluten-free (Chandel *et al*., 2014) 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, antioxidants, phytoconstituents, flavonoids, *etc*. (Singh and Raghuvanshi, 2012). According to the germination phase's consumption of carbohydrates for respiration, millet's protein content considerably expanded (Klimczak *et al*., 2002). During germination, an elevation in enzymatic activity leading to an increase in the total

protein content of finger millet. Furthermore, this study found that the time intervals for germination played a significant effect in influencing many alterations (Budhwar *et al*., 2020). According to studies, microbial enzyme activity encouraged protein breakdown throughout germination, which resulted in a significant rise in the overall protein composition of millets (Guzman *et al*., 2019). 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 cause the protein content to diminish (Guzman *et al*., 2019). Millets were enriched in micronutrients like iron, zinc, and salt as well as minerals like potassium, phosphorus, and calcium. However, the simple presence of certain elements in the diet is insufficient; the bioavailability of these minerals to the human body is essential (Dayakar *et al*., 2017). Millets reduced mineral bioavailability was influenced by phytic acid and anti-nutrients (Sharma *et al*., 2015).

3.1 Practical application of millets

Millets are an essential food crop with major economic benefits for developing nations. Millets are advantageous since they are grains that are vulnerable to pesticides and drought**.** Millets are recognized as healthy foods that create a lot of energy and aid in alleviating malnutrition. Foods made from millet are regarded to be possible prebiotics and probiotics with potential health advantages.These millet species' grains are frequently eaten as a source of folk remedies and crucial foods to maintain health (Nithiyanantham *et al*., 2019).

3.2 Traditional uses of millets

For moderate families, millet grains are an essential source of nutrition and income as food. Indigenous knowledge is crucial to the diagnosis of diseases and the delivery of healthcare in traditional systems. A rich diet in gluten can promote immune-mediated enteropathy recognized as celiac disease (Becker *et al*., 2014). Millets are a gluten-free food that can be used as a substitution by people with celiac disease and gluten intolerance (Annor *et al*., 2015; Saleh *et al*., 2013). Millets nutritional value is improved by food processing methods such as soaking, sprouting, fermentation, and puffing, which also improves digestibility and decreased the number of phytonutrients in their grains (Handa *et al*., 2017; Jaybhaye and Srivastav, 2015). The presence of antinutrient in finger millet was reported to lower glycemic effect, reduced starch digestibility, and absorption (Laxmi and Sumathi, 2002). For the therapy of celiac disease, constipation, and numerous non-communicable diseases, pearl millet was historically ingested (Jnawali *et al*., 2016).

3.3 Finger millet

Millets (*Eleusine coracana* L.) 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 (Singh and Sarita, 2016). Millets are categorized as non-allergenic because they are gluten-free. 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 (Singh and Raghuvanshi, 2012). For people having celiac disease, who are usually impacted by the protein concentration of wheat and some other common cereal grains, millet is a great alternative since it is gluten-free. Additionally, those who have atherosclerotic and diabetic cardiovascular disease can recover from it (Singh and Raghuvanshi, 2012).

Table 3: Mineral composition of finger millet (*Eleusine coracana* L.) flour (mg/100 g)

Mineral	Composition
Ca	70.89
Na	19.95
Mg	16.42
K	9.95
Mn	9.95
Cu	4.73
Cr	9.83
Fe	0.74
Zn	0.45
P	60.80
Na/K	1.60
Ca/P	1.17
Ca/Mg	4.31

Source: Audu *et al*. (2018).

3.4 Foxtail millet

Besides pearl millet, foxtail and finger millets are the second and third most prominent millets crops. Foxtail millet is a prevalent grain or animal feed not only in Asia, Europe, North America, Australia, and North Africa, but also in China, India, Korea, and Japan (Austin, 2006). The sixth-highest yielding grain, foxtail millet (*Setaria italica* L.), has been identified as a notable millet in respect of output globally (Saleh, 2013). Foxtail and finger millets offer rich suppliers of micro and macronutrients and have great antioxidant and nutraceutical properties.These crops include large proportions of iron, crude fiber, protein, fat, and other vitamins and minerals.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 (Saleh, 2013). Foxtail millet is high in nutritional components, including carbohydrates, protein, vitamins, and minerals. Like most millets, foxtail millet is high in unrefined fiber, which facilitates bowel movement and has a laxative action that is beneficial to a healthy gastrointestinal system (Bernard, 1996).

Table 4: Nutritional value of raw foxtail millet per 100 g

Composition	Value
Moisture	11.2
Protein	12.5
Fat	4.3
Ash	3.3
Carbohydrate	60.9
Iron	2.8
Calcium	31
Phosphorus	290
Vitamin C	0

Source: Laxmi *et al*. (2015).

4. Oats

Among cereal crops, oat (*Avena sativa* L.) seems exceptional in that it contains a number of elements that are important for human diet, livestock feed, wellness care, and cosmetics (Butt *et al*., 2008;Varma *et al*., 2016). It is an annually crop which has been raised for more than 2000 years in several parts of the world (Sang and Chu, 2017) and is considered the ancient types of plants cultivated in human civilization (Lasztity, 1998). Thousands of years later, other grains like wheat and barley first begun cultivated (Murphy and Hoffman, 1992). This grain is dense in dietary soluble fiber, phenolic compounds, vitamins, minerals, protein, lipids, and carbohydrates (Joyce *et al*., 2019). The use of oats as an early grain in breakfast cereals, beverages, bread, even newborn feeds is creating novel food products thanks to the appeal of ancient grains and their higher nutritive value (Boukid, 2017). Oats are mostly used in breakfast cereals including snack bars, however, their health-promoting qualities make them an excellent addition to other products, which would substantially benefit consumers (Sang and Chu, 2017; Sang *et al*., 2017). The viscous polysaccharide known as oat beta-glucan (OBG), which is made up of a linear branched chain of D-glucose monosaccharaides joined by mixed (1 3) and (1 4) linkages, is one of the main components of soluble fiber (Sang and Chu, 2017). It is positioned in the endosperm cell wall within the kernel (Sang *et al*., 2017). With a range of functional and nutritional benefits, including as lowering cholesterol, it is considered to be the major active component in oats (Whitehead *et al*., 2014) and antidiabetic benefits (Andrade *et al*., 2015). The aromatic rings of phenolic compounds comprise one or more hydroxyl groups (Chen, 2004). These phenolic substances can potentially prevent ailments like cancer, strokes, and coronary heart disease (Skoglund, 2008).

4.1 Value-addedoat-based products

Due to greater awareness of the numerous nutritional advantages of oats, the demand for products containing oats has surged recently. As a result, it is encouraged to be used in functional food products made from oats, including porridge, oatmeal, muesli, granola bars, oat flour, oat bread, biscuits, and cookies, as well as oat milk, oat-based probiotic drink, breakfast cereals, flakes, and baby food. Oat proteins have been employed in food products, like heat-resistant chocolates, because of their fluid and emulsifying qualities (Zwer, 2004).

Table 5: Utilization of oats for industrial purposes

Uses (Food)	Component of oat	References
Bread	Oat flour	Zhang *et al*. (1998)
Beverage	Whole oat	Gupta *et al*. (2010)
Biscuits and cookies	Oat flour	Ballabio *et al*. (2011)
Breakfast cereal	Whole oat	Rayan *et al*. (2011)
Pasta products	Oat starch	Chillo *et al*. (2009)

Table 6: Constituents and their energy values for oats per 100 g

Constituents	Energy value
Water, g	8.3
Carbohydrate, g	58.7
Protein, g	14.0
Fat, g	8.0
Dietary fiber, g	9.0
Ash, g	1.8
Energy, KJ	1.473
Energy, Kcal	363

Source: US DA, (2008).

4.2 Future aspects of oats

Numerous potentials in nutritious food items are presented by oat compounds. The bioavailability of antioxidant other food sources, along with their different effects on human and animal health, are urgently needed to be explored. Antioxidants and beta-glucan are just two of the unique ingredients found in oats. Oats need greater scientific study since they are a convenient food that all humans, regardless of age, eat in order to support and change their nutraceutical status including both geriatric and pediatrics diseases. investigation and research are required to identify novel beneficial ingredients in oats and extract these elements in portions that can be included in food items (Rasane *et al*., 2015).

5. Quinoa

For the past 5,000-7,000 years, Bolivia and Peru's Andean territory has been habitat to the farming of quinoa, a grain with a remarkable nutritional content.The United Nations recognized 2013 as the International Year was Quinoa in appreciation of its tremendous potential (Tang, 2015;Tsao, 2015;Gonzalez, 2014;Vega, 2010). Unsaturated fatty acids, a rich protein content, a low glycemic index, and all the essential amino acids may be detected in quinoa; it also includes vitamins, minerals, and other useful substances and is naturally gluten-free. Quinoa is simple to prepare and versatile in its preparation (Tang, 2015; Tsao, 2015; Gonzalez, 2014; Vega, 2010).

5.1 Historyof quinoa

Quinoa has been farmed in the Andean area of Bolivia and Peru for thousands of years (Jancurova, 2009; Vega, 2010). It is recognized by many local names, as well as quinoa or quinua (quinua is a quechua word) (Vega, 2010). 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 cereal, and even fermented into beer or chichi (the traditional drink of the Andes) (Vega, 2010; Cooper, 2015; Bazile, 2014). Quinoa is available in over 250 variants globally. Its categorization is based on plant shape or the color of the plant and color (Vega, 2010; Jancurova, 2009). This grain may be planted in Europe, North America, Asia, and Africa. In Europe, the initiative "quinoa: A Multipurpose Crop" is underway (Vega, 2010).

5.2 Phenolic compounds

A significant group of phytochemicals in cereals is known as phenolic compounds, which are typically found in the grain's outer layer, and each includes at least one phenol ring (Gross, 1980). Based on the number of phenol rings, phenols are classified into simple phenols and polyphenols. Simple phenols include phenolic acids having one or more hydroxyl on an aromatic ring. Flavonoids, lignans, phenolic acid dehydrodimers, and tannins having three or more phenol rings are characteristics of polyphenols (Khan and Shewry, 2009).

5.3 Phenolic acid

A class of phenolic compounds containing a single phenol ring is considered phenolic acids. The majority of phenolic acids are bound to the cellulose, protein, lignin, flavonoids, and sugars that make it up a cell by ester, ether, and acetyl connections (Dervilly-Pinel *et al*., 2001; Yuan *et al*., 2005). A class of phenolic compounds called phenolic acids only has one phenol ring. Most phenolic acids are connected to cellulose, protein, lignin, flavonoids, and sugars that form up the structural parts of cells through ester, ether, and acetyl bonds (Ikegawa *et al*., 1996; Kroon and Williamson, 1999).

5.4 Carotenoids

Antioxidants such as carotenoids provide vitamin A function, colorants, and other vital plant components (Dini *et al*., 2010). They have the ability to snuff out singlet oxygen, a significant superoxide in light-induced oxygen. Additionally, carotenoids have been linked to improved eye health and prevention of age-related macular degeneration (AMD) (Alves-Rodrigues and Shao, 2004).They can guard against ischemic stroke, lower the incidence of coronary heart disease, and shield skin from UV-related deterioration (Alves-Rodrigues and Shao, 2004).

Table 7: Chemical composition and vitamin content of quinoa per 100 g

Constituents	Value
Protein	16.5
Fat	6.3
Fiber	3.8
Ash	3.8
Carbohydrates	69
Energy Kcal/100 g	399
Vitamins	
Thiamin (B_1)	0.29-0.38
Riboflavin (B_2)	0.30-0.39
Niacin (B_3)	1.06-1.52
Pyridoxine (B_6)	0.487
Folate (B_9)	0.781
Ascorbic acid (C)	4.0
α-Tocopherol (E)	5.37
β-Carotene	0.39

Source: Koziol (1992); USDA (2011, 2005).

6. Amaranth

According to their uses for human consumption, the 60 species of Amaranthus spp. (Amaranthaceae family), popularly known as amaranth, can be classified into grain and vegetable amaranth (Mlakar *et al*., 2010). The amaranth plant bears panicle-like inflorescences and is typically referred to as a pseudo cereal since it does not related to the grass family, it does not contain gluten.This has resulted in amaranth grain being a favorite food among celiac disease sufferers in recent years (Thompson, 2001; Aguilar, 2015). A tropical plant titled amaranth has not yet been fully understood. Aztec, Inca, and Mayan societies all relied on amaranth as a key food source. A staple of the daily meal was amaranth in combination to corn and beans. Around 1400, Mexico was the major area for production, and it is estimated that more than 20,000 tons of amaranth were harvested there year for food (Tosi *et al*., 2001). Amaranth is one amongst the few crops whose complete grains may be consumed as cereals and whose leaves can be served as vegetables. The leaf, or "bleb," is highly prized as greens in Central America, and blossoms are used to color garments (Ferreira, 2007). However, there are numerous ways that amaranth grains have been employed for human food. Crushing them into flour for application in preparing bread, pancakes, cereal, cakes, many other flour-based goods is the most common use.The grains are been popped or flocculated to create porridge, a food that resembles cereal but is healthier and gluten-free. Antioxidant-rich bioactive elements are abundant in amaranth grains and associated products (Rastogi and Shukla, 2013; Klimczak, 2002; Piecyk *et al*., 2009).

Table 8: Nutritional value of amaranth per 100 g

Constituents (seed)	Value (%)
Protein	14.9
Fat	9.1
Carbohydrate	70.3
Crude fiber	2.8
Dietary fiber	12.0
Minerals (flour)	**Value (100 g)**
Fe	27.50
Ca	687
K	2163
Na	5040
Zn	3421
Mg	705.75
Mn	2.8
Cu	1.300
Se	5016

Source: Koziol (1992); Bressani (1994); Bonafaccia *et al*. (2003b).

6.1 Amaranth as a food

There are several food processing technologies that can boost nutritional density while lowering antinutrients, including as sprouting and lactic acid fermentation (Hotz and Gibson, 2007). The usual combination of amaranth flour and maize or wheat flour results in a balanced protein supply (Alvarez *et al*., 2010).

6.2 Amaranth as an additive and emulsifier

The use of amaranth foams and emulsions made with protein hydrolysates as nutraceutical foods in the control of severe degenerative diseases is conceivable.Additionally, the antioxidant peptides might be helpful to stop the accumulation of ROS, hence enhancing the shelf life of food items (Soriano and Escalona, 2015). Amaranth grains were used to isolate and preserve squalene, which proved good stability for use as a bioactive agent or an emulsifier in food (Tikekar *et al*., 2008).

7. Conclusion

The food sectors are concentrating on less-exploited ingredients due to the increasing difficulty in generating food products that support health. The pace of life in the modern period makes it tough for people to eat often sufficient to preserve their physical and mental well-being. Therefore, if you use these multigrain items in your daily life, you may completely satisfy all of the body's nutritional needs. Furthermore, due to its capacity to create food items with notable health benefits. A wide range of nutrients found in cereal grains may be valuable to human health. In this review, explored cereals have a similar nutritional profile to the major dietary grains, with the exception of having a larger protein content, a few more minerals, and, most significantly, a higher quantity of water-soluble fiber in the form of glucan.The adaptability and significance of multigrain for a dietary source, which has adequate quantities of all essential nutritional elements.

Conflict of interest

The authors declare no conflicts of interest relevant to this article.

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