

REVIEW ARTICLE

Cereal Based Beverages for Nutrition Security: An Integrative Review

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Abstract: Whole grains are processed in different ways to make diverse products that are considered as nutritious and healthier. Nutrition security ensures consistent access, availability, and affordability of foods and beverages that promote well-being of people. Cereals plays crucial role to secure global nutrition security. Cereal grains such as rice, wheat, maize, sorghum and buckwheat are rich in bioactive phytochemicals, in addition to being major staple crops and primary sources of energy and nourishment to human body. Bioactive phytochemicals such as phenols, flavonoids, carotenoids and tannins with potent antioxidant capacities, dietary fibres, resistant starch, and phytic acid, which highlight potential application in processing grains into functional beverages having health promoting functional properties. Despite the fact that a range of cereal grain-based beverages are manufactured across the world, they have received very lesser scientific recognition and technical attention. Grain-based functional beverages have been divided into several categories such as non fermented grain-based and grain-based milk substitutes, fermented non-alcoholic grain beverages. The aim of this review was to discuss the processing techniques, health benefits, problems and future prospects of cereal grain-based beverages which might be a potential new category of functional beverages demanding by food industry.

Keywords: Cereals, bio-actives, multigrain beverages, functional foods, health benefits, Nutrition Security

Introduction

Consumers have become more health-conscious and curious about consuming more nutritious and functional foods. Foods with health advantages referred to as functional foods have grown in popularity as a result of those who desire to use food as a natural medicine (Cencic & Chingwaru, 2010). Frequent consumption of wholesome grains improves healthy lifestyles because of the increased nutrient profile and high bioactive components present in whole grains (Kowalska et al., 2021). People, who live in the twenty-first century, are too busy and they have less time to cook grains since it is time-consuming. Cooked whole grains, on the opposite hand, are avoided because of their coarse texture and mild flavour. In addition, cooked grains are difficult to preserve for a long time as they are more susceptible to microbial spoilage.

The Nutrition and food security was recognized in the United Nations 2030 Agenda for Sustainable Development's 17 Sustainable Development Goals (SDGs), particularly the second Goal, which aims to "end hunger, achieve food security and enhanced nutrition, and promote sustainable agriculture". Functional foods can provide the best solution in achieving this goal as a functional food is a modern concept in which its' ingredients offer health benefits that extend beyond nutritional value. Mainly functional food products have been released into the market, and are designed and developed to lower Non Communicable Diseases (NCDs) including cholesterol, high blood pressure, and diabetes (Sanders, 1998).

The potential for cereal-based beverages as a functional food is enormous. These beverages can act as carriers for a variety of functional components, including vitamins, antioxidants, dietary fibre, and minerals. Anyhow, it is important to study further to

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understand the function of some functional components like antioxidants in cereal-based beverages completely. Dietary fibres provide well-known health benefits in foods, but still, when consider technologically they can result in higher viscosities in developed beverages must also be taken into consideration (Nirmala Prasadi & Joye, 2020). Although it is possible, adding fibres from outside sources is frequently extremely expensive.

By incorporating cow's milk with grains has considerable potential for processing into nutritious and functional beverages since it can also act as a potential carrier for bioactive ingredients. Further, it's possible to enhance the flavour of grains by combining them with cow's milk and thereby both components will contribute to a healthier food while enhancing the functional aspects of the food. Processing of multiple grains and milk into a multigrain beverage is an innovative concept for excellent functional food.

Grains are the food staples of almost every country and essential sources of calories for majority of the people, especially the poor. The nutrition security of the global food supply depends largely on grains and grain-based products. As an example, in African countries, fermented and unfermented cereal porridge varieties, which are similar in texture to beverages, are consumed daily and act as an essential component of the diet (Raheem et al., 2021). This review discusses the science behind the development of traditional and novel developments of cereal beverages as they are the most feasible method of consuming grains.

Functional foods and present status

Non-Communicable Diseases (NCDs) including disorders, hypertension, cancer, type 2 diabetes, periodontitis, and obesity have become more prevalent as a result of modern lifestyles and changing dietary patterns. Most of the disorders could be prevented and treated with the help of nutritious diets. Modern society consumers' view on food is as a means of disease prevention and control other than a medium for satiety (Siró et al., 2008). This transition in mindset has allowed a good range of processed food products such foods as functional foods. According to Corbo et al., 2014 "foods and food components that provide a health benefit beyond basic nutrition" is accepted as the definition of functional foods by most food scientists. Cereals can act an important role in the development of functional food because of the bioactive present. Bio actives such as dietary fibre, carotenoids, vitamins, minerals, prebiotics, probiotics, phytochemicals, enzymes, fatty acids, and

antioxidants which contain biologically active phytochemicals found in different types of plant sources do have a task in physiological function other than supplying nourishment. The various functional elements that could be present after incorporating grains into a beverage are shown in Figure 1.

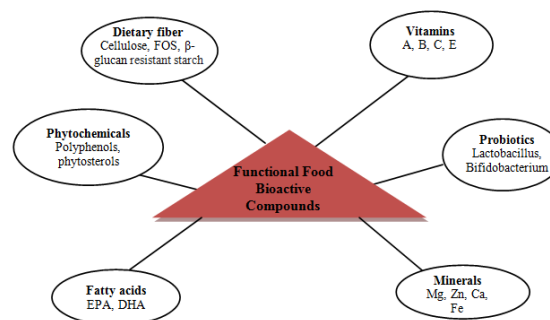


Figure. 1 Illustration of functional components present in a beverage according to Fernandes et al., 2019

The global functional food market size was recorded as USD 129.39 billion in 2015 (Karelakis et al., 2019). According to Functional Foods Market Analysis- 2021 the expected growth of the functional food market between 2014 - 2024 is given in Figure 2.

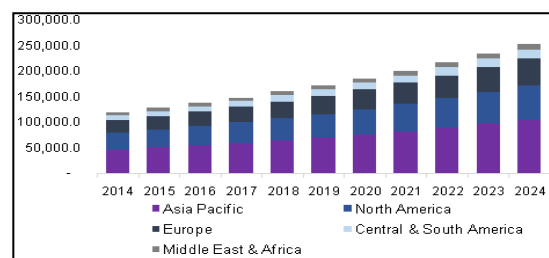


Figure. 2 Global functional food market shares

Figure 2 demonstrates that the worldwide demand for functional foods is increasing exponentially, necessitating the food industry's response. The food industry is dominated by products that contain dietary fibre, vitamins, and minerals as major bioactives. The beverages have the highest convenience when comes to ready-to-eat food. And they are considerably easier to process-heat treat, package, and serve than solid foods. The liquid medium is very suitable for transport of nutrients and bioactives because of the fact that it facilitates their easy absorption (Wootton - Beard and Ryan, 2011).

Functional beverages can be categorized as dairy-based, legume-based, cereal-based, fruit and vegetable-based depending on the raw ingredients utilized.

The dairy industry produces the foremost functional foods, followed by the bakery and cereal industries. The food and beverage industry in India was definitely growing at 14-15 percent (More, 2016). And drink and juices are the fast expansion two sub-categories that, has been a recent trend within the global beverage sector. All of those figures demonstrate the importance and extent of functional foods and drinks.

The various multi-grains products that were developed with healthy approaches are noodles (Kudake et al., 2017, 2018; Muley et al., 2015) and bread (Malik et al., 2016), nutria-bars (Kowalska et al., 2021) and porridge mix (Hussain, 2018). Recently, Panghal et al. 2018 emphasized the utilization of fruits, vegetables, and legumes in the formulation of a non-dairy probiotic drink which is packed with functional and nutritious components. Arya et al. 2013 introduced novel uses of multigrain in preparation of healthy food products.

Cereals have been investigated recently in regards to their possible use in developing functional foods. More than 73% of the world's harvested land is used to grow cereals, which provide for more than 60% of global food production. Because of their physical properties, such as low molecular weight, some grains have a significant potential for development into beverages (Charalampopoulos et al., 2002). This avoids sedimentation and results viscous solution. Most of the research has used rice (*Oryza sativa* L.) as a main ingredient because of availability and nutrition. And at the same time rice plays the role as the staple dietary source of carbohydrates of nearly one- half of the world population. Cardinali et al., 2021 has developed beverage from rice flour and fermented barley which has high nutritional profile. Charalampopoulos et al., 2002 developed a beverage from Cereal grains, mainly maize, sorghum, or millet grains. And grains were soaked in clean water to soften, then makes them easier to crush or wet-mill into slurry to prepare a beverage.

History of cereal-based beverages

Water and breast milk are the initial liquid forms ingested by the first people in the world. When considered the original drinks, milk is the first non-alcoholic drink and it was start consuming as a result

of breeding for domesticating animals in a primitive age. Around 11,000 years other beverage varieties, like tea, coffee, and more recently, soft and fruit drinks were consumed. The poor water quality can be the main reason to start consuming fresh drinks in early days. Fermentation was therefore utilized for the development of range of drinks. Beer was made possible by the domestication of crops and introduced and consumed between 4000 and 3500 BCE, in keeping with archaeological evidence (Poelmans and Swinnen 2011). According to Wolf et al., 2008 distilled alcoholic drinks were created at the similar years and credit has been given to the Sumerians and Egyptians for being the primary brewers. Further China is reported for having early alcoholic drink around 7000 B.C.

Introduction of grains into the human diet is seen as a major milestone forward in human evolution, as converting grains into staples necessitated extraordinary technical and culinary abilities. Sunsik and Kunu are two classic non-fermented drinks. Sunsik is a grain-based ready-to-drink beverage that has been popular in Korea. According to Lee et al., 2007 roasted rice, barley, adlay, oat, and black beans are the most prevalent Sunsik ingredients. Kunu is a non-alcoholic grain beverage made primarily of millet and sorghum. It's the most popular beverage in northern Nigeria, but it's also consumed in other regions of the nation (Gaffa, 2002). According to Altay et al., 2013 African and south American continents have introduced the majority of grain-based non-alcoholic drinks. Some of the traditional fermented non-alcoholic African traditional beverages include Borde prepared from maize, ragee, wheat, sorghum and barley, Obiolor prepared from sorghum and millet, Amahewu prepared from maize, Gowé prepared from millets and Kunan-Zaki prepared from sorghum (Gaffa et al., 2002). Fermented non-alcoholic beverages created in South America are Pozol, Fuba, Agua-agria, Napúand Champuz. According to Elaine Marshall, 2012 they were predominantly developed from maize. Kali and Ambil are fermented traditional beverages from India which were prepared from boiled rice and finger millet respectively. Ambil was prepared using sour buttermilk which was resulted by finger millet extract fermentation (Kumari et al., 2016).

Kefir is a fermented 'kefir grain' milk which was used as a traditional beverage. And these fermented grains are consisting of yeast, lactobacilli and lactococci in a protein and polysaccharide matrix. Grains were originated many centuries ago within the Caucasian mountains. According to Perry, 1990 within the last 200 years, beverage mixes made from malted grains

were consumed with dairy milk to improve its taste and wholesomeness came into being much popular.

Cereals and their role in human nutrition

Since grains are major carbohydrate source available throughout the year, that could provide plentiful supply of low-cost calories all around the world. The evidences prove that Cereals have a long history of use all over the world, Asia, Africa, South America, and in some areas of Central America.

According to Encyclopaedia of Grain Science, 2004 the seven major grains grown in the world are wheat, barley, maize, sorghum, rye, oats and rice. Besides these, pseudo cereals such as buckwheat, quinoa, and amaranth also contribute significantly to the healthy diet. According to Saturni et al. 2010 red rice and sorghum possess unique nutritional characteristics such as good sources of carbohydrates, dietary fibre, phenolic compounds and also minerals. And they can be considered as gluten-free. McKeivith, 2004 proves these grains are good source of micronutrients and phytochemicals as well as antioxidants. Due to the presence of water-soluble fiber, grains have the capacity to impart prebiotic effects (Brennan and Cleary, 2005).

Health benefits of bioactives present in cereals

Phenolic compounds

The chemical structure of Phenolic compounds has one or more hydroxyl groups linked to the benzene ring. Phenolic compounds are bitter-tasting components that alter the color, appearance, taste, and oxidative stability of all plant-based meals. They are mostly found within the pericarp of whole grains and could be concentrated by removing the bran. There are major three phenolic compounds- Flavonoids, tannins, and phenolic acids present in grains which are related to their anti-oxidative properties and invariably health benefits. Antioxidant characteristics contain in grain are beneficial to health since they will scavenge free radicals within the body (Dykes and Rooney, 2007). Because of their antiapoptosis, antiaging, anti-carcinogenic, and antiinflamming effect, phenolic compounds are getting more prominent (Hodzic et al., 2009). According to Kamiloglu et al., 2014 there is no strong evidence to prove that processed grains have higher phenolic and antioxidant characteristics than their unprocessed counterparts unless supporting multiple findings.

Sterols

According to Valsta et al., 2004 cereals can contribute up to 40% of the daily intake of plant sterols. Plant sterols such as stigma sterol, sitosterol, stanols, avenasterol, brassicasterols, and campesterol have the ability cholesterol absorption reduction (Moreau et al., 2002).

Vitamins and Minerals

According to Hübner and Arendt, 2013 Vitamins B & E and minerals such as Ca, Zn, Mg, and Fe are commonly found in cereals. The use of vitamins and minerals is important for the proper functioning of metabolic processes within the physical body. They are playing the role of cofactors for varied enzymes, and they also maintain osmotic pressure within the body.

Dietary fiber

Dietary fiber is also an important nutrient of our diet which is available in cereal foods. Dietary fiber can positively affect gastrointestinal health. They cannot be digested by human enzymes but those can be fermented inside the gut. Supporting their water solubility, dietary fibers could be categorized as insoluble fiber and soluble fiber. Insoluble fiber swells in water and might absorb up to twenty times its weight, whereas soluble fiber form get structure by bonding with water. Cereals are typically water-insoluble, but fruits and vegetables have higher soluble fractions (Thebaudina et al., 1997). Cellulose, hemicelluloses, and lignins are insoluble fiber varieties and food gums, pectin and mucilages are examples for soluble fibers. Oligosaccharides including Fructo-oligosaccharides, galacto-oligosaccharides, and inulin, as well as resistant starch, have recently been included in the list of fibers. According to Ji et al., 2016 dietary fibers in rice is higher than in consumed rice specifically because the outer kernel layers are removed by abrasive milling. According to Thebaudina et al., 1997 insoluble fiber increases the intestinal transit time, hence prevents constipation. Soluble fibers influence metabolism by binding to cholesterol and decreasing its absorption. Soluble fibers also inhibit the release of glucose into the blood circulation by producing a viscous film on the gut walls. By reducing the glycemic response, it improves insulin sensitivity. And according to Anderson et al., 2009 soluble fibers can increase the stomach emptying time and offers a chronic sense of fullness because of its viscosity.

Resistant starch

The starch that could escape from digestion within the small intestine and can be digested within the intestine is defined as resistant starch (Sajilata et al., 2006). Most researches prove with evidences on physiological effects that are in some ways almost similar to both insoluble and soluble fiber (Wiesenberger, 2012).

Oligosaccharides

Oligosaccharides could be a great source of prebiotics. They encourage the expansion of fine bacteria like bifidobacteria and lactobacilli, which are probiotics. These prebiotics could improve the gut health by reducing its pH and it results reduction of potentially hazardous bacteria, generation of vitamins, detoxifying possible carcinogens, and activation of some health-promoting compounds. According to Anderson et al., 2009 several studies have found that eating dietary fiber on a routine lowers the risk of carcinoma.

Fatty acids

Cereals are providing another essential nutrient which is fatty acids to the human body. The most efficient way for people to ingest essential fatty acids such as linolenic acid(n-3) and polyunsaturated fatty acid(n-6) is through their food (Innis, 1991). According to Uauy & Dangour, 2006 low intake of essential fatty acids in diet can negatively effect on human health. According to Innis, 2008 n-3 carboxylic acid shortage causes poor growth and reproductive failure in newborns and kids, whereas n-6 carboxylic acid insufficiency causes poor growth and reproductive failure (Connor, 1999). Therefore, correct fatty acid calculation of foods are important for adequate intake. Linoleic (18:2) may be a major unsaturated fatty acid while Palmitic (16:0) may be a major saturated fatty acid present in most cereals. Rice and oats are rich in oleic acid (18:1) and millets are richer in stearic acid (18:0) than other cereals (Lee et al., 2020).

Table 1: Grain Varieties and their phytochemicals present

Grain Variety	Phytochemicals Present	Reference
Wheat (<i>Triticum aestivum</i>)	Phenolic acids, carotenoids, tocopherols, alkyl resorcinols, benzoxazinoids, phytosterols, and lignans.	Luthria et al., 2015
Rice (<i>Oryza sativa</i>)	Tocopherols, tocotrienols, oryzanols, dietary fibers, vitamins, and phenolic compounds	Ghasemzadeh et al., 2018
Maize (<i>Zea mays</i>)	Phenolic acids (ferulic acid, coumaric acid, and syringic acid), carotenoids and flavonoids (anthocyanins)	Siyuan et al., 2018
Barley (<i>Hordeum vulgare</i>)	beta glucan and phenolic chemicals	Behall et al., 2004, Cavallero et al., 2002
Sorghum (<i>Sorghum bicolor</i>)	Polyphenols- Taninns, phenolic acids, anthocyanins, phytosterols and policosanols.	Espitia-Hernández et al., 2022 Awika and Rooney, 2004
Horse gram (<i>Macrotyloma uniflorum</i>)	Phlobatannins, Anthocyanins, Phenols, Flavonoids	Auxilia et al., 2013 Herath et al., 2020
Buckwheat (<i>Fagopyrum esculentum</i>)	Bioactive phenols- Rutin and Quercetin, Flavonoids, phytosterols, fagopyrins, fagopyritols	Lee et al., 2007 Ahmed et al., 2014
Finger Millet (<i>Eleusine coracana</i>)	Tannins, steroids, polyphenols, alkaloids, terpenoids, phytoestrogens, phytocyanins.	Rhythm et al., 2022
Quinoa (<i>Chenopodium quinoa</i>)	Flavonoid glycosides, phenolic acids, betalains, and saponins	Tang and Tsao, 2017
Cowpea (<i>Vigna unguiculata</i>)	Polyphenols(anthocyanin), flavonoids, phenolic acid	Sombié et al., 2018
Soybean (<i>Glycine max</i>)	Phenolic acids, flavonoids, isoflavones, saponins, phytosterols and sphingolipids	Luthria et al., 2007 Lee et al., 2008

Development of cereal-based beverage

The utilization of grains for beverages necessitates deal with one important challenge of their high particle weight. and low water solubility. Most of the cereals

have high starch content of above 60% and because of that mixing milled grains with water results in highly viscous dough like solution. The starch can be gelatinized with water(with increased temperature conditions) without hydrolysing.

High molecular weight proteins and cell wall polysaccharides in grains will remain mainly

insolubilized, therefore the yield for a beverage can be low and the soluble part will not be suitable for further processing.

To design a beverage based on cereals the following steps, mainly modified for barley by Kreisz et al., (2008):

- Evaluation of cereals or pseudocereals for the beverage production
- Milling or Make into a slurry to prepare Grain milk
- Substrate production with or without exogenous enzymes
- Alcoholic or non-alcoholic fermentation (optional)
- Blending and stabilization.

In some researches have used milled grain flour to prepare beverage other than blending cooked grain into slurry preparation. Ogunremi et al., (2015) have prepared a slurry by blending equal proportions of each of the flour in water (10% w/v). Cereal Milk Extraction is the main step of the beverage production. However, molecular weight of the grain particles must be taken into consideration while choosing the most effective technique for preparation of cereal milk.

Cereal milk extraction

Plant-based milks are becoming increasingly popular across the world as a functional beverage. In a time when lactose intolerance, cow milk allergy, calorie concerns, and hypercholesterolemia are common, they can be used as an alternative for dairy milk. In addition, there has been an increasing trend for vegan diets. Plant-based milks are also cost-effective alternatives for cow's milk when it is unavailable or inadequate (Valencia-Flores et al., 2013). Sethi and Rahul, 2016 has categorized plant-based milks into the following five types: (a) Cereal based, (b) Legume based, (c) Nut based, (d) Seed based and (e) Pseudo-cereal based.

And oat milk, rice milk, spelt milk and corn milk that have been tested for their nutritional profile are by Sethi and Rahul, 2016. Developing Beverage from cereal milk extraction is the most feasible method as it increases the consistency as well as stability of the product. Even using ground grains are difficult to stabilize as a beverage because of their high molecular weight.

Extraction of cereal milk generally concludes with a few steps. According to Hemanth et al., (2019), rice milk was prepared using four methods modified from the Illinois method of soy milk preparation.

Method 1: The high-protein rice was steeped in water (the ratio of rice to water is 1:5 w/v) for about 8 hours at $\pm 30^{\circ}\text{C}$.

Method 2: The soaked rice was washed using clean water and mashed.

Method 3: The rice was steamed at 100°C by passing steam through rice while mashing content with water in a cooker cum grinder. After steaming, the slurry was mashed again in order to get homogenous aqueous extract at 68°C for 3 minutes at a pressure of 2 kg/cm^2 .

Method 4: The aqueous extract of rice was filtered by a filter press and homogenized at the speed of 3000 rpm for 12 minutes.

Cereal milks, and plant-based milks in general, face technological hurdles in processing and storage, as well as not being as nutritionally balanced as cattle milks. In spite of that, the functionally active ingredients they contain, as well as the health advantages they provide, make them a compelling choice (Sethi et al., 2016). Rice containing foods are fermented by a mixed culture of microorganisms by spontaneous fermentation and, in the case of beverages, by adding a starter culture (Ray et al., 2016).

Role of cereal based functional beverages for nutrition security

Food security is described as the availability and accessibility of food for everyone, whereas nutrition security demands the consumption of a variety of diets that are rich in the necessary nutrients. Consuming cereal-based products can provide higher diet quality and they are recognized as nutrient-dense foods which could provide protein, lipids, B vitamins (including thiamin, niacin, and riboflavin), vitamin E, and minerals (calcium, magnesium, potassium, phosphorus, iron, and sodium) into the diet. The development of functional beverages paved the way for a diet rich in nutrients.

Table 2: Summary of the reported Dairy beverage utilizing cereals & legume

Constituents of Beverage	Functional Properties & Health Benefits	Chemical Properties	Process/Technology	Reference
Corn flour, Skim Milk, sugar (8%) Traditional mixed culture- <i>Streptococcus Thermophiles</i> and <i>Lactobacillus bulgaricus</i> (NCDC-263)	Improve microbial balance of the intestine	pH:4.1-4.5 and pH increases with storage time. Highly acceptable by sensory evaluation	Wet blending Inoculation & Incubation (42°C,4hr) Sterilization by Heating (95°C,15min)	Prafull et al., 2016
Tejate (Meso american drink) Maize (30%) Cacao (6%)	Packed with essential minerals of Potassium, Ferrous, Zinc, Magnesium & Copper. Maintain post-prandial glucose response	Contains resistant starch 0.81% in tejapayam 2.43% in Bolitatejate. Starch-lipid complexes (type 5 Resistant Starch) formed during annealing and gelatinization	Nixtamalization	Amaro et al., 2015
Wholegrains of barley, oats, buckwheat, and red rice	Contain high amount of fiber and antioxidants. Low glycemic Index	High total phenolic content and soluble fiber content. Highly acceptable sensory attributes	Roasting Cooking Blending Fermentation dilution with desired ingredients.	Fernandes et al., 2019
Haria A fermented rice based beverage	Beverage is known for many health benefits such as protect from many gastrointestinal diseases, particularly dysentery, diarrhea, acidity and vomiting	Titrateable acidity: 1.42% pH 3.61 Ethanol content: 2-3% (v/v) Contains terpene glycosides, chalcones glycosides, flavanones, lycopenes, carotenoids, tocopherols, saponins, flavonoids	Germination- 5 days	Ghosh et al., 2014
Rice Jann Rice (<i>Oryza sativa</i>), wheat(<i>Triticum aestivum</i>), jau (<i>Hordeum vulgare</i>), koni (<i>Setaria italica</i>), china (<i>Panicum miliaceum</i>), oowa (<i>Hordeum himalayens</i>), and chuwa (<i>Amaranthus paniculatus</i>)	Phenolics in rice is related with the in-crease in efficiency of donating hydrogen atoms to reactive oxygen radicals, which is a mechanism of anticancer activity	Ethyl alcohol <10 % Carbohydrate, amino-acid, vitamins	Rice are boiled in water until they become soft and edible. Then they are mixed with balam powder. And the rest of the stages are fermentation and storing	Roy et al., 2017

To improve the bioavailability of bioactive components, many strategies such as including product reformulation, the addition of functional ingredients, and the application of modern biotechnology can be used. Developed products which could achieve a balance between nutritional and quality modification with improved physicochemical and sensory properties can be altered from these interventions.

In comparison, developed countries are currently more focused on decreasing the energy value, of sucrose, and salt, while increasing the dietary fiber content of foods to prevent obesity and nutrient-related chronic diseases such as cardiovascular disease, hypertension, and diabetes mellitus. Nutrient-dense foods with long shelf lives are essential to prevent malnutrition. The United Nations introduced the 2030 Agenda for Sustainable Development in 2015, and set the goals “to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture” and “to ensure healthy lives and promote well-being for all at all ages”, because non-communicable diseases (NCDs) are the major challenge for sustainable development.

Conclusion

By combining the benefits of whole grains into a liquid medium, sometimes with dairy milk, multigrain beverages have a fine capacity utilization to be recognized as functional beverages. Cereal-based products with packed essential nutrients and various bioactive components can be developed using numerous grains, and certain negative features also are concealed. The grains selected for the preparation of a multigrain beverage are generally with high functional values (e.g., barley, red rice variety, sorghum, horse gram, millets etc.). Most of the selection is based on their phenolic content and high soluble fiber. According to the work done by various researchers on cereal-based beverages, it can be concluded that several methods could be followed for beverage preparation and development. Aside from these, additives may be added to improve the beverage's overall quality. Soaking, sprouting, malting, heating, grinding, and filtering, in any sequence, might be included in the processing procedures. Fermentation is required to produce a fermented beverage. Enzyme treatment is also possible for non-fermented beverages.

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