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## Cereals Nutraceuticals, Health Ennoblement and Diseases Obviation: A Comprehensive Review

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### ABSTRACT

Nutraceuticals have time-honored considerable interest because of their reputed safety, nutritional and therapeutic potential effects. Pharmaceutical and nutritional industries are conscious of the monetary success taking advantage of the more health-seeking consumers. Natural products such as cereals are likely to form the basis of nutraceutical as its revolution represents an enormous opportunity for growth and expansion. Wheat, rice, millets, barley, oat, buckwheat, corn, sorghum, flaxseed psyllium, brown rice, and products are notify the most common cereal based functional foods and nutraceuticals. The nutrients in the cereals have identified prospective for reducing the risk of coronary heart disease, diabetes, tumor incidence, cancer risk, blood pressure, reduces the rate of cholesterol and fat absorption, delaying gastrointestinal emptying and providing gastrointestinal health. Thus, the regular insertion of cereals and their processed products can make a payment to health endorsement and disease avoidance.

**Key words:** Nutraceuticals, Functional foods, Health, Diseases, Cereals.

### INTRODUCTION

Epidemiological and clinical studies have demonstrated the relationship between diet and health status. It is well known that populations consuming a large proportion of plant-based foods, including fruits, vegetables, whole grains and cereals or those with a high intake of seafood, have a lower incidence of cardiovascular diseases and certain types of cancer. Therefore, interest has been expressed in functional foods, nutraceuticals and dietary supplements (Frereidoon et al., 2007). The term "Nutraceuticals" which is combination of nutrition and pharmaceutical originated by Stephen De Felice in 1989 (Sumeet et al., 2010). According to him, nutraceutical can be defined as a food or part of a food that provides medical or health benefits, including the prevention and/or treatment of a disease. Hence it provides medical or health benefits, encompassing, prevention and treatment of diseases (Zeisel, 1999). Such products may range from isolated nutrients, dietary supplements and diets to genetically engineered "designer" foods, herbal products and processed foods such as cereals, soups and beverages. Presently over 470 nutraceuticals and functional food products are available with documented health benefits (Eskin et al., 2006). There is a lot of confusion regarding the terminologies like "nutraceuticals", "functional foods", "dietary supplements" "designer foods", "medical foods", "pharmafoods", "phytochemicals" etc. There seems to be thin dividing line in their interchangeable usage by different people on different occasions. "Pharmaceuticals" may be considered as drugs used mainly to treat diseases, while "nutraceuticals" are those that are intended to prevent diseases (Rajasekaran et al., 2008). The recently passed Dietary Supplement Health & Education Act (DSHEA), as part of the ongoing

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nutraceutical revolution, clearly signals that the time has come for the development and marketing of nutraceutical cereals. A nutraceutical is any substance that is a food or part of a food that provides medical and health benefits. In agricultural and biomedical research, functional foods and health-protecting materials (i.e., nutraceuticals including phytochemicals and botanicals) are perceived as offering some of the greatest opportunities for improving human health (Mary, 2003). Cereals are an important cost effective commodity in the world. Food ingredients from cereals with nutraceutical properties can contribute to health benefits to many people. Consumption of plant-based foods, including fruits, vegetables and whole grains, cereals and nuts as well as intake of marine foods plays a pivotal role in disease prevention and health promotion. Cereals like wheat, maize, rice, oats etc are now employed in preparation of foods that are similar in appearance to conventional foods and used in normal diet but have an added advantage of aiding physiological functions along with providing nutrition (Saikia et al., 2011).

In recent years, cereals and its ingredients are accepted as functional foods and nutraceuticals because of providing dietary fibre, proteins, energy, minerals, vitamins and antioxidants required for human health.

Cereals include dietary fibre such as  $\beta$ -glucan and arabinoxylan, carbohydrates such as resistant starch and oligosaccharides. Also, cereals can be used as fermentable substrates or the growth of probiotic microorganisms (Caralampoulos, et al., 2002). Common cereals are wheat, rice, oat, barley, flaxseed, psyllium, brown rice, and their products are notified the most common cereal based functional foods and nutraceuticals. Preventing cancer and CVD, reducing tumor incidence, lowering blood pressure, risk of heart disease, cholesterol and rate of fat absorption, delaying gastric emptying and supplying gastrointestinal are the protective effect of the cereals. Several of the nutrients in cereals have known potential for reducing risk factors for CHD; the linoleic acid, fiber, vitamin-E, Selenium and folate. Cereals also contain phytoestrogens of the lignin family and several phenolic acids with antioxidant properties (Truswell, 2002). Eating habits can drastically reduce healthcare expenditures if individuals were to modify their diets based on an existing knowledge of nutrition. The purpose of this paper is to summarize certain scientific and legal issues regarding the chemical compounds known as nutraceuticals. In the present scenario, the topic is appropriate because consumer attention in the relationship between diet and health is elevated, yet media reports about the consequences of certain food compounds may confuse not only consumers but also health professionals. This would provide background information about nutraceuticals and related scientific issues in some commonly consumed cereals with the potentiality of being considered as nutraceuticals.

### **Wheat (*Triticum aestivum*)**

Wheat (*T. aestivum*) is preferential not only for its nutritional significance but also for its functional and nutraceutical properties. Wheat is one of the major grains in the diet of vast

number of the world population and therefore, can play a significant role in the nutrition quality of the diet and human health. Whole wheat and wheat bran are the key source of antioxidants and dietary fiber (Leenhardt et al., 2008). Free and esterified phenolic acid have the greatest potential to be beneficial to health in wheat. Phenolic acid in whole wheat bran having strong antioxidant activity as compared to whole wheat cereal. Acid condition and enzymatic hydrolysis increase the solubility and activity of wheat phenols (Baublis et al., 2002). Whole grains are rich source of magnesium that act as co-factor for various enzymes, including enzymes involved in the body's use of glucose and insulin secretion. Now, research suggests regular consumption of whole grains also reduces risk of type-2- diabetes (Van and Hue, 2006). Wheat bran has attention to accelerate the metabolism of estrogen that is known promoter of breast cancer (Suzuki et al., 2008). Wheat also contains lignans (phytonutrients), actively protecting the breast against high circulating levels of hormones such as estrogen. There is a significant inverse relationship between measures of fiber intake and colon cancer risk, but all fibers are not equally involved in their protective action against colon cancer. Only wheat bran has been shown to reduce the concentration of bile acids and bacterial enzymes in the stool that is believed to promote colon cancer (Saikia et al, 2011).

Wheat germ oil (2.5%) obtained from the germ of wheat embryo or kernel. It is rich in octacosanol, is a 28 carbon long chain structured primary alcohol. It rich in tocopherol, beta caotene, folate, essential fatty acid includes linoleic acid and linolenic acid and zinc (murray et al, 2008). Wheat germ oil is used for increasing blood flow as well as has beneficial effects for skin and also has antioxidant properties, strengthening the immune system and restoring overall health (Konger et al., 2006).

### **Rice (*Oryza sativa*)**

Rice (*Oryza sativa* L) is known as the grain of life and is a major cereal crop is the staple food sources for half of the world population and second most widely consumed cereal in the world next to wheat (Kent and Evers 1994). Over 2 billion people in Asia alone derive 80% of their energy need from rice, which contains 80% carbohydrates 7-8% protein, 3% fat and 3% fiber (Juliano, 1985). Until recently, rice was considered only a starchy food and a source of carbohydrates and some amount of protein. Rice protein, though small in amount, is of high nutritional value (Chaudhary and Tran, 2001). The rice bran is a valuable by product of rice milling that contains high concentration of nutritional compounds, including lipids. The rice grain contains 5% bran of which 12-18% oil. A major rice bran fraction contains 12-13% oil and highly unsaponifiable components 43%. This fraction contains tocotrienol, gamma oryzanol and beta-sitosterol; all these constituents may contribute to the lowering of plasma level of the various parameters of the lipid profile. Rice bran also contains a high level of dietary fibers (beta- glucan, pectin and gum). It also contain 4-hydroxy-3-methoxycinnamic acid (ferulic acid), which is component of the structure of non- lignified cell walls. Rice bran and rice bran oil act as functional food and nutraceuticals. Rice

bran contains both soluble and insoluble fiber. Insoluble fiber adds bulk to gastrointestinal tract in human causing more frequent stools that pass through the system more quickly, requiring less pressure to expel, and absorbing more bile acids and prevents their resorption to the body (Wells, 1993). Rice bran lowers the serum cholesterol levels in the blood, lowers the level of bad cholesterol (low density lipoprotein) and increases the level of good cholesterol (High density lipoprotein). LDL/HDL ratio is a reliable marker for coronary heart diseases, higher the ratio more will be the risk of coronary heart diseases (Berger, et al., 2005).

Rice bran contains both Lutein and Zeaxanthin which improves eyesight and reduces the chance of cataracts. Vitamin- K and inositol Hexaphosphate plays an important role in preventing kidney stones and is potentially a valuable source of natural antioxidants like tocopherols, tocotrienol and oryzanol (Godber and Wells, 1994). These components of rice bran prevent from oxidative stress as well as lipid oxidation (Chiang An-Na, 2006).

The brown rice grain consists of an outer protective coating (referred to as the hull or husk) and the edible rice caryopsis. Brown rice consists of the outer layers of pericarp (which contains pigment), seed coat, the embryo and the endosperm (comprising the aleurone layer which encloses the embryo, subaleurone layer and the starchy or inner endosperm) ((Bender & Bender 1999). Brown rice and bran contain compounds like phenol (tricin) with putative cancer chemo preventive properties. Phenols are present at much lower levels in white than in brown rice. Rice bran contains phytonutrients which have shown disease preventing and health related benefits (Jariwalla, 2001). The consumption of rice bran or brown rice instead of milled white rice may be advantageous with respect to cancer prevention (Hudson, et al., 2000). In addition, rice bran products may have potential applications as nutritional ingredients in the context of their utility in functional foods (Jariwalla, 2001).

## Millets

Millet is one of the oldest foods known to humans and probably the first cereal grain used for household purposes. In Africa and India, millet has been used as a staple food for thousand of years. Millet is a tall erect annual grass with an appearance strikingly similar to maize (Bender & Bender 1999). Millet is unique due to its short growing season. It can develop from a planted seed to a mature, ready to harvest plant in as little as 65 days. Millet is related to sorghum (FAO, 1995). There are major millets includes Pearl millet (*Pennisetum glaucum*), Foxtail millet (*Setaria italica*) Proso millet (*Panicum miliaceum*) and Finger millet (*Eleusine coracana*) (Ghurumukh et al., 2003) and minor millets are Barnyard millet (*Echinochloa* spp), Kodo millet (*Paspalum scrobiculatum*), Little millet (*Panicum sumatrense*) etc. (Dubey et al., 2009)

Millet is highly nutritious, non-glutinous and non acid forming food, so is soothing and easy to digest. In fact, it is considered one of the least allergenic and most digestible grains available and it is a warming grain so will help to heat the body in cold or rainy seasons and climates (FAO, 1995). Millets contain no

gluten, so they are not suitable for raised bread. When combined with wheat, (or xanthan gum for those who have coeliac disease), they can be used for raised bread. The protein content in millet is very close to that of wheat; both provide about 11% protein by weight (Jones et al., 2006). Millets are rich in B vitamins, especially niacin, B6 and folic acid, calcium, iron, potassium, magnesium, and zinc (Rao et al., 1989).

Millets are also rich in phytochemical, including Phytic acid, believed to lower cholesterol, and Phytate, which is associated with reduced cancer. However, millets are also a mild thyroid peroxidase inhibitor and probably should not be consumed in great quantities by those with thyroid disease (Crawford and Gary, 2003). It is believed that millet based products would help the body to combat metabolic processes that lead to degenerative conditions. In this way, supplementing the diet with beneficial phytonutrients may reduce the risk of degenerative diseases during aging (Shahidi, 1992).

## Barley (*Hordeum vulgare*)

Barley is preferred not only for its nutritional importance but also for its nutraceutical properties. The active component in barley having nutraceutical property is the soluble fiber (1-3) (1-4)- $\beta$ -D-Glucan or  $\beta$ -Glucan.  $\beta$ -glucan is polysaccharides found principally in the cell walls of the aleurone layer and endosperm in barley kernels. In barley they are more concentrated in the endosperm (Bhatty, 1993).

Several hulls less barley cultivars containing low or high  $\beta$ -Glucan, variation degree of extract viscosity, and waxy or normal starch are found.  $\beta$ -Glucan, a soluble fiber implicated in hypercholesterolemia, hypoglycemia, and in reducing incidence of chemically induced colon cancer. Hull less barley may also used for feed stock for fuel alcohol production for the preparation of food malt with low or high enzyme activities and for brewer's and distiller malt (Bhatty, 1999). It may also lower cholesterol but most people do not eat enough barley to have an valuable effect (Truswell, 2002).

## Oat (*Avena sativa*)

Oat has long been recognized as a healthful and nutritious food and act as nutraceutical and functional food, containing high concentration of well balanced protein and soluble fiber, energy in the form of carbohydrates and oil, and several vitamins and minerals (USDA, 2005). It is good source of antioxidants, phytic acid and various phenolic compounds. These antioxidants are concentrated in the outer layer of the kernel and also helping to maintain the stability of processed oat products and can stabilize oils and fats against rancidity (Peterson, 2001). The active component in oat having nutraceutical property is the soluble fiber,  $\beta$ -Glucan. It is polysaccharides found principally in cell wall of the aleurone layer and endosperm in oat. In oat they are more concentrated in the aleurone layer (Bhatty, 1993).  $\beta$ -Glucan, a soluble fiber and has the ability to increase solution viscosity and a likely rapid fermentation in the small intestine.  $\beta$ -glucan can delay

gastric emptying, increases gastrointestinal transit time and luminal viscosity. These characteristics of  $\beta$ -glucan are associated with slow nutrient absorption, reduce blood glucose and insulin level (Welch, 1995). Short chain fatty acids (acetic acids, propionic acids and butyric acid) produced by fermentation in the colon may also influence the production of glucose and its utilization by peripheral tissues.(Jenkins,1995). Short chain fatty acids may modify cholesterol synthesis (Bridges, 1992). Human experiments have clearly shown that oat fiber tends to lower plasma total and LDL cholesterol (Low density lipoprotein) but wheat fiber does not and cereal foods with low glycaemic index such as pasta and oats are the beneficial for people with diabetes and might lower plasma lipids (Truswell,2002). The ability of  $\beta$ -glucan to bind metabolites, nutrients or carcinogens, or their interference with such binding, clearly could have great physiological significance and play an important role in maintaining the human health. In addition, they contain more than 20 unique polyphenols, which have shown strong antioxidant activity in vitro and vivo. The polyphenols of oats have also recently been shown to exhibit anti inflammatory, antiproliferative, and antiitching activity, which may provide additional protection against coronary heart disease, colon cancer and skin irritation (Mohsen, 2009).

#### **Buckwheat (*Fagopyrum esculentum moench*)**

Buckwheat is a crop which holds tremendous nutritional, functional and nutraceutical properties. It has been used as an important raw material for functional food production because of its functionalities and properties like, proteins, flavonides, flavones, phytosterols, thiamin-binding protein and other compounds (Yong-Soon, 2003).Buckwheat have special biological activities of cholesterol lowering effect, antihypertension effects and improving the constipation and obesity condition by acting similar as to dietary fiber and interrupting the vivo metabolism. Buck wheat is approved as an antihemorrhagic and hypotensive drug (Li and Zhang, 2001).It is used against circulatory disorders and as vasculoprotector.

Buckwheat leaves contain 3-8% glucoside named rutin, a curative chemical that strengthens capillary walls, reducing hemorrhaging in people with high blood pressure and increasing microcirculation in people with chronic venous insufficiency (Park et al., 2000). Buckwheat contains vitamin P, which contains the flavonoid rutin. Rutin is known for its effectiveness in reducing the cholesterol count in the blood. In addition, buckwheat is an effective preventative measure against high blood pressure. Rutin is known to keep capillaries and arteries strong and flexible. The effectiveness of rutin in buckwheat is strengthened with the addition of vitamin C (Udesky, 1992). Rutin and its derivatives exert different pharmacological effects that are normalization of increased vascular permeability and fragility, edema protection, hyaluronidase inhibition, antioxidant, anti inflammatory effect and are efficient against leg oedema, in chronic venous insufficiency, as demonstrated by clinical data (Koscielnny et al., 1996).The main responsible components of these extract or plant parts are phenolic like rutin. Among different properties many polyphenolic prove

antioxidative properties especially oxygen species scavenging (Wojcicki et al., 1995).

#### **Corn (*Zea mays*)**

Corn is a cereal related to wheat, rice, oats, and barley. Corn contains many nutrients including thiamin (Vitamin-B1), folate, Dietary fiber, Vitamin-C, Pantothenic acid (Vitamin-B5), phosphorous and manganese. Corns maintain the homocystein which is an intermediate product in an important metabolic process called the methylation cycle. It is directly responsible for damage of blood vessel, heart attack, stroke, and peripheral vascular diseases. Corn contains Cryptoxanthin, a natural carotenoid pigment which can reduce the risk of lungs cancer by 27% on daily consumption (Yuan, 2003).After the analysis of number of cereals namely corn, wheat, oat, and rice (Adom and Liu, 2002) reported that corn had highest free phenolic content (0.411 mg/g of grain) followed by rice (0.407 mg/g of grain), then wheat (0.368 mg/g of grain) and oat (0.343 mg/g of grain). Insoluble bound phenolic content of corn was significantly higher among all of the above cereals. Phenolic compounds may render their effects via antioxidation and relief from oxidative stress and its consequences. The antioxidative effect of phenolic in functional foods is due to a direct free radical scavenging activity, reducing activity and indirect effect arising from chelation of prooxidant metal ions. (Shahidi and Ho, 2007).

#### **Sorghum (*Sorghum bicolor*)**

Sorghum is an annual grass and has special adaptations to weather extremes and is a very stable source of nutrition as a result and acts as functional food. It is fairly neutral in flavor, and sometimes slightly sweet. Sorghum is commonly eaten with the hull, which retains the majority of the nutrients. It contains very high amount of fiber and iron, with a fairly high protein level as well. Sorghum is the only dietary source for 3-deoxyanthocyanidins, which are present in large amount in the bran of some cultivars and are structurally related to the anthocyanin Phytochemicals (Awika, 2004).The defense mechanism of sorghum against pathogens is due to the accumulation of high levels of 3-deoxyanthocyanidin phytoalexins in infected tissues (Lo et al., 1996).Luteolinidin and apigeninidin are the two major 3-deoxyanthocyanidins and they are structurally related to anthocyanidins. Both Luteolinidin and apigeninidin exhibited stronger cytotoxicity on the (Human Leukemia) HL-60 cell (Shin Chun- et al., 2007).

#### **Flaxseed (*Linum usitatissimum*)**

Flaxseed is a good source of phytochemicals and alpha-linolenic acid, which is converted to long chain omega-3 fatty acids in the nutraceutical and functional food area. Alpha linolenic acid is a precursor to omega-3 fatty acids such as eicosapentaenoic acid. Although omega-3 fatty acids have been associated with improved cardiovascular outcomes (Oomen, 2001). It also contain lignan (not flaxseed oil) possesses in vitro anti-oxidant and possible estrogen receptor agonist/antagonist properties, prompting

theories of efficacy for the treatment of breast cancer. Flaxseed oil contains only the alpha-linolenic acid component of flaxseed and not the fiber or lignan components. Therefore, flaxseed oil may have lipid lowering properties of flaxseed, but not the proposed laxative or anti cancer abilities (Goss, 2000). Like fish oil it may help to correct deficiency of these fatty acids and could be useful for those wishing to supplement their diets with a plant source of these nutrients (Lock wood, 2001).

### **Psyllium (*Plantago psyllium*)**

Psyllium stalks contain tiny seeds, also called psyllium (*Plantago psyllium*), is a plant native to Iran and India. The seeds are covered by husks, which is the part of the plant used in foods (Weis, 1996). The seed husk contains glycosides and mucilages which are used in the food industry to form gels that give thickening and textural changes to foods. It has an antidiarrheal effect and includes a lowered risk of heart diseases and weight (Sharma, 1986). The psyllium husk is a source of water soluble fiber, similar to fiber found in grains such as oats and barley. But the amount of soluble fiber in psyllium is much higher than oat bran. Every 100 grams of psyllium provides 71 grams of soluble fiber; a similar amount of oat bran would contain only 5 grams of soluble fiber. Psyllium fiber is not broken down as it passes down the gastrointestinal tract and so psyllium has no nutritive value other than as a source of fiber (Karawya, 2003). Psyllium is useful substance for treating chronic constipation, and to restore and maintain intestinal regularity, inflammatory bowel disease, ulcerative colitis, colon cancer and advised when soft bowel movements are desired, such as when a person has hemorrhoids, anal fissures, or during pregnancy (Baljit, 2007). In addition to these benefits, soluble fibers such as found can enhance the cholesterol – lowering effect of a low fat diet (Fрати-Munary, 1989).

Recently the United States Food and Drug Administration acknowledged psyllium's role in lowering blood cholesterol levels by allowing health claims to be made for products containing psyllium fiber. However it was recognized that psyllium is only one factor that can influence cholesterol levels and so the claim for psyllium is combined with a low fat diet that is also low in saturated fat and cholesterol. The combination of low fat diet, low in saturated fats and cholesterol plus psyllium, can reduce total cholesterol levels by 4% and low density lipoprotein (LDL) cholesterol by 7%. The soluble fiber in psyllium reduces absorption of blood cholesterol and bile acids from the intestine and that in turn lowers blood cholesterol levels (Winston, 2000). According to this view, psyllium in the diet appears to be safe, is well tolerated, and may improve the blood glucose and lipid levels of certain individuals as ensuring regularity.

### **Processed cereals and their nutraceutical properties**

The physical, chemical and enzymatic processing of cereals modifies the characteristics of starch, which is the major storage carbohydrate of all higher plants and is the major constituent of cereals and impart the nutraceutical properties.

However, it has been found that a part of starch consumed in the diet escape digestion and absorption in the small intestine and is fermented in the large intestine with the production of short-chain fatty acids (Asp, 1992). This fraction is called resistant starch (RS) which is associated with a reduction of the glycemic index, low absorption of cholesterol, and prevention of colon cancer (Englyst, 1992). RS is found naturally in a broad range of starchy products and can be added as a functional ingredient. RS concentration of cereals increases during processing. Process heating and cooling cycles are used for promoting starch retrogradation which, in turn, increases RS content. Another method for RS production involves starch gelatinization, enzymatic debranching of the gelatinized polymer, deactivation of the debranching enzyme, and separation of the resultant product either by drying, extrusion, or crystallization. Extrusion has been claimed as a unit operation for RS production; however, the RS levels obtained with this procedure are lower than those prepared using autoclaving (Agustiniano-Osornio, 2005).

The nutraceutical characteristics associated with the fermentation of the undigestible starch (RS). However, there is another nutraceutical property associated to the fermentation, which is the prebiotic effect. RS may also act as a prebiotic because it favorably influences the ecology of the microbial flora in the large intestine (Thompson, 2007). When RS and probiotics are consumed together, a symbiotic effect takes place; a prebiotic role of RS is to protect some of the ingested organisms on their hazardous path to the colon, effectively increasing the initial levels of the desirable species, once the colon is reached. When both the probiotics and the RS are present in the colon, then the RS may initiate its role as substrate for a portion of the probiotic organisms (Topping, 2003).

### **CONCLUSION**

Today the exploration and exploitation of the disease fighting properties of a multitude of phytochemicals found in both food and nonfood plants have created a renaissance in human health and nutrition research. At the same time, many opportunities for the development of novel dietary products have been created. With all new fields of study come new terms. "Nutraceuticals" and "functional foods" are two new terms used to describe health-promoting foods. Nutraceutical industry is growing at a rate far exceeding expansion in the food and pharmaceutical industries. In tomorrow's market, the most successful nutraceutical players are likely to be those companies in which functional products are just a part of a broad line of good satisfying both conventional and health value point. Future demand of nutraceutical depends on consumer perception of the relationship between diet and disease. Nutraceuticals have received considerable interest because of their presumed safety and potential nutritional and therapeutic effects". Hence a "nutraceutical" is any substance that may be considered a food or part of a food and provides medical or health benefits, encompassing, prevention and treatment of diseases. Nutraceuticals may range from genetically engineered foods to dietary supplements, herbal formulations and may even include processed

products like cereals, soups and beverages. Cereals are an important economic commodity worldwide. Food ingredients from cereals with nutraceutical properties can contribute to health benefits to many people. Consumption of plant-based foods, including fruits, vegetables and whole grains, cereals and nuts as well as intake of marine foods plays a pivotal role in disease prevention and health promotion. The nutraceutical revolution represents an enormous opportunity for growth and expansion. Wheat, buckwheat, oat, barley, flaxseed, psyllium, brown rice, soy and products are notified the most common cereal based functional foods and nutraceuticals. The nutrients in the cereals have known potential for reducing the risk of coronary heart disease, reducing tumor incidence, cancer risk, lowering blood pressure, reduces the rate of cholesterol and fat absorption, delaying gastrointestinal emptying and providing gastrointestinal health. Thus diet with the regular inclusion of cereals can contribute much to health promotion and disease prevention. With the rapidly increasing interest in the nutraceutical revolution, we need to establish a vibrant nutraceutical research community which is absolutely necessary to convert the majority of potential nutraceuticals to establish ones thereby truly delivering their enormous benefits to all of us.

Cereals like wheat, maize, rice, oats etc are now employed in preparation of foods that are similar in appearance to conventional foods and used in normal diet but have an added advantage of aiding physiological functions along with providing nutrition. Eating habits can drastically reduce healthcare expenditures if individuals were to modify their diets based on an existing knowledge of nutrition. The health promoting foods are promising for the economical growth of the country and nutritious foods of low cost may be processed for global utilization. Nutraceutical and beyond is the future of tropical countries to achieve the optimal productivity from their natural resources. The future of nutraceutical foods is bright for developing countries as they have rich sources of raw materials, economically available human resources and the large local consumption.

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