



## Health Benefits and Importance of Utilizing Wheat and Rye

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### ABSTRACT

Cereals are being utilized as the staple food in most parts of the world. The food products prepared from the cereals are the essential part of the daily diet worldwide. Several studies indicate that the consumption of whole grain food products reduces the risk of wide spread chronic diseases. Wheat and rye are the members of *Gramineae* family and are used to cure some common ailments. These are rich in different nutrients and their bran is the excellent source of dietary fiber. They also provide substances such as the lignans, alkyresorcinol, phytosterols, phenolic acids, folates, tocopherols and tocotrienols. The biologically active components found in wheat and rye have several health benefits. These not only help to prevent digestive disorders and cancer but also provide protection against cardiovascular diseases and help in reduction of the different health problems such as constipation, obesity, diabetes and appendicitis.

**Key words:** Wheat, rye, fiber, cardiovascular diseases

### INTRODUCTION:

Wheat is nutritious food worldwide and provides proteins, minerals, B-group vitamins and dietary fiber more in quantity than other cereal crops and help in preparation of different types of foods. The wheat grain consists of three distinct parts: bran (13-17%), germ (2-3%) and endosperm (80-85%) and contains all essential nutrients. In general, 70% carbohydrates, 12% water, 2% fat, 12% protein, 1.8% minerals, and 2.2% crude fiber are found in wheat grain kernel. It is also enriched with phosphorus, magnesium, manganese, zinc, selenium, iron, potassium and copper (Liu *et al.*, 2012). Wheat flour is the key ingredient in making the health beneficial foods. The dietary fibers in the wheat bran help to reduce colon cancer risk along with preventing and curing some digestive disorders (Qu *et al.*, 2005).

Rye is an important cereal crop, higher in fiber contents and has become the important ingredient of different foods considered beneficial from health perspective. It contains biologically active substances showing antioxidant properties by acting as reducing agents, free

radical-scavengers and thorough formation of complexes with metals (Tanwir *et al.*, 2013). Bioactive compounds present in large quantity in the rye bran are lignans, alkyresorcinol, benzoxazinoids, phytosterols, phenolic acids, folates, tocopherols and tocotrienols. The mouth feel and taste of food is manipulated by the lignin and cellulose (Katina *et al.*, 2007). Benzoxazinoids provide the health promoting effects such as weight reduction and appetite suppression effects, anti-allergic effect, anti-inflammatory effects and anti-carcinogenic effects (Hefni and Witthoft, 2012). Nutritionally optimized cereal foods are prepared by addition of rye flour. Dietary fiber present in rye may be soluble or insoluble. Mostly insoluble dietary fiber helps in enhancement of the digestibility and bioavailability of nutrients.

The cancer and chronic diseases risks factors can be minimized by the utilization of rye based products. It is thought that this reduction can take place by the activity of the antioxidants and through digestion of resistant carbohydrates and phytochemicals. The consumption of

rye based products is increasing these days as the consumers are well aware of health beneficial foods. Cardiovascular disease and type-2 diabetes can also be protected by the consumption of cereal based foods.

Cereal based industry is continuously growing and the production of rye based products is also increasing. Up to 80 % rye flour is used for bread baking while its utilization for the preparation of breakfast cereals and rye flakes is 55 % (Zeilinski *et al.*, 2007). Baking quality of rye flour is positively influenced by water extractable arabinoxylan, which is the main component of rye. However, the baking quality is negatively affected by the non extractable arabinoxylan. Therefore both the amount and extractability of arabinoxylans are important in determining its role in bread making. Rye arabinoxylan has high water holding capacity which is responsible for the retrogradation of starch and results in staling of bread. Oat and barley also contain higher amount of  $\beta$ -Glucan than rye. According to the dose, molecular weight and viscosity, it also helps to lower the cholesterol and control the glucose level (Rakha *et al.*, 2010).

Wheat and rye based food containing dietary fiber provide bulkiness to the foods when consumed (Korycinska *et al.*, 2009). For the proper health of human eyes and skin, the effect of lutein along with zeaxanthin, is considered as substantial. Likewise, for intoxication and the treatment of biliousness, various cereal stems are used. Additionally, starches and fiber present in whole grains ferment and produce numerous substances in colon that may prevent the bile acid to promote cancer effect. These seed sprouts are also utilized to cure sore throat, thirst, spasmic pain, coldness, cough and constipation (Wang *et al.*, 2010).

Cereal grains have some specific constituents that have various health benefits for humans, such as anti-disease factors and antioxidants. In this context, Phytic acid was found to play a key role in the medication of

hypercholesterolemia, cancer, kidney stones and hypercalcuria. Diets rich in dietary fiber and high in carbohydrates mostly originate from cereals that help in taking out of oral hypoglycemic agents or help in reduction of insulin in diabetic patients (Ragaee *et al.*, 2006). Immune functions are improved by the short chain fatty acid which help in the production of splenocyte cytokines, antibodies, T helper cells and leukocyte all of which have a vital role in immune protection. Lactic acid forming bacteria competitively hinder the growth of pathogenic bacteria which shows their positive control over immune functioning. This control over immune system helps in the reduction of insulinemia and glycemia. A diet low in fiber contents is responsible to the etiology of hemorrhoids. The Symptomatic hemorrhoids can be treated by increasing the fiber contents in the diet (Slavin *et al.*, 2009).

#### **Importance of health beneficial foods**

In market, the fiber enriched healthy food with low calories and sugar free is in greater demand. Purposely, the researchers have developed the fiber enriched food products to cure the diabetes hypertension, colon cancer and many other health related problems. Quite a number of health benefits of using fibrous products have been reported especially that are rich in lignin, gums, cellulose and hemicelluloses. Similarly, a  $\beta$ -glucan rich fibrous food helps to reduce the absorption of glucose in diabetic patients (Sudha *et al.*, 2007).

#### **Importance of wheat**

Wheat being used as staple food in Pakistan, fulfills the 60% of total calories and protein needed for the daily life. In the world about 65% of wheat grain is used by humans. In Pakistan, about 80% of total wheat is used for production of unleavened flat bread whereas about 20% is used for the production of bakery products (Khan *et al.*, 2009). Nutritionally, wheat germ is rich in essential

vitamins, deficiency of which can lead to various cardiovascular diseases. Furthermore, the consumption of

refined flour which is deficient in vitamins and minerals

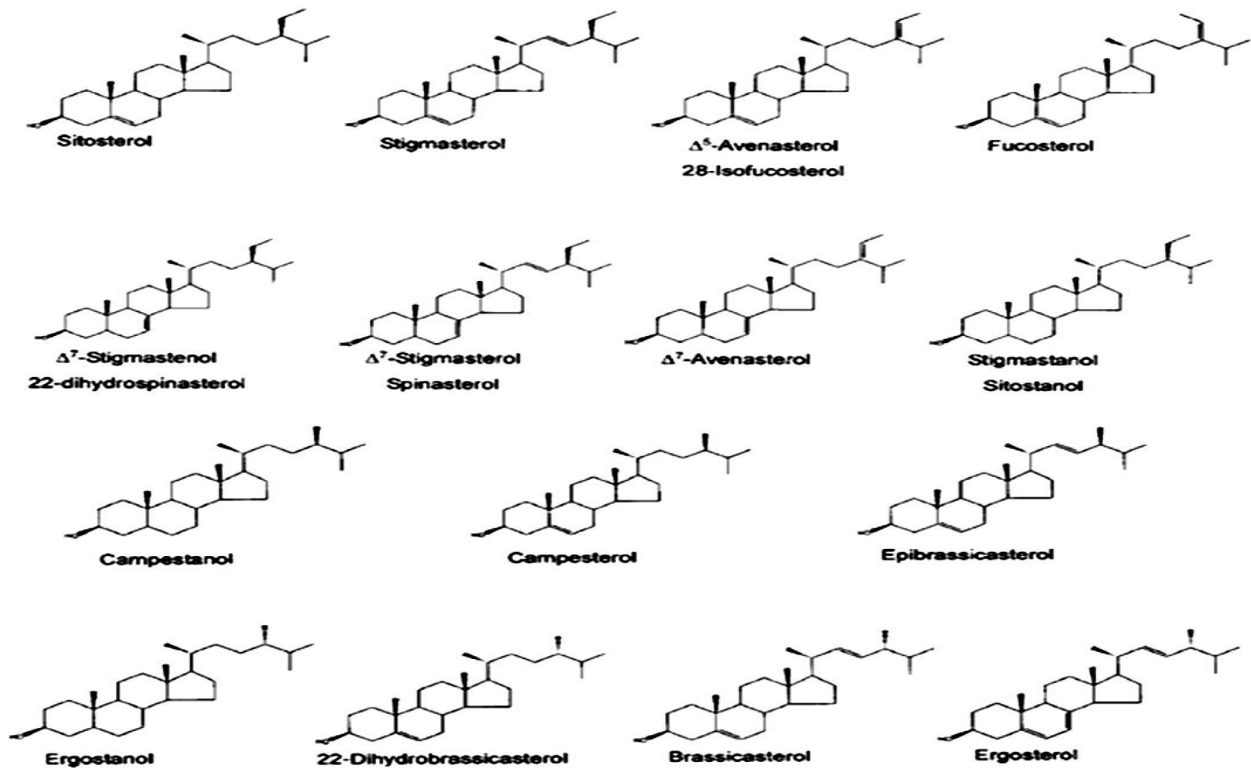


Figure 1:

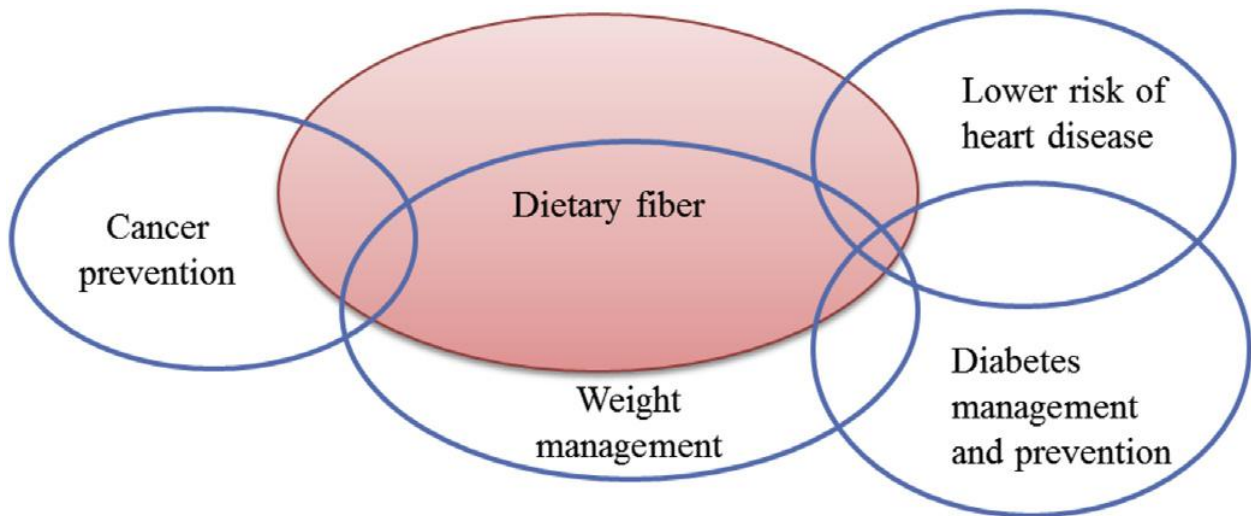


Figure 2:

lead to numerous digestive and nutritional disorders like constipation. However, in contrast to this, the usage of dietary fiber results in medication of various diseases like ischaemic heart disease, constipation, colon diseases such as appendicitis, diverticulum, diabetes and obesity (Kumar *et al.*, 2011).

### **Importance of rye**

Rye bran contain higher amount of dietary fiber and its complex comprehend the plant lignans along with various other bioactive compounds. Plant lignans e.g. enterolactone are being utilized as biomarkers for the intake of lignin rich food in blood concentration. However, numerous studies show that it really works, particularly in relation to upper digestive tract cancer. Quite a number of results have revealed that whole grain cereals such as rye are protective against myocardial infarctions. A consequent defensive effect has also been demonstrated against ischemic stroke and diabetes. It seems realistic to presume that the defensive effects are linked with many factors in dietary fiber complex (Hallmans *et al.*, 2003).

### **Folates**

Folate is a common term for various forms of folic acids including B vitamin. Folates are cofactors in many enzymic reactions, including the biosynthesis of amino acids and nucleotides. As folates are essential for proper body functioning, their deficiency may result in megaloblastic anemia and neural tube defects. Cereals, being a magnificent source of folate help to counteract

### **Health benefits of wheat and rye**

#### **Cancer**

The stomach, digestive tract, liver and colo-rectal cancer are the different forms of cancer whose prevalence varied among various countries. Different studies showed that Western lifestyle put an undesirable consequence on the incidence of various types of cancers. It is the localized

with these ailments. In Finland, where the fortification of folic acid is not done, cereals supply 36-43 % of the folate (Kariluoto *et al.*, 2006).

### **Sterols**

Plant stanols and sterols are the components that found naturally in cereal grains. Phytosterols occur in rye, corn, wheat, rice, fruits and vegetables. Different studies were performed to unveil the effects of food fortified with numerous plant sterols. Phytosterols which are structurally resembled with body's cholesterol, compete with cholesterol for absorption purpose, after consumption in digestive system. Resultantly, absorption of cholesterol is stopped and blood cholesterol level is decreased. Researchers have suggested that phytosterols provided in natural matrices are biologically active at various levels present in healthy diet and have enormous effects on whole body cholesterol metabolism.

### **Arbinooxylan**

Arbinooxylan are the main non cellulosic polysaccharides in cereals. These are the polymer of xylose. These have several health benefits as a dietary fiber (Mendis and Semsick, 2013).

1. Immuno modulatory activity
2. Exhibit cholesterol lowering activity
3. Prevention against alternate type 2 diabetes
4. Enhance the absorption of minerals
5. Act as fecal bulking agent
6. To have a prebiotic effect

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### **Colon cancer**

Colon cancer is one of the most widely spread diseases. In western world it is one of the major cause of death and mortality. Colon cancer occurred due to less consumption of dietary fibers. Various researches and studies have suggested an inverse association between high fiber consumption and colon cancer. The inhibitory effect of phytate against colon carcinogenesis has more importance. It has been explained by animal modeling that the inhibitory effects of dietary fiber on the development of colon cancer is influenced by its nature and source. In humans, oat and corn bran seems to be the less effective to overwhelm the incidence of cancerous growths in colon than that of wheat and rye bran (Rakha *et al.*, 2010). During a study, the scientists exhibited that, colon cancer cells HT-29 in human were suppressed when subjected to phytate. A down parameter of tumors proliferation marker named PCNA was also noticed. Furthermore, the occurrence of aberrant crypts was reduced by the use of phytate as a biomarker for colon cancer. Different researchers have recommended that on large intestinal cancers there is the synergistic effect of inositol and phytate. Due to 1, 2dimethylhydrazine (DMH), a significant decline in the prevalence of large intestinal cancer was seen in mice. Likewise, the protective effect of phytate was also reported against the carcinogenic induction with azoxymethane. It was mentioned that to inhibit carcinogenesis phytate and lipid operate in an organized manner. Some metabolic studies have confirmed that the consumption of diet with high dietary fiber and low dietary fat by various populations, pose a low risk for colon cancer, by diminishing the

excretion of colon tumors promoters like secondary bile acids as compared to the population those consume diet with high fat and low dietary fiber contents (Kumar *et al.*, 2010).

### **Colorectal cancer**

It is considered that wheat and rye has the greater dietary factors. Usually dietary fiber-rich food provides the protection against the colon and rectum cancer. It has been widely agreed that the people who consume less plant sterols as an important source of plasma but have dietary fiber enriched food in their diet have low risk of colorectal cancer. In another study, it is indicated that more than 60,000 individuals have increased risk of this cancer who utilize the less cereals, fruit and vegetables in their diet. Moreover, ample corroboration has been accumulated in favor of defending effect of high fiber diet against colorectal cancer risks. In an earlier study, the prospective information about colorectal cancers and the use of dietary fiber biomarkers complex such as avenantramides and alkyresorcinols have been revealed (Hallmans *et al.*, 2003).

### **Stomach cancer**

Different biological studies indicated that foods rich in fiber are considered as protective against stomach cancer. Mostly whole grain cereal fibers are at the top for its positive effect on health. Currently, a study was conducted on a population where the defensive organization was built for cardiac cancer and for adenocarcinomas of lower oesophagus. Usually there is no clue of defensive effect for oesophageal squamous cell carcinoma that sturdily aids the assumption. One stimulating probable mechanism for shielding effect of whole grain cereals are linked with their requisite properties in relation to N-nitroso compounds. Data was offered for associating the human health and whole grain

that leads toward a defensive influence of cereal grains in upper gastrointestinal track.

### **Hepatocellular carcinoma (HCC)**

Hepatocellular carcinoma is found to be a fatal malignant disease due to minimal diagnosis of cancer cells in human liver. In humans, for the treatment of liver cancer line HepG2, phytate plays the potential role. It results in inhibition of growth of HepG2 cells and hampers the cells capability to form colonies. Furthermore, it also contributes the conversion of cancer cells to less destructive phenotypes production of alpha-fetoprotein and favored the variation of malignant cells. As a result of HepG2 cells treatment with phytate, an augmentation in the expression of p21WAF1 protein and reduction in expression of mutant protein p53 were documented. This suggests that tumor suppressor gene activity enhanced by the phytates (Kumar *et al.*, 2010).

### **Pancreatic cancer**

Amongst various forms of cancer, pancreatic cancer proved to be the most resistant to a number of therapies. It was reported that about 31,270 numbers of mortalities were occurred in 2004 due to the effect of this cancer. Insensitivity of conventional therapies posed a conflict to apoptosis. It has been documented that the in vitro administration of phytate on human pancreatic adenocarcinoma cells (PANC) and MIAPACA, noticeably decrease their growth from 37.1 to 91.5%. This ultimately evinced the potential effectiveness of phytate for pancreatic cancer treatment. Moreover, a number of human studies are required to estimate safety and clinical utility of phytate to cure the pancreatic cancers suffering patients (Hallmans *et al.*, 2003).

### **Blood/bone marrow cancer**

The activity of phytate to reduce the growth of erythroleukaemia cells K-562c in humans has been tested. It has been observed that about 19-36% phytate

causes the reduction of K-562 cell population that leads to increased demarcation, as evinced by ultra structural morphology and improved haemoglobin synthesis (Kumar *et al.*, 2010).

### **Cancer preventive mechanism**

The mechanism occupied by the anti neo-plastic potential of phytate is not completely explored. It was recommended that it offer some valuable effects via its chelating ability. Nevertheless, innumerable studies have been suggested the anti-cancer activity of inositol compounds which includes anti-oxidant functions, pH reduction and mineral chelating ability, cell cycle inhibition, interrupting cellular signal transduction and improving natural killer cells activity.

### **Cardiovascular disease, stroke and myocardial infarction**

Some studies indicate a conspicuous relationship amongst a high utilization of fiber and reduced rate of cardiovascular heart diseases in people. Several epidemiological studies explained the remarkable protective effects of dietary fiber rich foods against the myocardial infarctions. A study linking approximately 22000 specific age group people had an inverse relationship among the quantity of fiber in the diet and rate of CHD. So this group of people took under consideration for long period of time and it was seen that due to the consumption rye dietary fiber, these people were more negatively related with the danger of myocardial infarction than that of people consumed fruit and vegetable fiber. People with the highest intake of fiber have the risk of 0.45 times more as in contrast with people with low ingestion of fiber (Rakha *et al.*, 2010).

A number of pathways are present for protection that includes the protective effects on insulin and lipid metabolism. The whole grains like wheat and rye are the rich source of Alkylresorcinols, phenols and lignans,

which possess strong antioxidants activity and anti-inflammatory properties that are linked to their disease preventing properties. There has been found a strong indication for protective consequences of whole grain products on diabetes, strokes and myocardial infarction. Conclusively, the involvement of whole grain based diet, e.g. wheat bran, rye bran etc, is very helpful in reducing the risk of different cardiac disorders.

### **Diabetes**

Diabetes mellitus is an entrenched threat factor for cardiovascular diseases (CVD). In many trails it was observed that the intake of rye bran improves the metabolic status of human and animals. It was a comparative study in which the effect of rye bran incorporated products was checked on the patients with insulin-dependent diabetes and normal persons and found significant results. It was also depicted that the inclusions of high rye bran products in the diet lower the glucose profile and improve the insulin levels. Similar diabetes preventing effect was also observed in rats. The results shows that the rats fed on the bread with high-fiber significantly lower the body weight, blood glucose and urinary glucose excretion as compared to the animals fed bread with low-fiber content. Another scientist examined that the use of rye fiber can limit the weight gain in normal rats and prolonged the survival period of diabetic rats (Shewry, 2009). It has been recognized that the ingestion of high wheat bran or combination of wheat and rye bran improves glucose tolerance in human subjects without diabetes and in individuals with glucose intolerance. Currently, it was reported that high intake of whole grains also relates with improve in insulin sensitivity. In two large-scale studies on women's shows the clear association between high intakes of dietary fiber from cereal grain and a reduced risk of diabetes. One of the study shows a low glycemic index was concurrently related with a decreased risk in younger people. In the

second study more recently on older people did not hold up this finding (Ragaei *et al.*, 2006). The conclusion of different experiments is that the fortification of refined grain products with whole grain products may lower the risk of diabetes and other linked complications. The use of high fiber products is also a sensible approach to retain good health. At present, here is need to explore the anti-diabetic potential of different high fiber cereal based foods and make them a safer and reliable remedies for metabolic disorders.

### **Whole Grains a remedy for Gallstones**

The foods which have high indigestible fiber, like breads and other food products made with whole wheat can help to avoid gallstones. The researchers reported that the individuals consuming the more fiber (Soluble and Insoluble) are at 13% lower risk of developing gallstones as compared to women consuming the fewest fiber-rich foods and on the other hands which consume more insoluble fiber are at 17% lower risk as compared to women eating the least. The gallstones formations have the inverse relation with fiber consumption. A study shows that 5-gram hike in insoluble fiber intake can drop about 10% the risk of gallstone formation. Mostly the health benefits associated with insoluble fiber. Insoluble fiber not only speeds intestinal transit and movement of food in intestines, but also lowers the secretion of bile acids, excessive secretion leads to gallstone formation. It also improves insulin sensitivity and decreases triglycerides in the blood. Besides the cereal grains we can get handsome amount of insoluble fiber form nuts and the edible skin of fruits and vegetables including, berries, pear, apple, many squash, cucumbers, and tomatoes. The beans like kidney beans and sprouts are also provide a large amount of insoluble as well as soluble fiber for the healthy life (Shewry, 2009).

## **Treatments of Some Common Aliments**

### **Internal Rejuvenation**

Eight percent of the wheat grain consists of protein that has a particular benefit due to its eight essential amino acids occurs precisely in balanced proportions. The metabolism of wheat protein provide many health-building amino acids a complete internal rejuvenation takes place. These amino acids are involved in the construction of flexible muscle which has to come back to it's relax state after stretching and bending. The availability of these amino acid play a significant role in construction and working of skin, clear eyesight, hair growth, nourishment of heart and lungs, brain, nervous system and glandular network, tendons and ligaments (Vitaglione *et al.*, 2008).

The B-complex vitamins, specially thiamin, riboflavin and niacin offered by natural brown wheat endorse high energy and nourishment to blood vessels and skin. Natural brown wheat and rye help to nourish the hormonal system heal wounds and regulate blood pressure due to the presence of a large quantity of minerals. To maintain internal water balance wheat also offers iron to enrich the bloodstream and phosphorus and potassium along with other nutrients. For restoration of internal harmony wheat and rye found to be help full (Kumar *et al.*, 2011). From the above discussion we can say that the proper inclusion of wheat and rye products in diet also retard the aging process and give a fresh look to human beings.

### **Tooth Disorders**

Wheat takes more time to eat and compels the chewing of foods also than the other foods. It is beneficial for the teeth and gum exercise but also a great aid to digestion. For sore throats and pyorrhoea wheat grass juice acts as an excellent mouth wash. It also prevents tooth aches and tooth decays. To chew wheat grasses consider beneficial

which draws out toxins from the gums and inhibit the bacterial growth (Kumar *et al.*, 2011).

### **Constipation**

The addition of bran in wheat and the rye flour make it more wholesome and beneficial. It is considered as outstanding laxative. The laxative effects of cereals bran are much better than that of cellulose in fruits and green vegetables, because it is easily broken down by the intestinal micro flora. The high concentration of insoluble fiber (cellulose) it is highly beneficial in the prevention and in curing of constipation. Its consumption gives a bulk-mass in the intestines which play a smoothing effect and make easy movement due to increased peristalsis (Haripriya and Premakumari, 2010). Furthermore, it is also observed that by preventing we cannot only make easy of stool movement but also can be prevented from the associated issues like hemorrhoids.

### **Skin Diseases**

Many researches explored that chlorophyll inhibit the proliferation of harmful bacteria. For skin diseases and ulcerated wounds wheat grass therapy can be effectively used. It promotes the cell activity and normal growth and retards bacterial action. Drinking of wheat grass juice creates unfavorable conditions for bacterial growth. Wheat grass juice poultice also have sterilization effects when applied on the infected area. Superficially over inflamed surface as in burns, scalds and various itching and burning eruptions wheat flour is useful as a dusting powder. To reduce freckles whole wheat flour, mixed with vinegar then boiled and applied outwardly (Shewry, 2009).

### **Digestive System Disorders**

For the detoxification of digestive system wheat grass juices are best. It is very helpful in prevention of disorders of the ulcerative, mucous, and severe



constipation, colon colitis, and some other digestive ailments (Kumar *et al.*, 2011).

### **Circulatory Disorders**

In wheat and rye the chlorophyll content is present that enhances lung and heart functions. It helps to reduce the toxemia or blood poisoning and capillary activity also increases. The higher level of iron in blood improves the functioning of Lungs. The effect of carbon dioxide is minimized and oxygenation improves. So it is the reason that for circulatory disorders wheat grass juice or other cereal grass juices prescribed (Mulloy *et al.*, 2009).

### **Ear diseases**

It is used for resolving the problem of septic discharge from the ear and in relieving ear pain. So in this case the wheat and rye grass extract has revealed very excellent results. The extract of wheat and rye grass is obtained through different processes and it is used to treat the ear diseases. It is also suggested that it is more effects as compared to it is taken orally (Singhal *et al.*, 2012).

### **Procurement of joint diseases**

Different joint diseases found in people of different age groups such as bone rotting, pain in the joints, swelling on the joints, osteoarthritis, etc. The wheatgrass therapy has to be employed patiently for long time for treatment of joints pain. It has strong assurance that this therapy gives positive results (Mulloy *et al.*, 2009).

### **Anti-asthematic and anti allergic agent**

Wheat and some other cereals such as rye have the anti-allergic actions due to the presence of the rich vitamin and antioxidant content in them. It was seen that respiratory symptoms like wheeze, cough, and shortness of breath not linked with vitamin C intake. But has the inverse relation with cough. It was observed that due to high dosage of vitamin C, patients had a higher forced

expiratory volume and higher forced vital capacity than those with a low vitamin C intake (Singhal *et al.*, 2012).

### **Wheat for Treating Boils**

If pus occurs in boils we can treat them at home with ease and without the help of surgeons knife. Prepare the fine powder of little Alse by grinding it. Fry the one table wheat flour in a little oil to a golden color. Then add tablespoon of water along with grounded Alse. Until the mixture turns thick then keep on stirring. Remove from fire and put on a clean piece of cloth, spread it over the cloth and bandage the boil when the mixture turns acceptably hot. Boil will burst giving instant relief within 2 to 3 days. A little boric has been added to a warm water and clean the boils and then apply sulphur ointment and bandage. Until the wound heal clean the wound and apply the ointment daily (Haripriya and Premakumari, 2010).

### **Wheat paste a remedy for Scars**

Roasted wheat paste/oil is used to eliminate scars. Wheat grains are roasted until it turns black and then paste is formed after grinding. Squeeze out the oil after putting in cloth. The regular use of this paste or oil provides relief and itching disappears (Vitaglione *et al.*, 2008).

### **Wheat for Treating Acne or Pimples**

After grinding the whole grains obtain the powder and then add the water in it and make the fine paste. This paste applies on pimples. For 1 hour keep it. After 1 hour wash it. Regularly do this so it found to be helpful for resolving the skin problems (Kumar *et al.*, 2011).

### **Conclusion**

The cereal grains and their products are consumed as the staple food since centuries. In Pakistan more than 80% of the energy requirements are fulfilled from the cereals products. Among which wheat and rye are most commonly used in Pakistan. They have the substantial contribution in provision of carbohydrates, proteins,

dietary fiber, vitamins and minerals. All the health benefits are linked with the provision of these nutrients and the bioactive components present in it. In this way, different illness like, diabetes, CVD, cancer, tooth decay, obesity, aging and many others disorders can be prevented through the utilization of wheat and rye. Due to lack of knowledge and the ineffective utilization of these grains we are lacking in getting desired benefits. In this review an attempt is made to educate the common peoples and to gain the attention of researches. A lot of

area is yet needed to be explored like the identification of bioactive components, their mechanism, effectiveness, safety, and many other aspects. A new approach can also be made to investigate that how the complex antioxidants present in wheat, rye and other cereals can be liberated, how can they be metabolized and which metabolic pathways are affected by antioxidants. This will provide new information on the health benefits of whole-grain cereals.

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