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A review on dietary fiber in cereals and its characterization

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Abstract
The consequence of food fiber has led to the expansion of a potential market for fiber-rich products and ingredients. Now days, research is being carried on novel resources of dietary fiber (DF), such as agronomic by-products which have traditionally been undervalued. The dietary fibers have its vital role in many physiological processes as well as in the avoidance of many ailments. However, dietary fibers have a number of scientific properties that can be applied in the formulation of foods resulting in surface modification and augmentation of the stability of the foods during their manufacturing and storage. There is a limited study on the effects of dietary fiber on vitamins. This signifies that less-fiber diets can increase the risk of ailment like colon cancer. The usage of fibers from new origins that are currently not fully exploited such as from bacteria, mosses, seaweeds, fruits and vegetables and the prospect of modifying the fibers joining them with other constituents and enhancing their nutritional and sensory attributes, would possibly broaden the field of application for dietary fibers. The present review assesses the classification, nutritional properties, physico-chemical properties and therapeutic functions of dietary fiber. The diets with the high intake of fiber are known to have positive effects on the health.

Keywords: Antioxidant, Cereals, Dietary fiber, Roasting

INTRODUCTION

Hipsley in 1953 was the first to use “dietary fiber” as a short hand term for the non suitable for eating constituents that make up the plant cell wall; It is generally supposed that these components were known to include cellulose, hemicelluloses, and lignin. Moreover “Dietary Fiber (DF) is a complex mixture of carbohydrates polymers that are associated with a number of other , non-carbohydrates components. The DF is predominantly found in plant cell walls and consists of non -starch polysaccharides (NSP) together with lignin, protein, fatty acids, waxes etc. (McDougall *et al.*, 1996). The term “dietary fiber” was undoubtedly an effort to set apart some possessions or constituents of the foods. Wheat, barley, oat, rye, and maize are the cereals which are consumed as staple foods for the population of Western nations, contributing about 50% of dietary fiber (DF) intake. DF plays a significant role in many physiological processes and expectation of other diseases (Rodriguez *et al.,* 2006). The expansion of fiber -enriched foods would facilitate consumers to fulfill such recommendations dietary fibers also have scientific properties that can be used in the formulation of foods, resulting in surface modification and extension of the stability of the foodstuff during production and storage space (Thebaudin *et al.,* 1997). Dietary fiber is that part of plant material which is mostly demanded by enzymatic absorption includes cellulose, non-cellulosic polysaccharides such as hemicelluloses, pectin’s, gums, mucilage’s and a non-carbohydrate component lignin. Mongeau (2003) classified DF into two categories with respect to their solubility in H_2O**:** insoluble dietary fiber (IDF) such as cellulose, hemicellulose and lignin; and soluble dietary fiber (SDF) such as pentosans, pectins, gums and mucilages. Fiber rich diets for example cereals, nuts, fruits and vegetables have confirmatory effects on fitness since its consumption has been highly correlated to decreased frequency of numerous diseases. Dietary fiber can be used in a multiple functional foods such as bakery, drinks, beverages and meat products. DF can be determined by dissimilar methods, chiefly by enzymic gravimetric and enzymic chemical methods.

According to (Kay,1982) Botany scientists DF as a fraction of the plant organs whereas chemical an-

alysts stated that it is a collection of chemical compounds whereas buyers as a substance with beneficial effects on personal physical fitness. "Dietary fiber is basically comprised of plant cells remains which cause hindrance to absorption by the alimentary enzymes of human", whose main components are hemicellulose, cellulose, lignin, oligosaccharides, pectins, gums and waxes (Trowell *et al.,* 1985). Crude fiber is a measure of the quantity of indigestible cellulose, pentose and lignin and its fortitude is mostly used to approximate the superiority of plant origin and it constitutes their slightest digestible fiber fraction. Therefore, it is a decisive factor for evaluating fiber methods is the revitalization of indigestible plant remains. The significance of food fiber escorts expansion of the potential market for fiber rich foodstuffs and ingredients. In today scenario, there is a flow towards novel resources such as agronomic by-products that have conventionally well known for its worth (Mongeau and Brassard,1982).

According to American journal of clinical nutrition, crude fiber is the residue of plant food left subsequent extraction by dilute acid goes after by dilute alkali". American Association of Cereal Chemists (AACC) in 2000 defined DF as the edible portion of plant or analogous carbohydrates which confront digestion and absorption in the human small intestine with absolute or limited fermentation in the large intestine. Further Australia New Zealand Food Authority (ANZFA) define DF as a part of edible portion of plants and its extracts, and its relating carbohydrates, which is challenging to assimilation in the human small intestine whereas full or partial fermentation in the large intestine takes place. It includes polysaccharides, oligosaccharides and lignins. The board on the definition of dietary fiber proposed that cellulose, hemicellulose and lignin are not soluble in water while the pectins, gums and mucilages are insoluble in water. Dietary fiber is considered as a precious functional food, i.e a food with health benefits in numerous situations. It is beneficial for well being and illness avoidance have been well verified (Jalili *et al.,* 2000; Topping *et al.*,1990).

Classification of dietary fiber: Dietary Fiber has various classifications that categorize the elements of DF based on their function in the plant and form of polysaccharide. The solubility of gastric juices, point of absorption is based on products of absorption and physiological classification (Tungland and Meyer, 2002). The most appropriately dietary fiber is classified into two categories such as water-insoluble known as least fermented fibers. For instance: cellulose, hemicellulose, lignin and the water-soluble called as well fermented fibers for example: pectin, gums and mucilages (Anita and Abraham, 1997). Cellulose, hemicellulose, and lignin are strongly intermeshed and chemically bonded by non-covalent forces and by covalent cross-linkage. Molecular genetics of cellulose, hemicelluloses and lignin-degrading systems advanced considerably during the 1990 (Pérez et al. 2002). Table 1 describes the classification of Dietary fiber found in their water solubility characteristics.

Cellulose: Cellulose is major cell wall constituent in plants; moreover it is un-branched linear sequence of numerous thousand glucose units with β-1, 4 glucosidic linkages. Aspinall (1970) reported that cellulose is insoluble in strong alkali. The (10–15%) quantity of cellulose, referred to "amorphous", it is willingly hydrolyzed by acid. Cellulose cannot absorb to any amount by the enzymes of the individual intestinal system. Cellulose makes up about 45% of the dry weight of wood. This linear polymer is composed of D-glucose subunits linked by b-1,4 glycosidic bonds forming cellobiose molecules. Cellulose can appear in crystalline form, called crystalline cellulose. In addition, there is a small percentage of non-organized cellulose chains, which form amorphous cellulose (Pérez *et al*., 2002).

Hemicellulose: These are polysaccharides present in cell wall. After removal of water soluble polysaccharides it may solubilized by aqueous alkali. It hold backbones of glucose units with β-1, 4 glucose linkages, quite be different from cellulose in the sense that they are miniature in size, hold diversity of sugars (xylose, glucose, fructose and sucrose) and is characteristically divided (Kay, 1982). Hemicellulose is a complex carbohydrate polymer and makes up 25–30% of total wood dry weight. It is a polysaccharide with a lower molecular weight than cellulose. It consists of D -xylose, D-mannose, D-galactose, D-glucose, L-arabinose, 4-O-methyl-glucuronic, D-galacturonic and D-glucouronic acids (Pérez *et al.,* 2002).

Lignin: It is a complex polymer containing approximately forty oxygenated phenylpropane units as well as a complex dehydrogenative polymers (Theander and Aman 1979). Due to its important intramolecular bonding, it comprises Carbon-Carbon linkages, lignin is mostly stationary i.e the reason that lignins sometimes vary in their molecular weight and methoxyl value. Lignin is, after cellulose, the second most abundant terrestrial biopolymer, accounting for approximately 30% of the organic carbon in the biosphere. The ability to synthesize lignin has been essential in the evolutionary adaptation of plants from an aquatic environment to land (Boerjan *et al.,* 2003).

Pectin: It is a substance which is a complex of polysaccharides in which D-galacturonic acid is a principle component. They are structural portions of plant cell walls. They proceed as intercellular cementing substances. Pectin is frequently soluble in H_2O and is totally metabolized by microorganisms. Because of its gelling behavior, such

Table 1. Classification of dietary fiber found in their water solubility characteristics.

Characteristics	Type of fiber	Explanation	Major Food resources
Water insoluble	Cellulose	Major structural part of plant cell wall, insoluble in alkali and soluble in acid.	Plants (vegetables and various bran)
	Hemicellulose	Cell wall polysaccharides, Contains β-1,4 glucosidic linkages, Soluble in dilute alkali.	Grains of cereals
	Lignin	Non-carbohydrate cell wall component, challenging to bacterial deprivation.	Woody plants
Water soluble	Pectin	Constituents of main cell wall, soluble in H_2O and gel forming.	Fruits, vegetables and legumes
	Gums	Mostly secreted at site of plant Injury, used in foods and pharmaceuticals	legume plants, sea-weed extracts, gums
	Mucilages	Synthesized by plants, used in food industry and hydroplilic stabilizer	Plant extracts such as gums

(Dhingra *et al.*, 2012)

Table 2. Functions and benefits of dietary fiber based on human health characteristics.

Functions	Benefits
Balance intestinal pH and stimulates Fermentation	Lessens menace of Colorectal malignancy
Lowers cholesterol level	Danger of heart problems reduced
Regulates blood pressure	Reduce risk of metabolic syndrome and Diabetes to much extent
Adjoin bulk to stools	Reduce troubles related to constipation
Add volume to diet, making feels stronger	Decrease hunger
Attracts water and turns to gel during absorption and losing assimilation of glucose	Subordinate inconsistency in blood sugar levels

(Dhingra *et al.,* 2012)

soluble polysaccharides can lessens the pace of gastric emptying and authorize to modest level on intestinal transit time (Jenkins *et al.,* 1978). Pectin is a major component of primary cell walls of all land plants and encompasses a range of galacturonic acid-rich polysaccharides. Three major pectic polysaccharides (homogalacturonan, rhamnogalacturonan-I and rhamnogalacturonan-II) are thought to occur in all primary cell walls (Willats *et al.,* 2001).

Gums and mucilages: These are that categories of plant fibers which are not a portion of cell wall components and formed in specialized secretary plant cells These are reported to be highly branched polysaccharides that configure out gels from bound water and organic materials (Van Denffer *et al.,* 1976). Sticky gum exudations create response to sufferings from gum arabic. Mucilages ooze into the endosperm of plant stones where they behave to stay apart from dehydration. Gums are considered to be pathological products formed following injury to the plant or owing to unfavorable conditions, such as drought, by a breakdown of cell walls (extra cellular formation; gummosis) while, mucilages are generally normal products of metabolism, formed within the cell (intracellular formation) and/or are produced without injury to the plant. Gums readily dissolve in water, whereas, mucilage form slimy masses (Jani *et al.,* 2009).

Effects of eating too much/too less fiber: Intake of the high amount of fiber can cause numerous health troubles. Some have uncomfortable side effects while others can lead to further severe fitness issues (Slavin, 2013). Fiber is a natural substance found in fruits, vegetables and cereal grains and these are an essential part of the diet of a healthy body (Anderson *et al.,* 2009). Moreover, fiber adds bulk to your diet, making you feel fuller faster and longer. It assists in digestion and be able to pass up the constipation. Too high amount intake of fibre results in Cramping, Diarrhoea, Malabsorption, Constipation, Intestinal gas and Intestinal blockage (Talley, 2006).

The risks of taking very less amount of fiber are Constipation, High Blood Pressure, Diabetes, Cardiovascular illness, Obesity, Malignancy (Anderson, 2009). It is important to consume adequate fiber on a regular basis to sustain health and vitality. Unluckily, most human beings don't even come close to intake the 20 to 25g of fiber per day recommended by the American Dietetic Association (Shulman, 2010). Although fiber can be added to the diet by taking supplements, which is finest to attain it by eating a healthy diet consisting of ample of fruits, vegetables and whole cereal grains (Kushi, 2012).

Dietary fiber content in foods and its consumption: Dietary fiber is a combination of chemically assorted substances such as celluloses, hemicelluloses, pectins, lignins, gums and polysaccharides like seaweeds or bacteria but do not consist of a defined chemical group (Thebaudin *et al.,* 1997). Cereals, vegetables, fruits and nuts naturally comprised with dietary fiber. Healthy adults should consume between 20

to 35 g of dietary fiber daily which is suggested by experts whereas non-starch foods mostly provide upto 20–35 g of fiber per 100 g (Selvendran and Robertson (1994); Lambo *et al.,* in (2005) reported that cereals are main sources of dietary fiber which contribute about 50% of the fiber intake in overseas. 30–40% DF attained from vegetables, approximately 16% from fruits and 3% from another sources. Arabinoxylans and (1/3)(1/4)-β-D-glucans are the main non-starch polysaccharides present diversely in wheat, barley and oat. The structural and physico-chemical properties of arabinoxylans manipulate its functions in manufacturing of products. Water-extractable arabinoxylans is highly sticky in hydrous solutions, whereas water-unextractable arabinoxylans generally practice strong water-holding capacity.

Furthermore, everyone should know about that range of molecular weight reported for β-glucans exemplify unevenness among cereals and oat β-glucans which mostly have higher molecular mass as compare to barley (Brennan and Cleary, 2005). The molecular weight of the glucans has notable results on product's viscosity which may effects end-use potential. One more stimulating constituent which is not commonly extracted from cereals but widely used as dietary fiber in diversity of foods is inulin. Inulin is a polydisperse fructan primarily comprise of D-fructose joined by β-(2-1) linkages (Colleoni-Sirghie *et al.,* 2003).

Nutritional properties of dietary fiber

Dietary fibers and cancers: Benefits of a diet rich in fiber are commonly have been discussed in past years. The unspecified protecting function of high fiber ingestion against cancer was strongly supported by Burkitt (1975). Burkitt and other researchers suggested that local people of Africa had a less occurrence of colon cancer as they consumed fiber-rich diets. There are a lot of troubles which estimates epidemiological studies of colon cancer, so there are several micronutrients in fruits and vegetables (vitamin C, E and β-carotene), which are associated with a high-fiber diet, that have protective against cancer. It is also promising factor that some of the clear defensive outcomes from foods obtained from plant origin may be due to an inverse association of their intake with that of meat and animal fat. Trock *et al.* (1990) and other researchers evaluate numerous case studies and found a strong protective effect for dietary fruit and vegetables, but this may not attribute the effect to fiber. Insoluble fibers such as wheat bran can increase faecal bulk and dilute its contents, which decrease interactions into the intestinal mucosa and any carcinogens available in the faecal matter. Moreover, insoluble fiber diminishes intestinal transit times; permit handful opportunities for faecal mutagens to compare within intestinal epithelium.

Dietary fibers and protein metabolism: Studies on Protein metabolism have revealed that an improved nutritional fiber intake is associated with an increased nitrogen loss in faeces (Breslau *et al.,* 1988). The nitrogenous substance is principally composed of bacterial origin and faecal mass improvement can expose bacterial increase on high-fiber diets (Metzler *et al.,* 2008). Time of digestion alters for proteins and the wholeness of absorption could have noteworthy suggestions for the use of high-fiber diets (David, 2011). Though, in recent studies it appears reasonably evidenced that dietary fiber manipulates absorption as well as assimilation of proteins.

Dietary fibres and intestinal transit time: Generally problem of constipation can be treated by intake of fiber rich diet. The physiological consequences are dependent on the types of dietary fibers, either insoluble or soluble (Galisteo *et al.,* 2008). Insoluble fiber such as wheat bran and cellulose, add bulk to stool, make softer faeces, lift up faecal bulk and reduce intestinal transit time (Cummings, 2001). The water-holding capacity of fiber is important in clearing up the faecal-bulk. The increased faecal weight is usually attributed for increasing bacterial cell mass, non-digestible fiber remains and faecal water (Salminen *et al.,* 1998). Fiber effect on faecal weight varies with the category and resource and occasionally with the practice on research of the foodstuffs. Fiber from cereals is more effective in increasing stool mass than fiber available from fruits. Soluble fibers like pectins not have any notable modification in colonic function or lowers intestinal transit time and mostly digestible by the human digestive system (Milton, 2003).

Dietary fibers and carbohydrate metabolism: Nutritional fibers have a negligible effect on carbohydrate metabolism, water-solvable fibers and foods loaded with sticky fibers have been initiated to reduce post prandial blood glucose levels. Such an act might be linked with viscosity (Jenkins, 1980).

Dietary fibers and mineral bioavailability: The concerns are that high fiber eating might well impair mineral incorporation due to chelating the minerals by means of dietary fibers (Gorinstein *et al.,* 2001). Connections between minerals and fibers with varying chemical conditions make it hard to forecast the bioavailability of minerals. A good number on studied on minerals concerning interactions with dietary fiber include iron, zinc and calcium (Hunt, 2003). The results of fiber bioavailability of minerals depend basically on the category of fiber consumed. Fiber from wheat bran supply mostly used in experimentations. Studies have revealed a damaging effect of wheat and corn cereal fibers on iron and zinc absorption in both animals and human beings. Various fiber ingredients such as guar gum, lignin and psyllium husk have inhibitory consequences on iron absorption

(Chawla *et al.,* 2010). Several studies exposed that dietary fibers never hold back iron or zinc absorption. The elimination of phytate has been revealed to obtain improved bioavailability of iron, zinc, calcium and phytate can be removed during the processing of fiber ingredients. Research has also indicated that wheat fiber compact calcium assimilation in both animals and humans.

Dietary fiber for antioxidants capacity: Sufficient every day eating of dietary fiber (DF) and antioxidants generate considerable consequences in the interference of chronic diseases (Saura-Calixto *et al.,* 2010). Frequent in-vitro in-vivo studies introduce the role of DF in intestinal health, cancer, obesity and diabetes. Dietary antioxidant capacity can be defined as the Antioxidant Capacity (AOC) of all foods obtained from plants and beverages whether alcoholic and non-alcholic, consumed daily in the diet (Cencic and Chingwaru 2010). This parameter represents the number of antioxidant units' equivalent to Trolox which should present daily in the human gut.

Dietary fibers and vitamin bioavailability: Dietary fiber intake enhances vitamin absorption by stimulating enzymes and bile secretion by rising in transit time (Lattimer and Haub, 2010). Several foods comprise inhibitors of vitamin consumption which lowers release time. Inhibitor proteases are there in several raw fruits and vegetables which may influence vitamin inclusion, such as substances can decrease bile salts absorption. Inspite of this inadequate work has been carried out on the effects of dietary fibers on vitamin bioavailability, so vitamins E and D acknowledged more consideration (Fernandez-Garcia, 2012). The effects of numerous diverse types of dietary fiber on vitamin E class were investigated. They originate that rats fed crude wheat bran had inferior hepatic a-toccopherol levels than rats fed ground wheat bran or cellulose, and terminated that coarse bran decreased toccopherol bioavailability. Studies have shown that a high-fiber diet can lead to the enhanced elimination of vitamin D. This may incompletely make apparent that the low vitamin D status noticed in vegetarians.

Dietary fibers and lipid metabolism: Lipid metabolism in dietary fiber was largely studied in a recent evaluation on soluble fiber and serum lipids. Glore *et al.,* (1994) point toward that the mainstream of verification to soluble fiber having the probable to inferior the levels of whole cholesterol and small density lipoprotein cholesterol in the serum. Investigation shows that addition of bile salts by dietary fiber may change significantly in cholesterol metabolism; however it leads to the beating of cholesterol from the body (Nair *et al.,* 2010). Bile acid secretion would require improved synthesis of bile acids from cholesterol. Moreover, the unavailability of bile salts in the intestine for micelle formation would also restrain lipid and cholesterol absorption (Sinha *et al.,* 2011). Dietary fibers, like barley and sugar beet, have been disclosed to increase faecal bulk and thereby dilute bile acids in the lower tract of the intestine. The occurrence of bacterial fermentation of dietary fibers could contribute to lipid metabolism.

Technological and functional properties of dietary fiber

Hydration and oil binding properties: The hydration properties of dietary fibers wrap up their most positive usage in foods because of a pleasant consistency (Cushen *et al.,* 2012). The hydration properties are described by various measurable parameters i.e water-absorption capacity (WAC), water-binding capacity (WBC), swelling and solubility (Azad, 2003). Hydration properties of dietary fibers are associated with the substantial arrangement of the polysaccharides and other factors like porosity, particle size, ionic form, level of pH, and temperature. Moreover ionic strength and pressure upon fibers are also dependable factors (Tudorica, 2002).The viewpoint of fibers to bound water is mostly related to the storage of the dietary fibers. Dietary fibers from algal sources named Laminaria digitata cover enhanced connection for water and oil than those from fruit juice by-products. By-products from cereals have the lowest similarity; these differences are linked to the chemical properties of the fibers and upon its hydration properties. Fleury and Lahaye (1991) reported that enhancement in H_2O increase with the rise in temperature is possibly related to improvement in the soluble nature of fibers.

Mostly Fibers have a capability to bound oil. Oil Absorption Capacity (OAC) is the extent of oil trapped by the fibers upon mixing followed by incubation and centrifugation. Caprez *et al.,* in 1986 reported that absorption of oil in cereal products such as wheat bran is principally linked to the peripheral properties of the bran specks but might be related to the whole charge density as well as to the hydrophilic nature of the elements. Alginate and Fucan from the algal source are main evidences (Fleury and Lahaye, 1991). Water holding capacity (WHC), Swelling Power (SP) and Oil Absorption Capacity (OAC) suggest some potential upon use of fibers as ingredients in food products. Dietary fibers with high OAC allows the stabilization of extra fatty foodstuffs and emulsions. Dietary fibers with high WAC may be used as functional ingredients to evade syneresis and regulate the viscosity and quality of various formulated foods (Grigelmo-Miguel and Martina-Belloso, 1999).

Texture and stabilizing properties: Textural and stabilizing properties result from the hydration properties of the fibers. The additions of dietary fibers into foods convert the consistency and solidity of the processing (Singh, 2017). The methods may vary accordingly. The thickening of xan-

than and locust-bean gums and gelling of carrageenans, pectins and the water-retention capacity contribute to the stabilization of the composition of foods in dispersions, emulsions and foams by converting the rheological properties of the continuous phase **(**Banerjee and Bhattacharya 2012). Owing to their water-retention ability and swelling properties, insoluble fibers can influence food texture. It is property which cannot be directly appraised by mechanical measures i.e by penetrometric measures. The influences of particle size and origin of dietary fibers on the firmness of apple and sugar-beet fibers disclose better inflexibility than wheat-bran fiber (Thebaudin *et al.,* 1997).

Antioxidant properties: Non-starch polysaccharides exhibits antioxidant properties and probably developed as potential antioxidants (Elleuch *et al.,* 2011).Various polysaccharide fractions obtained from rice bran recommend protection next to the superoxide radical, hydroxyl liberated radical, lipid oxidation and reveal the excellent potential for reducing power and chelating ferrous ions (Butsat *et al.,* 2009).The leading scavenging potential upon a hydroxyl radical about 96.3% was attained by polysaccharides extracted by way of boiled-water from rice bran by precipitated it with 40% ethanol with the concentration of 1.0 mg/ml. It was competent as compared to ascorbic acid (Zha *et al.*, 2009). Some suggestions are promising for use of fibers throughout elevated antioxidant activities such as ingredients that allow the stabilization of fatty foods and ultimately improve their oxidative stability by prolonging their shelf life. Such high fiber products have many technological properties like water holding capacity, water swelling capacity, water-solubility index, fat binding capacity, viscosity and antioxidant properties that may justify its consumption in ingredients in food sector.

Remedial functions of dietary fiber: Cereals, fruits and vegetables rich in fiber have a confirmatory effect upon their utilization. It has been related to a reduced incidence of many types of illness due to its positive effects such as an increase in feacal mass by declining the moment of intestinal transit and cholesterol level (Rodriguez *et al.,* 2006). Moreover, glycaemic index and propagation of the intestinal flora will initiate etc (Heredia *et al.,* 2002; Beecher 1999). Various purposes and paybacks of DF on a person's health are detailed in Table 2. It was proposed that the DF act as a defensive factor in tumor resulting decrease the time for arrangement and action of carcinogens. Through its stool-bulking factor, it may reduce the reflection of feacal carcinogens (Hill 1974; Burkitt 1975). Graham *et al.* (1978) reported that the ingestion of certain vegetables enriched in fiber was inversely correlated with the occurrence of cancer. Developments in diabetic management and a decline in insulin supplies reported that mild and modest diabetes on high fiber diets containing a regular or elevated quantity of carbohydrates (Dhingra *et al.,* 2012). Pectin, guar gum and gum- arabic as well demonstrate a hypolipidic results in humans (Kay and Truswell 1977). Walker (1974) reported in his study of the diet of people from South Africa on comparison basis and instigate that the native population of Africa consumed non-refined corn flour with a higher percentage of fiber. There are lower chances of diseases like atherosclerosis and colon cancer which has its high incidence among other population of western countries. Foods that are loaded with fiber grasp a broad field of compounds that can reduce the incidence of different types of cancer. Similar results have been reported by Kritchersky (1990) and Trowell (1976). Dietary fiber plays a significant role in avoidance of so many diseases resulting by taking diets with a higher level of fiber content; Cereals and cereal fiber have optimistic effects on health (Beecher 1999; Saura-Calixto *et al.,* 2010). Fiber from plant sources controls the intestinal transit time through its own action on the faecal matter. It creates an effect on carbohydrate and lipid metabolism which is typically related to components like flavonoids and carotenoids. Such components are supportive for strength and fitness of human beings (Heredia *et al.,* 2002 and Thebaudin and Lefebvre, 1997).

Dietary fiber in functional foods: Nutrients which effect positively on precise organic functions, civilizing health and reduce the hazard of different diseases are known as Functional Foods (Diplock *et al.,* 1999). The International Life Science Institute (ILSI Europe) in 1999 recognized that "a food product may consider as functional if it has been confirmed that it produces a valuable effect on one or more physiological functions. The consequences of food fibers lead to the development of immense latent advertise for fiber laden foodstuffs. In today's scenario there is a drift to come across novel resources of dietary fiber that can be used for its varied functionality in the food production (Chau and Huang, 2003). The addition of DF to bakery goods improves their dietetic worth as it makes possible to reduce the risk of obesity. DF can use as an alternate of fat without loss of quality attributes (Byrne, 1997). DF based on pectin, cellulose, soy, wheat, corn or rice isolates and root beet fiber is used for civilizing the uniformity of meat products such as sausages and salami. At the same time such fibers are efficient to make low-fat products like 'dietetic hamburgers' reported that fiber can also be created from the sources that might be measured as waste products. For instance; Straw from wheat, soya hull, oat hull, corn cobs along with stalks transformed into fiber components, which can be incorporated in particular food applications. Among foods that are rich in fiber largely consumed in mealtime ce-

reals and baked goods such as vital breads and cookies (Cho and Prosky, 1999; Nelson 2001). In the manufacturing of baked goods, addition of fiber rich ingredients increase the water hydration standards of flour used in baked goods. Toma *et al.,* (1979) informed that the bread baked along with potato skin as a substitute of wheat bran gives superior results in the terms of availability of minerals.

The adding up of dietary fiber to baked products might also develops their dietetic excellence since it makes promising feature to reduce the fat by using dietary fiber as alternate of fat with no quality reduction. Supplementation of rice fiber considerably enhanced the dietary fiber content, mineral and protein content of the cookies. Oat fiber can be included into milk shakes, ready-to-serve breakfast drinks, juices, ice tea, nutritional drinks and wine. Soluble fibers such as pectins, inulin, guar gum and Carboxy Methyl Cellulose used as useful ingredients in the milk based commodities (Nelson 2001). Fermented milk products supplemented with fiber from citrus sources has outstanding outcomes to nourish immunity in humans.

Effect of processing on the dietary fiber: The physio-chemical properties of fiber are capable to manipulate throughout the treatment like chemical, enzymatic, mechanical and thermal properties to increase its functionality (Guillon and Champ, 2000). Grinding of fiber may interfere with the water holding properties, particularly the kinetics of water uptake as the significant in the enlarged surface area, resulting the fibers hydrate in very short span. Upon Heating fibers commonly modified with the ratio of soluble to insoluble fiber. Mixture of both thermal and mechanical energy can considerably alter the composition of dietary fiber at all structural phases leads to novel functional properties (Spiller, 1986; Roehrig, 1988). In wheat fiber it formerly invent that thermal treatments such as boiling, cooking or roasting may increase total fiber. Some changes will take place in thermally processed kidney beans and said that solubilization of the polysaccharides ended up in decreasing TDF content, which is majorly due to loss of soluble fiber upon cooking, boiling and frying (Caprez *et al.,* 1986). Varo *et al.,* (1983) in diverse lab studies reported that using different analytical methods, the treated potato samples with high temperature contain extra water insoluble DF and low starch than uncooked samples. No any of modifications noticed in the whole dietary fibers and starch in the extruded samples. Herranz *et al.,* (1983) studied about nature of different fibers such as NDF, ADF, cellulose, hemicelluloses and lignin percentage of freeze and canned vegetables and observed that heating resulted in increase the NDF, ADF and cellulose percentages. An unimportant increase in hemicelluloses and nothing change in lignin samples were noticed. The effect of household cooking on dietary fiber and starch composition of processed potatoes products were assessed and resulted that microwave heating have profound effects on oil frying which lessens its substantial quantity if in-vitro digestible starch and significantly increases were noticed in both the resistant starch and water-insoluble dietary fiber. Thed and Phillips (1995) reported that water-soluble dietary fiber content was being not affected by none of the domestic food preparation methods. Camire *et al.* (1997) also accepted a number of revisions on distinctions in the dietary fiber composition of potato peels as affected by diverse methods of peelings such as abrasion, steam peeling and extrusion cooking

Conclusion

Several studies authenticate the dietetic benefits of dietary fibers. However sometimes it is difficult to express firm conclusions since different sources and composition (soluble or insoluble) of fibers experienced moreover it depends upon the outcomes. Insoluble dietary fibers improve intestinal passage hours. Dietary fibers obtained from cereals have been reported to decrease zinc, iron and calcium absorption, but this effect may be due to the incident of other components in fibers, like phytate. The trends signify that high-fiber diets can decrease the hazards of colon cancer. The range of structure and composition of dietary fibers make it difficult for their mechanisms of action. The usage of fibers from novel origins is currently not fully exploited such as from bacteria, mosses, seaweeds, fruits, vegetables etc. The prospect of modifying the fibers joining them with other constituents and enhancing their nutritional and sensory attributes, would possibly broadens the field of application for dietary fibers. For example, the action of cereal bran, vegetable or fruit pulp with an alkaline solution of hydrogen peroxide eradicates part of the lignin and enhances the water absorption capacity of the resulting fibers. The diets with high fiber intake will have positive effects on physical strength. The inclusion of fiber can change some prospects like consistency, texture, rheology and sensory attributes of the finished products. Fiber in breakfast cereals like bread, cookies, cakes, yogurt, beverages and animal protein products may have outstanding well-being outcomes.

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