ORIGINAL RESEARCH PAPER

Agricultural Science

COMPARATIVE ANALYSES ON PHYSICOCHEMICAL, MEDICINAL AND PHARMACOLOGICAL IMPORTANCE OF DIETARY FIBRES OF LOCALLY FOUND CEREALS - A REVIEW

KEY WORDS: Dietary fibres, phytochemicals, antioxidant, anti-inflammatory, anti-diabetic, anti-cancerous, anti-microbial activity.

Chaitee Das Msc. Student, Department of Food and Nutrition Barrackpore Rastraguru Surendranath College, Barrackpore, Kolkata-700120. West Bengal, India.

Debasree Ghosh* Assistant Professor, Department of Food and Nutrition Barrackpore Rastraguru Surendranath College, Barrackpore, Kolkata-700120. West Bengal, India. *Corresponding Author

ABSTRACT

Dietary fibre, is an essential part of plant material resistant to enzymatic digestion. Diets rich in fibre of cereals, nuts, fruits and vegetables have a positive effect on health and its consumption able to decrease the risk of several diseases. Influence of different processing treatments alters the physicochemical properties of dietary fibre and improves their functionality. Dietary fibre can be determined by different methods named- enzymatic gravimetric and enzymatic chemical methods. Mainly fibre rich food products are associated with physiological actions in small intestine, large intestine and have the properties on water dispersibility and solubility, viscosity, bulk absorption, fermentation ability, binding to other compounds and reduces cholesterol, attenuating blood glucose, maintains gastrointestinal (GI) health and positively affects calcium bioavailability and immune function. Food scientists and technologists explored its application in various food products through examination and utilization from various conventional and uncommon sources including agro-food processing by products. This paper represents physicochemical properties, health benefits, antioxidant properties and chemical compositions of local market grains.

INTRODUCTION:

Dietary fibre is defined as, plant cell polysaccharides and lignin which is not hydrolysed by digestive enzymes of animal and human. These consists of cellulose, hemicelluloses, lignin, oligosaccharide, pectin, gums, waxes etc [1]. Delayed gastric emptying and slower transit due to viscous polysaccharide results in reduced nutrient absorption[2]. According to 'American Association of Cereal Chemists' (AACC) in 2020 , dietary fibre is edible part of plants which is resistant to digestion by elementary enzymes [3]. Dietary fibres also used in bakery, drinks, beverages and meat products. The physico-chemical properties of dietary fibre alters by some processes named extrusion, canning, grinding, boiling, frying etc [4]. It is established as nutritionally important, health promoting ingredient. Consumption of dietary fibre produce short chain fatty acids (SCFA) improving glucose and lipid parameters in individual [5].

Clinical studies shows that Low Density Lipoprotein(LDL) and PP glucose level is lowered due to viscous dietary fibre and induce short term safety. Dietary fibre can be separated into two groups: i) Soluble fibre ii) Insoluble fibre.

Foods which are rich in insoluble fibres are wheat bran, whole grains and vegetables; soluble fibres are found in beans, oats, barley, some fruits, and vegetables. The best sources of fibre are whole grain breads, cereals, fruit and vegetables, dried beans and peas. They provide both of soluble and insoluble fibres [6]. Soluble and insoluble both contained whole grains and pseudo cereals are largely classified as cellulose, arabinoxylan, beta-glucan, xyloglucan and fructan[7]. According to Epidemiological and clinical studies, dietary fibre and whole grain intake is inversely related to type-2 DM, cancer and CVD[8]. The better classification evolved including the possible ways on the basis of source, molecular structure, solubility in water and functional properties[9]. Studies also showed that oligosaccharides known as 'resistant oligosaccharides' are considered as dietary fibre[10].

In 21st century, such lifestyle factors contributes weight gain and then results to obesity which represents as a co-morbidity including- Type-2 diabetes mellitus, dislipidemia, hypertension, obstructive sleep apnoea, cardiovascular disease[11]. Type-2 diabetes and systemic inflammation closely associated with gut microbial disequilibrium[12]. Besides these, immune function also enhanced by prebiotic fibre[13]. There is provided a suggested strategy to overcome all these problem by consuming dietary fibre through cereal based foods.

AIMS AND OBJECTIVES:

- The purpose of this study is to explore the medicinal properties of dietary fibres in human.
- To know the nutritional benefits of available dietary fibre.
- To assess the antioxidant properties of fibres in locally found cereals.

Table 1. Phytochemical Properties And Health Benefits:-

CEREAL NAME	NOMENCLATURE	PHYTOCHEMICAL PROPERTIES	HEALTH BENEFITS
WHEAT *(Triticum aestivum)*	Family: Poaceae-grasses Genus: Triticum L.- wheat *Sp*: Triticum aestivum L.	1) Various bioactive phytochemicals present in whole wheat namely phenolic acids, carotenoids, tocopherols, alkylresorsinols. 2) Some other miscellaneous compounds including sterols, steryl ferulates, benzoxazinoids and lignans[14]. 3) Phytochemicals present in wheat exhibits strong antioxidant activity which scavenges or neutralizes free radicals and reduced oxidative damage of DNA, proteins and membrane lipids[15].	Helps in preventing cancer including colon cancer, colorectum cancer, stomach cancer, hepatocellular carcinoma, pancreatic cancer, bone marrow cancer; cardio-vascular disease; stroke and MI; diabetes; cholelithiasis; tooth disorders; constipation; skin, ear disease; digestive system disorders etc[16].
OATS (*Avena sativa*)	Family: Poaceae-grasses Kingdom: Plantae Phylum: Magnoliophyta	1) The major phytochemicals present in oats including tocopherols and tocotrienols, phenolic acids, sterols, selenium and	Provides wide range of health benefits such as reduced risk of type-2 diabetes mellitus, obesity,

	Genus: Avena Sp: A. sativa L	avenanthramides (A group of N-cinnamoylanthranilate alkaloids) [17]. 2) Most of the phytochemicals functions as antioxidants that has potential to suppress oxidative stress and inflammation[18]. 3) Others are low amount of folate, polyphenols, ferulic acids and flavonoids etc.	irritable bowel movement etc.
BARLEY (*Hordeum vulgare*)	Family: Poaceae- grasses Class: Liliopsida Kingdom: Plantae Phylum: Magnoliophyta Genus: Hordeum Sp: H. vulgare	1) Barley contains about 125 mcg/gm tocopherol and tocotrienols which are near about 5 times than other barley products including McInerney, JK, Morell, MK and Bird, AR unpublished data[18]. 2) Phytochemicals present in barley including phenolic acids, flavonoids, lignans, tocols, phytosterols and folates[19].	Epidemiological study have shown that daily consumption of barley and its products reduces the risk of chronic heart disease (CHD) [20], colonic cancer[21], high blood pressure[22] and cholelithiasis.
Corn/ Maize (*Zea mays*)	Family: Poaceae- grasses Class: Liliopsida Kingdom: Plantae Phylum: Magnoliophyta Genus: Zea Sp: Z. mays	1) Corn phytochemicals are varies according to various types. Carotenoids found in yellow and red corn, anthocyanins found in red, blue, purple and black corn, phytosterols concentrated in kernel part of corn[23] 2) Corn silk portion contains phenols, polyphenols, tarpenoids, flavonoids; corn seeds contains anthocyanin, carotenoids etc[24].	Helps in preventing diverticular disease, eye disease, constipation, celiac disease etc[25]
SORGHUM (*Sorghum bicolor*)	Family: Poaceae- grasses Genus: Sorghum Sp: S. bicolor	1) Sorghum is the good source of phytochemicals namely tannins, flavonoids, phytosterols and polycosanols[26]	Regular consumption of sorghum helps to prevent cardiovascular disease, esophageal cancer and obesity[26]
MILLET (*Eleucine coracana)*	Family: Poaceae- grasses Genus: Panicum Sp: P miliaceum	1) Phytochemicals present in finger millet are tannins, flavonoids, terpenoid, glycosides, saponin etc. 2) Total phenolic content 6.57 mg/100gm and total flavonoid content 0.224 mg/100gm[27].	Millets phytochemicals contributes anticancerous, antidiabetic, antiageing, antihypertensive activities[27].
BROWN RICE (*Oryza sativa*)	Family: Poaceae- grasses Genus: Oryza Sp: O sativa	1) Major phytochemicals found in brown rice including dietary fiber, functional lipids, essential amino acids, phytosterol, flavonoids. 2) Beside these, gamma aminobutyric acid (GABA) and gamma-oryzanol, phytic acid also have high amount in brown rice[28]	Brown rice is high in fiber; lowers the risk of cardiovascular disease, stroke, obesity, type 2 diabetes; supports healthy digestion; reduce chronic inflammation, cancer and premature death[29].

Phytochemical Range In Wheat:

a) Tocopherols + Tocotrienols:- 2.3-8.0 gm/100 gm
b) Carotenoids :- 0.04-0.63 mg/ 100 gm
c) Methionine :- 0.17-0.24 gm
d) Selenium :- 0.0003-3 mg/ 100 gm.

Table 2. Pharmacological Properties Of Cereals:-

CEREAL-S	ANTIOXIDANT	ANTI INFLAMMATOR-Y	ANTIDIABETI-C	ANTICANCEROU-S	ANTIMICROBIA-L
WHEAT	Wheat antioxidants have free radical scavenging properties against 2,2-diphenyl-1-picrylhydrazyl radical (DPPH), 3-ethylbenzothiazoline-6-sulfonic acid, diammonium salt,peroxide radical anoin, oxygen radical and chelating radical[30].	The anti-inflammatory effects of wheat bran may be dependent on their particle size and could related to the changes of caecal Enterobacteriaceae sp.[31]	Wheat bran helps to decrease postprandial blood glucose because of its viscosity and glucose binding capacity[32].	Along with the decreased risk of various chronic disease, wheat is also preferable for carcinogenic illness like breast cancer[33].	Wheat shows antimicrobial effect against *Streptococcus mutans* and *Lactobacillus* sp. which causes dental caries and provides treatment for biliousness, intoxication and skin infections[34].
OATS	1) Most abundantly occurring antioxidants are vitamin-E, phytic acid, phenolic compounds and avenanthramides (AVA) [35]. 2) AVAs are very similar to the chemical structure of N-3,4-dimethoxy cinnamoylanthranilic acid which is used as an antiallergic drug to treat asthma and autoimmune disease [36].	Oats meal prevents inflammatory effects to chronic disease such as heart disease, cancer, arthritis, ulcerative colitis and crohn's disease.	Randomized controlled trials shows that, intake of oats as breakfast and supper cereal decrease glucose concentration due to its less glycaemic loads[37].	The well known antioxidant that is Phenol plays a key role for prevention of cancer development[38].	The ethyl acetate extract from oat is the control from microbes [39].
BARLEY	The outermost layer has highest scavenging capacity against 2,2'-azino-bis(3-ethylbenzothiazoline-	The anti-inflammatory property of barley grain expressed for	Barley is one mostly selected food which maintains post-	Barley associated with high dietary fibre content such as beta-glucan, lignan,	Barley shows antimicrobial property against *Candida albicans*,

	6-sulfonic acid (ABTS) and DPPH radicals and inhibits low density lipoprotein (LDL) oxidation compared with endosperm fraction[40].	short chain fatty acid (SCFA) and vanillic acid, arabinoxylan, lignans are major ingredients of this category[41].	prandial glycaemic response (PPGR) and helps in controlling glycaemic levels[42].	helps to prevent colon cancer and cardiovascular diseases[43].	*Bacillus subtilis*, E.coli and *Saccharomyces cerevisiae* through the protein extract Thaumatin.
CORN	Corn silk portion contains high source of antioxidant and creates strong antioxidant potential[44].	Anthocyanin contained purple corn , cyaniding 3-O-beta-D-glucoside prevents inflammation.	Regular and repeated consumption of corn silk tea is the most effective treatment for diabetes as corn silk has an enability to stimulate insulin secretion by repairing pancreatic beta cells[45].	Epidemiological studies have shown that anticancer potential of dietary proteins, peptides and amino acids are in the regulation of apoptosis and angiogenesis which prevents tumour development[46].	Corn silk has wide antimicrobial activity. So, it gives protection against UTI (urinary tract infection) [47].
SORGHUM	1) In case of sorghum, tannin sorghums are strong source of antioxidant that slowly hydrolyzes in foods and produces naturally occurring dark coloured products and upgrade dietary fibre levels. 2) It has high concentration of 3-deoxyanthocyanins (luteolinidin and apigenidin) which gives stable pigments and pH [48].	The anti-inflammatory activity of sorghum depends on both phenolic content and antioxidant activity[49].	Sorghum grains significantly reduce fasting glucose level and AUC (area under the curve) of glucose in T_2DM patients [50].	Polyphenol rich sorghum used to treat colon and breast cancer[51].	Phenolic extract of sorghum has antimicrobial activity on *Staphylococcus, Enterococcus, Campylobacter* etc. [52]
MILLET	1) Carotenoids and tocopherols together have high antioxidant properties present in millets. 2) Beside these, millets antioxidant raised by fermentation and germination [53].	Anti-inflammatory cytokines which are produced from several types of millets may helps in obesity, diabetes, prediabetes and other chronic disease [54].	Regular consumption of millet foods can prevent occurance of type-2 diabetes mellitus [55].	Novel protein FMBP can suppress growth of colon cancer cell by G1 phase arrest induction and loss of mitochondrial transmembrane potential which results in caspase dependent apoptosis of cancer cell [56].	Antimicrobial activities against *Streptococcus*, *Actinomyces*, *Candida*, Staphylococcus etc. [57].
BROWN RICE	Several compound like phytic acid, ferulic acid and sulphur compounds acts as antioxidants[58].	Brown rice chiefly unpolished rice along with contains vitamins, minerals, dietary fiber, EFA, gamma-oryzanol etc makes brown rice anti-inflammatory food product[59].	Some phytochemicals such as beta-sitosterol, stigmasterols and campesterol are steryl glycosides shows lowering blood glucose[60].	Studies shows that, chemo-preventive and biologically active molecules molecules can prevent cancer development [61].	It has highest antimicrobial properties against pathogenic bacteria such as Bacillus cereus may induce diarrhea and vomiting.

Table 3. Biochemical Properties Of Cereals :-

CEREALS	TDF	SDF	IDF	EFFECTS IN PREGNANT and NONPREGNANT WOMAN
Wheat (*Triticum aestivum)*	10.2-15.7	1.9-2.9	7.2-11.4	i)Good source of folic acid. ii)Delivered essential minerals like Zinc, Iron, Magnesium etc and contains resistant starch which are brown rice, oatmeal, pasta, noodles, brown bread.
Oat (*Avena sativa*)	10.3	3.8	6.5	i)Great source of energy, rich in fibre. ii)It has complex carbohydrate that prevents gestational diabetes. Also rich in vit-B_9 and Iron.
Barley(*Hordeum vulgare*)	14.6-27.1	2.6-5.0	12.0-22.1	i)Removes GI problems, has anti-inflammatory effects. ii)Reduce the prevalence of NTD babies. iii)Maintaind blood sugar level and decrease the risk of cardiovascular disease.

Corn (*Zea mays*)	3.7-8.6	0.5-2.5	3.1-6.1	i)Relief constipation. ii)Helps in preventing macular degeneration. iii)Reduce the risk of birth defects such as spina bifida, provides adequate immunity, essential for muscle and nervous system.
Sorghum (*Sorghum bicolor*)	7.55-12.3	1.05-1.23	6.52-7.90	i)Increases Iron in blood and strong immunity.
Millets (*Eleucine coracana*)	13.0-13.8	0.52-0.59	12.5-13.2	i)Boosts blood productions, reduce the risk of chronic hypertension and premature labour. ii)Promotes fluid balance and minimizes uneasiness, lowers the risk of developing hemorrhoids.
Rice (*Oryza sativa*)	9.9	4.4	5.4	i)Increased level of HDL that lowers the LDL level. ii)Beneficial for mental health, helps in good digestion, beneficial for brain-nervous system. iii)Controls body weight and prevents insomnia.
Rye (*Secalecereale* L.)	14.7-20.9	3.4-6.6	10.8-15.9	i)Rye bread is great for releasing constipation. ii)It fulfilled with vitamin B-complex.
Amaranth(*Amaranthus* sp)	11.8	2.7	9.1	-
Quinoa(*Chenopodium quinoa Willd*.)	7-9.5	2.1-3.9	4.9-5.6	i)Very high in fiber ii)Gluten free product and high in protein with all essential amino acids. iii)Low glyceamic index food to control blood sugar level and also high in Iron, Magnesium.
Buckwheat	11.9	6.1	5.8	i)Rich in flavonoids Rutin(strengthen blood vessels) and quercetin(reduce inflammation).
Teff [*Eragrostis tef* (Zucc.) *Trotter*]	4.54	0.85	-	i)Iron rich staple grain. ii)Good option for diabetics and gluten free whole grain.

Findings OfThis Study:-

This review paper explores the therapeutic study on dietary fibres of local market available, easily purchasable cereal products. The most discussing parts are the physicochemical properties, medicinal importance, oligosaccharides, different grains etc. Here some important findings are described briefly:

I) Oats (avena Sativa): Oats have high amount of dietary fibre component named Beta-glucan. Health benefits of controlling blood pressure, glucose level, body weight are associated with beta-glucan, functional protein, lipid-starch and phytochemicals present in oats grain. Antioxidant concentration present in the outer layer of kernel in the bran fraction; also contains some micronutrients such as Vitamin E, folates, zinc, iron, selenium, copper, manganese, carotenoids, phytic acid and so on.

Ii) Barley (hordeum Vulgare): Barley dietary fibre also named as Beta-glucan like oats; according to Food and Drug Administration (FDA) and European Food Safety Authority (EFSA), beta-glucan is an important component of barley which rising up its physicochemical properties. Research showed that barley is rich source of chromium and dietary fibre, moderate source of amylase starch along with antioxidants. Beneficial effects of barley are reduce hunger, improves digestion, reduce risk of gallstone formation and maintains cholesterol level in blood.

Iii) Maize/corn (zea Mays): Whole grain corn is typically rich in fibres many vitamins, minerals and antioxidants. It is not the high glycaemic food, so that consumption is beneficial for obesity, hypertension, high cholesterol and cardiovascular patients. The corn product, corn oil processed from milling is composed of linoleic acid under PUFA is good for health. It also contains significant amount of vitamin E, ubiquinone, phytosterols.

Iv) Sorghum (sorghum Bicolor): Sorghum has high amount of phytochemicals such as proanthocyanidins, anthocyanins, 3-deoxyanthocyanins, phenolic acids, phytosterols, polycosanols and dietary fibre. Sorghum is rich in antioxidants such as flavonoids, phenolic acids and tannins; these can lowers the oxidative stress and inflammation of the body.

V) Millet (panicum Miliaceum): Millet contains complex carbohydrates with higher level of dietary fiber and phytochemical properties. Epidemiological studies have shown that regular consumption of whole grain cereals can protect from the risk of cardiovascular disease, type II diabetes, GI cancers. Millet contains phytates, polyphenols, tannins, trypsin inhibitory factors which is termed as Neutraceuticals. The seed coat is an edible component of kernel and rich source of phytochemicals and dietary fiber.

Vi) Wheat (triticum Aestivum): Whole wheat is the good source of vitamins and minerals such as selenium, manganese, phosphorous, copper and folate. Wheat has high amount of antioxidant property found in aleurone layer which is also sold as dietary supplement. Some common plant compounds are ferulic acid, phytic acid which may impair the absorption of minerals, alkylresorsinols, lignans that prevent colon cancer, lutein that improves eyesight.

Vii) Brown Rice (oryza Sativa): Brown rice is the low glycaemic food, that can reduce the risk of developing type 2 diabetes up to 32%. It has rich source of dietary fiber that can reduce the risk of heart disease and also has high amount of magnesium which make the individual to less effective to heart disease and stroke. CONCLUSION: This study material is on the basis of dietary fibers from locally found cereals.

DISCUSSION:

Individuals consuming higher amount of dietary fiber are at lower risk for developing coronary heart disease, diabetes,

obesity and certain GI disorders. The whole grains of both cereals and pseudo-cereals contain wide varieties of dietary fibres such as arabinoxylan, beta-glucan, xyloglucan, pectic polysaccharides and fructan. The main effects of soluble fibre is, increase the viscosity of the gut and in case of insoluble fiber, dietary fibre absorbs more water and helps in bulk movement.

Studies show that most of the antioxidant grains are wheat, maize or corn, oats and rice according to descending order. Whole grain snacks 'popcorn' also has high level of antioxidant properties, anti-cancer bioactive grain is 'sorghum'. Brown rice also has anti-cancer activity; Several nutritious cereals such as oatmeal, corn, brown rice, quinoa, buckwheat helps in inflammation as they are high in fiber which has anti-inflammable activities.

CONCLUSION :

This review article is on the basis of dietary fibers from locally available cereals. We have selected these because wheat, oats, maize, sorghum, millet, barley, brown rice are easily available in the market and anyone irrespective of their financial condition can purchase these items. Though these are common for general people, most of them don't know their benefits for health.

So, it will beneficial to provide awareness and their interests towards these items for their health benefits.

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