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ijirset@gmail.com

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Lack of Insoluble Dietary Fibre in Food: a Challenge for Gut Health in India

¹Dr. Shashi Dwivedi & ²Prof. Anil K Dwivedi

¹Dept. of Chemistry, St. John's School, Mehrauli, Varanasi, Uttar Pradesh, India

²Dept. of Botany, DDU Gorakhpur University, Gorakhpur, Uttar Pradesh, India

ABSTRACT: Dietary fibre has long been established as a nutritionally important, health-promoting food ingredient. Modern dietary practices have seen a significant reduction in fibre consumption compared with ancestral habits. This is related to the emergence of low-fibre “Western diets” associated with industrialised nations, and is linked to an increased prevalence of gut diseases such as inflammatory bowel disease, obesity, type II diabetes mellitus and metabolic syndrome. The characteristic metabolic parameters of these individuals include insulin resistance, high fasting and postprandial glucose, as well as high plasma cholesterol, low-density lipoprotein (LDL) and high-density lipoprotein (HDL). Gut microbial signatures are also altered significantly in these cohorts, suggesting a causative link between diet, microbes and disease. Dietary fibre consumption has been hypothesised to reverse these changes through microbial fermentation and the subsequent production of short-chain fatty acids (SCFA), which improves glucose and lipid parameters in individuals who harbour diseases associated with dysfunctional metabolism.

KEYWORDS: insoluble, dietary, gut, fibre, food, health, syndrome, India, metabolism

I. INTRODUCTION

Gut health determines your overall well being – both physical and mental. Since our today's world mostly relies on refined carbohydrates and protein shakes, we have almost forgotten the magic ingredient – 'dietary fibers' (British spelling fibre) or 'roughage'. Dietary Fiber is a necessary component for supporting your gut health but almost 95% of the population doesn't meet their daily fiber requirement. Dietary fiber benefits are abundant considering their various curative and preventive properties.[1,2] But many people are still not meeting their daily fiber requirements and are in the dark about the importance of dietary fiber in our day-to-day life. Dive in here to know the importance of fibers, daily dietary fiber requirement, fiber benefits, fiber deficiency diseases and fiber deficiency symptoms. So, why is fiber important to your diet even though they have very little nutritional value? When we tell 'dietary fibers', we usually mean both soluble and insoluble fibers. Soluble fibers are those which are easily soluble in water and form gel-like consistency in intestines. They get fermented by the action of gut bacteria and release some calories on breakdown. Unlike the former, insoluble fibers don't break down by the action of digestive enzymes and offer no calories. The benefits of dietary fiber differ based on its type.[3,4]

Soluble fiber benefits

1. Lowers cholesterol and fat absorption

The formation of gel-like consistencies in the intestine blocks the absorption of cholesterol and fats which in turn reduces cholesterol levels in your bloodstream. As the cholesterol levels in the blood come down, the risks of strokes and heart attacks also get reduced.

2. Helps in weight management

As it blocks the absorption of nutrients in our intestines, digestion gets slower. Slow digestion prevents us from bingeing and mindless eating. Thus, fibers benefit us in weight management by restricting calories.



3. Feeds gut bacteria

The gel form of fibers in the intestines gets fermented by the gut bacteria, thereby enriching the gut microbiome. This process releases a few calories and gas. Thus, fibers benefit us here by avoiding any possible invasions by harmful microorganisms. But too much consumption of soluble fibers can cause bloating and gas formations.[5,6]

Insoluble fiber benefits

1. Reduces constipation

Insoluble fibers absorb fluids and other byproducts while remaining intact in the digestive process. This nature of insoluble fibers facilitates the easy passage of stool. The presence of insoluble fibers can reduce the blockages in the gastrointestinal tract and prevent constipation.

2. Lowers the risk of diverticular diseases

By helping to prevent constipation, it reduces the risks of colon cancers and hemorrhoids. Thus, insoluble fibers benefit us in maintaining a healthy digestive system.

Dietary fiber benefits (both soluble and insoluble)

1. Helps in achieving satiety

This gets the spotlight among other fiber health benefits! Fiber-rich foods fill up our stomach volume, thereby giving us a feeling of fullness. This reduces snacking and binge eating, thereby helping to prevent obesity and other related diseases. [7,8]

2. Lowers the risk of chronic diseases

The health benefits of a fiber-rich diet include reducing chronic lifestyle diseases like diabetes, obesity and cardiovascular diseases.

Effects of fiber deficiency on our body and digestive system

If we don't take recommended levels of daily fiber requirements, we can develop many fiber deficiency diseases that can manifest as several health or digestive issues.

1. Constipation

Fiber deficient diets can make bowel movements difficult, thereby increasing constipation. If you are experiencing constipation, try adding more fruits, vegetables and legumes to your diet.

2. Poor weight management

As discussed earlier, fiber benefits weight management by boosting satiety. Lack of fiber in our diets can make us consume more foods than is required by our body. Overeating for a long period can cause obesity and other related illnesses. Or if the fiber deficiency diet causes extreme illnesses, it can lead to unintentional weight loss due to poor directions.[9,10]

3. Fatigue

Diets rich in proteins and carbohydrates but lacking in fibre can make us feel weak, tired and dizzy in the long run. To avoid this, try to add fibres to your diet even if you follow a keto diet. And don't ever depend on supplements for fibres, only take whole fruits and vegetables!

4. Diarrhea

A fiber deficient diet can deprive the gut microorganisms of prebiotics – complex nutrients that assist the growth of good bacteria in the digestive systems. This can cause the pathogenic microorganisms to cause digestive disorders like diarrhea.

5. Risk of chronic diseases

Reducing our fiber intake can cause the downfall of our overall health, thereby increasing the risks of cardiovascular diseases, obesity and cancers.

6. Hemorrhoids

Hemorrhoids refer to the swollen veins in the rectum and anus which causes severe pain while pushing or straining a bowel movement. If you ever find blood in your stools, it may indicate the severe condition of hemorrhoids and it requires immediate medical attention. [11]

7. Irritable bowel syndrome

Irritable bowel syndrome is a condition where the intestines become extra sensitive to certain foods while manifesting symptoms like cramps, diarrhea and bloating. Fiber-rich foods like bran and whole grains can reduce the symptoms of IBS.

If the fiber deficiency in your diet is extremely high, you can develop more severe symptoms of fiber deficiency diseases. In such cases, it's worth consulting with your gastroenterologist or a stomach specialist doctor who can analyze your health condition. Some of the most common severe symptoms which require immediate medical assistance are,

- Painful bloating accompanied by bloody stools and nausea
- Pain while swallowing foods
- Heartburns
- Chronic constipation/diarrhea for more than three days
- Intense burning sensation in the upper abdomen while having acidic foods
- Stools containing blood/pus or even having coloured stools which are black/tarry
- Rectal bleeding
- Unexplained/unintentional weight loss

II. DISCUSSION

Soluble Fibre

Soluble fibre dissolves in water and fluids, forming a gel-like material as it travels through the system. As it reaches the colon it feeds good gut bacteria that is well-known to deliver a host of health benefits including weight loss and controls diabetes.

Some of the food sources rich in soluble fibre include: Oats, Peas, Beans, Apples, Citrus fruit, Carrots, Barley, Phylum,



Health Benefits

Augments Cardiac Health

Soluble fibre plays a key role in binding to cholesterol particles in the digestive tract and eliminates them from the system. Fibre works by assisting the body to lower total blood cholesterol levels by diminishing LDL or bad cholesterol levels and lowers the risk of cardiovascular disease. Furthermore, several pieces of evidence have proven that fibre-rich foods reduce inflammation and blood pressure that are valuable in uplifting heart-health.

Manages Diabetes

Soluble fibre is not well absorbed by the intestinal tract, it delays gastric emptying time, controls blood sugar spikes and reduces the risk of type 2 diabetes. In people with diabetes having a diet plentiful in soluble fibre such as oats, berries, nuts, beans and vegetables improve insulin action, lower blood sugar levels and also helps to keep diabetes under control.[12,13]

Promotes Weight Loss

This type of fibre is vital for weight management and shedding stubborn fat. Soluble fibre helps to keep gut bacteria healthy and supports overall fat loss by lowering appetite. Moreover, adding fibre rich foods helps you to stay at a healthy weight by keeping you satiated without adding calories and controls unwanted hunger pangs.

Promotes Bowel Movements

Soluble fibre stimulates the movement of food particles through the digestive system, slow the digestion process and absorb the nutrient. It also adds bulk to the stool, regularises bowel movements and averts the risk of constipation.

Ways To Add More Soluble Fibre

Garnish liberally psyllium flakes on breakfast cereals and other foods.

Relish a wholesome soup with broth and carrots, barley, peas and beans for a filling meal.

Munch on apples, berries, oranges or grapefruit for satisfying your sweet tooth.

Make your overnight breakfast jars with oats, dried fruits and nuts.

Also Read: Amazing Fibre Rich Indian Foods [14,15]

Insoluble Fibre

Insoluble fibre doesn't dissolve in fluids but absorbs and binds to other materials to form a stool. This process makes the stool softer, bulkier and regular. Insoluble fibre is mainly found in whole wheat bread, brown rice, seeds and skins of fruit, so it is best to consume fruits with peel.

Some of the food sources rich in insoluble fibre include:

Whole-wheat flour

Wheat bran

Nuts

Beans

Cauliflower

Green beans

Potatoes

Health Benefits

Digestive health:

Consuming a lot of insoluble fibre attracts water into the stool, making it softer and easier to move through the digestive tract and reduces strain on the bowel. This type of fibre promotes bowel health and regularity and helps treat bowel-related issues like constipation, haemorrhoids, and faecal incontinence. Besides these, it also improves insulin sensitivity and reduces the risk of developing diabetes.

Ways To Add Insoluble Fiber

Begin your day with a wholesome breakfast such as whole-grain toast, oatmeal or breakfast cereals.

Replace all-purpose flour with whole wheat flour while baking foods.

Snack on nuts for healthy snacks.

Have a rich array of salads, sautéed veggies or baked veggies.

The Soluble fibre market in India is mainly dominated by Indian players. FOS is produced by TATA Chemicals Ltd, Alkem Laboratories Ltd and Revolutionary Biotech Private Ltd. Partially Hydrolyzed Guar Gum (PHGG) by Taiyo Lucid India (TCI) and Shree Ram Industries. Galactofructose (Lactulose) produced by Lactose India. Beta-Glucan rich fibre and chitosan are mainly from Meteoric Biopharmaceuticals Private Ltd and Panvo Organics Private Ltd. Psyllium Husk/Powder by more than 20 players. Mannan Oligosaccharide (MOS) by Titan Biotech Ltd and Hexon Laboratories Pvt Ltd India is the largest producer and exporter of Psyllium Husks/powder nearly 80%. PHGG is exported to the world from India is 99% with only 1% being used to cater for Indian demand due to less domestic demand. India imports marginal volumes of inulin globally from China and the USA. FOS is mainly imported from China, Korea, the US and Europe and exports to Brazil and USA. The total demand for konjac fibre is met by the imports from China and minimal quantities is from Japan. Polydextrose imports from China and US. Ingredion, Roquette's resistant starch/resistant maltodextrin/dextrin is imported in India at low volumes [16]

Dairy (Yogurt) is one of the most consumed healthy and nutritious foodstuffs in India. Due to its nutritional properties, Inulin is a widely proven prebiotic fibre, as a texturizer, sugar and fat replacer and providing soluble dietary fibre

In the beverages sector – Inulin is completely soluble and gives beverages extra body and is also an ideal sugar replacer in low-calorie beverages. By enriching the fibre content or as a fat replacer, inulin is added to drinks

Functional foods – Inulin, FOS and psyllium husk/powder helps in lowering fat absorption and weight management. It dissolves in water and is broken down into a gel-like substance in the part of the gut digested and absorbed. Inulin and FOS lead to an improved taste and texture as prebiotic ingredients which stimulate the growth of beneficial intestinal bacteria. The addition of inulin or oligofructose increases the dietary fibre content of the diet foods like protein bars, slimming shakes, and soups products. Psyllium husk helps slow down the transit of the food through the stomach. As a result, it feels full for a long duration, thereby limiting more food consumption using slimming drink products

Bakery/cereals/bar – Soluble fibre ingredients such as inulin, FOS and Psyllium Husk are frequently used in bread, cookies, cereal snack bars and Breakfast Cereals for their functional benefits such as Low fat, low GI and no artificial ingredients are major trends. Psyllium husk powder is used in bakery products to retain moisture and help bread from becoming too crumbly and claiming more fibre content in the products. FOS is majorly used in cereal bars as a fat or sugar replacer

Baby food/Infant formulas – FOS is majorly used soluble fibres. It provides a bifidogenic and lactogenic effect, so it much helps to improve gut health for infants/ baby also helps in the reduction of constipation in children typically occurs at the stages after starting formula or processed foods during infancy. Some of the baby formulae contain inulin and FOS combination. Galacto-Fructose is recommended to pregnant women, nursing mothers and children

Other foods – psyllium husk is used in products like multigrain atta for the climate of high fibre content. Start-up companies are currently adding FOS and Inulin in snacks and claiming as fibre rich snacks

Pet food & Animal feed – In pet foods, largely used soluble fibres FOS, inulin, psyllium and MOS in the premium product category. MOS and FOS will increase the number of healthy, good bacteria in the pet's digestive system, to help reduce the number of bad bacteria. Its absorption of vitamins and minerals is high which leads to good growth of pet

Supplements – Psyllium husk, chitosan, FOS, Inulin, Psyllium, PHGG and beta-glucan are used mostly in Indian supplements products

Pharmaceuticals – Galactofructose, psyllium husk mostly used in a therapeutic formulation is used in the treatment of constipation, hepatitis encephalopathy, intestinal microflora, dental care, diabetes, and chronic liver disease and as an effective prebiotic[17,18]

High fibre and the dietary fibres concept are emerging in India. It is one of the factors for consumers in decision making and considering purchasing certain foods such as bread, cereal, cookies, fortified drinks and supplements, etc. India soluble fibres market is expected to witness robust growth by 2021-2026 by the benefits related to health and it is widely used for weight loss management, sugar replacer and constipation. COVID-19 pandemic has created growth opportunities for the soluble fibre market. The Ingredients like FOS, Inulin and psyllium segment is expected to grow at the highest CAGR by 2021-26, due to its various health benefits and extensive use as an additive, flavor enhancer and as replacement of fats & sugar. Its wide range of applications in the dairy, bakery, dietary supplements, and infant formula to pet food and animal feed. The Soluble fibre supply market in India is mainly contributed by the Indian players in the production and export of psyllium. Galactofructose (Lactulose) use in pharmaceuticals sectors was not seen in consumption in other food sectors because of its laxative effect. Awareness of staying healthy among consumers in India is expected to increase polydextrose demand in sugar reduction. Konjac, Chitosan, PPHG, Beta-glucan rich fibre, resistant starch and resistant maltodextrin have merely less penetration in the Indian market compared to the global market

First is coming up with the study on soluble fibre market, wherein we capture the supply-demand (2021-2026) scenario with key details on recent trends, how the market was changed in the last few years in terms of availability, applications, competitive ingredients, challenges, opportunities, and other details. This study will give you a historical picture in terms of the demand for different soluble fibre ingredients in India and how this sector will grow in near future because of ongoing health trends. [19]

III. RESULTS

Dietary fiber, the indigestible part of plant material, is made up of two main types. Soluble fiber easily dissolves in water and is broken down into a gel-like substance in the part of the gut known as the colon. Insoluble fiber does not dissolve in water and is left intact as food moves through the gastrointestinal tract.

The term fiber refers to all the parts of plant-based foods that cannot be digested or absorbed by the body. Unlike simple carbohydrates, including most breads and sugars, fiber is a complex carbohydrate and does not raise blood sugar levels.

Fiber is commonly found in vegetables, fruits, whole grains, and legumes. It is also sometimes called roughage or bulk. It is an essential nutrient, which means it must be eaten in the diet.

Fast facts on soluble and insoluble fiber:

Soluble and insoluble are the two main types of fiber. Many fiber-rich foods contain some of both.

Both forms of fiber have health benefits.

Humans have been using fiber as a dietary aid since ancient times.

In a society built on refined carbohydrates, or white breads, pastas, and sugar sweeteners, getting enough fiber can take effort. Soluble fiber dissolves in water and gastrointestinal fluids when it enters the stomach and intestines. It is transformed into a gel-like substance, which is digested by bacteria in the large intestine, releasing gases and a few calories.

Insoluble fiber does not dissolve in water or gastrointestinal fluids and remains more or less unchanged as it moves through the digestive tract. Because it is not digested at all, insoluble fiber is not a source of calories.

The health benefits of dietary fiber are plentiful. Some of the main ones are listed here.

Soluble fiber

- Lowering fat absorption and helping weight management: As a thick, spread-out gel, soluble fiber blocks fats that would otherwise be digested and absorbed.
- Lowering cholesterol: Soluble fiber prevents some dietary cholesterol from being broken down and digested. Over time, soluble fiber can help lower cholesterol levels or the amount of free cholesterol in the blood.

- Stabilizing blood sugar (glucose) levels: Just as it prevents fats from being absorbed, soluble fiber slows down the digestion rate of other nutrients, including carbohydrates. This means meals containing soluble fiber are less likely to cause sharp spikes in blood sugar levels and may prevent them.
- Reducing the risk of cardiovascular disease: By lowering cholesterol levels, stabilizing blood sugars, and decreasing fat absorption, regularly eating soluble fiber may reduce the risk of heart disease and circulatory conditions.
- Feeding healthy gut bacteria: Some soluble fiber-rich foods feed gut bacteria, as it is fermentable in the colon, and so it helps the bacteria thrive longer.[20,21]

Insoluble fiber

- Preventing constipation: As an indigestible material, insoluble fiber sits in the gastrointestinal tract, absorbing fluid and sticking to other byproducts of digestion that are ready to be formed into the stool. Its presence speeds up the movement and processing of waste, helping prevent gastrointestinal blockage and constipation or reduced bowel movements.
- Lowering the risk of diverticular disease: By preventing constipation and intestinal blockages, insoluble fiber helps reduce the risk of developing small folds and hemorrhoids in the colon. It may also reduce the risk of colorectal cancer.

Soluble and insoluble fiber

- Feeling satiated or full longer after meals: Soluble fiber slows down how quickly foods are digested, meaning most people feel full longer after fiber-rich meals. Insoluble fiber physically fills up space in the stomach and intestines, furthering the sensation of being full. These properties can help people manage their weight.
- Helping lower disease risk: Due to fiber's many health benefits, a high-fiber diet is associated with a lower risk of many diseases, including obesity, cardiovascular disease, diabetes, metabolic syndrome and others.[22,23]

The nutrition label on food packaging lists the amount of dietary fiber found in each serving of the product.

If a product is marketed as being high in fiber or having associated health benefits, the amount of soluble and insoluble fiber in grams (g) per serving must be listed under the dietary fiber heading. Some manufacturers may also voluntarily give the soluble and insoluble content of the fiber element of the product.

According to the FDA, foods that are considered high in fiber contain at least 20 percent of the recommended daily value (DV) of dietary fiber per serving. Foods that have 5 percent or less are considered poor sources of dietary fiber.

Beans, peas, and whole grains are high in fiber. Some fruits and vegetables are also relatively high in fiber. Common foods that are good sources of fiber Trusted Source include:

- cooked navy beans (1/2 cup contains 9.5 g)
- 100 percent ready-to-eat bran (1/2 cup contains 8.8 g)
- canned kidney beans (1/2 cup contains 8.2 g)
- cooked split peas (1/2 cup contains 8.1 g)

- cooked lentils (1/2 cup contains 7.8 g)
- cooked pinto/black beans (1/2 cup contains 7.8/7.5 g)
- cooked artichoke (one whole artichoke contains 6.5 g)
- cooked white beans/chickpeas/great northern beans (1/2 cup contains 6.3-6.2 g)
- mature soybeans (1/2 cup cooked contains 5.2 g)
- plain rye wafers or crackers (2 crackers contain 5.0 g)
- baked sweet potato with the peel (1 medium potato contains 4.8 g)
- raw pear or Asian pear (1 small pear contains 4.3-4.4 g)
- cooked green peas (1/2 cup contains 4.4 g)
- whole wheat English muffin/bread (1 muffin or 2 slices contains 4.4 g)
- cooked bulgur wheat (1/2 cup contains 4.1 g)
- raw raspberries (1/2 cup contains 4.0 g)
- boiled sweet potato without the peel (1 medium potato contains 3.9 g)
- baked potato with the peel (1 medium potato contains 3.8 g)
- stewed prunes (1/2 cup contains 3.8 g)
- dried figs or dates (1/2 cup contains 3.7-3.8 g)
- raw oat bran (1/2 cup contains 3.6 g)
- canned pumpkin (1/2 cup contains 3.6 g)
- cooked spinach (1/2 cup contains 3.5 g)
- shredded ready-to-eat wheat cereals (1 ounce contains 2.8-3.4 g)
- raw almonds (1 oz. contains 3.3 g)
- raw apple with the skin (1 medium apple includes 3.3 g)
- cooked whole wheat spaghetti (1/2 cup contains 3.1 g)
- raw banana or orange (1 fruit contains 3.1 g)[24]

A healthful diet contains a mix of both soluble and insoluble fiber. Soluble fibers are more common in foods, such as beans, peas, oats, barley, apples and citrus fruits. Good sources of insoluble fiber include beans, whole wheat or bran products, green beans, potatoes, cauliflowers, and nuts. While many fiber supplements exist, most do not contain the additional vitamins and minerals, including vitamin B and iron, found in fiber-rich foods. Supplements may also not be, as easily or fully absorbed by the body.

IV. CONCLUSIONS

It is helpful to keep some simple rules in mind when shopping or preparing meals. Good tips for increasing fiber intake include:

- Picking products that have whole grains close to the start of their ingredients list.
- Choosing foods naturally rich in fiber over supplements, such as Metamucil, Citrucel, and others.

- Eating beans, peas, or lentils on a daily basis.
- Eating at least one food daily that contains 20 percent DV per serving.
- Consuming fruits and vegetables with their skins or peels intact when possible.
- Looking up the best way to eat specific foods. The amount of dietary fiber in many foods changes, depending on whether they are raw, cooked, stewed, steamed, fried or baked.
- Picking unrefined grain and cereal products to include regularly in a diet.
- Picking whole fruits and vegetables rather than juices.
- Adding beans, peas, and lentils to soups and salads
- Adding more beans, peas, or lentils than meat, or making them the main ingredient when preparing pasta dishes, casseroles, or stir-fry.[25]
- Making dips or spreads out of chickpeas, beans, peas, lentils, and other pulses.
- Eating unsalted nuts, seeds, or dried fruits as snacks, or sprinkling them over cereals, salads, or yogurt.
- Starting the day with whole grain breakfast options, especially 100 percent ready-to-eat bran.
- Picking brown rice above the white variety.[26]

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