



A review on the role of fiber and fiber supplements in health

Shunmukha Priya S^{1*}, Suhasini Mudraganam², Vishnu Saraf³

¹ Nutrition Officer, Truweight Wellness Pvt. Ltd, Bangalore, Karnataka, India

² Chief Nutritionist, Truweight Wellness Pvt. Ltd, Hyderabad, Telangana, India

³ Chief Executive Officer, Truweight Wellness Pvt. Ltd, Bangalore, Karnataka, India

Abstract

Dietary Fiber has proved its beneficial effect on health through numerous studies. Different forms of fibers act in the body in diverse ways such as provides satiety, increases insulin sensitivity, inhibits cholesterol reabsorption, improves laxation, maintains pH of the gut and improves immunity. Studies recommend an intake of 38 to 40 g of fiber per day in the diet to avail these benefits. Though there are numerous beneficial effects of fiber in the body, studies also reported a lack of adequate intake of fiber in the diet. Hence, an attempt was made to review the beneficial role of fiber and fiber supplements in different health conditions such as obesity, diabetes, fatty liver, high cholesterol, constipation, gut health as well as immunity. Strength as well as weakness of the review and future recommendations on fiber study is also highlighted.

Keywords: Dietary Fiber, fiber supplements, health benefits, diseases

Introduction

Dietary Fiber (Fiber) forms one of the proximate compositions of any food product or a food group. It is broadly classified as soluble and insoluble fiber and has a combination of functional properties.

Definitions of Fiber

According to the Institute of Medicine Food Nutrition Board, the definition of Dietary fiber is 'nondigestible carbohydrates and lignin that are intrinsic and intact in plants' [1].

The term 'dietary fiber' (DF) was introduced in the 1950s, referring to plant cell wall materials. Later it was used to describe a class of plant-originated polysaccharides, which cannot be digested and absorbed in the gastrointestinal tract [2]. Dietary fiber is also defined as the edible part of the plant or carbohydrates that are resistant to digest and absorb in the human small intestine with complete or partial fermentation in the large intestine [3].

Though undigested, inclusion of 40g of fiber per day per person depending on gender and age, that helps in addressing issues of obesity, diabetes, dyslipidemia and so on [4]. Hence the importance of adding Fiber in the diet from foods such as millets, fresh or cooked vegetables, fruits, whole gram pulses and sprouts is very much important to attain good health and prevent lifestyle disorders [5].

In spite of such immense functional properties and health benefits, studies reported majority of the population consuming refined cereal based Indian diets leading to diseases. Through this review authors have made an attempt to highlight the benefits of fiber and role of fiber supplements.

The objective of this article is to review the health benefits of fiber and major fiber supplements that can be added in the daily diet when there is deficiency of fiber in the grain based diets. Considering the health benefits attempts must be taken to educate the population on fiber intake, addition of fiber supplements to compensate in the refined grain

diets. In the light of the above observations authors are highlighting few fiber supplements which can be consumed in the daily diet

Materials and methods

The review work was carried using in the following steps.

Literature Review

A review of literature was carried out from scopus and pubmed articles without limits to the year of publication. The search strategy involved a combination of the following sets of keywords Fiber, Fiber supplements, Health benefits, role of fiber, diseases, immunity.

Selection of Research Articles

The results were limited to review articles and original articles that were published in English and included abstracts. News, popular articles, case reports, and other original articles not associated with fiber were excluded from the review.

Inclusion and Exclusion Criteria

For this review, only studies that reported the direct effect of fiber and health benefits were included. The inclusion criteria were as follows: (i) Clinical human studies that includes observational study, randomized controlled trial, AND double-blind randomized controlled trial or single-blind, non-randomized controlled trial design, AND (ii) studies involving human adult subjects, AND (iii) studies examining the effects of fiber as a whole and not its bioactive components

The exclusion criteria were as follows: (i) studies that investigated the impacts of an individual bioactive component of fiber, OR (ii) studies on animals.

Data Extraction and Management

The articles were screened in three phases before they were included for the present review study. In the first phase, the

title of the articles that did not match the inclusion criteria were excluded. In the second phase, abstracts of the remaining studies were screened, and later, the studies that did not meet the set inclusion criteria were excluded. In order to standardize the data collection, all data extraction was performed independently with the use of a data extraction form which was MS. Excel.

Results

Search Results

The literature searches identified 65 potentially relevant articles based on the key words. Of those, 25 articles were excluded because they were not qualified based on the inclusion criteria or its bioactive compounds. The search was limited to review and original articles written in English with an abstract available, and studies only in humans.

Study presentation

The article is presented under two broad categories -

Health benefits of Dietary Fiber: In this section each health condition related to fiber is reviewed

Fiber supplements: In this section selected fiber supplements and their beneficial health action is reviewed. Strength and weakness of the study as well as future recommendations of the study is also mentioned.

Health benefits of Dietary Fiber

Prevents Obesity

Multiple studies from across the globe reported that fiber intake is important to prevent obesity and other lifestyle disorders [6]. Also, limited intake of dietary fiber is associated with obesity and heart related diseases [7]. Many clinical studies have shown a moderate weight loss of 5 to 10 per cent in obese patients reduces the risk factors of metabolic disorders by following a dietary modifications in the diet by consuming fiber rich foods [8]. The ability of fiber to reduce the glucose response of food is related to induction of satiety-related hormones like glucagon-like peptide-1, ghrelin, leptin, gastric inhibitory polypeptide, and peptide YY [9]. Indian studies reported that increased consumption of fiber in diet through intake of fruits, vegetables, whole grain cereals as well as pulses should be encouraged to lose weight [10].

Diabetes management

There are clinically proven studies that high fiber diets are beneficial in the management of diabetes. This is due to the soluble fiber content that delays glucose absorption from the small intestine and thus may help prevent the spike in blood glucose levels that follow a meal or snack [11]. Fiber intake is shown to be associated with lower postprandial glucose levels and increased insulin sensitivity in diabetic subjects. These effects were attributed to the viscous and/or gelling properties of soluble fiber [12].

Lowers Cholesterol

An urban study among the south Indian Population reported a significant positive association between low dietary fibre intake with total cholesterol and LDL-cholesterol [13]. Consumption of oat β -glucan reduces LDL cholesterol level in blood by forming a viscous layer when it enters the small intestine and inhibits intestinal uptake of dietary cholesterol

and reabsorption of bile acids. Prevention of bile acid reabsorption increases the synthesis of bile acids from cholesterol, this way reduces LDL cholesterol levels in the blood serum [14]. This leads to reduced cardiovascular diseases among the population.

Beneficial for Non Alcoholic Fatty liver Diseases (NAFLD)

Non alcoholic fatty liver disease could be majorly due to excessive intake of simple carbohydrates, saturated fats and less intake of dietary fiber as well as omega 3 fatty acid foods. Fiber plays an important role in maintaining blood glucose, insulin and free fatty acids at a constant level, in patients with NAFLD [15]. Fibers have been attributed to interference with lipid metabolism, which prevent the re-esterification of fatty acids in liver tissue and induce less synthesis and secretion of triacylglycerols [16]. Multiple studies from across the globe reported that foods with low glycemic index, dietary fiber rich cereal products, vegetables, protein rich products support overcoming fatty liver diseases.

Treats Constipation

Constipation problem is observed across the globe as well among almost all age groups. It is commonly a disorder of the gastrointestinal tract, which results in the infrequent stools or difficulty in stool passage or stool passage with pain and stiffness. This could be due to multiple reasons and inadequate fiber intake being a major causative factor. Adequate intake of dietary fiber reduces constipation in the gastrointestinal issue population [17]. Soluble fiber intake improves laxation and regularity of bowel movement with larger and soft stools during elimination of waste through the intestinal tract and prevents constipation [18]. Diets with soluble fiber such as psyllium is associated with the improvement of the symptoms in chronic constipation [19].

Improves Gut Health

Our gut harbors trillions of microbes that are highly diverse and metabolically active and is essential for normal functioning of many bodily systems [20]. These microbes undergo symbiotic that is probiotic and prebiotic co-evolution along with their host and have numerous functions such as production of various nutrients for their host, prevent infections caused by intestinal pathogens, and enhances normal immunological response. Thus, modification of the intestinal microbiota is very much essential to achieve, restore, and maintain favourable balance and the activity of microorganisms present in the gastrointestinal tract for the improved health condition of the host [21].

Enhances Immunity

The relation between intake of dietary fibers to improve immune functioning is being gradually studied across the globe [22]. Prebiotics are non-digestible fiber substances that provide a beneficial physiological effect to the host by selectively stimulating the favorable growth or activity of a limited number of indigenous bacteria. This ability of fiber to increase the growth of bifidobacteria and lactobacilli, are considered to be beneficial to overall human health. Fibers affect immune functioning via the production of short-chain fatty acids [18] in the fermentation process of dietary fibers and exerts numerous beneficial effects which includes

maintenance of epithelial barrier functions, regulation of proliferation and tumor suppression, reduction in oxidative DNA damage, and regulation of cytokine production. The fibers exhibit several anti-inflammatory effects and perform functions like the regulation of immune responses as well as in managing the inflammation [23].

Fiber supplements - Need

Studies from across the globe, Indian studies and authors earlier studies reported inadequate intake of fiber among the population irrespective of gender, physiological status and income. Hence, intake of fiber supplements are required to compensate inadequate fiber content from the grain based diets. Certain commonly available fiber supplements and their major role in the body are discussed below.

Psyllium husk

Studies show that psyllium supplementation of 10g/day for 4 weeks lowered LDL cholesterol from 6 to 24% and total cholesterol from 2 to 20%, with the greatest reductions in patients with high baseline cholesterol concentrations [24]. Psyllium husk which is a soluble fiber highly viscous, reduces low density lipoprotein cholesterol, and also maintains blood glucose. It has high water holding capacity, which softens hard stools and prevents constipation. 7 to 14g/day of Psyllium husk with more water is beneficial for people having hemorrhoids [25]. Psyllium was the only fiber supplement with sufficient clinical evidence to support recommendation for the treatment of chronic constipation [26].

Chia seeds

Salba-chia (*Salvia hispanica L.*) is one of the seeds which helps in maintaining Type 2 diabetes, reducing obesity, and thus weight management. Studies on Chia seed reported that, 100 g of chia seeds contains 34 to 40 g of dietary fibre which is equivalent to 100 % of the daily recommendations for the adult population [27]. Chia seeds have many nutritional properties as it is rich in polyunsaturated fatty acids: omega-3 and omega-6, soluble dietary fiber, also good amounts of proteins and phytochemicals. Hence are used to overcome diseases such as obesity, hypertension, cardiovascular diseases (CVDs), cancer and diabetes [28].

Black cumin seeds

Black cumin seeds (*Nigella sativa*) (*N. sativa*) have been used around the world for centuries to treat various diseases among humans. Powdered Black cumin seeds have shown a significant impact on plasma lipid concentrations, leading to lower total cholesterol, LDL-C, and TG levels while increased HDL-C [29].

Basil seeds

Basil seeds are rich with phytochemicals with numerous properties. Being fiber rich, basil seeds control sugar levels as well as cholesterol levels and helps in constipation and losing weight [30].

Flax seeds

Flaxseed is considered to be the richest source of plant lignans [31] and a half ounce of flax seeds provide 20 to 25 % of daily fiber requirements. It contains both soluble and insoluble fibers and is shown to be beneficial in lowering blood glucose levels, reducing cholesterol levels, weight

reduction and also a laxative. The insoluble fiber in flax seeds are proven to slow down the release of sugar in the blood and thus helps in reducing the blood glucose levels to great extent [32]. Studies have shown that the high intake of dietary fibers is beneficial for the prevention of obesity in both men and women [33].

Guar Gum

Guar gum is derived from the seeds of the drought tolerant plant *Cyamopsis tetragonoloba*, a member of Leguminosae family [34]. Guar gum shows cholesterol and glucose lowering effects because of its gel forming properties. It also helps in weight loss and obesity prevention as well as reducing blood glucose levels with its gelling properties. Also, due to gel forming capacity of guar gum soluble fiber, an increased satiation is achieved because of slow gastric emptying [35].

Fenugreek

Fenugreek seeds are well known for its fiber, gum, other chemical constituents and volatile contents. Fenugreek seeds contain 45.4% dietary fiber out of which 32 per cent are insoluble and 13.3 per cent are soluble. The gum is composed of galactose and mannose which are also associated with hypoglycemic effect [36]. An amount of 25 g of powdered fenu greek seeds were supplemented for a period of about one month and was found that both fasting and postprandial blood sugar levels were reduced significantly. So, it was concluded the usefulness of high fiber fenugreek diet in the management of diabetes [37].

Though beneficial, excessive intake of fiber has deleterious consequences in the body such as bloating, flatulence, constipation, low mineral absorption such as iron, calcium deficiency etc. Studies have been reported that high intake of dietary fiber is associated with bone loss and reduced mineral absorption in men.

Strength and weakness of the present study

Health benefits of fibre and different fiber supplements were reviewed in this article. Disadvantages of lack of dietary fibre intake are mentioned with studies supporting disease disorder of low dietary fibre intake consequences. Recommendation according to different age, gender, health status of individuals are limited. Also, only metabolic diseases were discussed in this review. Anti-cancer effect of fiber hasn't been reviewed.

Future recommendations of the study

Dietary fibre role in body weight management, disease control, development of convenience foods rich in dietary fibre to improve health status of urban population where prevalence of obesity is more common has to be studied and reported.

Conclusion

This review article highlights the beneficial role of fiber in preventing metabolic diseases. Also, inclusion of the fiber supplements to compensate the refined grain based diet would enhance the health and prevent as well as manage the metabolic diseases to an extent. Including adequate amounts of fiber in the daily diet through effective nutrition education may prevent the onset of lifestyle diseases and its complications.

Acknowledgement

The authors thank Truweight management for providing necessary support for the work.

Conflict of interest

Nil

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