

Dietary Fibre and its Effect on Health

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ABSTRACT

Dietary fibre constitutes the edible parts of plants, or similar carbohydrates, that are resistant to digestion and absorption in the small intestine. The health benefits of dietary fibre have long been appreciated. Higher intakes of dietary fibre are related to less cardiovascular and other diseases. It also plays a vital role in maintaining gut health. The aim of this article is to review the health benefits of dietary fibre.

Key words: Dietary fibre, Health effects, Prebiotic.

Introduction

The term dietary fibre was coined by Hipsley [1] as nondigestible constituents making up the plant cell wall and further this definition was revised several times. American Association of Cereal Chemists defined dietary fibre as the edible parts of plant or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine with complete or partial fermentation in the large intestine. Dietary fibre includes polysaccharides, oligosaccharides, lignin and associated plant substances [2]. Dietary fibre is naturally present in cereals, vegetables, fruits & nuts.

Recommended intake

Recommendations for dietary fibre intake are related to age, gender, and energy intake [3, 4]. Using the energy guideline of 2000 kcal/day for women and 2600 kcal/day for men, the recommended daily dietary fibre intake is 28 g/day for adult women and 36 g/day for adult men [5].

Types of dietary fibre

Dietary fibre includes soluble dietary fibre (SDF) and insoluble dietary fibre (IDF). SDF refers to fibres that cannot be digested or absorbed by human bodies however are partly soluble in water. Examples of SDF are pectin, gum arabic, guar gum, glucan, and some biological and synthetic polysaccharides. IDF cannot be digested or absorbed by human bodies and is insoluble in water. IDF includes components of the structure of cell walls, such as cellulose, hemicellulose, and lignin [6].

Effect on health

Cardiovascular health

Cardiovascular diseases, are the leading causes of mortality which include coronary heart disease (CHD), stroke, and hypertension [7]. Several studies suggest that sufficient fibre intake lowers the risk of coronary heart disease (CHD), through decrease in low density lipoprotein (LDL) levels [8, 9]. The results of randomized clinical trials are inconsistent, however recommend that fibre may play a beneficial role in reducing C-reactive protein levels, apolipoprotein levels and blood pressure, which are all biomarkers for coronary disease. Water soluble fibres (specifically, beta glucan, psyllium, pectin, and guar gum) were most successful for lowering serum LDL cholesterol concentrations, without influencing high density lipoprotein concentrations [4].

Obesity

Numerous studies indicate an inverse relationship between dietary fibre intake and change in body weight. Tucker and Thomas [10] supported this statement in a study comprising of 252 middle aged women over a period of 20 months. The participants lost an average of 4.4 lbs due to an 8 g increase in dietary fibre per 1000 kcal. The ability of dietary fibre to decrease body weight or attenuate weight gain could be contributed to several factors. Soluble fibre, when fermented in the large intestine, produces glucagon like peptide (GLP-1) and peptide YY (PYY) [11]. These two gut hormones play a role in initiating satiety. Dietary fibre may also fundamentally diminish energy intake [12]. Baer et al [13] observed that an increased consumption of dietary fibre decreases diet's metabolizable energy (ME), which is gross energy minus the energy lost in the feces, urine and combustible gases.

Diabetes

Over the past several years type two diabetes has increased exponentially. Carbohydrates with a low glycemic index results in a smaller glucose/insulin response while as carbohydrates with a higher glycemic

index has been known to increase blood glucose levels that leads to the dysfunction of beta cells in the pancreas thus decreasing insulin release. Also due to an over abundance of energy (high glycemic load) tissues for example skeletal muscle, liver and adipose become resistant to insulin. Regular consumption of fibre can attenuate glucose absorption rate, anticipate weight gain, and increase the beneficial nutrients and antioxidants in the diet, which may help prevent diabetes. Early research regarding soluble fibre suggests delayed gastric emptying and decreased absorption of macronutrients, resulting in lower postprandial blood glucose and insulin levels [14]. This is most likely due to the viscosity of soluble fibres inside the GI tract, as different types of soluble fibres have variable effect on viscosity and nutrient absorption. Guar has the highest viscosity as well as the greatest effect at decreasing postprandial blood glucose. Thus, it is assumed that an increased level of soluble fibre is associated with a decreased risk of diabetes [15,16]. Insoluble fibre only has a small effect on macronutrient absorption [17]. Some other studies suggest that the passage rate of foodstuff through the GI tract is enhanced by insoluble fibre intake thus resulting in a decreased absorption of nutrients, namely simple carbohydrates. The mechanisms behind insoluble fibre are more peripheral and not limited to nutrient absorption. [18] Some studies suggest that insoluble fibre can result in a reduced appetite and food intake [19]. This may lead to a decreased caloric intake and BMI. Short chain fatty acids, via fermentation, have also been reported to reduce postprandial glucose response [20, 21].

Laxation

It is well recognized that fibre is important for normal laxation due to the ability of fibre to increase stool weight. The increased weight is due to the physical presence of the fibre, water held by the fibre, and increased bacterial mass from fermentation. Larger and softer stools increase the ease of defecation and lessen transit time through the intestinal tract, which may mitigate constipation. In general, cereal fibres are the most effective at increasing stool weight [22]. Inulin, although extensively fermented, has little impact on stool weight [23], with less than a 1 g/ increase in stool weight with each g fibre fed as inulin.

Prebiotic effect and SCFA production

Fermentable fibres may provide various health benefits by altering the composition of the intestinal flora. Prebiotics are non-digestible substances that provide a beneficial physiological effect to the host by selectively stimulating the favourable growth or activity of a limited number of indigenous bacteria. This generally refers to the ability of a fibre to increase the growth of bifidobacteria and lactobacilli, which are considered beneficial to human health. Inulin and oligofructose have been extensively studied as prebiotics, and have been shown to significantly increase fecal bifidobacteria at fairly low levels of consumption (5–8 g per day) [16, 22]. Fermentable fibres that don't meet the definition for prebiotics still provide health benefits via production of SCFAs. The three most abundant SCFAs are acetate, propionate, and butyrate, each of which exerts unique physiological effects. Of these, butyrate is the most beneficial in terms of colonic health. Butyrate is the preferred energy source for colonic epithelial cells, and promotes normal cell differentiation and proliferation. SCFAs also help manage sodium and water absorption, and can improve assimilation of calcium and different minerals. Furthermore SCFAs lowers the colonic pH, which can restrain development of potential pathogens and promote the growth of bifidobacteria and lactobacilli. Different fibres produce variable amounts of SCFA at different rate. Short chain molecules, such as FOS, are generally fermented more rapidly than larger, longer chain molecules such as acacia gum[22].

Conclusion

Dietary fibre plays an important role in human health, with confirmed physiological benefits. The role of fibre in health has extended far beyond improved laxation and includes benefits for cardiovascular disease, weight management and colonic health. Since fibre intakes around the world are less than half of recommended levels, increasing fibre consumption for health promotion and disease prevention is a critical public health goal.

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