ISSN: 2347-467X, Vol. 06, No. (2) 2018, Pg. 354-358

Current Research in Nutrition and Food Science

Journal Website:www.foodandnutritionjournal.org

Wholegrains in the Management of Diabetes

ANJALI MUKERJEE

Health Total Pvt. Ltd., Andheri (West), Mumbai, Maharashtra, India.

Abstract

Dietary fibre is responsible for the decrease in the rate of glucose absorption along with aiding decrease in postprandial rise in blood glucose. Substantial research establishes the connection between consumption of wholegrains and type 2 diabetes management. Wholegrains are widely recognized for contributing significantly to our health and well-being as they contain essential nutrients and bioactive compounds, along with being rich in dietary fibre. This review article attempts to discuss the effect of the fibre in wholegrains on blood glucose, type 2 diabetes and HbA1c.

Article History

Received: 15 February 2018
Accepted: 20 August 2018

Keywords

Blood glucose
Diabetes,
Dietary fibre,
Wholegrains.

Introduction

Obesity is found to be a significant risk factor for type 2 diabetes[1]. Control of body weight by balancing calorie intake, increasing fibre and eating low glycemic index food along with appropriate exercise, to increase calorie expenditure is of major importance. Consumption of dietary fibre may provide protection against type 2 diabetes, mainly because of its soluble fibre fraction, as it is slowly digested and absorbed, thus resulting in reduced insulin demand[2]. Whereas, the insoluble fraction reduces transit time through the gastrointestinal tract[3], thereby giving carbohydrates less time to be digested and absorbed[4]. Wholegrain foods are rich in dietary fibre, and hence highly beneficial to manage diabetes.

In order to manage type 2 diabetes, we need to limit our saturated fat intake, consume more of monounsaturated fats, along with some amount of polyunsaturated fats, limit sugar and salt intake, and increase vegetable intake. However, apart from these, wholegrains should also be included in the diet. Grains of cereals, for example brown rice, whole wheat, oats, maize, corn etc., contain three main components namely- the endosperm (the middle part of the grain, rich in starch), germ (the innermost part of the grain which gives rise to the embryo) and the bran (the coarse outermost layer of the grain)[5], these together are referred to as the wholegrains, as opposed to refined grains that contains only the endosperm part. The percentage of bran and germ varies from cereal to cereal, but

CONTACT Anjali Mukerjee anjali@health-total.com Health Total Pvt. Ltd., Andheri (West), Mumbai, Maharashtra, India.

Doi: http://dx.doi.org/10.12944/CRNFSJ.6.2.10

the endosperm portion is constant, at about 80% of the entire grain.

When grains are milled, most of the nutrients are lost and what remains is only the starchy endosperm of the grain[6], also known as refined grain. The lost components have important health benefits, such as beneficial effects on glucose metabolism[7]. Wholegrains maybe consumed either whole, for example oats and brown rice, or in the form of cracked wheat such as bulgur wheat or they are used to make flour to prepare food items like bread[5]. When a grain contains more than 51% of its total components (i.e. the germ, bran and the starchy endosperm), by weight per serving, then they can be classified as a wholegrain[8].

Dietary Fibre

Dietary fibre is defined as the non-starchy indigestible part found in plant sources. Fibre is usually indigestible by the intestinal enzymes and are classified as soluble and insoluble fibre. According to studies, only the water-soluble fibre significantly affects the post-meal glucose concentration and the serum cholesterol concentration. Such fibre is fermented by the action of colon bacteria and that leads to the formation of short-chain fatty acids[9], such as butyric acid, acetic acid that maybe transported to the liver for energy metabolism. This fermentation process also releases carbon dioxide and hydrogen as byproducts[10,11].

Discussion

Role of Fibre on Blood Glucose

Both the soluble and insoluble fibre fractions are thought to affect type 2 diabetes. Although a few studies showed no differentiation in the response of soluble and insoluble fibre on the management of diabetes[12].

Soluble fibre binds to water available in the intestine, forming a gel-like matrix, in which it binds and traps glucose, which is then ejected even before glucose can be absorbed. One of the possible hypothesis could be the reduction in the digestive enzymatic activity in the intestinal lumen[9], or an alteration in hormone secretion by the gut mucosa cells[13,14]. Another contributing factor could be that the soluble fibre forms a viscous gel in the gastrointestinal tract and consequently delaying transit time[15], thereby reducing carbohydrate absorption, leading to lesser postprandial blood glucose and insulin levels[16]. The viscous material formed by the soluble fibre restricts the movement of water and glucose to the walls of the intestine, thus resulting in slow absorption of glucose.

A number of research studies demonstrated that consumption of insoluble fibre is inversely related to the risk of type 2 diabetes. Intake of insoluble fibre results in low absorption of carbohydrates, due to its ability to increase the food passage rate through the gastrointestinal tract[16]. However, due to overlap in function between the two types of fibres and difficulty in evaluating the physiological and chemical effects between the two, the National Academy of Sciences has advocated that the terms soluble and insoluble fibre, 'gradually be eliminated and substituted with specific beneficial physiological effects of a fibre[17].

It is of great interest to note that, fibre from fruits and vegetables was found to have no effect on type 2 diabetes risk, according to a large scale epidemiological study (cohort study comprising of 42,759 men). This study found that dietary fibre from whole cereal grains demonstrated substantial decrease in the incidence of type 2 diabetes, whereas, dietary fibre from fruits and vegetables showed no such effect[16]. However, it is important to note that consuming more low GI fruits and vegetables is highly beneficial for managing type 2 diabetes[18]. Fruits and vegetables also have powerful antioxidant properties which are beneficial for type 2 diabetes[19].

Impact of Consuming a Diet Rich in Wholegrains on Diabetes - the Research

Adding more wholegrains to daily diet is a healthy choice for the whole family and not just for people with diabetes. Wholegrains are considered to have low glycemic index[5], and therefore help manage blood glucose levels better. However, one needs to be careful with the portion sizes one consumes, as wholegrains are rich in carbohydrates and may increase the glycemic load if too much is consumed.

Many research studies point out to the lifestyle disease (type 2 diabetes, stroke, heart disease) risk reduction effect of a wholegrain rich diet. Wholegrain foods also keep the gut healthy due to the presence

of phytochemicals. Wholegrain foods have a high satiety value as they are rich in fibre and therefore help in weight management[5].

The way wholegrain foods are hypothesized to work is that they may affect the homeostatic regulation of blood glucose, along with regulating the various functional effects related to the neuro-hormonal responses controlling the glucose homeostasis. The presence of minerals such as magnesium and chromium, phytochemicals, organic acids and enzyme inhibitors in wholegrain foods along with its high fibre content, all work together to influence the digestion and absorption process of carbohydrates[8].

In 2002, Fung *et al.,* published a prospective study conducted in men, to see the effect of wholegrain intake on type 2 diabetes. In this study men suffering from type 2 diabetes were asked to consume a diet high in wholegrains. This study associated high fibre diet with declining risk of type 2 diabetes[20].

In another cohort study, healthy men and women (2286 and 2030, respectively) were recruited. Their diet recall and everything they ate between 1966 and 1972 was recorded. During the 10-year followup, it was found that 54 men and 102 women (from a nationwide register) developed type 2 diabetes. Further research into their diet reflected that those who consumed wholegrains were found to have a reduced risk of type 2 diabetes, according to this study[21]. Therefore, this study suggests an inverse relationship between wholegrain intake and the risk of type 2 diabetes.

Another large cohort study (based on 6 cohort study data) on type 2 diabetics was followed up for 12-18 years. They concluded that increasing the wholegrain consumption by two servings everyday was connected with a 21% decline in the risk of type 2 diabetes[22]. Another longitudinal study investigated the outcome of consumption of wholegrain fibre on the risk of type 2 diabetes and other metabolic risk factors. According to this study, those consuming 3 to 5 servings of wholegrains everyday had a 26% reduced risk of type 2 diabetes during the 8-13 year followup[23]. Findings from this study support the claim that increase in wholegrain consumption is beneficial to prevent type 2 diabetes.

Role of Fibre Intake on HbA1c Response

Research suggests that a diet rich in dietary fibre lowers the glycemic load and protects against insulin resistance in some, but not all. This effect is mediated through a reduction in postprandial glucose concentration, insulin demand, and insulin resistance via altering β-cell function.

According to a Cohort study, fibre intake influences the HbA1c levels differently in different genotypes of the TCF7L2 gene. High dietary fibre consumption inversely affected the prevalence of type 2 diabetes only in the CC genotype individuals. CC individuals showed a significant decrease in HbA1c levels, along with a decreased frequency of type 2 diabetes with high fibre intake. The T allele of TCF7L2 gene was found to be linked with raised HbA1c level and increased risk of type 2 diabetes. This effect magnified with high fibre intake. Therefore, according to this study, the protective effect of high fibre intake was seen only among the CC genotype individuals, whereas the TT genotype carriers were deprived of this protection altogether, and the CT individuals showed intermediate results[24].

The study inferred that dietary fibre consumption may perhaps alter the relationship between TCF7L2 gene and the incidence of type 2 diabetes. Consuming high fibre may provide protection from type 2 diabetes only to the non-risk allele carriers, i.e. CC genotype and not to the CT and TT genotype carrier.

Conclusion

Type 2 diabetes is a complex disease precipitated due to poor lifestyle, genetics and wrong food consumption. Intake of wholegrains is found to benefit reduction in both fasting blood glucose and postprandial blood glucose, due to its high fibre content. Although several studies have reported a protective association between consumption of wholegrains and type 2 diabetes, mainly due to their high fibre content, it is interesting to note that individuals with the genetic background having the TCF7L2 risk allele TT, lack this protection, whereas this protective effect is limited to TCF7L2 non-risk CC genotype carriers. However, according to Hindy *et al.,* (2012), his observations that the TCF7L2 risk allele TT carriers do not benefit from high fibre intake in reducing their HbA1c, cannot be translated into

dietary advice. However, it does raise a question, whether a high fibre intake is beneficial for type 2 diabetes in 'all' individuals.

Wholegrains apart from being rich in B vitamins, minerals and antioxidants have a low glycemic index and high satiety value. Therefore, practicing portion control is easy and glycemic load can be reduced. Wholegrain consumption is recommended over refined grains. But in individuals having TCF7L2 risk allele TT, fibre in the form of isabgol, methylcellulose or wheat dextrin should be avoided so as to prevent risk of type 2 diabetes.

Aknowledgement

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest

Author confirms that there are no conflicts of interest.

References

1. https://skemman.is/handle/1946/12063
2. Slavin JL, Martini MC, Jacobs DR Jr, Marquart L. Plausible mechanisms for the protectiveness of whole grains. *Am J Clin Nutr*.1999;***70***(suppl):459S–63S.
3. Anderson JW. Physiological and Metabolic Effects of Dietary Fiber. *Fed Proc*.1985;***44***: 2902-6.
4. Anderson JW, Bryant CA. Dietary fiber: diabetes and obesity. *Am J Gastroenterol*.1986; ***81***:898–906.
5. https://www.diabetes.org.uk/guide-to-diabetes/enjoy-food/carbohydrates-and-diabetes/wholegrains-and-diabetes-
6. http://www.health.state.mn.us/divs/hpcd/chp/cdrr/nutrition/facts/wholegrains.html
7. Weickert MO, Mohlig M, Schofl C, Arafat AM, Otto B, et al. Cereal fiber improves whole-body insulin sensitivity in overweight and obese women. *Diabetes Care*.2006;***29***: 775-80.
8. Liu S. Whole-grain foods, dietary fiber, and type 2 diabetes: searching for a kernel of truth. *Am J Clin Nutr*.2003;***77***:527–9.
9. Nuttall FQ. Dietary Fiber in the Management of Diabetes. *Diabetes*.1993;***42***(4):503-8.
10. Cummings JH. Microbial digestion of complex carbohydrates in man. *Proc Nub Soc*.1984; ***43***:35-44.
11. Wijrsch P. Dietary fiber and unabsorbed carbohydrates. *In Sugars in Nutrition*.1991;***25***. Gracey M, Kretchrner N, Rossi E, Eds. New York, Raven,p. 153-68.
12. Schulze MB, Liu S, Rimm EB, Manson JE, Willett WC, Hu FB. Glycemic index, glycemic load, and dietary fiber intake and incidence of type 2 diabetes in younger and middle-aged women. *Am. J. Clin. Nutr*.2004;***80***:348-56.
13. Meyer JH, Gu YG, Jehn D, Taylor IL: Intragastric versus intraintestinal viscous polymers and glucose tolerance after liquid meals of glucose. *Am J Clin Nutr*.1988;***48***: 260-66.
14. Morgan LM, Goulder TJ, Tsiolakis D, Marks V, Alberti KGMM. The effect of unabsorbable carbohydrate on gut hormones. *Diabetologia*.1979;***17***:85-9.
15. Schneeman BO. Dietary fiber and gastrointestinal function. *Nutr Res*.1998;***18***: 625-32.
16. Lattimer JM and Haub MD. Effects of Dietary Fiber and Its Components on Metabolic Health. *Nutrients*.2010;***2***(12):1266-89.
17. Baliga BS, Bloomgarden Z and Nonas C. 2006. Nutritional Strategies for the Diabetic/ Prediabetic Patient. Edited by Jeffrey I. Mechanick, Elise M. Brett. CRC Press. p: 81-105
18. Mohammad A. The role of fruits, vegetables, and spices in diabetes. *Int J Nutr Pharmacol Neurol Dis*.2011;***1***(1):27-35.
19. Carter P, Gray LJ, Troughton J, Khunti K, Davies M. Fruit and vegetable intake and incidence of type 2 diabetes mellitus: systematic review and meta-analysis. *The BMJ*.2010;***341***:c4229.
20. Fung TT, Hu FB, Pereira MA, Liu S, Stampfer MJ, Colditz GA, Willett WC. Whole-grain intake

and the risk of type 2 diabetes: a prospective study in men. *Am J Clin Nutr*.2002;***76***: 535–40.

21. Montonen J, Knekt P, Järvinen R, Aromaa A, Reunanen A. Whole-grain and fiber intake and the incidence of type 2 diabetes. *Am J Clin Nutr*.2003;***77***:622–9.
22. de Munter JSL, Hu1 FB, Spiegelman D, Franz1 M, van Dam RM. Whole Grain, Bran, and Germ Intake and Risk of Type 2 Diabetes: A Prospective Cohort Study and Systematic Review. *PLoS Med*.2007;***4***(8):e261.
23. Ye EQ, Chacko SA, Chou EL, Kugizaki M, Liu S. Greater Whole-Grain Intake Is Associated with Lower Risk of Type 2 Diabetes, Cardiovascular Disease, and Weight Gain. *J Nutr*.2012;***142***(7):1304-13.
24. Hindy G, Sonestedt E, Ericson U, Jing XJ, Zhou Y, Hansson O, Renström E, Wirfält E, Orho-Melander M. Role of TCF7L2 risk variant and dietary fibre intake on incident type 2 diabetes. *Diabetologia*.2012;***55***: 2646–54.