



Different Approaches to Manage Type-2 Diabetes: Special Emphasis on Dietary Fibre



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Abstract

In recent years, several deaths have been reported due to diabetes worldwide and India is no exception. A proper care of diet and constant medication is the only way to counter this disease presently. It is very difficult for a diabetic patient to keep a tab on his cumbersome diet plan and this has led to an enormous responsibility on scientists, particularly those related to food and nutrition, to look for solutions to this problem. High sugar or starch-containing foods are the target foods which diabetic patients cannot consume in a normal quantity. Actually, these foods have high glycemic index and increase the blood sugar level abruptly after their consumption and unfortunately, such foods are mostly staple like rice and wheat products and are an integral part of any diet throughout the world. In countries like India the consumption of rice and/or wheat is directly related to the satiety value of people and if someone skips rice or bread from his meals, he remains hungry psychologically. So, it is very difficult to have a control on the consumption of such foods. Incorporation of dietary fibre in such foods is one of the best solutions for this problem and market is providing consumers with a variety of such products. Dietary fibre has an ability to absorb the glucose in the small intestines and ensure a controlled release of this glucose into the bloodstream, thus, preventing the abrupt rise in blood glucose level. Both the demand and the variety of dietary fibre fortified foods are on the increase which is undoubtedly a positive sign. This mini-review presents the approaches presently being administered and researched to prevent and control diabetes including the role of different drugs and diet management.

Keywords: Dietary fibre; Glycemic Index; Diabetic; Blood Glucose; Insulin

Introduction

Type 2 diabetes occurs due to deficiency of insulin (malfunctioning of pancreatic beta cells) or by insulin resistance which affects the glucose transportation from blood to cells. In 1985, the diabetic population of the world was 30 million which has increased to 415 million in 2015 and is expected to cross 642 million in the year 2040 [1] and this alarming prevalence may be attributed to obesity, lifestyle, stress, and bad diet [2]. Type 2 diabetes can be prevented by controlling the obesity, practicing exercise and reducing glucose intake [3,4]. Foods with a high glycemic index like sugar cannot be consumed by diabetic patients in a normal quantity. Upon consumption, such foods can abruptly increase the blood sugar level. Staple foods like rice and wheat including their products which are an integral part of any diet throughout the world are also grouped under such category. Asking people to avoid such food that is a part of the culture and is being consumed from generations is not-at-all an easy task. One of the possible solutions to this problem may be the modification of the nutritional composition of traditional foods with least compromise in sensory quality attributes, for instance, incorporation of dietary fibre. Dietary fibres have been reported to possess many health benefits. Dietary fibres are the non-digestible part of edible foods which can be soluble or insoluble. Fruits are the good source of soluble fibre

whereas cereals are a good source of insoluble fibre. Among the different health benefits, the postprandial control of blood glucose levels after the consumption of high glycemic index foods has been shown by different fibre sources [5,6,7].

Medicines for type 2 diabetes

Type 2 diabetes is a threat to our society and precise medication and highly personalized approach is the hope to achieve better outcomes. Many useful medications are available in the market that has been used to treat type 2 diabetes. Some of them are discussed as.

Metformin

The trade name for metformin is Glucophage and is used as a first line medicine for the treatment of type 2 diabetes. Liver glucose production is suppressed (hepatic gluconeogenesis) by the consumption of metformin hence, there is a decrease in the blood glucose level.

Glucagon-Like Peptide 1 Receptor Agonists

This drug is used for the treatment of type 2 diabetes. It maintains the normal blood glucose levels in the body by increasing the insulin secretion from the pancreas in addition to slowing the process of glucagon secretion.

Thiazolidinediones

These are the compounds which regulate lipid and glucose metabolism in liver, muscles and adipose by activating the peroxisome proliferator-activated receptor-gamma due to which insulin sensitivity increases and blood glucose level decreases.

Sulfonylurea as bind to ATP sensitive K⁺ and close channels in the beta cell membrane and cause depolarization which increases the intracellular calcium. This, in turn, leads to increase in the fusion of insulin vesicles with the cell membrane and thus increases the secretion of insulin.

Acarbose is an inhibitor of alpha-glucosidase which is used in the patients with type 2 diabetes. It delays the carbohydrate digestion and absorption in intestines hence decreases the postprandial hyperglycaemia.

Dipeptidyl peptidase 4 inhibitor prevents the degradation of in cretins and stimulates the insulin release in addition to inhibition of glucagon release thereby lowering the body blood glucose level.

Sodium-Glucose co transporter 2 (SGLT2 inhibitors) is a protein found in apple bark with powerful anti-diabetic effects. It increases the urinary excretion of glucose by inhibiting the SGLT2 which otherwise reabsorbs the glucose from urine thus lowering the blood glucose level.

Insulin is produced by the DNA recombined technique and is administered as subcutaneous injections by using syringes, pumps, inhalers or insulin pens [8].

The estimated cost of the drugs recommended to diabetic patients has estimated at more than \$100 billion per year in the United States alone. Drugs in use for type 2 diabetes are 2 to 3 times costlier compared to drugs for other diseases. People

in developed countries are able to procure such drugs but for the other countries where most of the people are economically weak, alternatives to these expensive drugs are the need of the hour [9]. Since, this disease is directly related to what we eat, so nutritionally modified foods for diabetic people can be one such alternative.

Dietary Fibre and Diabetics

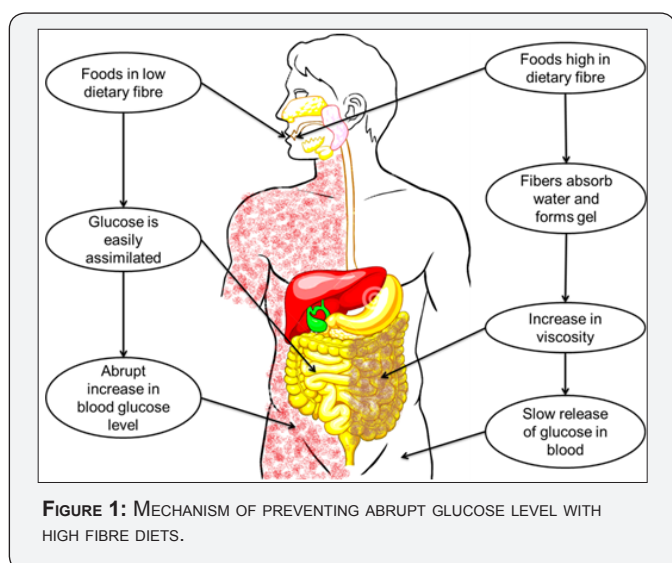
The consumption of high carbohydrate-containing foods increases the blood glucose level of diabetic patients abnormally and therefore, such patients need to take necessary precautions after consumption of high carbohydrate meals. Diet management has reportedly shown promising results in dealing with diabetes. There are several dietary approaches to control the blood glucose. Type and the amount of the carbohydrate affect the blood glucose level [10]. One can manage the carbohydrate intake by keeping the amount of carbohydrate intake constant and incorporating appropriately fixed dose of insulin or another hypoglycemic drug. On the other hand, a patient can follow the carbohydrate counting method. In this approach, a patient's diet does not remain constant so the patient has to adjust insulin intake accordingly [10].

Some functional foods have been studied for a long time now for their possible role in prevention and treatment of diabetes and at the same time fulfilling the criteria of being a complete food. Among such foods, those high in dietary fibre content have shown a versatile effect on blood glucose control. Foods can either be naturally rich in dietary fibre or incorporation of dietary fibre in foods is also possible and both have been proven to be useful for the diabetic patients [11,12,13,14]. Lot of work has been done on the incorporation of dietary fibre, a few examples of which have been summarized in Table 1.

Table 1: Dietary fibre incorporated foods useful for diabetic patients.

S. No.	Food Product	Type of fibre	References
1	Bread	Dietary fibre and L-carnitine	[15]
2	Flat bread	Banana peels	[16]
3	Jam	Tomato pomace	[17]
4	Noodle, steamed bread or bread	Okara (by-product of tofu)	[18]
5	Cookies	Mosambi peel	[19]
6	Papaya Jam	Mosambi peel	[20]
7	Sausages	Apple pomace	[21]
8	Sausages and Patties	Pineapple pomace	[22]
9	Cookies	Grape pomace and grape seed flour	[23]
10	Cake	Gilaburu fruit pomace	[24]
11	Wheat chips	Barley Flour	[25]
12	Biscuit	Mango peel powder	[26]
13	Cookies	Extruded orange pulp	[27]

In addition to dietary fibre incorporated foods, consumption of whole foods is also believed to be beneficial for diabetic patients. The whole foods are minimally processed or refined in which most of the edible part is retained and the addition of additives and other artificial substances is avoided. The whole foods include cereals, fruits, vegetables, pulses and others. Several epidemiologic studies have concluded that the diets rich in whole grains may safeguard against type 2 diabetes [28,29]. The positive effects of whole grains on diabetics have been attributed to the presence of biologically active constituents, including dietary fibre [30]. Fruit is an important component of our daily diet. In addition to the bioactive compounds, fruits are a good source of soluble fibre. Some of the fruits high in dietary fibre content are litchi, durian, jackfruit, mangosteen, pomegranate, guava and avocado [31,32,33]. Whole pulses are also a good source of low glycemic index carbohydrates and contain 4 to 7% of dietary fibre [34]. Vegetables are low in sugars and contain a good amount of fibre which can help in preventing the abrupt blood glucose level when consumed with meals. From the above discussions, it may be concluded that there is a positive link between dietary fibre intake and prevention and control of diabetes, the mechanism of which is simply summarized in Figure 1.



Conclusion

Prevention of any disease is the best possible solution to it but that may not be practical always. Food has got a direct role in the onset as well as management of type-2-diabetes. A proper diet as per the physical requirements of a person can minimize the risk of getting diabetic. Any person who is suffering from diabetes can better manage the disease by following a proper diet plan. The role of dietary fibre in blood glucose management is well established and the diabetic people are being benefitted by foods which are high in dietary fibre naturally or in which dietary fibre has been incorporated. Although a wide range of high fibre foods are already available

and the new ones are hitting the market regularly, the need is to bring such changes in the regular meals in addition to making them more economical.

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