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Research Article
Effect of Wheat Bran on Anthropometric Measures, Serum Glucose and Lipid Profile in Type 2 Diabetes Patients

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Abstract

Background and Objective: Type II diabetes mellitus represents one of the most serious and widely spread chronic diseases. The aim of the study was to investigate the effects of wheat bran fiber in type II diabetes mellitus patients. **Materials and Methods:** The study was carried out in Makkah among 160 diabetes individuals who were randomly selected. The subjects consumed 40 g per day of wheat bran for 30 days. Anthropometrics measurement and blood samples were taken for various biochemical analyses before and after the experimental period. Data were analysed using the SPSS program. Using a t-test to compare the significant differences between the measures associated with the subject before and after taking the bran. **Results:** Findings indicate that the consumption of 40 g per day of wheat bran for 30 days offers an improvement in fasting glucose levels and the level of serum lipids along with total cholesterol, very low-density lipoprotein and triglyceride. Moreover, wheat bran is shown to have other beneficial effects regarding the reduction of weight in obese diabetic patients. **Conclusion:** It was concluded that wheat bran has beneficial effects in patients with diabetes mellitus and obesity. As such, it should be encouraged as a disease management strategy. However, additional studies focused on the long term consumption of dietary fiber are needed.

Key words: Type II diabetes mellitus, wheat bran, serum lipids, glucose level, triglycerides, total cholesterol, dietary fiber

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Diabetes Mellitus (DM) represents one of the most serious and widely spread chronic diseases, which affects people all over the world. It is a chronic metabolic disorder syndrome resulting from a variable interaction of hereditary and environmental factors. The main pathophysiological features of type 2 diabetes are impaired insulin secretion and increased insulin resistance. The impairment of pancreatic β cell function notably shows progression over time in type 2 diabetes[1]. Dietary fiber denotes carbohydrate polymers[1] with 10 or more monomeric units[2], which are not hydrolyzed by the endogenous enzymes in the small intestine of humans[2]. The digestive and viscosity characteristics of dietary fiber are the likely modes of action that affect diabetes and obesity risk. These mechanisms appear to decrease nutrient absorption, therefore, decreasing metabolizable energy. Dietary fiber may also be able to decrease gross energy of a food due to its lower energy density[3]. Many studies utilize soluble fiber in the context of a healthy diet and these have been shown to potentially play a role in managing daily glucose levels both in healthy individuals and individuals with impaired glucose metabolism[4]. Diabetes, a disease highly prevalent among the Saudi population, represents a serious clinical and public health problem. The incidence and prevalence rates of T1DM and T2DM in Saudi Arabia were found to be high and rising, particularly among women. In Saudi Arabia there are many socioeconomic, dietary and lifestyle factors linked with DM. Comprehensive studies on the role of these factors and their contribution towards the incidence of DM, are the need of the hour. It is highly possible that healthy practices connected with the prevention and management of DM can easily be implemented in a manner that does not conflict with the cultural mores of Saudi Arabia[5,6].

This study aims to investigate the possibility of using dietary fiber, such as wheat bran, for the management of diabetes mellitus type 2 in patients' residences in Holy Makkah, Saudi Arabia.

MATERIALS AND METHODS

Study area: The study was carried out at Department of clinical nutrition, Umm Al Qura University, Saudi Arabia from September, 2017-March, 2018.

Subjects: Participants in this study (160 patients) were randomly selected, though all were suffering from type II diabetes and had BM ranging between 21-36 kg m^{-2}. The subjects included 88 females (56 of whom were obese, 24 who were overweight and eight of whom were of normal weight) and 72 males (24 who were obese, 24 who were overweight and 24 who were of normal weight). Their ages ranged from 40-60 years old. About 16 (10%) of the patients were over 60 years old.

The protocol was approved by the Faculty of Applied Medical Sciences Research Ethics Committee at Umm Al Qura University, Saudi Arabia and each of the subjects was provided with informed consent before their participation. All applicable institutional regulations concerning the ethical use of human volunteers were followed during this research process.

Anthropometric measurements: Anthropometrics is the gold standard for the assessment of nutritional status. Body Mass Index (BMI) is frequently used as a popular and rapid clinical measurement of relative obesity and malnutrition[7]. BMI<18.5 was categorized as underweight; a BMI between 18.5 and 24.9 was categorized as a normal weight class; a BMI between 25.0 and 29.9 was categorized as overweight; a BMI between 30.0 and 34.9 was categorized as obesity class 1; a BMI between 35.0 and 39.9 was categorized as obesity class 2 and a BMI$\geq$40.0 was categorized as obesity class 3[8].

Wheat bran intake: Wheat bran was purchased from the Makkah local market.

Biochemical analysis: Blood samples were taken from superficial blood vessels of the subjects before and after the experimental period. The serum was separated from the blood after 30 min of waiting. Afterward, we centrifuged the blood sample at 3000 rpm. Laboratory investigations included the following: Fasting blood glucose, triglycerides, total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and very low-density lipoprotein (VDLP). Each of these measures was determined according to the standard procedures[9].

Statistical analysis: Our Statistical analysis was performed by using a computer program statistical package for the social sciences (SPSS), program version 20.0. The universal analysis was conducted using a t-test to compare the significant differences between the measures associated with the subject before and after taking the bran. The $p<0.05$ values were considered to be statistically significant.

Table 1: Effect of wheat bran intake on anthropometric measurement in diabetic patients

Parameters	Before intervention (Mean±SD)	After intervention (Mean±SD)	p-value
Weight	81.34±14.50	78.40±14.06	0.05
BMI	29.48±4.18	27.11±3.96	0.05

Table 2: Effect of wheat bran intake on serum glucose level (mg dL^{-1}) and lipid profile in diabetic patients

Parameters	Before intervention (Mean±SD)	After intervention (Mean±SD)	p-value
Glucose (mg dL^{-1})	159.50±39.51	136.05±36.88	0.004
Triglycerides (mol L^{-1})	168.20±42.15	161.65±41.62	0.019
Cholesterol (mg dL^{-1})	239.90±52.16	218.50±50.013	0.000
LDL (mg dL^{-1})	156.10±55.57	156.55±48.70	0.931
HDL (mg dL^{-1})	47.50±17.45	48.05±15.15	0.454
VLDL (mg dL^{-1})	33.58±33.58	32.33± 8.32	0.025

RESULTS

The data of Table 1 illustrates the effect of wheat bran on diabetic patient. It shows that there was a significant decrease ($p \leq 0.05$) in both weight and body mass index after consuming 40 g of wheat bran every day for one month from 81.34±14.50 and 29.48±4.18 before the intervention to 78.40±14.06 and 27.11±3.96, respectively after the intervention.

The data in Table 2 displayed that the reduction in the cholesterol, triglyceride and Very Low-Density Lipoproteins (VLDL) from (239.90±52.16 mg dL^{-1}, 168.20±42.15 mol L^{-1} and 33.58±33.58 mg dL^{-1} respectively) before intervention to (218.50±50.013 mg dL^{-1}, 161.65±41.62 mol L^{-1} and 32.33± 8.32 mg dL^{-1}, respectively) after intervention was statistically significant ($p \leq 0.05$). Also the reduction in blood glucose level from 159.5±39.51 mg dL^{-1} before intervention to 136.05±36.88 mg dL^{-1} after intervention was statistically significant ($p > 0.05$). While there was a very slight but statistically insignificant ($p > 0.05$) increase in LDL and HDL level from 156.10±55.57 and 47.50±17.45 mg dL^{-1} before the intervention to 156.55±48.70 and 48.05±15.15 mg dL^{-1}, respectively after the intervention.

DISCUSSION

Wheat bran is rich in dietary fiber, β-glucans, vitamins, minerals, antioxidants, lignans and other phytochemicals that can contribute to a beneficial effect on the health of those with diabetes mellitus type II. The consumption of whole grains, including bran, is further linked to protection against insulin resistance and, thus, against diabetes[10]. The synergic effect of many beneficial components such as fiber, resistant starch and antioxidants may be responsible for slowing the rate of glucose absorption, delaying insulin release and blunting glycemic response, which may influence weight management[11].

Epidemiological studies have consistently revealed that higher fiber intakes are correlated with lower body weight, BMI, waist circumference[12], improved plasma lipid profiles, including reduced low-density lipoprotein cholesterol (LDL-C) concentrations[13], improved glycemia and insulinemia and type 2 diabetes in adults[14].

Our findings showed that there was a significant decrease in both weight and body mass index from 81.34±14.50 and 29.48±4.18-78.40±14.06 and 27.11±3.96, respectively after consuming 40 grams of wheat bran every day for one month. This result agrees with the results of Elmadbouly[15], who found that the mean value of BMI reduced significantly among participants who consumed wheat bran supplementation during their study period. Moreover, high-fiber diets may have special advantages for obese diabetic individuals. Weight-reducing high-fiber diets promptly decrease the need for insulin or oral hypoglycemic agents and quickly decrease serum glucose and lipids[16]. Fiber consumption is associated with increased satiety and decreased energy intake, while viscous fiber is thought to exert the greatest effect on appetite regulation. Besides, the study conducted by Stevenson *et al.*[17], reported a reduction in food intake following a test meal with wheat bran.

Also our results showed that there was a significant decrease in serum glucose levels from 159.5±39.51-136.05±36.88 mg dLβ[1] after consuming 40 grams of wheat bran every day for one month. This result agreed with the results of Haripriya *et al.*[18], who recorded that participants that supplemented their meals with wheat bran demonstrated a reduction of serum fasting glucose of 22.80 mg dLβ[1] and a reduction of postprandial glucose levels of 39.8%. Also, Afaghi *et al.*[19] recorded that the consumption of 15 g wheat bran in each meal for two weeks by gestational diabetes mellitus subjects reduced the fasting blood glucose concentration by 16.1%.

Furthermore, Afaghi *et al.*[20] recorded that postprandial blood glucose levels were reduced in subjects who consumed high glycemic meals containing 25 g of wheat bran daily. They

also reported that there was a 10.3 and 11.5% reduction in fasting blood glucose levels in the two groups of subjects who consumed 15 and 25 g of wheat bran daily.

Chandalia *et al.*[21] reported that increasing the number of fibres from a variety of dietary sources has been shown to improve glycemic control in type 2 diabetic patients. It has also been found that an intervention involving fiber supplementation for type 2 diabetes mellitus can reduce fasting blood glucose and glycosylated haemoglobin (HbA1c). This suggests that increasing dietary fiber in the diet of patients with type 2 diabetes is beneficial and should be encouraged as a disease management strategy[22].

Furthermore, we also found that there were significant decreases in the serum levels of cholesterol, triglycerides and very low-density lipoprotein and very slightly increase in low-density lipoprotein and high-density lipoprotein (Table 2) after consumption of 40 g of wheat bran daily for one month. This finding is consistent with another study that found a significant reduction in total serum cholesterol after consuming wheat bran-based breakfast cereal for 3 weeks, which contains approximately 13.5 g of fiber. For them, serum cholesterol was reduced from 5.576-4.385 mol L^{-1} [23]. Moreover, pooled data for 6 prospective cohort studies including 286,125 subjects indicate that a 2-serving-per-day increment in whole grain consumption might remarkably reduce diabetes risk by 21%. Interestingly, associations for consumption of the outer bran portion of the kernel, but not germ intake, were comparable to those of whole grain intake[24].

The mechanisms of the reduction in plasma cholesterol concentrations induced by increased dietary fiber intake are controversial. However, the increase in bile-acid excretion probably explains most of the reduction and the reduction in cholesterol absorption may also have contributed to this finding. Besides, other studies have also reported a variable increase in bile-acid excretion resulting from the consumption of pectin, oat bran, bagasse and diets with a mixture of soluble fiber and insoluble fiber but not psyllium[21]. Also, other research indicates that dietary fiber consumption contributes to a number of unexpected metabolic effects independent from changes in body weight, which include improvement of insulin sensitivity, modulation of the secretion of certain gut hormones and effects on various metabolic and inflammatory markers that are associated with the metabolic syndrome[24].

Epidemiological studies are also accumulating experimental evidence to show that fiber may reduce the risk of certain chronic diseases, such as type 2 diabetes[17]. The main limitations was the small number of study participants and the short duration of the dietary intervention.

CONCLUSION

We can conclude from the results that wheat bran has a beneficial effect on diabetes and obesity. The results showed a decrease in cholesterol, triglycerides and blood glucose levels after the dietary intervention. As such, it should be encouraged as a disease management strategy. However, additional studies on the long term consumption of dietary fiber are still needed.

SIGNIFICANCE STATEMENT

This study discovers the effects of wheat bran on serum glucose and lipid profile that can be beneficial for patients with diabetes mellitus and obesity. This study will help the researcher to uncover the critical areas of the mechanisms of the reduction in plasma cholesterol concentrations and blood glucose.

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