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Glycemic responses of oat bran products in type 2 diabetic patients

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Summary *Background and aim:* Cereal products with low postprandial glycemic response are encouraged in the management of hyperglycemia. In this study, we determined the postprandial glycemic response of two different oat bran products in patients with type 2 diabetes. In addition, we investigated the effects of oat bran flour on postprandial glucose response following an oral glucose load.
Methods and results: A randomized, controlled, repeated measures design with two test series was used. Twelve type 2 diabetic patients participated in five 2-h meal glucose tolerance tests on separate occasions. Volunteers were given in random order oat bran flour, oat bran crisp and glucose load providing 12.5 g glycemic carbohydrate (series 1), 25 g glucose load alone and 25 g glucose load with 30 g oat bran flour (series 2). Finger-prick capillary blood analysis was carried out fasting and then 15, 30, 45, 60, 90 and 120 min after the start of the meal. The oat bran flour had a lower 0–120 min area under the glucose response curve (AUC) (47 ± 45 mmol min/L) than the glucose load (118 ± 40 mmol min/L) ($p < 0.002$), but there was no difference between the oat bran crisp (93 ± 41 mmol min/L) and the glucose load in this respect. The oat bran flour decreased the glucose excursion from baseline by 1.6 mmol/l (2.4, 0.8) (mean (95% CI)) and 1.5 mmol/l (2.0, 1.1) at 30 and 45 min after the glucose load, respectively.
Conclusions: Oat bran flour high in β-glucan had a low glycemic response and acted as an active ingredient decreasing postprandial glycemic response of an oral glucose load in subjects with type 2 diabetes.

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Introduction

An association with dietary glycemic index (GI) and risk of developing type 2 diabetes has been shown in two large cohort studies [1,2]. In addition, a recent meta-analysis of randomized trials showed that replacing high-GI foods with low-GI foods improves glycemic control in diabetic patients [3]. Although the long-term benefits of low-GI diets have not been fully established, the European nutritional recommendations for patients with diabetes prefers carbohydrate containing foods which are rich in fiber or have a low GI [4]. The mechanism why the low-GI foods produce a low glycemic response is suggested to be the ability of low-GI foods to slow down the rate of carbohydrate digestion and absorption. However, a recent kinetic study showed that the lower GI of breakfast cereals was due to an earlier increase in the rate of disappearance of glucose from the systematic circulation, which was mainly due to an early hyperinsulinemia [5].

Enrichment with β-glucan, a viscous dietary fiber, has frequently been associated with low glucose response [6–8]. In addition, cell structure, particle size and food form are important factors affecting postprandial glucose response of starchy foods [9]. The most common methods in the manufacture of cereal products can be expected to disrupt the food structure, gelatinize the starch and consequently increase the glycemic responses of those products. Therefore it is a challenge to create new cereal products with low postprandial glucose response. Furthermore, there is obvious need to determine the glycemic response on a product by product basis.

The first aim of this study was to assess the postprandial glycemic response of two different oat bran products (oat bran flour and oat bran crisp) and the second aim was to test the hypothesis that oat flour can dampen the glucose response following an oral glucose load.

Methods

Subjects

Sixteen subjects were recruited to take part in the study. The subjects had to fulfill the following inclusion criteria: previously diagnosed type 2 diabetes mellitus treated with diet only or a fasting plasma glucose value >7.0 mmol/l, age 18–75 years and body mass index <35 kg/m^2. Exclusion criteria were administration of any antihyperglycemic therapy, presence of hepatic, renal or thyroid dysfunction, history of unstable coronary artery disease (i.e. myocardial infarction, unstable angina pectoris, coronary artery bypass graft (CABG), or percutaneous transluminal coronary angioplasty (PTCA) within the previous 6 months), temporal ischemic attack or stroke within 6 months prior to screening, history of cancer, presence of celiac disease or other clinically significant gastrointestinal disease and presence or history of allergic reaction to oat.

A total of 13 subjects met the inclusion criteria. One subject dropped out during the run-in period. The mean age of 12 subjects (7 men and 5 women) who completed the study was 66 ± 7 years and the mean body mass index was 28.9 ± 3.5. Two subjects had a body mass index less than 25, five subjects had a body mass index in the range 25–29.9 and five subjects in the range 30–<35. The mean pretrial fasting plasma glucose concentration was 7.1 ± 0.7 mmol/l.

The subjects gave written consent for the study at the screening visit and the study protocol was approved by the Research Ethics Committee, Hospital District of Northern Savo.

Test products

The test products were extruded oat bran flour (NATUREAL® GI-flour, Finn Cereal, Vantaa, Finland) and oat bran crisps (NATUREAL® GI-crisp, Finn Cereal, Vantaa, Finland). These oat bran products are made using milling and cooking extrusion to add the solubility and viscosity of β-glucan and at the same time keep the high molecular weight unaffected. Oat bran crisps consisted of oat bran (70%) and starch (30%). Macronutrient composition of test products is presented in Table 1.

Series 1

Experiments were carried out with 12.5 g glycemic (available) carbohydrate. Cold water was mixed properly into oat bran flour (61.6 g) with a fork and

Table 1 Nutrient composition of the test products per serving

	Oat bran flour	Oat bran crisp	Oat bran flour
Serving size (g)	61.6	29.1	30.0
Glycemic carbohydrate (g)	12.5	12.5	6.1
Dietary fiber (g)	19.5	6.3	9.5
β-Glucan (g)	9.4	3.0	4.6
Protein (g)	15.0	5.3	7.3
Fat (g)	6.9	2.3	3.4