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“Let food be your medicine” Inclusion of wheat porridge, a whole grain meal, and legumes lowers postprandial glucose in diabetic patient

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ABSTRACT

The present case report shows the importance of a meal consisting of whole grains and legumes in lowering postprandial glycaemia. A diabetic patient decided to try out diet and lifestyle modification to control the hyperglycemia. He incorporated wheat porridge for his breakfast and dinner along with other food. The postprandial glucose came down to 145 mg/dl after three months. To test the efficacy of wheat porridge in controlling the postprandial glycaemia, the intake of wheat porridge was stopped for 7 days. Then the glucose level increased to 231.4 mg/dl. However, the level came down after restarting the intake of wheat porridge (197.5mg/dl). After adding a small quantity of psyllium husk and black gram (a legume), the postprandial glucose came down to 163.5 mg/dl, indicating the protective role in lowering postprandial glycaemia.

Keywords: Porridge, Wheat, Legumes, Diabetes Mellitus Type 2.

Introduction

Diabetes mellitus is a chronic disorder of carbohydrate, protein and lipid metabolism that leads to vascular complications resulting in morbidity and even mortality [1]. Type 2 diabetes often manifests in the adulthood, generally, in those who are obese and leading a sedentary life style [2].

Common symptoms associated with the disease are frequent urination, weight loss, lack of energy (lethargy) and excessive thirst [3]. Biochemical examination of blood indicates high levels of blood glucose (hyperglycemia) [4]. Hyperglycemia can be controlled by administering drugs which work on different principles, but ends with some side effects [5, 6]. Therefore, controlling by diet and lifestyle modification is advocated [2].

Once hyperglycemia is noted in a patient, the immediate advice that follows would be to reduce or avoid free sugar in the diet. Depending on the severity of the hyperglycemia, even carbohydrate is also restricted. Any inhibition or withdrawal of food from a patient puts him in an intimidating position, especially, in a social gathering.

Against such a backdrop, we report here a case study of a patient, who managed hyperglycemia through life style modifications. The patient was taking normal Indian food along with a bowl of wheat porridge during breakfast and dinner. Lunch consisted of usual diet without any wheat porridge. His work demanded moving about and he used to walk at least 2 Km in a day. With this type of lifestyle, the results reported here is encouraging to diabetic patients and warrants further study in a larger population.

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Case Presentation

The patient was declared diabetic on 25/6/2011 based on the biochemical reports, which indicated hyperglycemia in the blood and presence of sugar in the urine. He was advised to take medicines to control hyperglycemia. Since his hunger pangs increased on medications, the dose was tapered and discontinued. He decided to restrict carbohydrate in his diet and to do moderate exercises like walking. These modifications helped him to bring down the glucose level to 250 mg/dl within a month's time. However, he was on Losar 50, one tablet a day for his hypertension.

Meanwhile, he looked into the history of diabetics in his family. His grandfather, an active person with moderate intake of food, did not have any diabetics in his life. However, his grandmother, a house wife and an obese person, was a diabetic patient. They had eight children and seven of them had diabetics at some stage of their adult life. One offspring did not have any diabetics. The diet habits of all the children were recorded. Then it was found that the non-diabetic offspring included wheat porridge daily in his breakfast while others took normal food for their breakfast. The breakfast of non-diabetic person included wheat porridge with milk, sugar or jaggery syrup along with one or two sandwiches stuffed with fillings made of legumes.

Management and Outcome

Based on the above findings, the patient included wheat porridge in his breakfast. Wheat porridge was made with wheat particles obtained by grinding wheat coarsely and different particle sizes of wheat were tried for making the porridge. According to Bureau of Indian Standards (BIS), wheat particles should be between 300 μm and 850 μm [7]. After trying different particle sizes, it was found that inclusion of particles lower than 300 μm gave a better result in eliminating the symptoms of the disease and hunger pangs. The porridge made from these particles gave good satiety. Similar observations are reported earlier [8]. Since these sizes are not included as porridge by BIS, we labeled it as a proprietary food.

Wheat particles were roasted and the nutrient compositions of the ready to cook particles are given in [table 1](#). It was analyzed in a NABL accredited laboratory (Varni Labs, Mira Road, Mumbai, reference, VAL/TC/17020499 & VAL/TC/1704/0306).

When the patient had only porridge for the breakfast, he felt cravings for tea with sugar at around 11 am. In order to overcome this habit, some amount of normal food was also included with wheat porridge during the breakfast. This eliminated the cravings for tea.

Symptoms of diabetics were reduced in the patient after

Sr. No.	Nutritional component	Quantity per 100g sample
1.	Protein	14.6 g
2.	Fat	2.0 g
3.	Carbohydrates	79.8 g
4.	Energy	395.9 k Cal
5.	Total sugar	4.6 g
6.	Total Dietary fiber	2.3g

Table 1: The nutritional composition of wheat porridge used in the study

taking wheat porridge (table 2). Later on, he included wheat porridge in the dinner, as a desert, with addition of one or two teaspoons of sugar. This pattern of diet was continued for months. The intake of free sugar was not stopped but used moderately.

Symptoms	In the initial stage before wheat porridge was taken	Three months after wheat porridge was taken
Thirst	High	Reduced
Hunger pangs, Cravings for snacking etc.	Very high	Reduced to normal eating habits
Urination frequency especially in the night	High. At least 4 times in the night.	Only 1 – 2 times in the night
Sleep pattern	Disturbed with dreams.	Sound sleep of at least 3-4 hours
Feeling of tiredness (fatigue)	High with aches in the muscles.	Much reduced
Lethargy to do work	Very high	Low

Tendency to take nap after lunch	High	No, if moderate amount of food is consumed.
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Table 2: The status of diabetic symptoms in the patient before and after including wheat porridge in the diet

After taking the above diet for more than 3 months, the postprandial glucose and HbA1c status of the blood and presence of sugar and ketone bodies in the urine were analyzed (Table 3). The status of postprandial level of glucose and the presence of sugar in the urine at the onset of disease in 2011 is also given in the (table 3).

Sr. No.	Year	Blood glucose (mg/dl)	Presence of sugar in the urine	Ketone bodies	HbA1c	eAG mg/dl
1.	2011	306.8	+++	-	-	
2.	2017	145.0	-	-	5.7	118.6 %

Table 3: The postprandial blood glucose of the patient in 2011 and 2017

In order to confirm the effect of wheat porridge on the postprandial glucose level, the intake of porridge was stopped for about 7 days and the glucose level was measured. The postprandial glucose increased to 231.4 mg/dl (table 4).

Sr. No.	Conditions	Blood glucose (mg/dl)	Presence of glucose in the urine	Presence of ketone bodies in the urine
1.	Without wheat porridge for 7 days	231.4 (n=3)	+++	-
2.	After restarting of wheat porridge diet	197.5 (n=2)	-	-

3.	After taking composite wheat porridge given in Table 5	163.5 (n=2)	-	-
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Table 4: The postprandial glucose level in the blood and the presence of sugar and ketone bodies in the urine of the patient, after the exclusion and inclusion of wheat porridge in the diet

After taking the glucose reading for 3 days, wheat porridge was again included in the diet. The postprandial glucose was measured and the average level was 197.5 mg/dl. In order to bring down the blood glucose, a composite wheat porridge explained by Ahmed & Urooj (2015) was used with modification. Instead of oats we used black gram powder. Black gram is a legume and it is normally available in Indian homes. The composition of the composite wheat porridge is given below (table 5).

Sl.No.	Ingredients	Quantity
1.	Roasted wheat porridge granules	3 table spoons (45 g)
2.	Psyllium husk	½ teaspoon (2-3 g)
3.	Black gram powder	1 teaspoon (5g)
4.	Salt	A pinch for the taste

Table 5: The ingredients used for making the composite wheat porridge

Instead of psyllium husk, a small piece of okra cut into small pieces can be used to increase the mucilage in the porridge. After taking the composite wheat porridge the postprandial glucose level was in the range of 150-170 mg/dl as shown in Table 3. When the postprandial glucose was in 150 -160 mg/dl range, the composite wheat porridge was replaced with plain wheat porridge along with side dish made of vegetables or legumes.

Discussion

The results presented in Table 3 & 4 indicate the protective role of wheat porridge in lowering postprandial glucose in the present case study.

“Whole wheat contains intact cereal germ, endosperm and bran.” [9] Intake of whole grain was beneficial to health as

reported in many epidemiological studies [9]. The population that consumed whole grain had lower Body Mass Index (BMI) [9], lower incidence of Type 2 diabetes [10], cardiovascular disease [11] and colorectal cancer [12]. Whole grain diet also reduced the risk of mortality [13].

Wheat porridge, a whole grain meal, has distinct physico-chemical properties. "The amount of insoluble fiber, resistant starch, phytochemicals, granular size, porosity, the interaction of starch and protein within the structural matrix may influence in the digestion and absorption of carbohydrates" [9]. "Wheat has predominantly insoluble fiber and less amount of soluble fiber like β -glucan" [1]. The amount of dietary fiber in the porridge was low (table 1). However, the soluble fibers from other food may also influence the matrix.

Wheat porridge becomes viscous due to gel formation and this property may slow down the amylase activity on the consumed food. Viscous gel formation also delays gastric emptying and this may have reduced hunger pangs (table 2).

In the present case study inclusion of wheat granules less than 300 μ m alleviated the symptoms better and showed lower postprandial glucose in the blood. Actually the amylase activity is expected to be high in smaller granules resulting in hyperglycemia due rapid digestion and absorption. However, in the present study such effect was noted. This may be due to the small size of insoluble fiber in the matrix. As the size of insoluble fiber decreases, the surface area increases [14]. The increased surface areas may facilitate adsorption of glucose, formed during amylase activity [1]. The binding of glucose may have inhibited diffusion of glucose in the intestine [1, 9]. Apart from the adsorption of glucose by insoluble fiber, the viscosity of wheat porridge may have delayed the amylase activity as explained above.

"Low postprandial glycaemia during breakfast has its effect on the following second meal like lunch" [9]. The low postprandial glycaemia in the present case study may have reduced oxidative stress in the patient. Oxidative stress initiates cytokine production which impairs insulin signaling [9]. Therefore, under the low oxidative stress and with less cytokine production, the attenuation of insulin resistance may have promoted better metabolism leading to alleviation of symptoms (table 1).

Regular exercise like walking may have contributed to the alleviation of symptoms because contraction-induced glucose uptake occurs through activation of parallel but distinct insulin-independent pathways [15].

The present case study has its limitations. However, it deserves some attention because the present case study was carried for more than 2 years and the results obtained are consistent and encouraging. This study supports the suggestions made by Aune et al (2013), 'to include at least two servings of whole grains per day in the diet to reduce type 2

diabetes risk [16]. Wheat porridge, a whole grain meal, is easy for the patients to make and hence can be included in their diet. It can be taken along with side dish with vegetables and legumes to compensate low soluble fibers in the wheat.

In the light of the present case study, following studies are warranted.

The study presented here needs to be carried out on a larger population of diabetic patients to confirm the findings.

Efforts are directed to study the glucose adsorption; glucose diffusion and amylase kinetics of different granular size of wheat under different conditions.

It was intriguing to observe an increase in protein level (14.0 g%) in the roasted wheat granules. Normally it is around 11g% in the whole wheat flour. Wheat porridge is prepared by roasting and during the heat treatment Maillard reaction takes place between amino acids and sugars. The increased protein content may be due to breakdown of complex protein molecules into digestible proteins by heat treatment. Similar observations are reported recently [17]. This observation is important in the efforts to combat malnourishment in the population. If protein content could be increased by simple heat treatment, then it should be adopted in all the feeding programs of children. The SAT mix developed by Sree Avittam Thirunal Hospital in Trivandrum to feed the infants and children. They used roasted grain (wheat) and legumes (green gram and black gram) in equal proportions [18]. The diet was a great success to reduce malnourishment among children in Kerala. The present observation of increased protein content after roasting warrants further research on the quantity and quality of protein along with amino acids in the SAT mix.

When composite wheat porridge was included in the diet, the postprandial glucose was comparatively low. It was observed that the urine was almost colourless while the stool was dark in colour, indicating the increased sequestration of bile salts in the faeces. Hence lipid profile was carried out after taking the composite wheat porridge for two weeks.

The total serum cholesterol - 215 mg/dl, HDL - 45 mg/dl, LDL - 145 mg/dl, Triglycerides - 126 mg/d and the Cholesterol-HDL ratio was 4.8:1.

The patient had a history of total cholesterol of 240 mg/dl and his HDL was never higher than 38 mg/dl. The ratio of cholesterol was above 5.6. Based on this observation, the cholesterol lowering effect of composite wheat porridge in hyperlipidemia patients need to be carried out to confirm the observation.

Since lipid metabolism is influenced by composite wheat porridge, it is worth looking into its effects in patients with fatty liver, high serum creatinine in Chronic Kidney Disease (CKD) and elevated uric acid in gout disease.

Conclusion

The present case study indicates the protective role of wheat porridge in lowering the postprandial glucose in a diabetic patient. Diet modification can play a great role in controlling the disease. Here is another case of science meeting the traditional wisdom, the wisdom quoted by Hippocrates- "Let food be thy medicine..."

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