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Original Article

GLYCEMIC AND LIPEMIC RESPONSE OF WHEAT GRASS INCORPORATED RECIPES

Uma Iyer*, Minal Sharma, Swati Dhruv, Uliyar V Mani

Department of Foods and Nutrition, Faculty of Family and Community Sciences,
The Maharaja Sayajirao University of Baroda, Vadodara -390 002, Gujarat, India
*Corresponding author email: umamsufn@hotmail.com

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Abstract : Wheatgrasss (Triticum aestivum) the young green plant which grows to produce the cereal grain is one of the "functional foods" that is gaining popularity as a potential nutritional product with medical and health benefits. However, no in-depth controlled clinical trials have been conducted to study the therapeutic effect of wheatgrass. A study was planned to determine the glycemic and lipemic response of wheatgrass incorporated recipes. For the study 30 normal healthy female subjects were randomly divided into 5 groups consisting of 6 subjects each. The 6 subjects in each group were fed one test meal. Serum glucose of the subjects, fed recipes incorporated with wheatgrass (providing 75 g of carbohydrate), were estimated in all the samples. Serum triglyceride was estimated in fasting and two hour post glucose/ post recipe samples. With respect to glycemic index of the wheat grass supplemented recipes it was found that the highest and lowest glycemic response was elicited by vegetable cutlet (121.7%) and Muthia (33.8%) respectively. The least percentage rise in triglycerides was observed for vegetable cutlet (1.5 %).Wheatgrass has a definite role in lowering the glycemic and lipemic responses and could be effectively used in the management of diabetes mellitus.

Key words: glycemic response, lipemic response, wheatgrass

INTRODUCTION

Diabetes Mellitus is a chronic metabolic disorder arising either due to relative or absolute deficiency of a hormone called insulin or inability or resistance of body to use available insulin. These defects result form interplay of genetic and environmental effects[1].

The goals in the management of Type II Diabetes Mellitus (T2DM) are alleviation of symptoms through normalization or near normalization of fasting and postprandial blood glucose levels and prevention of acute and long-term complications [2]. The therapeutic utility of the concept of Glycemic Index (GI) (i.e. ranking of individual carbohydrate foods according to their postprandial glucose excursions) is in the classification of foods eliciting low and high GI and incorporating the low GI foods in a diabetic diet for a longer period of time [3]. This would prevent wide fluctuations in blood glucose levels, which in turn would influence triglyceride levels and thus prevent hyperglycemia and hyperlipidemia respectively.

In this regard wheatgrass (Triticum aestivum) the young green plant that grows to produce the cereal grain is an upcoming "functional food" which may be of importance because of its potential nutritional and health benefits. A functional food is defined as, "any food that has a positive impact on an individual's health, physical performance or state of mind in addition to its nutritive value". Thus a study was planned to determine the glycemic and lipemic response of wheatgrass incorporated recipes.

MATERIAL AND METHOD

Determination of the Glycemic Index of the wheatgrass incorporated recipes

Table 1 : Protein, fat, fibre content and glycemic index of test recipes (Mean ± SD)

Recipes	Protein(g)	Fat(g)	Fibre(g)	% GI	F Value for GI values
R1	17.1	17.7	2.3	41.6 ± 9.41	
R2	18.2	21.8	2.1	45.6 ± 18.67	
R3	11.4	20.8	3.2	129.7 ± 14.62	0.42
R4	11.6	20.8	2.6	45.2 ± 20.81	
R5	15.9	19.4	1.2	33.8 ± 6.96	

Recipes : R1 = Paratha + Curd, R2 = Dhebra + Curd, R3 = Vegetable Cutlet, R4 = Samosa, R5 = Muthia

Table.2 : Comparison of the glycemic index of recipes with and without wheatgrass supplementation

Recipe	Glycemic Index	
	Without any Supplementation	With Wheatgrass (15g)
Paratha + curd	81.6 ± 9.95	41.6 ± 9.41
Dhebra + curd	26.4 ± 14.18	45.6 ± 18.67
Vegetable cutlet	124.6 ± 2.89	121.1 ± 14.62
Samosa	40.7 ± 18.58	45.2 ± 20.81
Muthia	52.3 ± 12.53	33.8 ± 6.96

Table. 3 : Triglyceride responses of wheatgrass supplemented recipes (Mean ± SD, mg/dl)

Carbohydrate Source	Fasting Responses	Post-Prandial 2 hour	% Rise over Fasting
Glucose	64.5 ± 31.50	50.0 ± 26.37	3.8 ± 15.10
R1	53.0 ± 15.04	49.9 ± 28.21	
Glucose	52.4 ± 15.89	49.9 ± 17.91	19.6 ± 13.05
R2	67.9 ± 10.07	87.6 ± 17.99	
Glucose	61.9 ± 32.75	47.5 ± 22.58	1.5 ± 12.78
R3	68.9 ± 26.37	70.4 ± 24.82	
Glucose	67.9 ± 31.63	59.1 ± 23.07	32.2 ± 41.01
R4	40.3 ± 15.30	72.5 ± 48.75	
Glucose	84.9 ± 48.15	63.9 ± 33.31	4.7 ± 11.42
R5	79.4 ± 39.37	84.1 ± 44.52	

Recipes : R1 = Paratha + Curd, R2 = Dhebra + Curd, R3 = Vegetable Cutlet, R4 = Samosa, R5 = Muthia

Study Group: The study group comprised of 30 normal healthy volunteers in the age group of 20-24 years enrolled from the Foods and Nutrition Department of The M.S University Baroda, Vadodara, Gujarat. The subject's anthropometric measurements were taken and dietary intake was recorded using the 24-hour dietary recall method. These 30 subjects were randomly divided into 5 groups consisting of 6 subjects. The 6 subjects in each group were fed one test meal.

Assay Methods: Venous fasting blood samples (FBG) were drawn from each subject after an overnight fast (12 hours). The subjects were given a glucose load of 75 g of glucose dissolved in 200 ml of water. Post glucose blood samples were drawn at exactly 20 min (PG_{20}' BG) and two hour (PG_2 BG). Serum was separated from the blood and collected in clean serum tubes. Serum glucose levels were estimated in all the samples (FBG, $PG_{20'BG,}$ PG_2BG) by enzymatic kit supplied by Glaxo India Limited, and serum triglyceride was estimated in fasting and two hour post glucose samples by Enzymatic kit supplied by Merck.

On their second visit, the subjects were fed recipes supplemented with wheatgrass(15 g) providing 75 g of carbohydrate. Serum glucose and serum triglyceride were estimated in a similar manner.

Determination of glycemic response and lipemic response: For each subject, blood glucose response curve was plotted for both glucose load and test carbohydrate food and the glycemic index of the recipe was calculated. Also the mean percentage rise / fall in triglyceride were calculated in fasting and two-hour postprandial sample.

Statistical Analysis: Percentages were calculated along with mean and standard deviation. The sample Mean and standard deviations for glycemic index (GI) of each of the recipes fed to the subjects was calculated from the result obtained after blood analysis. Analysis of variance (ANOVA) was used to compare GI values among the test meals. Mean percentage rise / fall in serum triglyceride from fasting to two hour postprandial were calculated for each of the test recipe fed. All the tests were considered significant at $p<0.05$ levels

RESULTS

The mean values for BMI (21.4) and waist/ hip ratio (0.73) of the subjects selected for determining the glycemic index of wheatgrass incorporated recipes were within the normal range The GI values of the wheatgrass incorporated recipes ranged from 33.8-121.7% (Table 1). Vegetable cutlet incorporated with wheatgrass elicited the highest glycemic response (121.7 %) and muthia with wheatgrass elicited the lowest glycemic response (33.8 %). The protein content of the five recipes ranged from 18.2 to 11.4 g, fat content ranged from 17.7 to 21.8 g while fibre content ranged from 1.2 to 3.2 g (Table 1).

Comparing the glycemic index of recipes (without supplementation) with the glycemic index of wheatgrass incorporated recipes (Table 2), it was evident that addition of 15 g of wheatgrass to the recipes brought about a decrease in GI value as compared to the same recipes without wheatgrass except for dhebra with curd and samosa. The least percentage rise in triglycerides from fasting to two hour postprandial was observed for vegetable cutlet (1.5 %). The rest of the four recipes showed a rise in TG levels ranging from 3.8-32.2 %. (Table 3).

DISCUSSION

Diabetes mellitus is associated with increased mortality and an increased risk of developing cardiovascular, renal, retinal and neuropathic complications leading to premature disability and death [4]. Reduction of postprandial glycemia is now considered a desirable goal for the control of diabetes mellitus. In this regard diet plays a significant role, especially the concept of low glycemic index foods in a diabetic diet helps in preventing hypoglycemia and hyperlipidemia[5].

Like spirulina, wheatgrass is also a storehouse of nutrients (minerals, antioxidants, enzymes, good quality of amino acids, water soluble and fat soluble vitamins and dietary fibre). Our studies with spirulina gave encouraging results[6-8] and hence it was thought worthwhile to determine the glycemic and lipemic response of wheat grass incorporated recipes in normal subjects.

The GI values of the wheatgrass incorporated recipes ranged from 33.8-121.7%. The difference in the glycemic response of each recipe could be attributed to the various food factors known to affect GI. Legumes and dals have higher amylose content (30-40%), which is more resistant to cooking and digestion than amylopectin [9], so low GI of muthia can be attributed to the presence of dal (Red gram dal, Bengal gram dal).

The protein content of the five recipes ranged from 18.2 to 11.4g. Legumes/pulses contain twice as much protein than cereals. Amino Acids are known to stimulate insulin secretion[10]. The lower GI of muthia and paratha + curd over vegetable cutlet can be due to their high protein content.

Another factor is the rate of hydrolysis of starch is influenced by dietary fibre. Pulses and legumes are known to have a rich source of fibre in the form of galactomannans, which are more viscous than fibre present in wheat and rice. The viscosity of the dietary fibre has been shown to correlate positively with the reduction in postprandial plasma glucose levels[11]. The high fibre content of muthia coming from pulses and the absence of the same in vegetable cutlet can be responsible for the differential glycemic responses. The process of boiling and pressure-cooking of vegetables used for the preparation of vegetable cutlet and samosa could have resulted in easier digestibility of starch. Further bread which is a precooked fermented product made from refined flour was one of the ingredient in vegetable cutlet. This could have lead to faster digestion and degradation and consequently high GI in case of vegetable cutlet While muthia had larger particle size causing delayed digestion by hydrolytic enzymes and eliciting lower glucose response.

Addition of 15 g of wheatgrass to the recipes brought about a greater decrease in GI value as compared to the same recipes without wheatgrass except for Dhebra + curd and samosa. Wheatgrass contains good quality amino acids, enzymes such as super oxide dismutase, vitamins and minerals especially those involved in defense mechanism. Thus it can be speculated that addition of 15 g of wheatgrass may bring in the insulin peak earlier in the recipes with wheatgrass due to the presence of good quality amino acids. Also, wheatgrass may possess some factor / factors which affect's the digestion of carbohydrates thereby bringing hypoglycemic effect.

Diets that minimize postprandial glucose and insulin rise, also reduce triglycerides, low GI starchy foods have shown a reduction in blood lipid levels[12]. The least percentage rise in triglycerides from fasting to two hour postprandial was observed for vegetable cutlet.

The primary findings regarding the hypoglycemic and hypolipidemic effect of wheatgrass imply that the incorporation of wheatgrass in a diabetic diet may prove to be effective in the management of diabetes mellitus. However in depth clinical trials need to be conducted to test the efficacy of wheatgrass as a hypoglycemic and hypolipidemic agent. It is also required to conduct detailed nutrient analysis of wheatgrass to determine the factor responsible for its hypoglycemic effect.

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