BLOOD GLUCOSE RESPONSES TO CONVENTIONAL LEGUMINOUS DISHES IN NORMAL AND DIABETICS

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ABSTRACT

The glycaemic responses of conventional leguminous dishes including Mash *(Vigna mungo),* Moong *(Vigna radiata),* Masoor *(Lens esculenta),* Chana dhal *(Cicer arietnum)* and Biryani incorporated into the mixed meal and served with white boiled rice as conventionally consumed in Pakistan were studied in six normal and six diabetic subjects. Subjects were given a fifty gm carbohydrate portion of the different test meals in random order after an overnight fast. Taking the response of chapatti plus egg as 100 %, the relative glycaemic responses of the mixed meals containing Mash, Moong, Masoor, Chana dhal and Biryani were determined 91 ± 6.7, 111 ± 6.7, 108 ± 6.8, 88 ± 6.2 and 101 ± 6.4 percent respectively in normal subjects and 102 ± 3.8, 123 ± 15.9, 107 ± 6.5, 87 ± 7.9 and 103 ± 3.6 percent in diabetic subjects. It was concluded that conventional leguminous dishes which containing white boiled rice as a mixed meal may be of less use in the dietary management of diabetes.

Keywords: Diet; Glycaemic response; Type II Diabetes mellitus and Conventional leguminous meals.

INTRODUCTION

The Mediterranean diet is focused on a high intake of monounsaturated fats, particularly through the consumption of olive oil and vegetables. People who eat a Mediterranean-style diet are less likely to develop new-onset diabetes. Such diet stresses a high intake of legumes, nuts and fish. (Martinez *et al.,* 2008).

Lower insulin and higher leptin suggest that low glycaemic meals promote a postprandial glucose levels for reduced food consumption; this may be advantageous in the control of obesity and related disorders including insulin resistance and type 2 diabetes. (Barkoukis *et al*., 2007). Numerous studies have shown that the postprandial plasma glucose and insulin responses are influenced by both the amount of carbohydrate consumed and their sources (Gannon and Nuttall, 1991; Rasmussen *et al*., 1991; Wolever *and Bolognesia,* 1996). Diabetes prevalence is relatively low among individuals include plant-based and vegetarian diets. (Barnard *et al*., 2006).

High fiber foods take longer time to digest rather than low fiber foods and giving slower rise in blood glucose levels. Such foods include vegetables, whole grains and legumes. Mani *et al*., (1992) determined the glycaemic index of conventional Indian foods incorporated into mixed meals of the type traditionally eaten in that country. The factors in legumes which are involved in lower glycaemic responses by slowing the absorption of carbohydrates or inhibiting its digestion include dietary fiber and uronic acid (Baer *et al*., 1998). Eating food with low glycaemic index can help people with diabetes to improve metabolic control (Brand *et al*., 1991). The effect of mixed meals should beanalyzed for the dietary treatment of diabetes (Akhtar *et al*., 1987). Therefore, present study has been designed to determine the blood glucose responses of some conventional leguminous dishes in the diet of normal and diabetics.

MATERIALS AND METHODS

A group of six normal and six diabetics from both sexes (previously diagnosed Type II diabetes) were recruited from the staff of the University of Agriculture, Faisalabad. Five diabetics subjects were treated with oral hypoglycemic agents while one was treated with diet alone.

Another group of normal volunteers were also recruited from the staff of University of Agriculture. Age, height, weight and body mass index (BMI) of subjects are listed in table I. The subjects which have diabetes duration of more than seven years were taken Placid, Dianil and Atlin. Those subject who have ten or more than ten year disease were taken Amaryl and Neodipar.

Volunteers came to the laboratory at weekly interval in the morning after 12-16 hrs overnight fast. After fasting, blood samples were obtained. The volunteers were served one of the six different test meals containing 50 g available carbohydrates and asked to consume it within 15 minutes. Oral hypoglycemic agents were given immediately before taking the meal. The order of test meals was randomized.

Mash *(Vigna mungo),* Moong *(Vigna radiata),* Masoor *(Lens esculenta),* Chanadhal *(Cicer arietinum)* with

boiled rice and Chicken Biryani were served as test materials. Bread served with egg in sunflower oil was used as a control meal. (Wolever *et al.,* 1985). The other test meals were consisting of leguminous dishes. Proximate analysis was carried out to determine moisture, ash, protein, carbohydrates, fiber and fat contents by AOAC (1990) methods. The aim was to test the chemical constituents and nutrients of the test meals.

Finger prick capillary blood samples were obtained at (fasting), 30, 60, 90, 120, 150 and 180 minutes in diabetic subjects and at 15, 30, 45, 60, 90, and 120 minutes in normal subjects. Blood glucose was measured by Glucometer using a glucose-oxidase reaction specific for glucose (One Touch, life scan, U.S.A). Incremental areas under the blood glucose responses curves (IAUC) were calculated using the method prescribed by FAO/WHO using a computer programme.

The IAUC after each test meal was expressed as percentage. Results were expressed as intervals and IAUC values subjected to analysis of variance (ANOVA) using MSTATC computer programme. After demonstration of heterogeneity the significance of differences between means were determined using the DMR tests. (Steel *et al*,, 1997).

Table 1. Age, height, weight and body Mass index (BMI) of Subjects:

| Subject	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m^2)
Normal	37.3	168	73	25.8
Diabetics	44.1	140	77	29.1

RESULTS AND DISCUSSION

Table 2. Proximate composition of test meal (percentages)

Samples	Moisture	Ash	Crude protein	Dietary fiber	Crude fat	Carbo-Hyd rates
Chapatti	42.2%	1.6%	15.4%	3.5%	1.5%	55.5%
Fried Egg	67.1%	1.3%	53.5%	0.5%	27%	3.4%
Mash	62.7%	4.6%	13.1%	3.5%	12.5%	40.6%
Masoor	66.9%	1.3%	15.3%	4.5%	15.5%	24.35%
Moong	64.6%	5%	28.4%	6.5%	17.5%	14.3%
Chana dhal	70.3%	6.6%	21.8%	6.5%	9.0%	22.5%
Boiled rice	64.8%	1.3%	12.2%	2%	0.5%	31%
Biryani	61.5%	2.6%	28.6%	1%	6.5%	27.8%

The moisture content of chapatti (Table 2) was found to be 42.25%, in boiled rice 64.8%, in biryani 61.5% and in case of leguminous dishes was 62.7% - 70.3%. The percentage of ash in chapatti, egg, biryani and leguminous dishes ranged from 1.6% - 6.6%. The crude protein content found in chapatti was 15.4%, in fried egg 53.5%, in biryani 28.6%, cooked leguminous dishes 13.5% - 28.4 % and in boiled rice it was 12.2%. Amount of fiber in test samples were ranged from 0.5% - 6.5%. Amount of fat in test sample were ranged from 0.5% - 27%.

Fasting blood glucose levels were similar in normal and diabetics before each test meal. The variation in IAUC between the glycaemic responses of the test meals in normal and diabetic subjects was non-significant ($p > 0.001$). Mean blood glucose levels (mg/dl) of control and test leguminous dishes in normal and diabetic subjects are shown in fig. 1 and fig. 2. These are as follows:
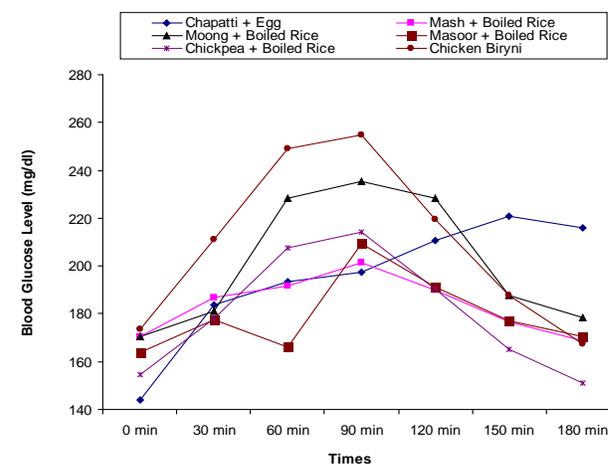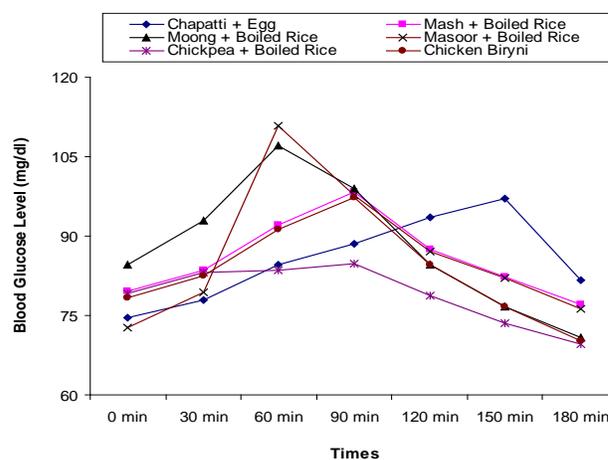
The glycaemic index (GI) of five leguminous dishes were calculated by using 50g of available carbohydrate from chapatti and egg as control diet taking their GI value as 100.

The GI value of Mash dhal with boiled rice was found to be 91 ± 6.7 ($P < 0.001$) in normal subjects and in case of diabetics it was 102 ± 3.8, compared with control meal. Cooked Mash dhal has found to contain less protein and fiber

as compared to other dishes. It contained 13.1 % protein and 3.5 % dietary fiber which are important nutrients in controlling diabetes. Antinutritional factors include (Phytate and Polyphenols) and amylase type starch hinders the bioavailability of legumes as in Mash (Gillon and Champ, 2002). Moreover, the inclusion of white boiled rice (12% protein, 2% fiber) in meal was also responsible for high glycaemic value. The mean GI value of Masoor dhal and boiled rice was found 108 ± 6.8 in normal as in case of diabetics was 107 ± 6.5 as compared with control meal. Antinutritional factors varied between cultivars and even within cereals and legumes. Phytate content varied from 233 to 991.11 mg/100g and phytate/phosphorus percent varied from 82 to 225% while polyphenols varied from 198.43 to 676.21 mg/100g. (Valencia *et al*., 1999).The mean GI of Moong dhal with boiled rice was 111 ± 6.7 while in case of diabetics was 123 ± 15. GI value of Chana dhal with boiled rice was 88 ± 6.2 in normal and in diabetics was 87 ± 7.9 (p<0.001). Most of the dietary fiber found in some legumes was affected by duration of cooking. The raw Chana dhal found 13.6% dietary fiber while cooked was found 6.5% (Baer *et al*., 1998).

GI value of *biryani* in normal was 101 ± 6.4 and in diabetics was 103 ± 3.6. The amount of carbohydrates and sources affected postprandial glucose and insulin responses. Individual foods have different glycaemic indices. The glycaemic index of rice was found to be 98. This is considered as a high value for the dietary management of diabetics. All the leguminous dishes were served with 25 gram of boiled white rice. Intake of boiled white rice is not safe for diabetics (Rehman *et al*., 1992).

These conventional leguminous dishes are considered as less beneficial in lowering the blood glucose levels due to addition of white boiled rice.White rice actually lacks the necessary quantities of important nutrients, including vitamin E, thiamin, niacin, vitamin B_1, B3, B6, peak rise in plasma glucose levels were decreased by only 16% by intake of rice than the whole wheat based diet (Dilwari *et al*., 1981). The complete milling and polishing that converts brown rice into white rice destroys 67% of the vitamin B3, 80% of the vitamin B1, 90% of the vitamin B6, half of the manganese, half of the phosphorus, 60% of the iron, and all of the dietary fiber and essential fatty acids.

Cooking may not alter the blood glucose level but cooking alter the dietary fiber content which included resistant starch (RS) and non-starch polysaccharides (NSP). It increased the solubilization of the non–starch polysaccharides (NSP) in the legume. The increase of resistant strach (RS) in the legumes is due to the presence of cell- enclosed starch and retrograded starch formed during cooking. (Peter *et al*., 1998). Excessive cooking also reduces the biological values of protein (Alma*s*., 1979).

Further work is required to determine the effect of whole wheat chapatti with whole legumes (with husk) containing diet. Improvements will occur to glycaemic control relate to cooking, starch, satiety and nutrient retention. Brown rice than white rice may give lower value on the glycaemic index.

Thus there has been a strong evidence suggesting that eating a variety of whole grain food will give the best picture than meal containing white boiled rice.

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