EFFECTS OF COOKED LENTILS ON GLYCEMIC CONTROL AND BLOOD LIPIDS OF PATIENTS WITH TYPE 2 DIABETES

Hamidreza Shams[(1)], Farideh Tahbaz[(2)], Mohammadhassan Entezari[(3)], Alireza Abadi[(4)]

Abstract

INTRODUCTION: Diabetes control is one of the main conflict issues in diabetes management. Scientists, recently, recommend [increasing low glycemic index (LGI) foods in dietary regimen. The effects of cooked lentil as a low glycemic index food on serum blood glucose and lipid profile among type 2 diabetic patients has been investigated in this study.

METHODS: In a randomized cross-over clinical trial which was performed on 30 patients with type II diabetes mellitus, subjects were randomly divided into 2 groups. Group A followed the normal diet and Group B followed normal diet with 50gm cooked lentil and 6gm canula oil substitute of 30gm bread and 20gm cheese. After 6 weeks, groups stopped their diets and put on wash out period for 3 weeks and later the diets where switched between the them. Diet continued for another 6 weeks. Anthropometric measurements, dietary intakes, serum lipids and glucose levels were determined at the beginning and the end of each test period. Data were analyzed by Food Processor II and SPSS-13.

RESULTS: BMI, LDL_C, HDL_C, TG and serum Fructozamine were not significantly affected by dietary regimens. But Total cholesterol and fasting blood glucose decreased significantly in regimen containing lentil ($P<0.05$).

CONCLUSION: Consumption of cooked lentil as a LGI food in breakfast led to reduction of FBS and TC and improvement of glycemic control in type 2 diabetic patients.

Keywords: Diabetes Mellitus, Lentil, Lipid profiles, Blood glucose, Glycemic index, Clinical Trial.

***ARYA Atherosclerosis Journal* 2008, 3(4): 215-218**

Date of submission: 1 Dec 2007, ***Date of acceptance:*** 7 Mar 2008

Introduction

Diabetes mellitus is one of the most important endocrine diseases causes many different disturbances in metabolic status of body organs. In 1995, 135 millions persons had been affected by diabetes[1]. It seems to have about 300 millions diabetic patients by the end of 2050[1]. 40% of all cases with diabetes mellitus are living in Asia[2].

Diabetes control is one of the main objectives in diabetes management. Diet therapy is a well documented strategy for controlling diabetes and its complications such as cardiovascular diseases[3]. Previous studies have shown that low glycemic index diets such as legumes and nuts had useful effects on lipid profiles and glycemic control in diabetic patients[4].

Nonetheless, documented studies about the effects of lentil as one of low glycemic index foods on glycemic control and lipid profile are limited. The aim of this study was investigation the effects of lentil consumption on glycemic control and lipid profile among type 2 diabetic patients. 100 gm of lentils contains 116.7 kcal energy, 9.04 gm protein, 20.15 gm carbohydrates, 0.374 gm fat and 4.94 gm dietary fibers[5].

1) MSc. Nutrition and Food Science Dept. Shahid Beheshti University of Medical Science & Health Services (SUMS) Tehran, Iran. E-mail:shams515@gmail.com
2) PhD. Assistant Professor. Nutrition and Food Science Dept. SUMS. Tehran, Iran.
3) PhD. Assistant Professor. School of Health, Isfahan University of Medical Science & Health Service. Isfahan, Iran.
4) PhD. Assistant Professor. Social Medicine Dept. School of Medicine. SUMS. Tehran. Iran.

Corresponding author: Hamidreza Shams

Materials and Methods

Thirty individuals with type 2 diabetes mellitus aged between 45 to 60 years old, who referred to diabetic clinic in Alzahra hospital - affiliated to Isfahan University of Medical Sciences- were selected. Study group had not thyroid disease, kidney and digestive diseases. Patients had not use Insulin, warfarin, Aspirin, corticosteroids and any other lipid modulators.
After subjects' agreement by signing a written consent, they were entered to study. They were asked about a normal breakfast diet and if they normally consume bread and cheese in breakfast or not. During a 15 days training course, all subjects were educated about new dietary regimen and food questionnaire completing method.

Then they randomly allocated into two groups (A & B). At the 1st phase of study, group A followed, general diet with some instructions about restriction of inordinate legumes consumption. Group B followed normal diet with 50gm cooked lentil and 6gm canula oil substitute of 30gm bread and 20gm cheese in an isocaloric breakfast with the same amount of macronutrients for six weeks. After 6 weeks these two groups stopped their diets and put on washout period for 3 weeks and later the diets where switched between the two groups and this time, diet continued for another 6 weeks period.

Anthropometric measurements, dietary intakes, serum lipids and glucose levels were determined at the beginning and the end of each period. The weight and the height were measured by SECA scale whit the accuracy of 100 gm and 0.5 centimeters respectively.

Nutritional intakes were analyzed by Food Processor II software and other data were analyzed by SPSS-13 software. The plasma glucose was measured by enzymatic method (CHOD-PAP) administered by Pars azmoon Iran Co. Lipid profiles include total cholesterol, HDL_C and TG were measured by enzymatic method[6] and LDL_C by Friedwald formula[7]. Fructozamine was measured by using Nitroblutetrazolin (NBT) method.

After the end of each interventional period, comparing the mean of indices was done by independent t-test. Since the difference between indices before and after of the intervention in each period is highly important, the paired t test was used to compare changes of the means. Results were considered significant when $P<0.05$. Data are expressed as Mean ± SD.

Results

Mean age of participants was 50.2±3.8 years old. Mean of BMI was 28.9±4.1. Diets components in different periods of study which was collected by food questionnaire showed that there was not any significant difference in the amount of total calories, protein, lipid, carbohydrate and dietary fiber between two groups before and after intervention (Table 1).

Mean of plasma glucose levels at the end of each period of study in comparison with beginning of each period had a significant reduction. ($P<0.05$) (Table 2). Significant difference was detected between mean of plasma glucose in the lentil consuming group and group without lentil in its regimen ($P<0.05$).

TABLE 1. Food component before and after of treatment in two groups (Mean±SD).

Food component	Control group		Treatment group	
	before	after	before	after
Energy (Kcal)	1794.6±463.5*	1782.6±441.3	1778.3±424.7	1806.9±492.6
Carbohydrate (gm)	248.6±68.3	232.4±75.6	224.4±85.8	216.7±64.6
Protein (gm)	83.8±21.3	86.6±26.2	76.4±28.1	80.1±19.8
Fat (gm)	58.6±24.9	56.6±28.5	62.3±24.1	61.4±3.4
Dietary fiber (gm)	24.6±8.9	23.3±6.4	24.4±5.5	28.6±3.4

TABLE 2. Comparison of Fasting Blood Sugar and Lipid Profiles between Groups (Mean±SD).

Indexes	Control group			Treatment group		
	before	after	p	before	after	p
FBS(mg/dl)	154/6±12.5*	153.1±10.3	NS	154.3±14.7	151.9±12.6	P<0.05
Total cholesterol (mg/dl)	232.6±15.3	236.4±17.6	NS	228.07±15.8	220.1±14.6	P<0.05
Triglycerid (mg/dl)	233.8±64.3	232.6±61.1	NS	223.4±58.7	223.1±62.2	NS
LDL_C (mg/dl)	142.4±16.8	143.9±14.5	NS	144.3±13.1	145.1±14.3	NS
HDL_C (mg/dl)	48.6±24.9	48.9±23.2	NS	46.4±14.1	45.6±18.9	NS

Discussion

Results of this study showed that by substituting baked lentils in breakfast, it's possible to develop glycemic index control and serum total cholesterol level in diabetic patients and to some extent prevent the problems of diabetes. As in current study consuming baked lentils cause a significant reduction in total cholesterol and fasting plasma glucose levels ($P<0.05$).

However it didn't have a significant influence on other lipid profiles include LDL_C, HDL_C and triglyceride. Some of the other studies like the current study proved that a low glycemic index diet (LGID) develops glycemic control of diabetic patients[4, 8]. But unlike them Lafrance believes that this diet doesn't have any influence on glycemic control[9].

Reduction of plasma glucose in current study is the same as Leoni K [11], Jarvi[12], and Jenkins13 and Kim J-I[14] studies. However the results of Luscombe study[10] aren't the same as our study. In that study against expectation fasting plasma glucose increased after the LGI diet, which can due to reduction of blood density in LGI diet as a result of water reservation, slower digestion of starch and lower availability to glucose [10]. In Kabir study like current study, there wasn't any significant influence on lipid profile levels except for the total cholesterol[15]. Many studies have defended the treatment effect of three meals in day of LGI diet, (but not only breakfast) [3, 4, 8]. The kind and structure of food is one of influencing factors on glucose absorption from starchy foods and as a result glycemic index of foods that can include amylase to amylopectin ratio found in raw foods, the amount of monosaccharide, the amount and kind of dietary fiber, the amount and kind of food processing, great amounts of lipids and proteins and existence of anti nutrients such as fitic acid, lectin and tannin. Probable influences of LGI diets on glucose metabolism includes: 1-reduction of glucose poisoning or influence of great amounts of glucose on destruction of pancreas β cells. 2-reduction of proteins and key enzymes glycozilation which are responsible for metabolic processes.

The matrix and natural plant nuts of LGI foods surrounds granules of carbohydrate and limits digestive enzymes access and distribution of solutions to inside of these nets. So they prevent the immediate increasing of postprandial blood glucose. One of the mechanisms of LGI diets in blood lipids reduction is greater amounts of amylose in comparison to amylopectin in these diets. Because digestion and absorption of amylose part of starchy foods are much slower than amylopectin. In other hand, Glycemic index of amylase is less than amylopectin[17].

LGI diets are richer than HGI diets in anti nutrients (incluce fitic acid, lectin and tannin). These materials cause reduction of starch digestion and balance postprandial glycemia increasing[18]. LGI diets altering blood lipids by reduction of activity of HMG-Co A reductase enzyme, disturbance in reabsorbing of bilious acids and cholesterol from ileum and hindrance of hepatic cholesterol synthesis by propionate (SCFA)[19].

Lentil is one of the richest sources of β-glucan wich is capable of total cholesterol reduction by increasing steroids excretion in stool or increasing production of Short chain escapable fatty acids(SCFA) such as propionates. In some studies, since it contains lots of insoluble fibers, little fermentation of them isn't capable of producing large amounts of SCFAs. Lentil contains 70% carbohydrates which 38% of this amount is made up of oligosacharids. Other carbohydrate which exists in lentil is (RS) resistance starch[20].

Insignificant change in serum TG and HDL_C levels in current study is similar to most of results reported by previous studies. Among previous studies Luscombe[10] and Wolever[21] were the only ones that reported reduction of TG by LGI diet. Beside this, great biological differences in TG levels among different persons can be due to influence of diet.

An insignificant change in serum fructosamine levels is similar to Kabir study results[15], but is converse to Fontvielli's results[22].

It seems that in current study and many similar studies which didn't achieve powerful results, more time is need to observe effects of LGI diets. The difference between current study and some other similar studies is consumption of more than one kind of LGI foods in breakfast in other studies, which caused to intensification of effects of these foods. There is need to more long term studies for a better evaluation of these hypothesizes[23].

This study, in the same direction of results of many previous studies, showed that LGI diet which contains intermediate amount of carbohydrates from LGI sources is likely to function more effectively in reduction of risk factors of cardiovascular diseases in comparison with many other diets.

Reference

1. Wild S, Bchir Mb, Gojka R, Green A, Sicree R, KING H. Global Prevalence of Diabetes, Estimates for the year 2000 and projections for 2030. Diabetes Care .2004 (27):1047–1053.
2. Wild S, Sicree R. Global prevalence of diabetes. Diabetes Care. 2004; 27, 1047-53.
3. Salwa W, Rizkalla M, Taghrid L: Improved plasma glucose control whole-body glucose utilization and lipid profile on a

low–glycemic index diet in type 2 diabetic men. Diabetes Care,2004,27, 1866-71.
4. Giacco R ,. Parillo M, (2000): Long term dietary treatment with increased amounts of fiber-rich low glycemic index natural foods improves blood glucose control in type 1 diabetic patients. Diabetes Care 23, 10, 1461-5.
5. Movahhedi A,Rusta R(2000).Table of food Components.Iranian Institude of nutrition and food science research.pp17.
6. Burtis CA, Ashwood ER. Tiets text book of clinical chemistry. 1999, 3rd Ed . Sauders WB, Philadelphia: 778-980.
7. Friedewald WT, Fredrickson DS. Estimation of the concentration of Low density Lipoprotein- Cholesterol in plasma without use of the preparation ultra-centrifuge. Clin Cham 1972, 18: 499-502.
8. Gilbertson H, Brand-Miller J, Thorburn A, Evans S, Chondros P, Werther G. The effect of flexible low glycemic index dietary advice versus measured carbohydrate exchange diets on glycemic control in children with type 1 diabetes. Diabetes Care 2001, 24: 1137–1143.
9. Lafrance L, Rabasa L, Poisson D, Ducros F, Chiasson J. Effects of different glycemic index foods and dietary fiber intake on glycemic control in type 1 diabetic patients on intensive insulin therapy. Diabet Med 1998, 15: 972–978.
10. Luscombe ND, Noakes M, Clifton PM. Diets high and low in glycemic index versus high monounsaturated fat diets: effects on glucose and lipid metabolism in NIDDM. Eur J Clin Nutr 1999, 53: 473–478.
11. Leonie K, Noakes M, Peter M, Clifton N. The Effect of High- and Low-Glycemic Index Energy Restricted Diets on Plasma Lipid and Glucose Profiles in Type 2 Diabetic Subjects with Varying Glycemic Control. Journal of the American College of Nutrition 2002, 21(2): 120–127.
12. Jarvi AE, Karlstrom BE, Granfeldt YE. Improved glycemic control and lipid profile and normalized fibrinolytic activity on a low-glycemic index diet in type 2 diabetic subjects. Diabetes Care 1999; 22: 10–18.
13. Jenkins DJ, Wolever TM, Collier GR, Ocana A, Rao AV, Buckley G, et al. Metabolic effects of a low-glycemic-index diet. Am J Clin Nutr 1987; 46:968–75.
14. KimJ-I, Kim J-C, Kang M-J. Effects of pinitol isolated from soybeans on glycemic control and cardiovascular risk factors in Korean and cardiovascular risk factors in Korean patients with type 2 diabetes mellitus. Eur J Clin Nutr 2005; 59: 456-458.
15. Kabir M, Oppert J, Vidal H, Bruzzo F. Four-Week Low-Glycemic Index Breakfast With a Modest Amount of Soluble Fibers in Type 2 Diabetic Men. Metabolism. 2002; 51(7): 819-26
16. Paolisso G, Giugliano D, Pizza G, Gambardella A, Tesauro P, Varricchio M, D'Onofrio F. Glutathion infusion potentiates glucose-induced insulin secretion in aged patients with impaired glucose tolerance. Diabetes Care 1992; 15 :1–7.
17. Byrnes SE, Miller JCB, Denyer GS. Amylopectin starch promotes the development of insulin resistance in rats. J Nutr 1994; 125: 1430–7.
18. Rea RL, Thompson LU, Jenkins DJA. Lectins in foods and their relation to starch digestibility. Nutr Res 1985; 5: 919–929.
19. Garg A. Insulin resistance in the pathogenesis of dyslipidemia. Diabetes Care 1996; 19: 387–389.
20. Alisoti M, Wends J, Glvnis M, Blaricom JA, Doreen R. Effect of green lentils on colonic function, nitrogen balance,and serum lipids in healthy human subjects. American Journal of Clinical Nutrition 1995; 62: 1261-1267
21. Wolever T, Jenkins D, Vuksan V, Jenkins A, Buckley G, Wong G, Josse R. Beneficial effect of a low glycemic index diet in type 2 diabetes. Diabet Med 1992; 9: 451–458.
22. Fontvieille A, Rizkalla S, Penfornis A, et al. The use of low glycemic index foods improves metabolic control of diabetic patients over five weeks. Diabet Med 199; 9:1-7.
23. Tsihlias E, Gibbs A, McBurney M, Wolever TS. Comparison of high- and low-glycemic-index breakfast cereals with monounsaturated fat in the long-term dietary management of type 2 diabetes. *Am J Clin Nutr* 2000; 72: 439–49.