

Lentils as a functional food to improve glucose tolerance and decrease cardiovascular disease risk in hypercholesterolemic overweight individuals

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SPG Contributions	Project Status	Duration/Timeline of Project (Year to Year)	Total Project Cost
\$138,957.00	Completed	August 2013 – October 2014	\$138,957.00

Project Description

Cost of diabetes and its complications (e.g. CVD) accounts for 15% (\$9 billion) of total annual health care expenditures in Canada (2009 figures) and this is expected to increase as the prevalence of type 2 diabetes grows. It is imperative to explore new strategies to reduce risk of diabetes and its complications and to improve management of persons with Type 2 diabetes mellitus (T2DM) and reduce CVD risk.

Pulses contain numerous compounds (high fibre, anti nutrients, phytochemicals) and attributes (low glycemic index) with demonstrated effects towards improving glycemic control and reduction of CVD risk factors. Pulse rich diets are associated with decreases in serum glucose and haemoglobin (HbA1c) and this is important in the search for adjuncts to improve the management of T2DM and thereby reduce CVD risk.

Compared to control foods, consumption of three cups of cooked lentils given weekly for 12 weeks will significantly improve glucose tolerance, increase insulin sensitivity, and lower LDL-cholesterol in hypercholesterolemic overweight individuals.

The study was designed according to clinical trial evidence standards for Canadian, Australia/New Zealand and European Union regulatory bodies and thus could be used to substantiate a health claim.

Multi-site (Winnipeg and Toronto), randomized controlled parallel group food study for 12 weeks.

Participants consumed one serving of 0.3 cups of cooked lentils per day for the first five days, followed by 0.6 cups per day, five days/week (equivalent to three cups/week) of lentils in the form of side dishes, entrees and soups (10 different items with a cycle of two weeks) for 12 weeks.

The control diet consisted of potato-based foods in dishes similar to those containing lentils in the same 12-week schedule including the smaller serving size for the first five days.

No. Participants: 102 participants: 51 Toronto site, 51 Winnipeg site in order to have statistical power. Half the participants at each site consumed the lentil diet, the other half the potato control diet.

The following assessments were conducted:

- 1) Anthropometric measurements-waist circumference, body weight and calculation of body mass index (BMI)
- 2) Blood samples for HbA1c, insulin, glucose, lipid profile, C-reactive protein, polyphenols
- 3) Urea and liver function tests (AST, ALT, GGT)
- 4) Advanced glycation end products (by AGE-Reader) assessed as markers of glycemic and oxidative stress
- 5) Oral glucose testing
- 6) Food frequency questionnaire

Primary end points: post-prandial glucose and LDL cholesterol

Secondary endpoints: lipid profile, glycemia, anthropometrics, serum markers for inflammation (C reactive protein and liver inflammation), colonic fermentation (urea), and vascular parameters (heart rate and blood pressure)

Outcome

Previous studies had suggested consumption of pulses could reduce the rate of absorption after a meal. However, contrary to the hypothesis, there was no significant difference in post-prandial glucose response and LDL cholesterol levels between the lentil or potato diets, nor in the serum lipid profile or anthropometric parameters (weight, body mass index or waist circumference) in the Winnipeg trial participants.

However, of significance and perhaps of greater health impact was the observation that lentil consumption may reduce glycation of proteins in the blood. Glycation of proteins in the blood reflects better overall blood glucose control, and it is possible that regular lentil consumption (over months and years) could reduce the progression to pre-diabetes and type 2 diabetes in at-risk individuals.

Those participants consuming three cups of lentils per week also had a reduction in markers of inflammation. Oxidative stress and inflammation are important contributors to the underlying mechanisms of chronic disease including type 2 diabetes.

Data suggests there is no direct effect of eating lentils on glucose uptake into the blood following a meal but rather there is a better overall control of blood glucose levels and thus less glycation of proteins in the blood.

Confirmed effect of lentil consumption on reducing levels of glycated HbA1c would be significant as glycemic control is a key cornerstone in management of type 2 diabetes.

Note: HbA1c values are used as a measure to assess glycemic control (degree of control of glucose metabolism) in diabetics. In diabetes, higher amounts of glycated hemoglobin are associated with CVD, nephropathy and retinopathy.

Individuals consuming three cups of lentils per week had a reduction in markers of inflammation.

Trial conducted to established standards of evidence (sample size, duration, controls,etc) which means data can be used to support future health claims.

Furthers body of knowledge of relationship between pulse consumption and health particularly as it relates to coronary heart disease risk and type 2 diabetes.

Research Objective

OBJECTIVE 1

To examine the effect of lentils on glucose tolerance, biomarkers of insulin sensitivity and risk for cardiovascular disease, vascular function, and tolerability, enjoyment and side effects of the test foods in overweight or obese individuals with elevated LDL-cholesterol.