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Food Chemistry 67 (1999) 229–231

Food Chemistry

www.elsevier.com/locate/foodchem

Coriandrum sativum — mechanism of hypoglycemic action

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Received 7 December 1998; received in revised form and accepted 15 March 1999

Abstract

The effect of coriander seeds (*Coriandrum sativum*) on carbohydrate metabolism was studied in rats fed a high fat cholesterol diet. The spice showed significant hypoglycemic action. There was an increase in the concentration of hepatic glycogen as was evident from the increased activity of glycogen synthase. Activity of glycogen phosphorylase, and gluconeogenic enzymes, revealed decreased rates of glycogenolysis and gluconeogenesis. The increased activities of glucose-6-phosphate dehydrogenase and glycolytic enzymes suggest the utilization of glucose by the pentose phosphate pathway and glycolysis.

1. Introduction

Food and medicine are, in fact, two sides of the same coin and man has been provided with both these materials by plants. From very early times spices are believed to have played an important role in Ayurvedic preparations. They increase the secretion of saliva rich in α-amylase which facilitates the starch digestion in the intestine, rendering the meal rich in carbohydrates more digestible. They favour the cleansing of the oral cavity from food adhesion and bacteria and protect the mucous membrane against thermic, mechanical and chemical irritation (Pruthi, 1976). The hypoglycemic effects of curry leaf and mustard have been studied (Beena, Annie & Leelamma, 1995). Onion and garlic are reported to have hypoglycemic properties (Augusti & Mathew, 1973; Chang & Johnson, 1980). Extracts and preparations from spices, such as coriander, have been reported to improve glucose tolerance and should be tested on human subjects with diabetes (Pruthi, 1993). Apart from these, no demonstration of beneficial effects of this spice on carbohydrate metabolism has been carried out. As coriander is a common spice used in Indian homes, it was proposed to investigate this aspect in detail using rats as experimental animals.

2. Materials and methods

Male albino rats of Sprague Dawley strain weighing 60–70 g were divided into two groups of 6 rats each. Group 1 — Control (the normal laboratory diet +2% cholesterol +15% coconut oil). Group II — Experimental (the above diet mixed with 10% powdered coriander seeds).

The laboratory diet was supplied by M/s. Hindustan Lever Ltd. Water was given ad libitum. The rats were maintained in good laboratory conditions. They were given weighed quantities of diet and maintained on the respective diet for a period of 90 days. Weight gains and diet consumed were based on the 90 days. At the end of this period the rats were starved overnight and killed by decapitation. The tissues were removed to ice cold containers for various estimations. Liver glycogen was estimated by the method of Caroll, Langely and Roe (1956). In this method, glycogen is precipitated from the extract by alcohol and determined by the anthrone method. Blood glucose was estimated by the method described by Rothwell and Stock (1979). The following procedures were used for the estimations of various enzyme activities: hexokinase (EC 2.7.1.1) (Crane & Sols, 1972), phosphoglucomutase (EC 2.7.5.1) (Najjar, 1952), glycogen phosphorylase (EC 2.4.1.1) (Singh, Venkitasubramanian & Viswanathan, 1961), glycogen synthase (EC 2.4.1.11) (Leloir & Goldemberg, 1962), glucose-6-phosphatase (EC 3.1.3.9) (Swanson, 1972) and glucose-6-phosphate dehydrogenase (EC 1.1.1.49) (Kornberg & Horecker, 1952). Protein in the enzyme

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0308-8146/99/$ - see front matter
PII: S0308-8146(99)00113-2

extract was estimated by the method of Lowry, Rosebrough, Farr and Randal (1951). Statistical analysis was calculated using Students '*t*' test (Bennet & Franklin, 1967).

3. Results

The animals in the two groups showed almost similar weight gain i.e., 65 ± 2.6 g. The diet consumption was similar in both groups, i.e., 11.5 ± 1.5 g per day. There is a significant decrease in fasting blood glucose level and increase in the concentration of hepatic glycogen in the rats of the experimental group (Table 1). Hexokinase and phosphoglucomutase activity increased significantly in the liver of rats administered coriander seeds (Fig. 1). The activity of glycogen synthase in the liver was increased and that of glycogen phosphorylase showed a decrease in the rats of the experimental group compared to the control group (Fig. 2). Significant reduction in glucose-6-phosphatase activity was observed in the experimental group, whereas glucose-6-phosphate dehydrogenase activity showed a significant increase (Fig. 3).

Table 1
Concentration of blood glucose and hepatic glycogen[a]

	Group I	Group II
Blood glucose (mg/100 ml)	86.6 ± 1.99	63.9 ± 1.47^{b}
Hepatic glycogen (mg/g wet tissue)	59.9 ± 1.6	87.6 ± 2.3^{b}

[a] Values expressed as mean ± SE of six rats.

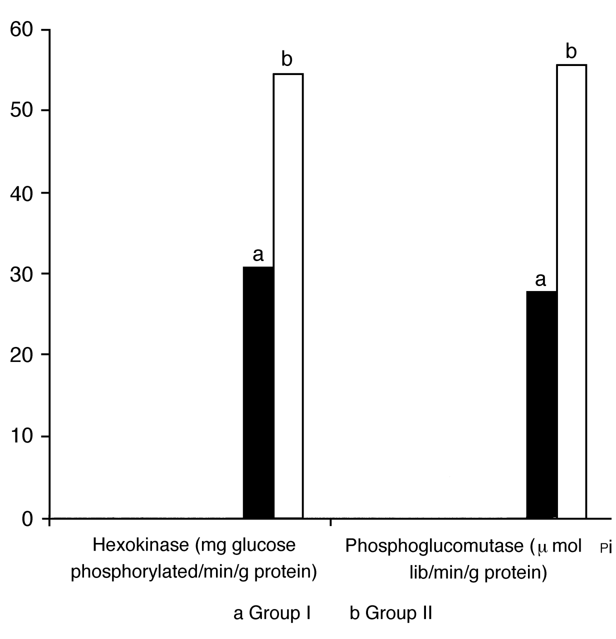

Fig. 1. Activity of glycolytic enzymes in liver.

4. Discussion

It is evident from the results that the supplementation of 10% coriander seeds caused significant hypoglycemic action in rats fed a high fat cholesterol diet. The decreased level of blood glucose may be due to the higher rate of glycolysis, probably by the high activity of hexokinase and phosphoglucomutase, two of the key enzymes of glycolysis. There was an enhanced rate of glycogenesis as evidenced by the higher amount of hepatic glycogen present in the experimental group. The spice administered group showed a decreased rate of glycogenolysis, as indicated by the lower activity of glycogen phosphorylase in the liver. The increased activity of glucose-6-phosphate dehydrogenase in the experimental group suggest the utilization of glucose by the pentose phosphate pathway. The coriander administered group showed decreased gluconeogenesis, as evidenced by the lower activity of glucose-6-phosphatase in the liver.

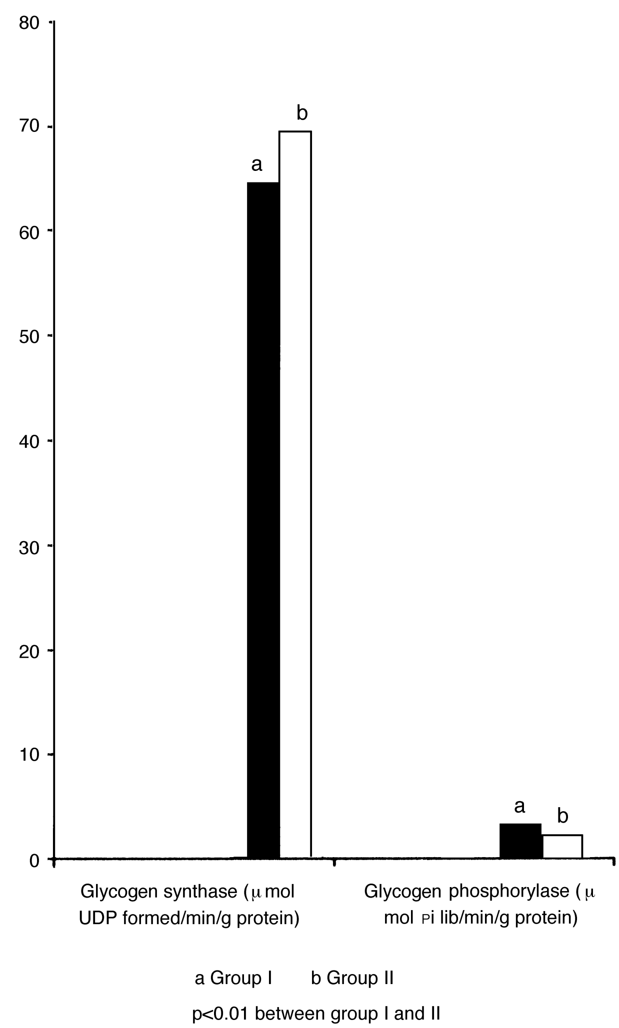

Fig. 2. Activity of glycogen synthase and glycogen phosphorylase in liver.

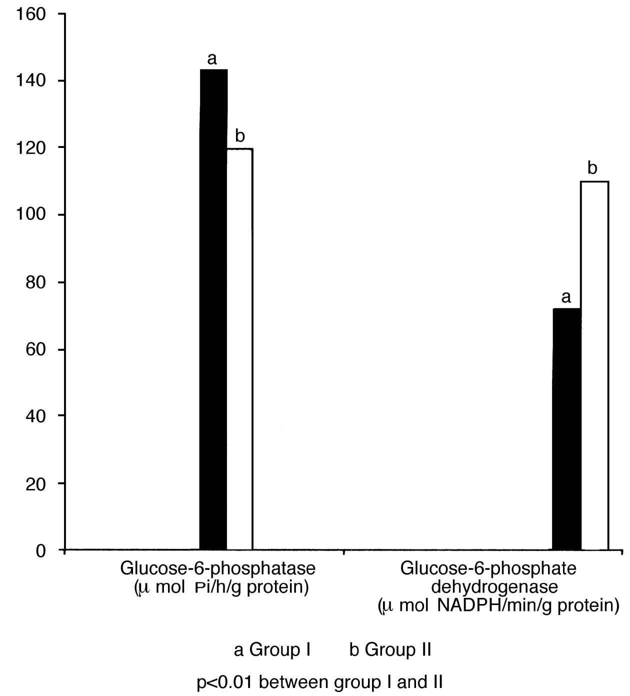

Fig. 3. Activity of glucose-6-phosphatase and glucose-6-phosphate dehydrogenase in liver.

A possible mechanism in hypoglycemia is the enhancement of insulin level in blood, either by stimulating pancreatic secretion of insulin from β-cells or by activating the inactive form (Jain & Vyas, 1975). Villar and Larner (1961) reported that the administration of garlic reduced blood sugar levels and elevated hepatic glycogen. This is in agreement with our observations on rats administered coriander seeds. Thus, the hypoglycemic action of coriander seeds may be due to increased utilization of glucose in liver glycogen synthesis and decreased degradation of glycogen to give blood sugar. It may also be due to the increased rate of glycolysis and decreased rate of gluconeogenesis. The above observations clearly indicate that coriander seeds exert hypoglycemic activity by enhanced glycogenesis, glycolysis and decreased glycogenolysis and gluconeogenesis.

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