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THE HYPOGLYCAEMIC AND HYPOCHOLESTEROLAEMIC PROPERTIES OF BLACK CARAWAY (*Carum carvi* L.) OIL IN ALLOXAN DIABETIC RATS.

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ABSTRACT: The effect of 10 mg Black caraway oil/kg body weight orally administered to normal and diabetic rats was investigated. The oil was able to significantly ameliorate the diabetes-induced loss of body weight of the rats. Treatment of diabetic rats with the oil significantly ($P < 0.001$) reduced the hyperglycaemia and hypercholesterolaemia by 55% and 74% respectively. The increases in serum and liver total proteins and liver total lipids brought about by diabetes were prevented by treatment with the oil.

It can thus be concluded that Black caraway oil has hypoglycaemic and hypocholesterolaemic effects in diabetic rats and also prevents lipid infiltration of organs such as the liver. These findings are significant in view of the prevalence of diabetes and other lipid-related ailments such as fatty liver, arterosclerosis and other cardiovascular diseases, especially in urban populations.

Key Words: Blood glucose; Blood lipids; Diabetes mellitus; Black caraway (*Carum carvi* L.); Hyperglycaemia; Hyperlipidemia; Hypercholesterolemia.

INTRODUCTION

Hypoglycaemic and hypolipidaemic properties have been attributed to several plants and their products. Such plants include garlic (1), onion (2), cabbage (3) and *Momordica charantia* (4). The products of some of these plants have been recommended for the treatment and/or management of diabetes mellitus and lipid inflitration of organs and tissues.

Black caraway, locally known as "Bakin algaruff" and "Kamun Sulum" in Hausa and Kanuri, respectively, is a native of Europe and West Asia, but is presently cultivated in commercial quantities in Borno State of Nigeria.

The seeds have found use in food processing such as flavouring of biscuits, bread, cakes, soup and cheese as well as seasoning and pickling of sausages (5). The seeds also have pesticidal properties (6).

Black caraway seeds yield 3-8% volatile oil (7) containing proteins, essential amino acids, phosphorus, calcium, potassium, magnesium, sodium and fatty acids. The major components of the fatty acids are oleic and linoleic acids. This oil has been shown to decrease arterial blood pressure and heart rate (8) as well as preventing flatulence, promoting gastric juice secretion and inhibiting eicosanoid generation in leucocytes and membrane lipid peroxidation (9).

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Local traditional medicine practitioners have made several unsubstantiated claims as to the potency of Black caraway oil in the treatment of various ailments; the most significant of which is the claim that the oil "cures" diabetes mellitus. In view of the high prevalence of diabetes mellitus in the local population and the widespread use of this oil by the majority of the unlettered diabetic patients (in most cases to the exclusion of orthodox treatment) it became pertinent to investigate the claims made by traditional healers. The ultimate aim of the present study is to investigate the effect of Black caraway on diabetes-induced hyperglycaemia and hyperlipidaemia (especially hyper-cholesterolaemia) which are the two major complications of diabetic conditions.

MATERIALS AND METHODS

Animals

Twenty-four male white Wistar rats weighing 200 - 250g were divided into four groups of six animals each. All the animals were maintained on a standard rat chow (DFFRI Vom Feed Mill, Jos) and water *ad libitum* throughout the six weeks of experiment.

Group I animals were maintained as untreated controls while Group II rats were given, intragastrically, 10 mg Black caraway oil per kg body weight everyday for the duration of the experiment. Animals in Groups II and IV were made diabetic by injection of 70 mg alloxan per kg body weight into the tail after a 24 hr fast (10). Diabetes was confirmed in the rats 24 hours later by Benedict's qualitative test for urine sugar and glucose tolerance test (G.T.T.). These tests were performed at the beginning and termination of the experiment. Group III diabetic rats remained untreated while the animals in Group IV were each given the experimental oil daily as described for Group II above. All animals were weighed at the end of every week.

Collection and analysis of samples

The experiment lasted for six weeks and tail blood was collected at intervals for the estimation of fasting blood glucose. The rats were sacrificed 24 hours after the last dose of the oil, in the fasting state, by dacapitation. The liver was immediately extracted, blotted and weighed. Serum was prepared by allowing the blood collected to clot for 1 hour and then centrifuged for 10 min at 3,000g. Liver lipids were extracted as described by Chandhary (11). An aqueous homogenate was prepared and the supernatant used for the estimation of liver total proteins.

Blood glucose was determined by the method of Trinder (12). Serum cholesterol was estimated by the method of Allain *et al*. (13). Serum and liver total proteins were determined using the method of Teitz (14) while liver total lipids were determined as described by Chaudhry (11).

Statistical analysis

Results are presented as the mean ± SD of six determinations and the difference between two means was assessed for statistical significance using Student's t-test.

RESULTS

Groups I and II rats showed progressive significant increases in body weight (Fig. 1) throughout the period of the experiment. The percentage increases in the body weight for the two groups were similar.

Diabetes in Group III animals caused gradual decreases in body weights of the rats reaching a significant 18% decrease by the end of the experiment. Black caraway oil (Group IV) appeared to have partially prevented this fall in body weight such that at the end of the experiment the drop was only approximately 8% of the original weights.

Fig. 2 shows the fasting blood glucose profiles of normal, diabetic and treated diabetic rats during the course of the experiment. This figure shows that the fasting blood glucose of the normal rats remained within a narrow, insignificant,

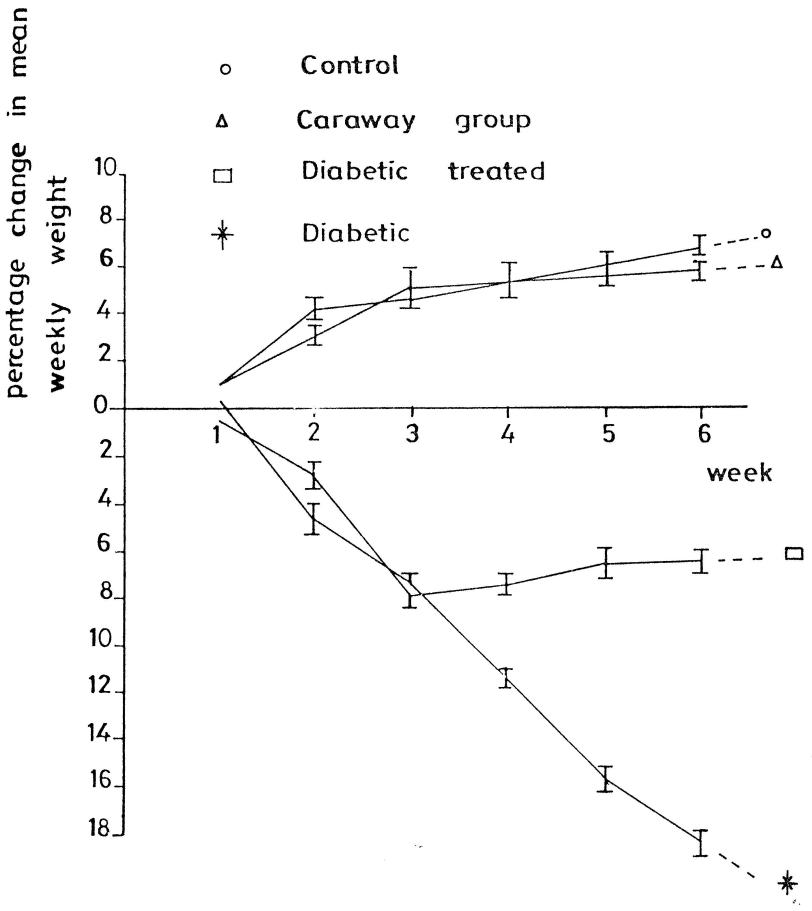

Fig. 1: Graph of percentage changes in mean weekly body weights for the control, test oil only, diabetic and diabetic treated rats.

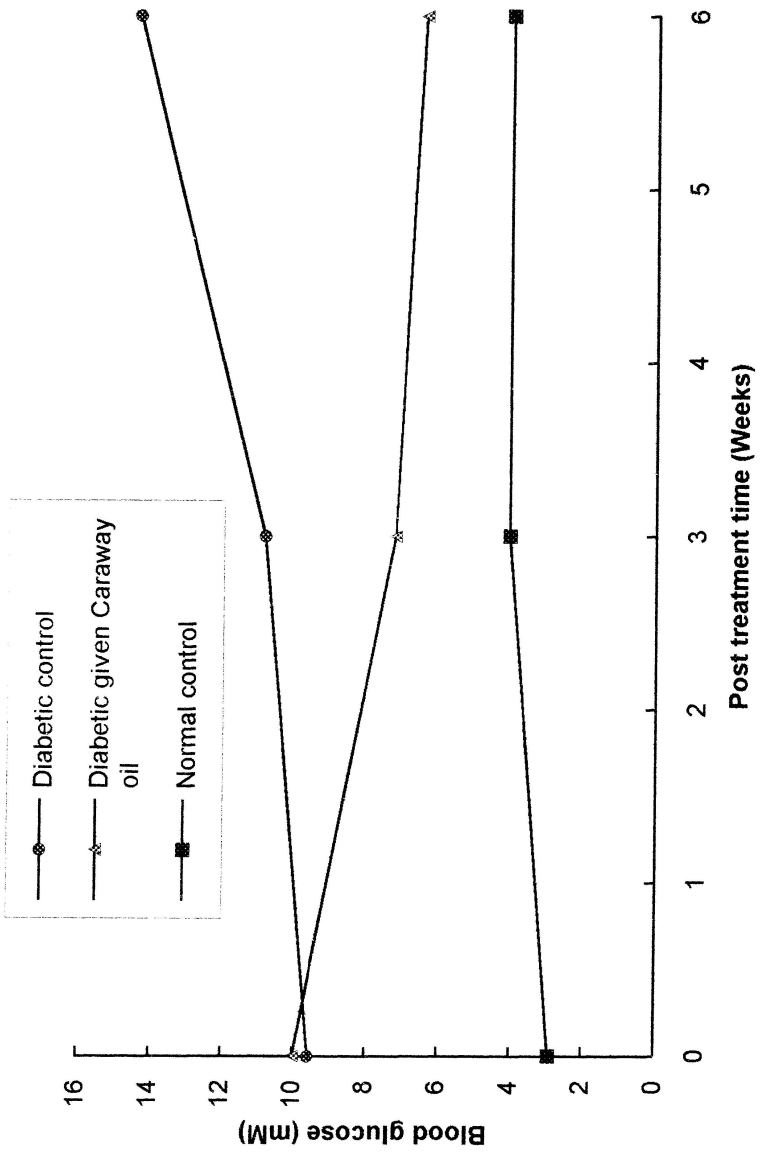

Fig. 2: Blood glucose profile of normal, diabetic and treated diabetic rats over a period of 5 weeks.

range throughout the experiment. The initial fasting blood glucose for the diabetic groups indicate that the rats were indeed diabetic. For the untreated diabetic group, the blood glucose showed progressive significant ($P < 0.001$) increase during the course of the experiment. Intragastrically administered Carraway oil (10 mg/kg body wt.) not only prevented this increase but significantly ($P < 0.001$) ameliorated the diabetes-induced hyperglycaemia.

The biochemical indices analysed in all groups of rats are summarized in Table 1. The results indicate that the untreated diabetic rats had a very significant hyperglycaemia when compared with normal rats. Interestingly, when the oil was given to normal rats (Group II) it caused a slight but insignificant increase in fasting blood glucose, but in the diabetic rats (Group IV) the oil significantly ($P < 0.001$) decreased the blood glucose by about 55% as comapred with the untreated diabetic group.

Serum cholesterol in normal rats was significantly ($P < 0.001$) reduced by the oil. Diabetes increased the serum cholesterol by a significant 193% ($P < 0.001$) from the normal level of Group I animals. However, Black caraway oil was able to significantly ($P < 0.001$) decrease this parameter to a level significantly ($P < 0.001$) below the normal level. The serum and liver total lipids showed a similar pattern of response to diabetes and caraway oil.

Black caraway oil caused a slight but insignificant decrease in the serum total proteins in normal rats. In the diabetic rats the oil completely prevented the increase in this parameter recorded in the untreated diabetic rats.

DISCUSSION

The considerable increases in fasting blood glucose, serum cholesterol as well as serum and liver total lipids induced by diabetes observed in this study had been reported by several workers (15,16) and extensively reviewed by others. The experimental oil partially (completely in some cases) normalised the diabetic levels of these parameters. Similar results have been observed with similar oils from garlic (17), onions (18), cabbage (3) and *Momordica charantia* (19). Extensive research has been carried out on the oils of garlic, onions and cabbage and the hypolipidaemic and hypoglycaemic effects of these oils have been attributed to the volatile disulphide contents (20) whose *in vivo* metabolism, amongst other factors, leads to a reduction in the $NADH/NAD^+$ ratio in the body, thus causing a drastic reduction in lipid synthesis, an increase in β-oxidation of fatty acids, as well as a decrease in gluconeogenesis (21).

Caraway oils also contain volatile components whose identities have not been confirmed. But it is conceivable that they may be sulphur-containing compounds resembling the disulphides of garlic, onions and cabbage oil since caraway oil has a slightly pungent smell resembling that of garlic oil (22,23).

However, other hypotheses are possible, such as the stimulation of glucose uptake by tissues in the presence of components of caraway oil in circulation, thus leading to lowered blood glucose, even in the apparent absence of insulin in the system. This would slow down or reduce the usually rapid mobilisation of lipids from lipids depots (24) thereby preventing the hyperlipidaemia consequent to diabetes. Dichloroacetate is a compound that mimics insulin action on target cells (25) and interestingly lowers blood glucose in diabetic rats but not in normal rats, as observed in the present investigation. Understandably, any comment on the possible mechanism(s) of action of the experimental oil at this stage would be conjectural and any definite statement would have to await further research.

The prevention of diabetes induced increases in serum total proteins and amelioration of the diabetes induced loss of body weight by the oil of caraway may be due to the "correction" of the diabetic condition which can lead to loss of body weight (26) probably as a result of reduction in the mass of fatty tissues due to lipid mobilisation and breakdown of tissue proteins (27).

Table 1: Biochemical parameters of normal and diabetic rats treated and untreated with Black caraway oil.

Parameters	Control Group (Normal rats)	Normal rats given Black caraway oil	Diabetic control group	Diabetic rats given Black caraway oil
Blood glucose (mM)	4.89 ± 0.48^a	5.56 ± 0.36^b	16.39 ± 0.83^c	7.44 ± 0.60^d
Serum cholesterol (mM)	2.54 ± 0.25^a	1.55 ± 0.23^b	7.42 ± 0.39^c	1.92 ± 0.23^d
Serum total lipids (mg/dl)	5.11 ± 0.12	4.77 ± 0.15	14.68 ± 0.25	5.49 ± 0.18
Serum total proteins (mg/dl)	7.3 ± 0.4^a	7.0 ± 0.3^a	11.2 ± 0.5^b	7.55 ± 0.7^a
Liver total lipids (mg/dl)	53.3 ± 5.0^a	55.6 ± 3.1^a	62.2 ± 1.0^b	41.2 ± 3.0^c

Values represent the means ± SD (n = 6). Values with different superscripts are statistially different ($P < 0.001$).

It is therefore concluded that Black caraway oil really reduces diabetes-induced hyperglycaemia, hypercholesteroaemia and fatty infiltration of liver, thereby lending credence to the claims of the traditional medicine practitioners that it could be used, at least, for the management, if not the cure, of diabetes. Further experiments are presently in progress to investigate the mechanism(s) by which the oil exerts these effects.

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