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Alloxan-Induced Diabetes in Rats and the Effects of Black Caraway (*Carum carvi L.*) Oil on Their Body Weight

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Abstract: The effect of different doses of Black caraway (*Carum carvi L.*) oil on the body weights of alloxan-induced diabetic rats was studied. Forty white male albino rats of the Winster strain weighing between 145-240g were used for this study. Diabetes was induced in the experimental rats with alloxan (70mg/kg body weight). Group 1 rats served as the normal control, group II served as the caraway control, whereas group III rats served as the diabetic control. Groups IV, V, VI, VII and VIII were the test groups. All the test groups were administered various doses of the black caraway oil ranging from 5mg, 10mg, 20mg, 40mg and 80mg per kg body weights respectively. Group II (the caraway control) rats were administered 10mg/kg B.W. of black caraway oil. The duration of the experiment was 10 weeks. The weights of the animals in each group were recorded daily throughout the duration of the experiment. The blood glucose levels in the different groups were assayed. The results show that the normal control, the caraway control and the diabetic rats treated with 10mg/kg B.W. of black caraway oil showed progressive and steady increase in the % mean weekly body weights, while the diabetic untreated rats and the other test groups showed decreasing and alternating increments respectively in the % mean weekly body weights. The blood glucose level in the 10mg caraway treatment group was significantly reduced ($p<0.01$) compared to the diabetic control and the other treatment groups. This shows that the black caraway oil increases the % mean weekly body weights of the diabetic/non-diabetic rats at a dose not more than 10mg/kg B.W. It can also be inferred that the 10mg/kg B.W. of caraway oil is the safe dose that can be used in managing Diabetes mellitus. The information obtained from this study would be used in the management of diabetic patients.

Key words: Albino rats, Alloxan, diabetes, caraway oil, body weight.

INTRODUCTION

Diabetes mellitus is a disease characterized by chronic hyperglycaemia and glucosuria produced by an absolute or relative insufficiency of insulin. The ailment may result into the development of further metabolic and anatomic disturbances among which is Lipemia, hypercholesterelaemia, loss of weight, ketosis, arteriosclerosis, gangrene, pathologic changes in the eye, neuropathy, renal disease and coma[1,2]. Hyperglycaemia and glucose intolerance are common manifestations of several types of hormonal disturbances or imbalances, of which the most important is diabetes mellitus[3]. This disease is the seventh leading cause of death in the world.

Weight Loss which is one of the clinical features of diabetes mellitus may be due to the degeneration of the adipocytes and muscle tissues to make up for the energy lost from the body due to frequent urination and over conversion of glycogen to glucose. Weight loss is a very serious issue in the management of diabetes mellitus[4,5].

The search for a cure for diabetes mellitus continues along traditional and alternative medicine. Many herbal supplements have been used for the treatment of diabetes, but not all them have scientific evidence to support their effectiveness[6]. Bitter melon (*Mormodica charantia*), Fenugreek and Soy beans have been studied as possible treatment in patients with diabetes, but the results of these were inconclusive or

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showed these products to be ineffective[7-9]. This led to the study of many other plant products including Black caraway (*Carum carvi L.*) oil as possible treatment for diabetes mellitus.

The black caraway oil has been reported to have both hypolipidemic and hypoglycemic properties[10]. The caraway plant which is known scientifically as *Carum carvi L.* is indigenous to Europe and West Asia[11] and is now being cultivated in commercial quantity in Marte Local Government Area of Borno State, Nigeria. Chemical analysis reveals that the plant contains proteins, essential amino acids, phosphorus, calcium, potassium, magnesium, sodium, petroselinic acid and polyunsaturated fatty acid. The major fatty acids present are oleic and linoleic acid[12].

In the present study, black Caraway oil has been studied in alloxan- induced diabetic rats and its effect on body weight and blood glucose was studied.

MATERIALS AND METHODS

Forty white male albino rats of the Winster strain weighing between 145 and 240g were used. The rats were randomly divided into eight groups of five rats each and maintained on a standard feed and water adlibitum throughout the experiment. Diabetes was induced in groups III to VIII rats by injecting them with 70mg/kg body weight alloxan administered through the tail vein after fasting the animals for twenty four hours[13]. Diabetic condition was confirmed 24hours after alloxan injection. Not all the rats were diabetic at 24hours, but they were all found to be diabetic after 72 hours.

5mg, 10mg, 20mg, 40mg and 80mg/kg body weight of black caraway oil were then administered gastrointestinally by intubation to the test rats to the next test rats in groups IV to VIII respectively. Group III rats served as the diabetic control. Group II rats which were non-diabetic were given 10mg/kg body weight of black caraway oil (caraway control group), while group I rats served as the normal control. The body weights of the animals in all the groups were recorded daily throughout the duration of the experiment. Blood glucose levels were assessed in all the animal groups by using blood from the tail vein of the rats[14]. 2 hours postprandial blood glucose and urine sugar tests were also conducted on the rats fortnightly to monitor the progress of their diabetic state. The experiment lasted for a period of 10 weeks.

This study was conducted between January and March, 2005 at the Biochemistry Department of University of Maiduguri, Nigeria.

All data generated were analyzed using "Analysis of variance" (ANOVA).

RESULTS AND DISCUSSIONS

A general increase was observed in the level of blood glucose in the diabetic control rats (Table I). This increase is statistically significant ($p<0.01$) compared to the normal control, normal rats fed with black caraway oil and the various groups of diabetic rats treated with the caraway oil. This increase which is as a result of the destruction of the beta cells of the pancreas by alloxan was brought to normal in the diabetic rats treated with 10mg/kg wet weight

Table 1: 2 hours Postprandial blood glucose test. (mmol/L)

	0 Week		4th Week		8th Week		10th Week	
	FBS	2HPP	FBS	2HPP	FBS	2HPP	FBS	2HPP
Group I (Normal Control)	6.72±0.67^{a}	7.21 ±0.96 ^{a}	6.51 ±0.72 ^{ab}	7.14± 0.63 ^{ab}	6.00 ±0.42 ^{cd}	5.90± 0.72 ^{cd}	5.64 ±0.44 ^{gh}	5.66 ±0.95 ^{gh}
Group II (Caraway Control)	6.81±0.58^{a}	7.74± 0.96 ^{a}	6.01 ±0.35 ^{ab}	6.90 ±0.72 ^{ab}	4.81 ±0.62 ^{cd}	5.31 ±0.95 ^{cd}	4.78 ±0.54 ^{gh}	5.64 ±0.50 ^{gh}
Group III (Diabetic Control)	10.64±2.08^{b}	13.33±1.92 ^{b}	12.73±2.01 ^{bc}	12.91±1.95 ^{bc}	12.94±1.44 ^{ef}	18.72 ±3.35^{ef}	13.51±1.55 ^{jk}	20.55±6.12 ^{jk}
Group IV (5mg Rx group)	13.82±2.54^{c}	17.22± 2.67 ^{c}	8.50 ±1.22 ^{ab}	10.12±1.94 ^{ab}	10.31±2.25 ^{ef}	16.20±3.12 ^{ef}	9.22 ±1.44 ^{lm}	13.21±3.01^{lm}
Group V (10mg Rx group)	13.51±2.15^{c}	17.23 ±2.28 ^{c}	7.92 ±0.55 ^{ab}	7.95 ±1.35 ^{ab}	7.70 ±1.45 ^{cd}	9.66 ±2.45 ^{ef}	7.51 ±1.23 ^{gh}	9.00 ±1.85 ^{lm}
Group VI (20mg Rx group)	11.33±1.90^{c}	15.41± 1.98^{c}	7.01 ±0.32 ^{ab}	7.35 ±0.60 ^{ab}	10.13±1.46 ^{ef}	12.31±2.15 ^{ef}	8.44 ±0.65 ^{gh}	10.66±1.04^{lm}
Group VII (40mg Rx group)	10.14±1.63^{c}	13.76± 2.62 ^{c}	7.34 ±0.34 ^{ab}	10.12±1.02 ^{ab}	8.71 ±1.58 ^{cd}	10.41±1.66 ^{ef}	8.12 ±0.44 ^{gh}	9.91 ±1.55 ^{lm}

Key: FBS = Fasting blood glucose 2HPP = 2hours Postprandial

- Values are mean ± standard deviation (n=5)
- All groups were compared to each other at ($p<0.01$)
- Values with different superscripts horizontally are statistically significant at ($p<0.01$)

Table 2: Urine Sugar Test using Benedict's solution

	4th Wk	8th Wk	10th Wk
Group I (normal control)			
G1[1]	Nil	Nil	Nil
G1[2]	Nil	Nil	Nil
G1[3]	Nil	Nil	Nil
G1[4]	Nil	Nil	Nil
G1[5]	Nil	Nil	Nil
Group II (caraway control)			
G2[1]	Nil	Nil	Nil
G2[2]	Nil	Nil	Nil
G2[3]	Nil	Nil	Nil
G2[4]	Nil	Nil	Nil
G2[5]	Nil	Nil	Nil
Group III (Diabetic control)			
G3[1]	++++	++++	++++
G3[2]	++++	++++	++++
G3[3]	++++	++++	++++
G3[4]	++++	++++	++++
G3[5]	++++	++++	++++
Group IV (5mg Rx group)			
G4[1]	++++	+	Nil
G4[2]	++++	Nil	Nil
G4[3]	++++	++	+
G4[4]	++++	Nil	Nil
G4[5]	++++	Nil	Nil
Group V (10mg Rx group)			
G5[1]	+++	Nil	Nil
G5[2]	++	Nil	Nil
G5[3]	+++	Nil	Nil
G5[4]	++	Nil	Nil
G5[5]	+++	+	Nil
Group VI (20mg Rx group)			
G6[1]	++	Nil	Nil
G6[2]	+++	+	Nil
G6[3]	+++	Nil	Nil
G6[4]	-	-	-
G6[5]	-	-	-
Group VII (40mg Rx group)			
G7[1]	+++	Nil	Nil
G7[2]	+++	+	Nil
G7[3]	+++	Nil	Nil
G7[4]	-	-	-
G7[5]	-	-	-
Group VIII (80mg Rx group)			
G8[1]	+++	+	Nil
G8[2]	+++	Nil	Nil
G8[3]	+++	Nil	Nil
G8[4]	-	-	-
G8[5]	-	-	-

Key: Rx = Treatment. G = Number of rats in a group (+ = 50mg, ++ = 100mg, +++ = 150mg, ++++ = 200mg, - = death, Nil = Negative)

concentrations of black caraway oil (Table I). This is in agreement with the studies carried out by Ene *et al*,[15].

Though no mechanism to the effect of black caraway oil on blood glucose has been proposed, it could be suggested that the oil might contain substances that mimic the action of insulin. It could be that the oil promotes utilization of blood glucose in the syntheisis of fatty acids, since caraway oil contains medium chain fatty acids[16].

From the result of the urine sugar test (table 2), the sugar was seen to disappear faster from the urine of the diabetic rats treated with 10mg/kg body weight of black caraway oil compared to the other treatment groups. Sugar disappeared completely from the urine of the diabetic rats treated with 10mg/kg body weight of black caraway oil at the 8th week, while traces of sugar were still present in the urine of the other treatment groups at same period of time. The disappearance of sugar from the urine of diabetic rats in the 10mg/kg body weight caraway group at the 8th week concurs with the increment in weight at the same period of time. This could be explained by the fact that the glucose threshold level which was exceeded in the diabetic rats was brought to normal with 10mg/kg body weight of black caraway oil compared to the diabetic and other treatment groups[10]. During the course of this study ie from the 4th week of treatment, two rats each died in the 20mg, 40mg and 80mg treatment groups, while none died in the other treatment groups. This death could be due to toxicity resulting from high dose of the caraway oil[15].

The normal control and the normal rats treated with black caraway oil showed increments in the percentage mean weekly body weights. The diabetic untreated rats showed drastic decrease in the percentage mean weekly body weights. The diabetic treated rats in 5mg, 20mg, 40mg and 80mg caraway treatment groups showed inconsistencies in their % mean weekly body weights, while the diabetic rats treated with 10mg/kg body weight of caraway oil showed progressive and steady increase in their % mean weekly body weights (Fig. 1). This could be explained by protein sparing action ie gluconeogenesis from muscle protein (ketogenic amino acid) would result in decrease in total protein. Since the oil has hypoglycaemic effect, this is expected hence the need for gluconeogenesis from protein would become inevitable for usage of mainly glucose dependent tissues such as brain and nerve cells.

In the diabetic condition, only 5% of an ingested glucose load is converted to fat in an insulin-deficient-diabetic, thus resulting in excess glucose instead of being converted into fatty acid and glycogen for storage is excreted in urine. Also plasma free fatty acid concentrations may rise remarkably due to the mobilization of free fatty acids from adipose tissue by lipolysis of triglycerides. After the glucose level of the blood has been reduced to the physiologically allowable limit of 70% of the normal fasting level of

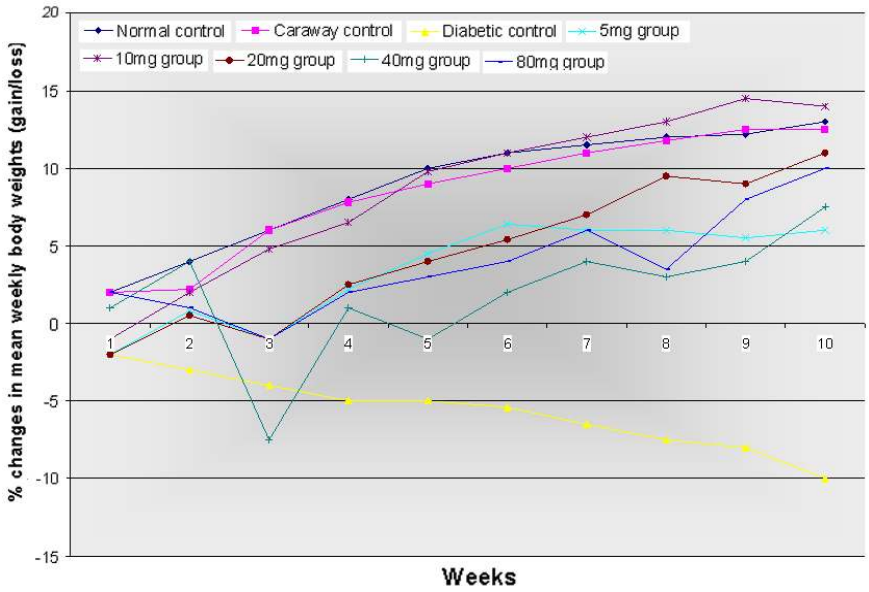

Fig. 1: Percentage changes in the mean weekly body weights of rats in the various animal groups.

about 90mg/100ml blood, a massive mobilization of storage fat occurs with a subsequent flooding of fatty acids into the liver and kidney[3]. The hypoglycaemic effect of the caraway oil at a non toxic level brought all these abnormalities to normal, hence the steady and progressive increment in the % mean weekly body weight at 10mg/kg wet weight concentration.

Conclusion: Since a dose of 10mg/kg body weight of black caraway oil in comparison with the other treatment doses significantly brought the blood sugar level of the diabetic rats to normal and equally brought about a steady and progressive increase in the % mean weekly body weight of the diabetic rats, this dose can be considered as the optimum dose that can be used in the management of diabetes mellitus.

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