
Effect of *Ziziphus jujuba* Leaf Extract on Body Weight, Food Intake and Serum Lipid Levels in Sucrose-induced Obese Rats.

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Rats were provided with 32% w/v sucrose solution as a supplement to their normal diet for 125 days to induce obesity. The parameters studied include body weight analysis on day 1, 30, 60, 90 and 125; daily food intake and serum lipid levels at the end of treatment. The hydroalcoholic extract of *Ziziphus jujuba* leaves at the doses of 200, 400 and 600 mg/kg, p.o. given daily for 125 days caused reduction in body weight, daily food intake and serum total cholesterol, LDL-cholesterol, VLDL-cholesterol and triglycerides along with an increase in HDL-cholesterol levels. The results obtained with 400 and 600 mg/kg dose of *Ziziphus jujuba* extract were significant when compared to sucrose control group. These results suggest that *Ziziphus jujuba* leaf extract possesses significant weight reducing, hypophagic and hypolipidemic properties in sucrose-induced obese rats.

Obesity is an important metabolic disorder, which affects a large number of people throughout the world. Overall, obesity related conditions are estimated to contribute to 3 00 000 deaths each year¹. Insulin resistance, NIDDM, dyslipidemia, coronary heart diseases, osteoarthritis and gout are some of the important non-fatal but debilitating complications of obesity².

Ziziphus jujuba Lam, commonly known as Indian jujube belonging to the family Rhamnaceae, is a small subdeciduous tree, which is cultivated and grown wild in many parts of the world. The leaves of *Z. jujuba* are traditionally used to cure kapha, biliousness, diarrhoea, stomatitis, gum bleeding, syphilitic ulcers, asthma and to reduce obesity³. In addition, the leaves of *Z. jujuba* are reported to show hypoglycemic activity in alloxan-induced diabetic rats⁴. However, the effect of *Z. jujuba* leaves on experimentally induced obesity is not scientifically documented. With this background information, the present investigation has been taken up to study the effect of *Z. jujuba* leaf extract (ZJE) on body weight, daily food intake and serum lipid levels in concentrated sucrose solution-induced obese rats. Fluoxetine, a serotonin reuptake inhibitor has been chosen as the reference drug as it has been reported to reduce hunger and food intake in humans

and produce hypophagia in rats⁵⁻⁶.

Fresh leaves of *Z. jujuba* Lam collected from the damp fields near Belgaum were identified in the Department of Botany, R. L. Science Institute, Belgaum. The leaves were shade dried and powdered and extraction was carried out by percolation using 70 % ethanol at room temperature. After 24 h the dark green filtrate was collected and evaporated under reduced pressure using a Rotavapour apparatus. The extract was subjected to qualitative chemical tests for the detection of phytoconstituents. The hydroalcoholic extract was suspended in 1 % CMC and employed for animal studies. Before performing the experiments, clearance was obtained from the Institutional Animal Ethics Committee.

Wistar rats of equal number of either sex were divided into 6 groups of 6 animals each. The group I served as normal control (received normal pellet chow and water *ad libitum*) and the remaining 5 groups were given 32 % w/v sucrose solution as a supplement to their normal diet and water⁷. Group II served as sucrose control and received 1 % CMC solution (0.5 ml/100 g/d). The remaining groups were given ZJE 200 or 400 or 600 mg/kg/d orally or fluoxetine 10 mg/kg/d, i.p. The treatments were continued for 125 d. The body weight of each animal was determined initially on day 1 and then on d 30, 60, 90 and 125. The daily food intake for

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a group of 6 rats was also assessed. At the end of treatment, blood was drawn through retro orbital puncture, serum was separated and the serum levels of total cholesterol (TC), HDL-cholesterol (HDL-C) and triglycerides (TGs) were estimated by using biochemical diagnostic kits obtained from Beacon. The serum levels of VLDL-cholesterol (VLDL-C) and LDL-cholesterol (LDL-C) were calculated using Friedwald's formula⁸. Statistical analysis was performed by using one way analysis of variance (ANOVA) followed by Dunnet's 't' test for comparison of treated groups with sucrose control group. P-values <0.05 were considered statistically significant.

It has been reported that when adult rats are offered concentrated sucrose solution as a supplement to their chow diet, increased their total calorie intake by about 20 % and gained weight due to postingestive nutritive and hyperphagia promoting effects of sucrose⁷. Increased food intake is responsible for defect in energy balance, leading to positive energy balance and obesity. Accordingly in the present study, Sucrose supplementation has caused increase in body weight and daily food intake when compared to normal control. Rats treated with ZJE at the dose of 400 and 600 mg/kg showed significant ($p < 0.05$) decrease in body weight studied on d 30, 60, 90 and 125 when compared to sucrose control indicating its weight reducing effect. Fluoxetine (10 mg/kg) was also effective in causing significant decrease in body weight when compared to sucrose control. Treatment of ZJE at the dose of 200, 400 and 600 mg/kg and fluoxetine (10 mg/kg) has caused decrease in daily food intake when compared to sucrose control indicating its hypophagia producing effect. (Table 1)

In obesity, the lipid disorder is characterized by increase

in serum levels of TC, LDL-C and TGs along with decrease in serum HDL-C levels². It has also been reported that feeding high sucrose diet to normal rats produce hypertriglyceridemia due to both increased hepatic triglycerides secretion and decreased removal of triglycerides⁹. As expected, feeding concentrated sucrose solution for 125 d has caused increase in serum levels of TC, LDL-C, VLDL-C and TGs along with decrease in serum HDL-C levels as compared to normal diet fed rats. Rats treated with ZJE (400 and 600 mg/kg) and fluoxetine (10 mg/kg) have also showed significant ($p < 0.05$) decrease in serum concentration of TC, LDL-C and TGs along with little decrease in serum levels of VLDL-C when compared to sucrose control. ZJE (600 mg/kg) and fluoxetine (10 mg/kg) treated rats have also showed significant ($p < 0.05$) increase in serum HDL-C levels when compared to sucrose control (Table 2). The lipid lowering effect of ZJE was in accordance to its previously reported hypolipidemic actions in alloxan induced diabetic rats¹⁰. On the basis of effects on serum lipid levels in experimental animals by ZJE, it can be stated that the extract contains some active component(s), which affects glucose and lipid metabolism. The preliminary phytochemical studies showed the presence of flavonoids, saponins, tannins, and triterpenes in hydroalcoholic extract. However there is a need to isolate and identify the active constituent(s) responsible for its hypolipidemic activity.

The results obtained with ZJE 200 mg/kg were not significant when compared to sucrose control. In conclusion, the present study demonstrated a dose-dependent weight reducing, hypophagic and lipid lowering effect of hydroalcoholic extract of *Ziziphus jujuba* leaves in sucrose-induced obese rats.

TABLE 1: EFFECT OF ZJE ON BODY WEIGHT AND FOOD INTAKE IN SUCROSE- INDUCED OBESE RATS

Treatment (mg/kg)	Body weight gain in g (as compared with d 1) at				Food in take for 6 rats (g/d)
	30 d	60 d	90 d	125 d	
Normal control	15.83±0.83	29.38±0.62	36.83±0.75	46.50±0.55	125.8±4.62
Sucrose control	23.43±0.47	43.61±0.54	57.71±0.50	72.70±0.43	186.6±3.84
ZJE (200)	18.25±0.47	39.40±0.36	51.81±0.21	65.35±0.23	164.1±4.16
ZJE (400)	14.65±0.44*	30.93±0.45*	45.05±0.41*	56.70±0.25*	146.8±2.76*
ZJE (600)	12.53±0.44*	25.70±0.29*	37.26±0.19*	47.53±0.29*	127.0±3.16*
Fluoxetine (10)	12.50±0.61*	24.75±0.18*	35.58±0.25*	47.38±0.22*	128.9±2.86*

Values are mean±SEM for 6 rats. * $p < 0.05$ significant when compared to sucrose control.

TABLE 2: EFFECT OF ZJE ON SERUM LIPID LEVELS IN SUCROSE-INDUCED OBESE RATS

Treatment (mg/kg)	Serum lipid levels (mg/dL)				
	TC	HDL-C	LDL-C	VLDL-C	TGs
Normal control	88.63±1.15	12.35±0.58	57.10±1.04	17.18±0.64	85.90±0.72
Sucrose control	111.7±1.23	10.70±0.41	76.72±0.98	24.24±0.64	121.21±0.38
ZJE (200)	103.2±0.70	13.15±0.75	67.29±0.86	22.72±0.2	113.63±0.35
ZJE (400)	93.63±1.22*	15.61±1.31	60.13±1.12*	19.89±0.57	99.48±0.31*
ZJE (600)	86.83±0.65*	17.30±0.72*	50.89±1.04*	18.64±0.5	93.21±0.27*
Fluoxetine (10)	86.92±0.84*	17.63±0.58*	51.43±0.96*	17.86±0.39	89.30±0.39*

Values are mean±SEM for 6 rats. *p<0.05 significant when compared to sucrose control.

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Hepatoprotective activity of the *Trikatu Churna* – an Ayurvedic formulation

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Ethanol extract of *Trikatu Churna* an Ayurvedic formulation was evaluated for hepatoprotective activity in rats by inducing liver damage with carbon tetrachloride. The ethanol extract at an oral dose of 150 mg/kg exhibited a significant protective effect by lowering serum levels of glutamic oxaloacetic transaminase, glutamic pyruvic transaminase, alkaline phosphatase and total bilirubin. Liv 52 syrup was used as positive control.

Trikatu Churna, an important Ayurvedic formulation, is

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official in Ayurvedic formulary of India, Part II'. It is therapeutically useful in the treatment of anorexia, dyspepsia, throat infections and tuberculosis'. It contains one part of each of *pippali* (fruits of *Piper longum*), *marica* (fruits of *Piper*