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Research Article

Treatment Effects of Fenugreek (*Trigonella foenum-graecum*) Seed Powder against High Calorie Diet Indused Obesity in Rats

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Abstract: Obesity is a medical condition in which excess body fat has accumulated to the extent that it may have an adverse effect on health, leading to reduced life expectancy and/or increased health problems. WHO estimates traditional medicines, mostly plant drugs cater to the health needs of nearly 80% of world population. The aim was to study the influence of Trigonella foenum-graecum seed powder on the basic parameters of obesity induced by hight calorie diet. We included 40 male rats and divided them to 4 groups of 10 animals in each group. Normal rats (groups 1, 3) were fed by a standard chow, while the others (groups 1, 4) were fed with high-caloric diet during 14 weeks. From week 15 to 18, groups 2 and 4 were treated with Trigonella foenum-graecum seed powder (Fg). Liver function markers were estimated by biochemical analyzer Microlab 300 and commercial kits from Elitech diagnostic according to the standard protocols provided by manufacturers. The serotonin content was determined in brain using ion-exchange chromatography and fluorescence methods. We have shown that consumption of high-calorie diet leads to changes in food behavior and the development of obesity in rats. Treatment of obese rats with Trigonella foenum-graecum seed powder leads to normalisation of key physiological and biochemical parameters. Treatment with Fg significantly suppressed the increments of body weight, fat weight. Fg improved lipid levels. These results demonstrated the treatment effect of *Trigonella foenum-graecum* seed powder on the basic parameters of obesity induced by hight calorie diet.
Keywords: Fenugreek; Seed; Obesity; High calorie diet; Weight; Lipid level; Treatment.

INTRODUCTION

Today, obesity becomes pandemic, According to the World Health Organization (WHO), more than 1.9 billion adults were overweight in 2014, and more than half a billion were obese [1]. Obesity is one of the major risk factor for morbidity and mortality. Obesity, defined as abnormal excess accumulation of fat in adipose tissue. One of the main environmental factors causing obesity is the high fat diet which has come into wide use today. Obesity represents one of the most important risk factors for chronic diseases [2]. Statistical studies have demonstrated the adverse influence of obesity on hypertension, diabetes, cirrhosis, heart disease, venous thrombosis and embolism, atherosclerosis, acute and chronic nephritis and toxemias of pregnancy. Also there is a greater severity of degenerative arthritis in the knees, hips and lumbar spine, increased incidence of gall bladder disease, earlier appearance of varicose veins, more frequent fractures, increased fetal mortality and greater difficulty in obstetrical delivery in obese females [3-5]. In addition to the physical disorders mentioned, there are serious mental disorders like neurosis stemming from obesity. These are the reasons that force us for the correction of obesity. Strategy for reversing obesity seems to be the development of therapeutic agents for body weight reduction by decreasing food consumption or absorption, increasing energy expenditure, or both [6-8]. It is highly desirable that antiobesity drugs produce sustained weight loss with minimal side effects. Unfortunately, despite the short-term benefits observed, pharmacological treatment of obesity is associated with weight gain rebound after treatment completion, with undesirable side effects [9]. Over the years, many medications have been used to manage obesity but most of them are now withdrawn due to their serious adverse effects [10]. In the face of this unmet medical need, there is requirement of new potential antiobesity drug to combat this syndrome.

Fenugreek (*Trigonella foenum-graecum* L.; TFG) also known as Greek hay is a wellknown leguminous annual herbaceous plant extensively cultivated in Asia, Africa and Europe. Fenugreek belongs to the family Fabaceae and is used in many parts of the world for the treatment of diabetes. TFG seeds have been shown to possess hypoglycemic, hypolipidemic, and antioxidant effects [11, 12]. The

present study was therefore undertaken with an objective to examine the treatment effects of fenugreek (*Trigonella foenum-graecum*) seed powder on a weight gain, adipose tissue weight, serotonin levels, on serum lipid levels induced by high calorie diet

MATERIAL and METHODS

Research was conducted according to with the standards of the Convention on Bioethics of the Council of Europe's 'Europe Convention for the Protection of Vertebrate Animals' used for experimental and other scientific purposes' (1997), the general ethical principles of animal experiments, approved by the First National Congress on Bioethics Ukraine (September 2001) and other international agreements and national legislation in this field. Animals were kept in a vivarium that was accredited in accordance with the 'standard rules on ordering, equipment and maintenance of experimental biological clinics (vivarium)'. The tools used to research were metrological control.

Animals and housing conditions

Studies conducted on 40 non-linear rats and divided to four groups of 10 animals each. The animals of each experimental group were individually housed in polypropylene cages in an environmentally controlled clean air room, with a temperature of 22±3^{0}C, a 12 h light/12 h dark cycle and a relative humidity of 60±5%.

Animals and diet

Rats of group 1 (Control, C) were given water ad libitum and were fed by a standard food during 14 weeks of the experimental period. Food consumption was measured daily at the same time (09:00 to 10:00 h) and body weights were determined once a week. The (HCD) group was fed by a high-caloric diet and water ad libitum [13]. The body weights were determined once a week. Rats of group 3 (C_Fg) were fed by a standard nutriment and treated with 150 mg/kg (body weight) fenugreek seed powder during 21 days. Food consumption was measured daily at the same time (09:00 to 10:00 h). The body weights were determined once a week. The (HCD_Fg) group was fed by, a high-caloric diet and treated with 150 mg/kg (body weight) fenugreek seed powder during 21 days. Food consumption was measured daily at the same time (09:00 to 10:00 h) and body weights were determined once a week.

On the end of the study, animals of all the 4 groups were sacrificed and adipose tissue weights were measured.

Analytical methods

Liver function markers as serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), gamma-glutamyl transpeptidase (GGT), and triglycerides (TGs), total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) were estimated by biochemical analyzer Microlab 300 (Elitech, France) and commercial kits from Elitech diagnostic (France) according to the standard protocols provided by manufacturers. The serotonin content was determined in brain using ion-exchange chromatography and fluorescence methods which were described previously [14-16].

Statistical analysis

Statistical analysis of data was carried out by the software package 'Statistica 8.0'. For the analysis of data distribution type, Shapiro-Wilks criterion was used. As the data were normally distributed, we used Levan criterion for evaluating the equality of variance and Student's t test for independent samples. We calculated mean values (M) and standard deviations (SD). Significant difference was considered at $p \leq 0.05$

RESULTS AND DISCUSSION

Figure 1 shows the dynamics of body weight increase in all rats groups. The initial weight of rats that were on a high-calorie diet was 178,7±16,2 g. Throughout the period of the development of obesity it was shown a gradual increase in body mass of rats and after 14 weeks of experiment the weight of animals was 414±19,6 g. The feeding of HCD for 14 weeks caused a significant ($p < 0.05$) increases in body weight gain and BMI of rats, in comparison with the control rats [16-18].

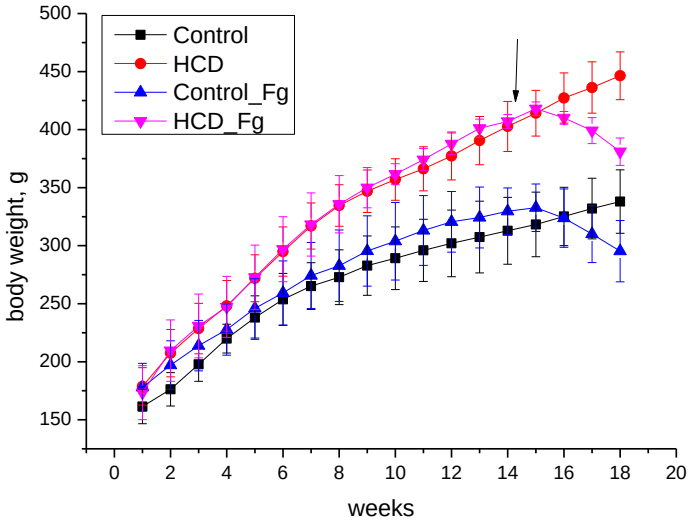

Fig-1: Body weight (g) of control rats (C), rats fed a high-calorie diet (HCD), obese rats treated with fenugreek (HCD_Fg) and control rats treated with fenugreek (C_Fg).

Treatment with Tg for 21 days significantly suppressed the increase in the body weight gain of HCD-fed rats. The initial weight before treatment was 418 g. After 21 days of administration Tg weight of obese animals was 381 g. So the animals lost weight 37 g. Over the same period the weight of the animals that were in the HCD increased by 32 g.

As shown in Figure 2, the mass of adipose tissue in obese group of animals is much higher than the mass of adipose tissue control group of rats. These results suggest that by the end of the experiment, the tested animals suffered obesity, which was further confirmed by change of basic biochemical parameters of blood serum (Fig 4). Treatment with Tg significantly suppressed the increase in adipose tissue weight of HCD-fed rats.

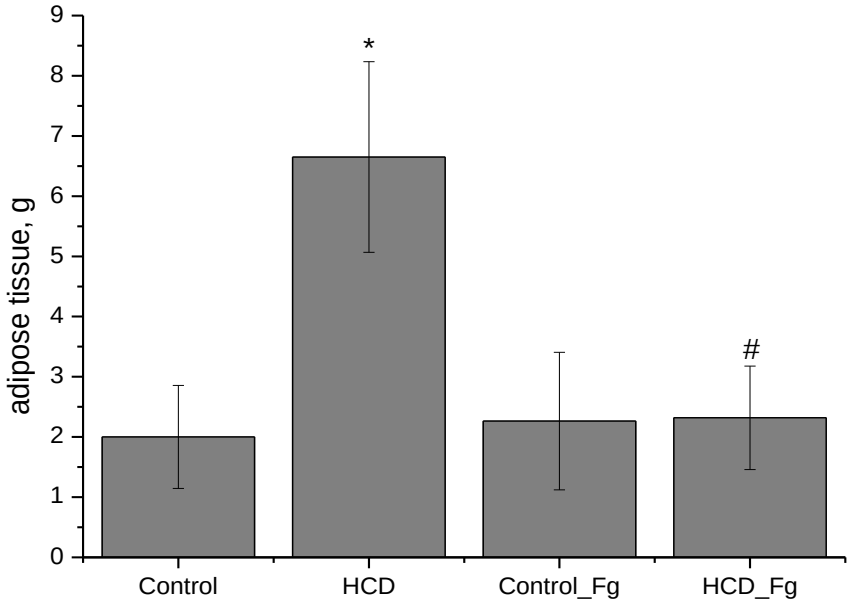

Fig-2: Adipose tissue weight (g) of control rats (C), rats fed a high-calorie diet (HCD), obese rats treated with fenugreek (HCD_Fg) and control rats treated with fenugreek (C_Fg).

Data are presented as the M ± SD for ten animals in each group. Values are statistically significant at $p<0.05$.
* $p<0.05$ compared to control rats; # $p<0.05$ compared to HCD rats.

Studies have shown a decrease in the content of serotonin in 1.66 times in the brain of rats under joint consumption HCD compared with the control group of animals (Figure 3). Treatment with Tg for 21 days showed normalization of serotonin in the brain of rats.

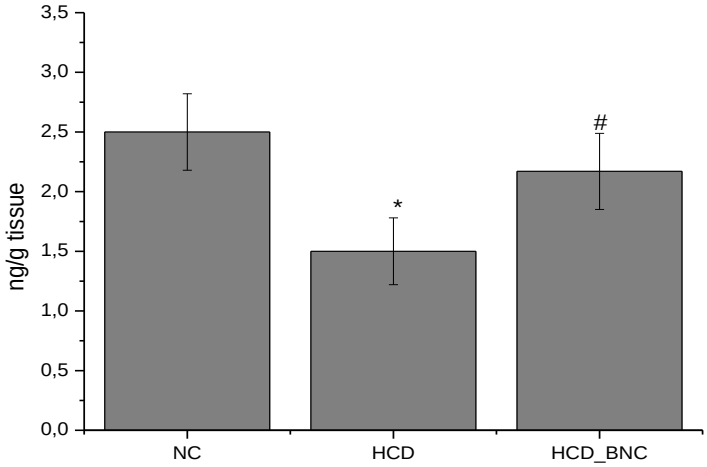

Fig-3: Serotonin level in brain tissue of control rats (C), rats fed a high-calorie diet (HCD), obese rats treated with fenugreek (HCD_Fg).

Data are presented as the M ± SD for ten animals in each group. Values are statistically significant at $p<0.05$.
* $p<0.05$ compared to control rats; # $p<0.05$ compared to HCD rats.

The lipid profile are shown in Figure 4 After obesity induction week, there were significant increments of cholesterol, triglyceride, and LDL-C and significant decrement of HDL-C in the obese induced group as compared to negative control group Following treatment weeks, there were significantly redused of cholesterol, triglyceride, and LDL-C in the Fg treated groups as compared to negative control and positive control group (Fig 4).

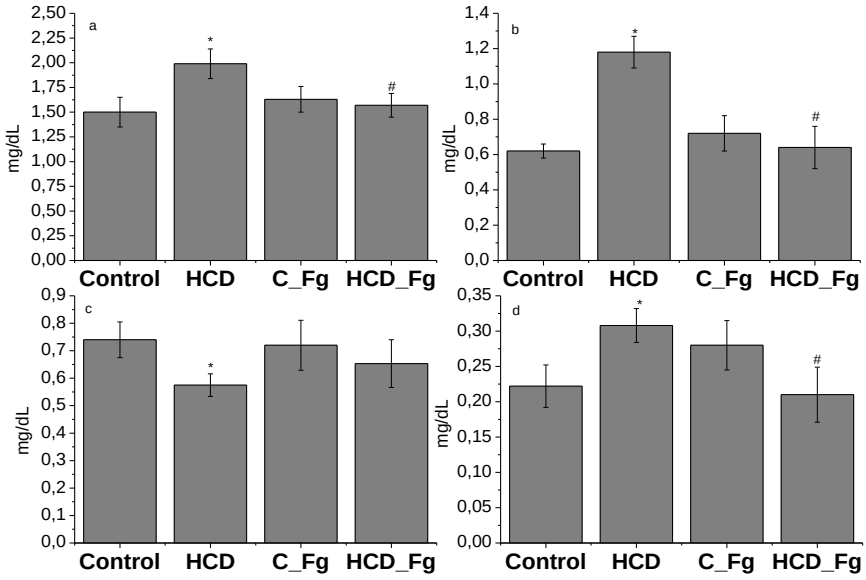

Fig-4: Lipid levels (a- total cholesterol (TC), b- triglycerides (TGs), c- high density lipoprotein cholesterol (HDL-C), d- low density lipoprotein cholesterol (LDL-C)) in serum of control rats (C), rats fed a high-calorie diet (HCD), obese rats treated with fenugreek (HCD_Fg) and control rats treated with fenugreek (C_Fg).

Data are presented as the M ± SD for ten animals in each group. Values are statistically significant at $p<0.05$.
* $p<0.05$ compared to control rats; # $p<0.05$ compared to HCD rats.

The serum AST, ALT, and GGT activities were significantly increased in HCD group, when compared to the control group. A significant reduction in AST, ALT, and GGT activities was observed in HCD_Fg group in comparison to the HCD group (Table 1). Treatment of obese rats with Fg led to positive reduction of ALT, AST and GGT in Fg treated group as compared to negative control group and positive control group (Table 1).

Table-1: Serum levels of liver enzyme markers of control rats (C), rats fed a high-calorie diet (HCD), obese rats treated with fenugreek (HCD_Fg) and control rats treated with fenugreek (C_Fg).

Parameters	Groups			
	C	HCD	CFg	HCDFg
ALT (U*L-1)	63,35±2,17	88,75±9,92*	61,28±6,49	77,44±3,43*#
AST (U*L-1)	250,6±25,1	310,9±22,9*	278,3±43,5	281,7±21,75
GGT (U*L-1)	1,52±0,15	3,52±0,32*	1,66±0,23	1,72±0,38#

Data are presented as the M ± SD for ten animals in each group. Values are statistically significant at $p<0.05$.
* $p<0.05$ compared to control rats; # $p<0.05$ compared to HCD rats.

The present study observations on the fenugreek seed treatment in reducing the body and adipose tissue weight is in line with the findings of earlier study by Toshiaki Handa et al [19]. There are two possible mechanisms to reduce body weight and adipose tissue weight by fenugreek. One mechanism is when fenugreek flushes out the carbohydrates from the body before they enter the blood stream resulting in weight loss [20]. Another possible mechanism is that fenugreek seeds contain a high proportion (40%) of soluble fiber. Dietary fibre and, in particular, viscous dietary fibre have been shown to increase postprandial satiety and to decrease subsequent hunger in short-term studies [21]. This fiber forms a gelatinous structure (similar to gaurgum) which may have effects on slowing the digestion and absorption of food from the intestine and create a sense of fullness in the abdomen, thus suppresses appetite and promotes weight loss [20].

However in the present study fenugreek seed extract did not alter the food intake of animals. A dose dependent decrease in total body weight was seen with fenugreek administered group of animals in comparison with control groups. Fenugreek does not have any effect on the weight of solid organs like liver, spleen and kidney; it only decreases the total amount of adipose tissue. These results establish that fenugreek seed extract has useful anti-obesity property. Further studies in humans are required to correlate the studies done on animals.

Our results are consistent with literature data. According to Bordia et al. fenugreek given at a dose of 2.5 g twice daily for 3 months to healthy individuals showed no affect on the blood lipids. However, fenugreek administered in similar fashion to coronary artery disease patients with or without type-2 diabetes significantly decreased blood lipids, total cholesterol and triglycerides, without affecting the HDL-cholesterol [22, 23]. Hannan et al. in 2003 showed beneficial effects on dyslipidemia Trigonella-derived SDF [23, 24]. Lipid-lowering effect of fenugreek seeds can be attributed to its role in modulating the activity of several glucose and lipid metabolism enzymes or to its ability to enhance biliary cholesterol excretion [23, 25, 26].

Other researchers have shown hypocholesterolemic effect of ethanol extract of Trigonella seed explaining interaction saponin-like active components with bile salts in the digestive tract and modified lipid metabolism [27]. Uemura et al. (2011) showed that Trigonella seed-derived saponins, diosgenin, inhibited the accumulation of TG and the expression of lipogenic genes in a hepatic cell line (HepG2 cells) by inhibiting the transactivation of liver-Xreceptor-a and suggested that fenugreek could ameliorate dyslipidemia by decreasing the hepatic lipid content in diabetic mice via diosgenin [28].

CONCLUSION

As in the present study beneficial decrease in total body as well as adipose tissue weight is seen, fenugreek can be accepted as one of the herbal preparation for treating obesity. Therefore, consumption of Fg in daily dietary intake is a one-step action towards prevention of obesity and weight management principle.Further study is needed for exploring the other mechanism of anti-obesity by fenugreek.

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