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The Effect of Chamomile Extract on Blood Sugar Level, Lipid Profile and Body Weight in High-Fat Diet Fed Rats

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ABSTRACT

The addition of herbs to the diet is one of the methods for the treatment of obesity. It is aimed to examine the extracts of chamomile to use in the treatment of obesity, against high-fat diet. In this study, 6-8 weeks old fifteen female Sprague-Dawley rats were used. Five of the rats separated randomly for the control group and fed with a standard pellet for ten weeks. Ten rats were fed with a high-fat diet for four weeks. After this period, the rats were randomly divided into two groups (high-fat control and chamomile). Blood samples were taken for lipid profiles and glucose. With the high-fat diet, body weights and total cholesterol had increased significantly ($p<0.05$). Chamomile had a 39.2% decrease in body weight and a 38.8% decrease in blood glucose ($p<0.05$). There was no difference between groups in other lipid parameters. Chamomile may be used in the treatment of obesity.

Keywords: Chamomile, high-fat diet, obesity, weight loss

INTRODUCTION

Obesity is one of the most common diseases all over the world. It is a risk factor for early mortality and comorbidities such as hypertension, type 2 diabetes, dyslipidemia, coronary heart disease, stroke, sleep apnea, and some cancers [1]. Therefore, obesity is one of the major problems in public health. In the World

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Health Organisation (WHO) obesity fact sheet, it was stated that in 2016, more than 1.9 billion adults aged eighteen years and older were overweight; of these, over 650 million adults were obese [2]. Therefore, the underlying mechanism of obesity has been investigated, and several approaches gain importance for preventing or treating obesity [3–5]. There are a lot of reasons for obesity. One of them is the disruption of energy balance[6]. A high-fat diet, in particular, has been associated with obesity and comorbid diseases [7,8]. Chamomile (*Matricaria chamomilla* L.*)* is a member of the Asteraceae family and contains various phenolic compounds (a polyphenol group member) and flavonoids. Chamomile is the most common herb in the diet as a herbal tea. It is thought that chamomile extract acts as a pain killer. In addition to that, it has antiseptic, antibacterial, antioxidant, and anti-inflammatory activity also protects from some diseases like high-fat liver, Type 2 diabetes, and cancer[9,10]. Although chamomile is well studied in some diseases like diabetes and maintaining blood glucose levels, the anti-obesity effect on body weight has not been examined[11-13].

Herbs rich in phytochemicals have been used to maintain well-being, prevent and treat several diseases for decades[14,15]. Polyphenol, naturally occurring in plants, effectively regulates physiological and molecular pathways, including energy metabolism, adiposity, and obesity[16,17]. Chamomile has been traditionally used for weight loss in Turkey. In addition to weight loss, chamomile is also used for health benefits in cosmetics, the food industry, and medical applications[18].

Although herbs are commonly used as a tea in daily diet, the effect of most of the herbs on health has not been well established. Therefore, if there was not known the effects of the herbs on health, using herbs for the treatment of some diseases may have negative consequences. With all of the knowledge, this study planned to examine the effects of chamomile on blood glucose level, lipid profile, and body weight in high-fat diet-fed rats.

METHODOLOGY

Research Protocol

A high-fat diet was applied for ten weeks in all rats except the control group. After four weeks, the high-fat diet-fed rats were separated randomly into equal two groups. One group was chosen for the chamomile group, and the other was selected for the high-fat diet control group. Chamomile applied for six weeks via gavage. The high-fat and control groups have taken placebo (water) via gavage from the beginning of the fourth week to the end of the tenth week. Blood samples were collected at the beginning, end of the fourth week, and end of the study. Animals with net weight change greater than 50 g were considered obese.

Sample Selection

In this study, 15 Sprague-Dawley albino female rats (83-202g) aged 6-8 weeks were used. All of the rats were fed a standard diet ad libitum for ten days. The rats were kept in 21.8 ° C and 60% humidity, twelve hours of light, and twelve hours of darkness. The rats were randomly allocated to cages with a maximum of five rats in each cage in the Istanbul Medipol University Regenerative and Restorative Medical Center (MEDITAM).

Initially, five of the rats were randomly separated and determined as a control group; they were fed with a standard diet and 2 mL water via gavage throughout the study. Then the remaining rats formed the high-fat diet group. These rats were fed with a high-fat diet for four weeks. After high-fat diet-fed rats (n=10) were randomly separated into two equal groups. The three groups comprised:

(i) Control Group (n=5)- Standard diet

(ii) High-Fat Control Group (n=5)- High-fat diet

(iii) Chamomile Group (n=5)- High-fat diet + 100 mg/ kg chamomile extract

Standard and High-Fat Diet

The standard diet consisted of corn, full-fat soy (obtained from genetically modified soybean), sunflower seed meal, wheat ram, wheat flour, alfalfa flour, sugar beet molasses, beef meat-bone-chicken flour, dicalcium phosphate (inorganic), calcium carbonate, vitamin premix, and mineral premix.

High-fat diet applied for according to Ari et al.[19] protocol. The high-fat diet contained 25 g butter for each 100 g standard pellet. The butter was melted and added to the standard pellet until the pellets had absorbed all the melted butter. The high-fat diet was given to all groups except the control group until the end of the study.

Preparation of Chamomile Extract

Chamomile flowers were obtained from the local market in May 2016. The flowers were controlled by Tuğba İduğ (Ph.D. lecturer) and İrem Atay Balkan (Ph.D. lecturer). A hydroalcoholic solution (100 g Chamomile in a 1 L solution containing 37% ethyl alcohol and 63% distilled water) of chamomile was extracted in a Soxhlet apparatus. After the alcohol was evaporated, the solution was lyophilized and kept at -20°C until use. The extract was weighed 100 mg for each kg of rat weight. It was dissolved in water with a maximum of 2 mL of gavage per rat. The dosage of chamomile extract was decreased according to negative weight changes in Chamomile groups.

Weight Measurement

Rats were taken one by one from their cages, and their weights were taken using sensitive scales (0.0001 g/ 200 g) every Monday until the end of the study.

Blood Samples

One ml of blood was collected from each rat at the beginning (day 0), middle (day 28), and at the end of the study (day 70) from the subclavian vein. The blood samples were centrifuged at 3000 rpm for ten minutes at +4ºC. The blood serum samples were analyzed at Istanbul Medipol University MEGA Hospitals Complex Biochemistry laboratory. The values of serum Low-Density Lipoprotein (LDL), High-Density Lipoprotein (HDL), triglyceride (TG), total cholesterol (TC), and blood glucose were analyzed utilizing Cobas 6000 (Roche, Tokyo) biochemistry auto-analysis.

Statistical Analyses

The SPSS 18.0 statistics program (IBM, NY, USA) was used for the statistical analysis. The values were mean and ± standard deviation (SD), differences in comparisons of multiple groups were made using the One-Way ANOVA test. Independent t-tests were used to compare the difference between day 28 and day 70 data. The general linear analysis was made for repeated weight measures. The changes were tested using the paired-sample t-test method and were considered significant when $p < 0.05$ and $p < 0.01$.

RESULTS and DISCUSSION

Control and high-fat diet-fed rats' weight changes were calculated from day 0 to day 28. Average weight changes were 46.00±18.52 g for the high-fat intervention group and 29.00±9.24 g for the control group. In comparison, the average weights increases were 43.7% in high-fat diet-fed rats, 15.9% in the control group. This increase was found statistically significant ($p<0.05$). The average weight changes of control and high-fat diet-fed rats can be shown in Figure 1. It was found that the chamomile group has weight loss from day 28 to day 70 when the average weight change compared with the high-fat control group. The average weight change was 18.06 ± 8.16 g for the high-fat diet control and 13.37±6.75 g for the chamomile group. Also, it was shown that on day 70 chamomile group has a lower weight than the high-fat diet-fed rats in Figure 2 ($p<0.05$).

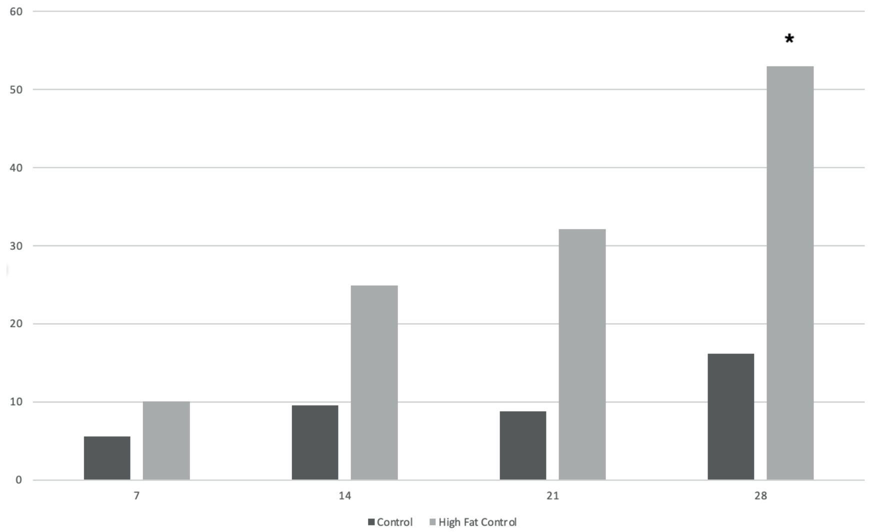

Figure 1. High-fat diet fed rats and control group average weight change for 4 weeks. *p<0.05

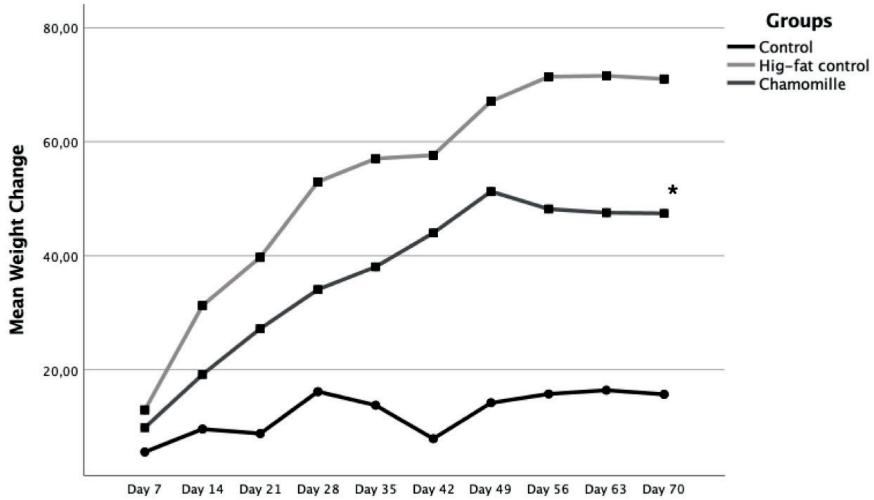

Figure 2. The difference in the High-Fat-Control, Control, and Chamomile group average weight change for ten weeks. (*p<0.05)

This study found a significant difference between the weight change of the control group and the high-fat control group. It was found that rats' weight was increased with a high-fat diet compared to the standard diet—bodyweight was affected differently by the quantity of food and a variety of nutrients[-7,8]. In one study, the metabolic syndrome rat model developed with a high-fat and high-carbohydrate diet. As a result of a high-carbohydrate (8 weeks) and high-fat diet (16 weeks), found an increase in body weight, energy intake, and BMI, compared with the control group [21]. In another study, male rats were fed a high-fat diet for 16 weeks. It was stated that beta-cell dysfunction was observed in the female offspring of these rats. Consumption of a high-fat diet leads to increased body weight, energy intake, higher adiposity values and leptin levels, and fatty liver masses [22]. Despite that, few studies showed no significant difference between a high-fat diet and weight gain in rats [19,23]. One study found that no effect on weight changes of consumption of a high-fat diet between a high-fat and a low-fat diet for sixteen weeks [23].

Day 28 and day 70 biochemical analyses were compared for all groups. It was found that TC was increased in the high-fat control group and blood glucose decreased in the Chamomile group (p<0.05). Examined to change of TC and glucose within groups, it was shown that the control group has the lowest level of TC, and the chamomile group has the lowest level of glucose in Table 1.

Table 1. Biochemical Analysis Results of Control, High-fat Control, and Chamomile Group.

		TC mg/dL n±SD	TG mg/dL n±SD	LDL mg/dL n±SD	HDL mg/dL n±SD	Glucose mg/dL n±SD
Control						
n=5	**Baseline**	45.12±9.39	69.68±15.18	-10.13±3.38	41.32±7.62[a]	307.80±26.33[a]
n=5	**Day 28**	57.64±6.72	60.0±8.80	2.60±2.40	47.20±4.47[a]	123.04±15.87
n=5	**Day 70**	57.70±6.72[a]	82.92±36.31	0.00±0.00	51.40±6.62	99.08±4.83[a]
High-Fat Control						
n=5	**Baseline**	55.50± 6.46[Å]	61.83±1 6.51	-6.50±2.32	49.63± 3.45[aÅ]	223.86± 40.98[a]
n=5	**Day 28**	65,30±4,75	50.70± 10.95	3.33±1.52	58.23±7.19[a]	130.0±12.21
n=3	**Day 70**	65.80±8.17 [aÅ]	94.70±16.78	0.00±0.00	55.13±7.02[Å]	106.80± 9.44[a]
Chamomile Group						
n=5	**Baseline**	53.32± 11.09	69.70±27.72	-5.26±8.99	44.64± 4.67[a]	206.34± 44.85[a]
n=5	**Day 28**	74.64± 14.20[Å]	65.54± 17.50	4.40± 4.61	59.24± 8.24[a]	201.48± 37.58[Å]
n=5	**Day 70**	68.78± 10.89[aÅ]	87.64±53.10	0.00± 0.00	60.84± 9.82	123.34±12.92[aÅ]
Referans levels						
		77.33±5.30	56.00±4.12	15.06±1.22	54.59±5.08	71.11±23.58

TC:total cholesterol, TG: tryglyseride, LDL: low density lipoprotein, HDL: high density lipoprotein

⊕ Independent T-test statistically significant difference was found at p <0.05., day 28 and day 70 was analyzed.

a One-way ANOVA, p<0.05 within-group

People have used herbs for decades for the treatment of various diseases. Chamomile is a herb used to treat and prevent obesity with different properties, but there are only a few studies about this effect [9,12,18,24]. This study found that the chamomile effect reduces body weight compared to a high-fat diet in rats. Some studies have shown that chamomile's anti-obesity effect is linked to apigenin content [25,26]. In another study, the effect of chamomile extract on blood glucose levels and body weight were examined in rats. It was found that the chamomile group has a lower body weight than the control group [27]. According to these results, chamomile extract can be used to reduce body weight against a high-fat diet, and it was thought to prevent obesity. However, which molecules are responsible for these effects and how they work will be investigated further.

Although chamomile affects body weight, blood sugar level, and lipid profile in this study, few limitations exist. Rats number is one of the limitations. In the beginning, each group had five rats, but some rats have died during blood collection. In addition to that LDL, cholesterol results were found different from the literature. LDL cholesterol was calculated with the Friedewald low-density lipoprotein cholesterol method (F-LDL-C) [28]. Therefore, it was thought that the cause of differences in different formulations. Despite the limitations, the effects of chamomile on body weight, blood sugar, and lipid profile have been shown in this study. Therefore, it was thought that this herb might be used for the treatment of obesity. Primarily chamomile tea may be used in the diet for reducing body weight. But further investigation is needed to understand the mechanisms and which phytochemicals are responsible for these effects.

The importance of macronutrient distribution has been long known in the development of obesity and many diseases. A high-fat diet is mainly associated with some metabolic diseases such as cardiovascular disease, Type 2 diabetes, fatty liver, neurological disease, kidney dysfunction, and obesity. Various medical and traditional methods have long been used in the treatment of obesity. The use of plants has always been widespread by people with no specialized or medical knowledge of how they function. Chamomile is an example of the plants used in the treatment of obesity. In this study, the effects of chamomile on body weight, blood lipid level, and blood sugar level in rats were investigated. It is found that a high-fat diet caused an increase in body weight. In addition, chamomile against a high-fat diet affects limiting weight gain. In the chamomile group, blood glucose levels significantly decreased. The use of chamomile could be an effective strategy for restricting weight gain, but further studies are needed to understand the anti-obesity effects of chamomile and other herbs.

STATEMENT OF ETHICS

This experiment was approved by the Istanbul Medipol University Animal Experiments Local Ethics Committee (IMU-HADYEK, decision no: 84) before the study.

CONFLICT OF INTEREST

No conflict of interest was declared by the authors.

AUTHOR CONTRIBUTION

HKBG and NB have planned and conducted to study. Tİ has helped for extraction of chamomile and laboratory use. HKBG has prepared the first draft of the research. NB and Tİ have checked for the final document.

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