

# **Ameliorative effect of green tea on obesity and elevation of liver enzymes caused by high fat diet in hamsters**

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## **Abstract:**

High fat diet causes obesity and affect liver enzymes, due to the progression of non-alcoholic fatty liver disease. In this study, the effect of high fatty diet on the body weight and liver enzymes of golden hamsters was demonstrated and the potential protective effect of green tea against obesity and elevation of liver enzymes was investigated. The study was conducted between January and July 2020 in College of Medical Technology. Three groups of golden hamsters were fed a basal diet pellets (CON), a high fat diet (HFD) and a high fat diet with steeped green tea (GT), respectively. The body weight was increased significantly in the HFD group and no significant increase in the GT group compared to the CON group. The HFD feeding elevated the liver enzymes (aspartate transaminase, alanine transaminase and alkaline phosphatase) significantly compared to the CON group. However, the levels of these liver enzymes were significantly decreased in the GT group compared to the HFD group. The study findings suggest that steeped green tea could prevent body weight gaining from high fat diet and improve the levels of liver enzymes. Therefore, green tea might be considered as a potential plant in the treatment of obesity and non-alcoholic fatty liver disease.

**Keywords:** Obesity, High fatty diet, Alanine aminotransferase, Alkaline phosphatase, Aspartate aminotransferase, Steeped green tea.

## التأثير التحسيني للشاي الأخضر على السمنة وارتفاع إنزيمات الكبد الناجمة عن النظام الغذائي عالي الدهون في الهامستر

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### الملخص:

يسبب الغذاء عالي الدهون السمنة ويؤثر على إنزيمات الكبد نتيجة لتطور مرض الكبد الدهني غير الكحولي. في هذه الدراسة؛ تم اختبار تأثير الغذاء عالي الدهون على وزن الجسم وأنزيمات الكبد للهامستر الذهبي وتم التحقيق في التأثير الوقائي المحتمل للشاي الأخضر ضد السمنة وارتفاع إنزيمات الكبد. أجريت الدراسة بين شهري يناير ويوليو 2020. تم تغذية ثلاث مجموعات من الهامستر الذهبي بالأعلاف المخصصة لحيوانات التجارب (CON) وغذاء عالي الدهون (HFD) ونظام غذائي عالي الدهون مع الشاي الأخضر المنقوع (GT)، على التوالي؛ لوحظ زيادة وزن الجسم بشكل ملحوظ في مجموعة الغذاء عالي الدهون HFD ولم يكن هناك زيادة معنوية في المجموعة المعالجة بالشاي الأخضر GT مقارنة بالمجموعة الضابطة CON. أدت تغذية مجموعة HFD إلى زيادة في إنزيمات الكبد (الأسبارتات ترانس أميناز AST، ألانين ترانس أميناز ALT، والفوسفاتيز القلوي ALP) بشكل ملحوظ مقارنة بالمجموعة الضابطة. في حين انخفضت مستويات إنزيمات الكبد بشكل ملحوظ في مجموعة GT مقارنة بمجموعة HFD. تشير نتائج الدراسة إلى أنّ الشاي الأخضر المنقوع يمكن أن يمنع زيادة وزن الجسم من الغذاء عالي الدهون ويحسن مستويات إنزيمات الكبد. لذلك؛ يمكن اعتبار الشاي الأخضر نباتاً محتملاً في علاج السمنة ومرض الكبد الدهني غير الكحولي.

**الكلمات المفتاحية:** السمنة، غذاء عالي الدهون، الأسبارتات ترانس أميناز، ألانين ترانس أميناز، والفوسفاتيز القلوي، الشاي الأخضر المنقوع.

**Introduction:**

Liver is the second largest organ in the body and responsible for the maintenance of lipid homeostasis as well as metabolism of lipids and carbohydrates, hormone production, detoxification and clotting factors synthesis[1,2]. Fat, reported to provide 9 kcal per gram, is considered as the greatest energy density dietary nutrient and can promote a high energy consumption[3,4]. Dietary fat has been found to affect the endocrine system, and hypothyroidism was reported to have an effect on liver function[5]. Consumption of high dietary fat has also shown a development of metabolic syndrome and may result in retention of triglycerides in different organs, causing steatosis and organ dysfunction, due to the packing incapability of adipose tissue[6,7]. Accumulation of fat in liver was found to have a critical role in the initiation and progression of non-alcoholic fatty liver disease[8]. This liver metabolic syndrome encompassed a group of liver disorders, ranging from steatosis to non-alcoholic steatohepatitis, and may develop to fibrosis, cirrhosis and liver failure. The non-alcoholic fatty liver disease was also found to be associated with diabetes and obesity and considered as a major cause of liver-related morbidity and mortality[9,10,11]. The Food and Drug Administration (FDA) currently has no approved treatment for non-alcoholic fatty liver disease, and therefore, searching for safe compound with preventive and/or therapeutic effect is urgently needed[8]. Green tea is a most commonly consumed beverage in many countries, second to water, produced from a plant called *Camellia sinensis*[12]. It has shown a variety of potential health benefit, including anticarcinogenic, anti-inflammatory, antimicrobial, and antioxidant properties[13]. The polyphenols content, particularly the bioactive catechins which contribute 15% of the green tea leaves, mainly contributes to health-promoting effects of the green tea[14,15]. It was suggested that liver enzymes in wistar rats could be reduced by green tea[16], and the catechins in the green tea is a useful option in the treatment of the non-alcoholic fatty liver disease in humans[17]. Several studies claimed that serum levels of liver enzymes in NAFLD could be improved using green tea extracts[18,19]. However, a recent study reported that the significant association of having normal liver enzymes with drinking green tea, as a beverage, is not significant with using green tea supplements[20]. The aim of the current study is to demonstrate the effect of high fatty diet on liver enzymes of rats and the therapeutic role of steeped green tea on ameliorating this effect.

**Materials and Methods:**

The study was conducted between January and June 2020 in the College of Medical Technology-Misurata. 15 male golden hamsters, weighted between 300 to 350 grams, were bought from local pet store in Misurata and used in the

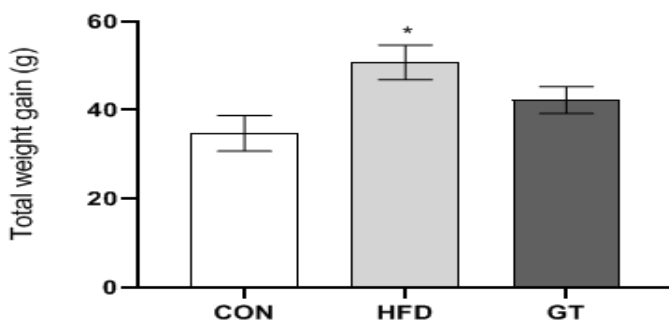
study. The Hamsters were divided into three groups, control (CON) group, high fat diet (HFD) group and high fat diet with green tea (GT) group and each group were located in a cage. The cages were put in room temperature (approximately 25°C) and maintained regularly. Blood was taken from all hamsters and liver enzymes including, aspartate transaminase (AST), alanine transaminase (ALT) and alkaline phosphatase (ALP), were measured. The enzymes were estimated using Cobas (integra 400 plus) system (Rouche, Germany) in the laboratory of Misurata Medical Center. The hamsters were provided free access to food and water. The CON-group was fed with normal hamster food (Rat diet pellets), the HFD- group with high fat diet, and the GT-group with high fat diet and steeped green tea. The high fat diet was prepared in-house as in the Table.1. All groups were fed for four weeks and the steeped green tea was given to the GT group after two weeks of feeding. The green tea used is a China product and was obtained from the local market. The steeped green tea was prepared by boiling 1 litre of water with 3g of the tea dried leaves for 5 minutes, according to the procedure adopted by El-Beshbishy in preparing a beverage of green tea extract[21] with some modifications. The prepared steeped green tea was then given as a beverage to the GT group instead of water. The effect of the high fatty diet on weight gaining and liver enzyme, as well as, the curative effect of green tea were assessed and statistically evaluated by one-way ANOVA using Graph Pad Software (Graph Pad Softwer, San Diego, CA, USA).

**Table (1):** The composition of the high fat diet (HFD) prepared in-house[22]

Content	Quantity (g)
Cooking fat	400
Fructose	100
Casein	100
Cholesterol	10
Rat pellets (Chow)	390

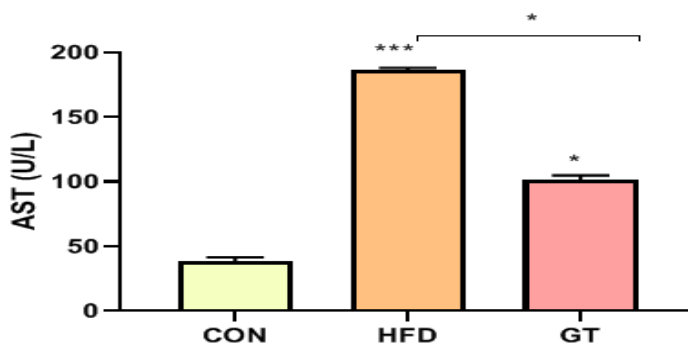
**Results:**

In the current study three groups were used for the assessment of the high fatty diet effect on liver enzymes of hamsters and the curative effect of green tea. The HFD group were found to be increased in body weight compared to the control group (Fig.1) and this increase was found statistically significant. The GT group was also increased in body weight, however, the increase was not significant.



**Fig. (1):** Total weight gain in the hamster groups

Aspartate transaminase (AST), Alanine transaminase (ALT) and Alkaline phosphatase were measured in the three groups and statistically evaluated by one-way ANOVA. According to the statistical analysis (Fig.2) significant increase of AST was found in the HFD group compared to CON group and significant decrease in the GT group compared to HFD group ( $P < 0.05$ ).



**Fig. (2):** The levels of AST in the hamster groups

ALT (Fig.3) was also statistically increased significantly in the HFD group compared to CON group and decreased significantly in the GT group compared to HFD group ( $P < 0.05$ ).

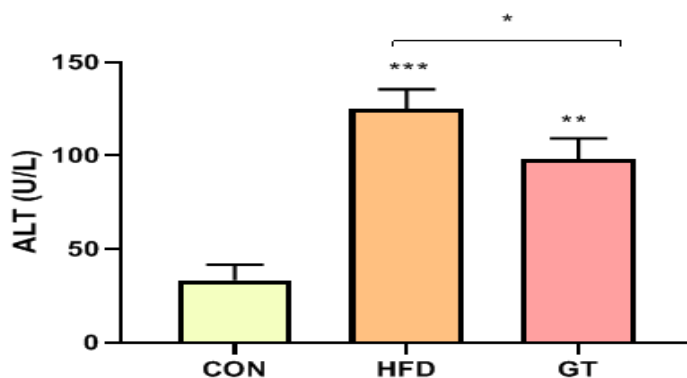


Fig. (3): The levels of ALT in the hamster groups

The results also showed that ALP was significantly increased in the HFD group compared to CON group (Fig.4) and significantly decreased in the GT group compared to the HFD group ( $P < 0.05$ ).

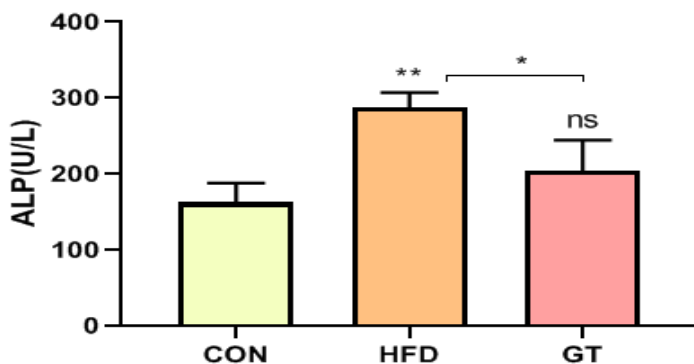


Fig. (4): The levels of ALP in the hamster groups

### Discussion:

Obesity has been found to be associated with imbalance in the intake and expenditure of energy[23]. The high fat diet has been found to be particularly important in the attribution of increasing the prevalence of obesity all over the world[3,24]. The aim of this study was to investigate the effect of high fat diet on the liver enzymes of hamsters and the curative effect of steeped green tea. In the current study the high fat diet showed a statistically significant ( $P < 0.05$ ) positive effect on hamsters (HFD group) weight compared to CON group (Fig.1). The results were consistent with many studies on rats and mice [25,26,27,28]. The high fat diet also showed a statistically significant ( $P < 0.05$ )

increase in the liver enzymes, AST, ALT and ALP, levels of the HFD group. These results were also found to be a consistent with a study conducted on human male volunteers[29] and another study on rats[30]. The elevation of liver enzymes AST, ALT and ALP is considered as a marker of certain liver diseases[31]. The increased levels of these enzymes in the HFD group of the current study might be due to the progression of the non-alcoholic fatty liver disease[8]. The administration of steeped green tea instead of water in the GT group showed ameliorative effect on the function of the liver. The ameliorative effect was observed by a statistically significant decrease in the serum AST, ALT and ALP enzymes in the GT group of hamsters compared to HFD group. Although serious health concerns might be caused by addition of green tea to diet[32], many studies reported its potential health benefits[13,16,17,18,19]. The current study showed a good indication to the health benefit of the green tea to those who consume a high fat diet.

### **Conclusion:**

It can be concluded from the current study that high fat diet causes an obesity and elevation of liver enzymes. Moreover, green tea has a significant ameliorative effect against weight gaining and elevation of liver enzymes and might be considered as a potential treatment in the prevention of non-alcoholic fatty liver disease.

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