Journal of Home Economics, Volume 30, Number (4), 2020

The 7th international- 21th Arabic conference for Home Economics "Home Economics and sustainable development2030" December -15th, 2020

http://homeEcon.menofia.edu.eg

Journal of Home Economics

ISSN 1110-2578

Effect of Oat and Saffron on Body Weight Gain in Rats Fed on High Fat Diet

Adel Abd-Elmotty, Nehad R. EL-Tahan , Aya M.R. E.

Department of Nutrition and Food Science, Faculty of Home Economics, Menoufia University, Egypt.

Abstrsct

The aim of this study was to investigate the effects of oat and saffron on the lipids profile and oxidative status of rats fed onhigh fat diet. Forty five females albino rats were divided into nine groups each with five rats. One of them was negative control group fed on basal diet and the other group was Group (2)as positive control group (untreated group) fed on high fat diet.Group (3) fed on5% oat. Group (4) fed on10% oat. Group (5) fed on15% oat.Group 6fed on 5% saffron.Group (7)fed on 10% saffron.Group (8)15% saffron.Group (9)fed on 5% oat and 5 %saffron (1:1)as mixture. At the end of experiment (4 weeks), the blood samples were collected after 12 hours fasting and serum was separated for determination of lipid profile. Atherogeric index**,** urea, creatinine, uric acid, glutamic oxaloacetic transaminas **(**GOT), glutamic pyruvic transaminas (GPT), alkalinephsphatase (ALP) and GOT\GPT ratio were determined. At the same time, the liver organ was removed, washed in saline solution, blotted were assessed by filter paper, weighted, and kept in formalin solution 10% for histopathological examinations. The obtained result revealed that the saffron (15) % significantly reduced the elevated serum triglycerides (T.G), low density lipoprotein (LDL-c), very low density lipoprotein (VLDL-c), followed by the mixture, and oatsignificantly increased high density lipoprotein (HDL-c).The elevated (GOT) and (GPT) were significantly decreased.

Keywords: Biochemical analysis, cereals and plants, histopathological examination.

Introduction

High fat diet consumption has increased significantly worldwide. High fat diet typically refers to food that is quickly prepared, rich in saturated fat, purchased from restaurants using precooked ingredients, and served in a packaged form. Previous studies have shown that a high intake of sweetened beverages increases cardio-metabolic risk factors, obesity, hypertension and metabolic syndrome **(Marriott *et al.,* 2010 and Malik *et al.*, 2010).**

Diet composition plays an important role in the development of obesity and its associated metabolic diseases. Dietary fat is the most energy-dense macronutrient and causes less satiety than carbohydrate or protein. Prolonged ingestion of high-fat diet (HFD) has been found to induce hyperphagia, body-weight gain and fat deposition and increase the levels of circulating glucose, insulin and Triacylglycerol (TAG) in rats **(Savastano and Covasa, 2005 and Myung *et al.,* 2015).**

Excess fat in the diet leads to metabolic disorders including obesity, hypertension, hyperinsulinaemia, and diabetes that can be debilitating for individuals and also constitute a public health challenge. These diseases are characterized by chronically increased circulation of free fatty acids (FFAs) and elevated insulin secretion, which are linked to pathogenic mechanisms such as altered oxidation of various biomolecules that can impair cellular functions and lead to apoptosis **(Minhwa and Yuna, 2015).**

High fat diet has many unpleasant health consequences. It negatively affects brain health by damaging regions relevant to memory tasks and by diminishing brain derived neurotrophic factor levels **(Molteni *et al.,* 2002).**This amplifies the risk of developing dementia and Alzheimer's disease later in life **(Strasser and Fuchs, 2015).** A high intake of Western food, characterized by high levels of saturated fat, was associated with increased serum total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-c), with an 8% increase in the likelihood of having sustained high LDL-c **(Zhang *et al.,* 2016).**In combination with a sedentary lifestyle, an increased prevalence has been noted of chronic non-communicable diseases, such as diabetes, heart disease, and cancer, which are estimated to account for 78% of all deaths. Thus, this diet is detrimental to the health and will aggravate existing lifestyle diseases **(Hopping *et al.,* 2010).** The most common risk factor for developing

coronary heart disease patients is the consumption of a high-fat diet which contains high levels of LDL-c (**Benajiba, 2016).**

The consumption of high-fat, energy-dense foods coupled with a lack of physical activity are associated with a worldwide rise in the prevalence of obesity and related comorbidities **(Blaisdell *et al.*, 2014).** For this reason, high-fat diets (HFD) are largely used in animal research to induce obesity and study-related comorbidities. In animal research, HFD are made of purified ingredients including casein, sucrose, and/or maltodextrose, starch, soybean oil or lard, and an added source of fiber. Choosing the proper control diet is essential to ensure that the effects of HFD on phenotypic, metabolic, and behavioral alterations are not confounded by other dietary components **(Camila *et al.*, 2017).**

Western eating habits, characterized by red meat, refined sugar, refined cereals, nuts and other saturated fats, are gaining popularity in modern society. In turn, the prevalence of overweight and midlife obesity are increasing. In the typical American diet, fat provides 35% caloric per day **(Last and Wilson, 2006).** A large number of studies have shown that a HFD is a risk factor for many diseases, such as type 2 diabetes, hypertension, gastrointestinal diseases and tumors**(Tang *et al.*, 2012)**, as well as for various forms of accelerated cognitive decline **(Fu *et al.*, 2017and Sah *et al.*,2017**). Recently, much more attention has been paid to the relationship between HFD and cognitive function. It has been shown that a HFD contributes to cognition dysfunction and neurodegenerative diseases in animals that have not been operated upon surgically **(Solfrizzi *et al.*, 2005 and Goldbart *et al.*, 2006).** Clinical research has also found that consuming a large amount of saturated fatty acids is a major risk factor for neurodegenerative diseases **(Lan *et al.*, 2018).**

Oat grain is characterized by its good taste and dietetic properties, as well as an ability to stimulate metabolic changes in the bodies of humans and animals. Furthermore, oat grain is a rich source of proteins with favourable amino acid contents and high nutritional value, and as other beneficial ingredients including dietary fibre, antioxidants, vitamins, phenolic compounds, minerals, and essential unsaturated fatty acids **(Biel *et al.*, 2009 and Singh *et al.*, 2013).**

Several studies have described oats as a functional food with the ability to lower sugar levels, reduce hypertension, help control

childhood asthma, reduce body weight, and also provide immunomodulatory, and antiatherogenic effects **(Singh *et al.*, 2013**). Oats also contain significant amounts of vitamins, minerals, fiber, and phytochemicals that regulate intestinal transit times and increase the production of butyrate and/or other faecal short chain fatty acids produced by gut microflora. As a result, the long-term dietary intake of oats or oat bran might benefit patients suffering from inflammatory bowel disease, ulcerative colitis, colorectal adenoma or cancer **(Thies *et al.*, 2014).**

Oats and oats products are generally considered healthy and the consumption of oat bran is believed to lower LDL cholesterol **(Liu *et al.*, 2004 and Singh *et al.*, 2013).** Avenanthramides (AVAs) helps in preventing free radicals from damaging LDL cholesterol **(Singh *et al.*, 2013) .**Both animal studies and human clinical trials confirmed that oats antioxidants have the potential of reducing cardiovascular risks by lowering serum cholesterol, inhibiting LDL cholesterol oxidation and peroxidation **(Ji *et al.*, 2003 and Inglett & Chen 2012).** Therefore, it is emphasised that the consumption of oats and oats products is extremely important to reduce the risk of cardiovascular disease **(Bazzano *et al.*, 2003; Chen *et al.*, 2004, 2007 and Singh *et al.*, 2013).**

Several recent reports suggested that the consumption of oats attenuated hyperglycemia and diabetes, prevented obesity, abdominal fat and improved liver function by inhibiting lipogenesis in animal models as well as in a clinical trials. Consequently, a daily oat supplement can act as an effective adjuvant for the treatment of metabolic disorders in humans **(Dong *et al.*, 2011 and Chang *et al.*, 2013).**

Saffron (*Crocus sativus, L.*), the most expensive spice in the world belongs to the family *Iridaceae*. The components of saffron i.e. crocin, saffranal and picrocrocin are present in red stigmatic lobes of the flower. The coloring properties of saffron are mainly due to water soluble crocins that are glycosyl esters of crocetin with different sugar moieties **(Carmona *et al.*, 2006).** Picrocrocin, a colorless glycoside is the major bitter compound of saffron. Furthermore, it acts as a precursor of saffranal the main compound responsible for aroma **(Jan *et al.*, 2014).** Several studies have reported that saffron has potent antioxidant activity, mainly due to the presence of crocin. However, the combined effect of other bioactive components of saffron provides it a significant

antioxidant activity. Many other researchers reported that saffron has several health benefits including reduction of coronary artery diseases, hypertension, stomach disorders, dysmenorrhea and learning and, memory impairments **(Khazdair *et al.*, 2015).** Moreover, saffron has been observed to have anti-inflammatory, anti-atherosclerotic, anti-obesity, antigenotoxic and cytotoxic properties **(Mashmoul *et al.*, 2013).**

Recent studies showed that saffron extract offers some protection against obesity and related metabolic disorders owing to its high antioxidant activity and different biological properties. One of the potential weight loss effect of saffron including reducing calorie intake by blocking dietary fat digestion via inhibiting pancreatic lipase and acting as an antioxidant, as well as suppressing inflammatory cytokines and adipocyte differentiation **(Mashmoul *et al.*, 2013).**

Saffron *(Crocus sativus, L.*) has many biological effects such as antioxidant property **(Saeed *et al.*, 2017).** So This study validate the use of saffron and oat as a treatment against high fat diet and its effects.

Materials And Methods

Plant Materials:

Oat (*Avena sativa*) were obtained from hyper shop in Shebin El-kom. Safforn (*Crocus sativus*) was purchased obtained from Ragab El Attar herbalist, Al Azhar, Cairo, Egypt.

Rats and diets:

Rats: Forty five obese albino female rats mean weight was 175 ± 5g were obtained from Institute of Ophthalmology, Medical Analysis Dep., Giza, Egypt.

Kits and diet components: Kits and the basal diet which consists of casein as a source of protein, corn oil as a source of fat, choline chloride, vitamin mixture, cellulose as a source of fiber, salt mixture and corn starch were obtained from Gomhoria Co., Dokki, Giza, Egypt.

Blood samples were collected after 12 hour fasting at the end of the experiment, using the retro-orbital method, by means of a micro capillary glass. Blood was collected into dry clean centrifuged for 10 minutes at 3000 r.p.m. to separate the serum. Serum was carefully aspirated and transferred into clean quit fit plastic tubes and kept frozen at (-20C°) until the time of analysis.

Experimental Design:

Group(1): Rats were fed on basal diet as negative control group for 28days.

Group(2): Rats were fed on high fat diet a as a positive control group.

Group(3): Ratswere fed on high fat diet and 5% oat/kg diet.

Group(4): Rats were fed on high fat diet and10% oat/kg diet.

Group(5): Ratswere fed on high fat diet and15% oat/kg diet.

Group(6): Rats were fed on high fat diet and 5% saffron/kg diet.

Group(7): Ratswere fed on high fat diet and 10% saffron/kg diet.

Group(8): Ratswere fed on high fat diet and 15% saffron/kg diet.

Group(9): Rats were fed on high fat diet and 10(5% and 5 %) as mixture from oat and saffron/kg diet.

Biological evaluation of the different diets was carried out by determination of feed intake (consumption), body weight gain (BWGg/day) and feed efficiency ratio (FER) according to **Chapman *et al*., (1959)**. Using the following formulas:

BWG = Final weight (g) – Initial weight (g).

FER = Body weight gain / Feed intake.

Cholesterol, TG, H.D.L-c and L.D.L-c were determined according to **Allain *et al*., (1974)**, **Fossati and Prencipe (1982)**, **Lopez (1977)** and **Lee and Nieman (1996)** respectively.

Serum LDL-c was colorimetrically determined according to the method described by**Friedwald and Levy (1972).** The concentration of the sample was calculated from the following equation:

LDL-c concentration (mg/dl) = Total cholesterol – ($\frac{TG}{5}$+ HDL-c)

Serum VLDL-c was color metrically determined according to the method described by **Friedwald and Levy (1972).** The concentration of the sample was calculated from the following equation:

VLDL-c concentration (mg/dl) =$\frac{TG}{5}$

Glutamic oxalic transaminase (GOT), Glutamic pyrofic transaminase (GPT) and alkaline phosphatase (ALP) were determined according to the methods described by **Bergmeyer and Harder (1986), Kachmar and Moss (1976) and Varley *et al*., (1980)** respectively.

Histopathological Examination:

The organ liver was removed and washed in saline solution and stored in (10%) neutral formalin solution according to methods described by **(Drury and Wallington 1980)**.

Statistical Analysis:

The data were statistically analyzed using a computerized Costat program by one way ANOVA using a completely randomized factorial design, when a significant mean effect was detected, the means were separated with the Duncan's Multiple Range Test. Differences between treatments at $P \leq 0.05$ were considered significant. The results are presented as mean ± SD according to **Snedecor and Cochran, (1967).**

Results and Discussion

Effect of feeding with different levels of oat, saffron and their mixture on feed intake (FI), feed efficiency ratio (FER) and body weight gain (BWG):

It could be observed that the feed intake in control (+ve) group was lower than control (-ve) group, the levels were 6.74±0.88 and 14.87±0.62 g/day, respectively with a significant difference at ($P \leq 0.05$). All the mean values of tested groups were higher than control positive group and lower than control negative group.

There is no significant difference between G3 & G9 and also between G7and G8. Rats which fed on diet contained 15% saffron (G8) recorded the highest feed intake as compared to all the other treatment groups.

Data presented in the same table (1) revealed that feed efficiency ratio (FER) in rats without treatment (positive group) was 0.25±0.003 while in normal group was 0.086±0.002. Meanwhile, (G8) rat which were fed on diet contained 15% saffron recorded the lowest (FER) as compared to all the other treatment groups.

The results denote that in the same table there were a significant increasing in (BWG) for positive control group. All rats fed on all tested treatment, G3, G4, G5, G6, G7 and G8 had a significant increase in BWG when compared to negative group except G9 fed on 10% mixture.

There is no significant difference between normal group and G8, also the same statically result among groups G4, G6, G5 andG7.

Rats fed on diet contained 5% oat (G3) recorded the highest (BWG) as compared to all the other treatment groups.

These results in the same line of **Singh *et al. (*2013) who found that** oats are considered to be a whole grain with a number of nutritional benefits. Oat can help to lose weight because it help feel full longer than other foods. The fiber content of oat can also aid the digestive system. it's also one of the very best sources of resistant starch. That's the kind that digests slowly and triggers the release of digestive acids that suppress appetite and accelerate calorie-burn. In fact, **Thies *et al. (*2014)** found that swapping just 5 percent of daily carbohydrates for resistant starch could boost your fat-burning metabolism by a whopping 23 percent.

Table (1): Effect of feeding different levels oat, saffron (5, 10 and 15%) their mixture on FI, FER and BWG

Animal Groups	FI (g/day)	FER Mean±SD	BWG (g/28d) Mean±SD
Group (1) Control – ve	14.87±0.62^{a}	0.086±0.002^{b}	35.92 ± 6.0^{c}
Group (2) Control + ve	6.74±0.88^{e}	0.253±0.003^{a}	47.77 ± 6.1^{a}
Group (3) 5% oat	9.84±0.21^{d}	0.160±0.003^{a}	44.35 ± 1.3^{a}
Group (4) 10%oat	10.85 ± 0.17^{c}	0.137±0.09^{a}	41.78 ± 1.0^{b}
Group (5) 15%oat	10.06± 1.5^{c}	0.138±0.07^{a}	38.99 ± 1.6^{b}
Group (6) 5% saffron	10.74 ± 0.88^{c}	0.139±0.05^{a}	41.97 ± 6.1^{b}
Group (7) 10% saffron	12.04±0.21^{b}	0.113±0.03^{b}	38.35 ± 1.3^{b}
Group (8) 15% saffron	12.37 ± 0.62^{b}	0.103±0.06^{b}	35.92 ± 6.0^{c}
Group (9) 10% mixture of all plant	9.15 ± 0.16^{d}	0.121 ± 0.001^{a}	31.18 ± 1.0^{d}

*Non significant differences between the values had the same letter.
Significant at $p \leq 0.05$.

Effect of feeding different levels of oat, saffron (5, 10 and 15%) and their mixture on some organs weight:

The results denote that there were significant increases in liver, spleen and kidneys weights of rats of positive group as compared to the normal rats.

For weight of liver, there are non significant differences among rats then fed on diet of G2, G3 and G4. Also, mean values of liver weight for G5, G6, G7and G8 indicated non significant differences at ($P \leq 0.05$). At the same time, there is no significant change between normal group (C-ve) and G9. Rats which were fed on basal diet contained 10% mixture (G9) recorded the lowest weight of liver as compared to all the other treatment groups.

Regarding spleen weight, there is no significant difference rats and fed on diet of G2 and G3 the same recorded for G1 and G9. And also, there is no significant difference among G4, G5, G6 and G7. Rats which were fed on basal diet contained 15% saffron (G8) and 10% showed mixture were significant differences between them. Rats which were fed on basal diet contained 15% saffron (G8) recorded the lowest weight of spleen as compared to all the other treatment groups.

Concerning kidneys weight, there is no significant difference between rats fed on diet of G3 and positive group .There are non significant change between G4 and G5. At the same time, there are non significant difference among normal group, G4 and G5. Rats which were fed on basal diet contained 10% mixture recorded the lowest kidneys weight as compared to all groups. The above results matched with the result finding by **Thies *et al. (*2014)** who stated that oat helped to weight loss, kept organs healthy and decreased the accumulation of fat in the internal organs.Saffron supplements are purported to curb appetite and reduce cravings. Some proponents suggest that saffron increases brain levels of serotonin and, in turn, helps prevent compulsive overeating and the associated weight gain.

Saffron at the different levels reduced the weight of rats more than the levels of oat. This due to saffron showed promise as a means of controlling compulsive eating, and supposedly mood-enhancing effects could contribute to the decrease in snacking frequency. Saffron supplements are purported to curb appetite and reduce cravings. Saffron

increases brain levels of serotonin and, in turn, helps prevent compulsive overeating and the associated weight gain **(Khazdair *et al.*, 2015)**.

Table (2): Effect of feeding different levels of oat, saffron (5, 10 and 15%) and their mixture on some organs weight (g)

Animal Groups	Liver weight g	Spleen weight g	Kidneyweight g
Group (1) Control – ve	2.52^{c}±0.34	0.48^{c}±0.17	0.43^{d}±0.21
Group (2) Control + ve	3.82^{a}±0.76	0.68^{a}±0.02	0.53^{a}±0.01
Group (3) 5% oat	3.51^{a}±0.84	0.63^{a}±0.001	0.51^{a}±0.06
Group (4) 10%oat	3.42^{a}±0.14	0.60^{b}±0.005	0.50^{b}±0.07
Group (5) 15%oat	3.02^{b}±1.03	0.58^{b}±0.07	0.48^{b}±0.01
Group (6) 5% saffron	3.10^{b}±0.76	0.57^{b}±0.12	0.46^{c}±0.21
Group (7) 10% saffron	2.92^{b}±0.56	0.55^{b}±0.06	0.45^{c}±0.03
Group (8) 15% saffron	2.72^{b}±0.94	0.50^{c}±0.32	0.44^{c}±0.11
Group (9) 10% mixture of all plant	2.62^{c}±0.66	0.51^{c}±0.25	0.42^{d}±0.23

*Non significant differences between the values had the same letter.
Significant at p≤0.05.

Effect of feeding different levels of oat, saffron (5, 10 and 15%) and their mixture on liver functions:

Results of aspartate amino transaminase (AST), alanine amino transferase (ALT) and alkaline phosphatase (ALP) are presented in Table (3).

It could be noticed from Table (3) that rats without treatment (C +ve) the mean value of AST enzyme was 47.25±5.82 while in normal rats (C - ve) group was 22.06±1.07 U/L and showed a significant differences (at $p \leq 0.05$). All rats fed on all tested treatment revealed significant increasing in serum levels of AST when compared to negative group.

There are non significant difference between G4, G5 and G6. Rats which were fed on diet contained 15% saffron (G8) recorded the best lowest level in serum AST as compared to all the other treatment groups.

For GPT , rats without treatment (C +ve), indicated enzyme activity of 46.10±1.10 U/L while negative group was 29.51±0.94 U/L, showing a significant increase in serum level of GPT in rats as compared to normal rats. G3, G4, G5, G7, G8 and G9 showing a significant difference when compared to (C +ve) group expect rats fed diet contained 5% saffron (G6).

The best treatment was recorded for G8 (rats which were fed on diet contained 15% saffron), which didn't significantly differ from normal group.

Data presented in the same table (3) indicated that mean value of (ALP) enzyme, rats (C +ve) group was 23.7±3.47 U\L while in normal rats was 9.3±1.32 U\L. These results denote that G3, G4, G5 and G6 were significantly increased in mean value of (ALP) enzyme of rats as compared to normal rats.

It could be noticed that there is no significant difference among the values of (ALP) enzyme of G7, G8 and G9. Liver is a main organ that controls metabolic functions in the living body. HFD can also increase level of liver fat and hepatic insulin resistance more rapid than increment in peripheral fat deposition. Development of fatty liver induced by HFD is associated with increases in the levels of serum GPT, GOT and ALP which are the most common diagnostic markers of liver (**Myung *et al.,* 2015)** . The outer layer of the oat (*Avena sativa*), known as oat bran, is an excellent source of dietary fiber, which contains B-complex vitamins, protein, fat and minerals. In addition, the use of oat bran into fatty diet improved radical scavenging and SOD-like activities in rat's liver (**Chang *et al.,* 2013)**. Supplementations of saffron reduced plasma GOT and GPT levels of the HFD-fed rats. It shows that saffron exerts protection against hepatic damage in HFD-induced obese rats. A high level of plasma ALP is typically found in the animals with cholestatic liver disease and also induced by hepatotoxic agents. The significant reduction in plasma ALP level of the saffron extract (80 mg/kg) supplemented rats supports the non-occurrence of cholestasis to experimental rats (**Jan *et al.,* 2014)**.

Table (3): Effect of feeding different levels of oat, saffron (5, 10 and 15%)and their mixture on liver functions (U/L)

Liver function	GOT(U/L) Mean ± SD	GPT(U/L) Mean ± SD	ALP(U/L) Mean ± SD
Animal Groups			
Group (1) Control – ve	22.06±1.07^{d}	29.51±0.94^{c}	19.3±1.32^{b}
Group (2) Control + ve	47.25±5.82^{a}	46.10±1.10^{a}	23.7±3.47^{a}
Group (3) 5% oat	45.87±0.42^{a}	41.79±2.28^{b}	22.73±5.06^{a}
Group (4) 10%oat	41.66±1.76^{b}	40.29±0.26^{b}	22.24±3.13^{a}
Group (5) 15%oat	37.52±7.22^{b}	35.93±1.25^{c}	22.23±7.5^{a}
Group (6) 5% saffron	41.10±4.92^{b}	44.43±1.21^{a}	21.97±2.05^{a}
Group (7) 10% saffron	33.12±0.51^{c}	37.80±0.48^{b}	20.63±1.35^{b}
Group (8) 15% saffron	30.31±1.80^{c}	31.44±0.79^{c}	19.94±1.35 ^{b}
Group (9) 10% mixture of all plant	31.12±0.51^{c}	34.80±0.48^{c}	20.71±3.11^{b}

*Non significant differences between the values had the same letter.
Significant at p≤0.05.

Effect of feeding different levels of oat, saffron (5, 10 and 15%) and their mixture on lipid profile:

Date presented in Table (4) showed significantly (P≤0.05) increased serum total cholesterol level in rat fed on high fat diet. The mean value ± SD of serum cholesterol (C +ve) group was 212.55±12.38 mg/dl compared to 99.78±5.25 mg/dl in normal group.

There were significant differences between tested groups. Rats which were fed on diet contained 10% mixture (G9) recorded the lowest total cholesterol as compared to all the other treatment groups.

Concerning triglycerides**,** the data in the same table revealed that the mean value of serum levels triglycerides was 190.70±3.11 mg/dl for positive group as compared to normal rats which was 79.40±0.96 mg/dl showing a

significant increase in serum level of triglycerides in rats as compared to normal rats.

There is no significant difference between G3 and positive control group, and also there is no significant difference between G8 and G9. Rats which were fed on diet contained 10% mixture (G9) recorded the lowest triglycerides as compared to all the other treatment groups.

Table (4): Effect of feeding rats with oat, saffron (5, 10 and 15%) and their mixture on total cholesterol and triglyceride (mg/dl)

Animal groups	Lipid Fraction	
	Total cholesterol**(mg/dl)** Mean ± SD	Triglycerides**(mg/dl)** Mean ± SD
Group (1) Control – ve	99.78±5.25^{i}	79.40±0.96^{g}
Group (2) Control + ve	212.55±12.38^{a}	190.70±3.11^{a}
Group (3) 5% oat	201.29±6.92^{b}	186.30±1.44^{a}
Group (4) 10%oat	195.78±1.72^{c}	173.40±2.04^{b}
Group (5) 15%oat	184.12±4.71^{d}	160.00±3.82^{c}
Group (6) 5% saffron	174.31±6.15^{e}	106.00±2.85^{d}
Group (7) 10% saffron	160.48±9.24^{f}	94.10±4.72^{e}
Group (8) 15% saffron	149.46±2.62^{g}	86.10±6.74^{f}
Group (9) 10% mixture of all plant	137.08±1.04^{h}	80.10±0.92^{f}

*Non significant differences between the values had the same letter.

Significant at $p \leq 0.05$.

Effect of feeding different levels of oat, saffron (5, 10 and 15%) and their mixture at different level on lipid fraction (mg/dl)

It is obvious that in (C +ve) group, the mean value of serum levels HDL-c was 28.38±5.33 mg/dl. In normal rats the mean value of serum levels the HDL-c was 60.58±3.62 mg/dl. These finding denote that there was a significant decrease in HDL-c in the serum of positive group rats as compared to normal rats.

There are non significant differences between rats fed on diet of G6, G7, G8 and G9. Meanwhile, rats which were fed on diet contained 10% mixture (G9) recorded the highest increase in serum level of HDL-c as compared to all the other treatment groups. There is no significant difference between G3 and positive control group

Data presented in the same table showed the serum level of (LDL-c) was significantly elevated in positive group to 134.03±8.07 from 20.86±2.74mg/dl in normal group. Tested materials showed a significant decrease in the previously mentioned parameter as compared to (C +ve) group.

There is no significant difference between G5 (rats which were fed on diet contained 15% oat) and G6 (rats which were fed on diet contained 5% saffron).G9 recorded the lowest decrease in serum level of LDL-c as compared to all the other treatment groups. There is no significant difference between G3 and positive control group

Data presented in the same Table (5) indicated that in positive group, the mean value of serum levels (VLDL-c) was 49.68±0.64 mg/dl. In normal rats the serum level of (VLDL-c) was18.94±0.19 mg/dl. These findings denote that there was a significant increase in the serum levels of (VLDL-c) in the rats (C +ve) group as compared to the normal rats.

In concern to (VLDL-c), there are non significant differences among G6, G7, and G8 and also, between normal group and group (5). The best treatment were recorded G9 (rats which were fed on diet contained 10% mixture of all plant materials), which was significantly different from the other groups.

As regards to, rats without treatment (C +ve) group in Table (5) the serum level of LDL-c/HDL-c increased dramatically from 0.34±0.04 for normal group to 4.72±1.03 for positive group. Rats fed on all treatments had a significant decrease in the serum LDL-c/HDL-c and by increasing the levels of tested materials.

In concern to serum LDL-c/HDL-c, there is no significant difference between rats fed on diet of G2 and G3. And also, there are non significant differences among G4, G5 and G6. Meanwhile, rats which were fed on diet contained 10% mixture (G9) recorded the lowest decrease in serum level of HDL-c/HDL-c as compared to all the other treatment groups. Also, There is no significant changes among G7,G8 andG9.

Cardiovascular disease is one of the leading causes of death worldwide. The need for functional foods that promote cardiovascular health, including cholesterol-lowering foods, is growing. One such functional food ingredient is oat β-glucan. β-glucan is a highly viscous soluble fiber located primarily in the endosperm cell wall of oats.1 It is composed of glucose molecules with mixed β-(1→4) and β-(1→3) bonds. This specific chemical structure is responsible for physical properties, such as viscosity and solubility, as well as the potential to influence cholesterol metabolism. Oats are an excellent source of β-glucan and a readily available food source that can be easily incorporated into the diet. Oat β-glucan may reduce total blood and low-density lipoprotein (LDL) cholesterol levels. The cholesterol-lowering effect of oat β-glucan is most likely mediated by forming a viscous layer in the small intestine, inhibiting intestinal uptake of dietary cholesterol and re-absorption of bile acids. Inhibition of bile acid re-absorption can, therefore, increase the synthesis of bile acids from cholesterol and reduce circulating LDL cholesterol levels (**Dong *et al.*, 2011 and Chang *et al.*, 2013).** Saffron treatment was associated with a reduction in cholesterol and LDL levels and increase in HDL concentrations, only the changes in HDL was statistically significant. These results are in contrast with those observed in some previous studies **(Jan *et al.* 2014).**

Showed that treatment with saffron (25 to 100 mg/kg per day) significantly reduced TG, total cholesterol, LDL-C and very low-density lipoprotein cholesterol (VLDL-C) in rats as a result of inhibiting pancreatic lipase and malabsorption of fat and cholesterol. In the current study, HDL-C increase was significant in group fed on 15% during the study period.

Table (5): Effect of feeding Rats with oat, saffron (5, 10 and 15%) and their mixture on HDL-c, LDL-c, VLDL-c and LDL-c/HDL-c

Lipid fraction Animal Groups	HDL-C Mean±SD	LDL-C Mean ±SD	VLDL-C Mean±SD	LDL-C/HDL-C Mean±SD
Group (1) Control – ve	60.58±3.62^{a}	20.86±2.74^{g}	18.94±0.19^{c}	0.34±0.04^{d}
Group (2) Control + ve	28.38±5.33^{e}	134.03±8.07^{a}	49.69±0.64^{a}	4.72±1.03^{a}
Group (3) 5% oat	30.05±4.08^{e}	132.97±8.48^{a}	31.77±3.94^{b}	4.36±0.22^{a}
Group (4) 10%oat	44.38±4.36^{d}	124.85±6.59^{b}	26.55±0.76^{b}	2.81±0.19^{b}
Group (5) 15%oat	49.55±1.64^{c}	113.30±3.71^{c}	21.27±0.76^{c}	2.29±0.13^{b}
Group (6) 5% saffron	52.03±4.16^{b}	107.88±8.58^{c}	14.40±0.28^{d}	2.06±0.26^{b}
Group (7) 10% saffron	52.46±1.94^{b}	95.67±6.61^{d}	11.88±0.58^{d}	1.82±0.52^{c}
Group (8) 15% saffron	52.81±7.63^{b}	85.78±6.61^{e}	10.87±0.58^{d}	1.62±0.57^{c}
Group (9) 10% mixture of all plant	54.16±1.04^{b}	47.67±0.61^{f}	8.25±0.38^{e}	1.38±0.12^{c}

*Non significant differences between the values had the same letter.
Significant at $p \leq 0.05$.

Histopathological examination of liver

Microscopically, liver of rats from group (1) revealed the normal histological structure of hepatic lobule (Photo, 1). On the other hand, liver of rats from group (2) revealed congestion of central vein focal necrosis of hepatocytes associated with inflammatory cells infiltration, hyperplasia of biliary epithelium and fibroplasia in the portal triad (Photo,2). However, liver of rats from group (3) revealed focal necrosis of hepatocytes associated with inflammatory cells infiltration and congestion of hepatic sinusoids (Photo, 3). Examined sections from group (4) showed steatosis of sporadic hepatocytes, activation of

Kupffer cells and congestion of hepatoportal blood vessel (Photo, 4). However, sections from group (5) revealed focal necrosis of hepatocytes associated with inflammatory cells infiltration and activation of Kupffer cells (Photo, 5). Sections from group (6) showed no histopathological changes except Kupffer cells activation (Photo, 6). Meanwhile, liver from group (7) showed hydropic degeneration of hepatocytes Photo and focal necrosis of hepatocytes associated with inflammatory cells infiltration (photo, 7).Moreover, liver from group 8and 9 liver showed normal histological structure(photos 8 and 9). Histopathological findings of the liver samples demonstrated protective effect of saffron extract at concentration of 80 mg/kg body weight. **Jan *et al.(* 2014)** found that the hepatoprotective activity of saffron against fatty liver could be due to modulation of liver enzymes in parallel with major normalisation of liver size and structure as well as a distinct reduction of fatty infiltration in hepatocytes of the HFD induced obese rats.

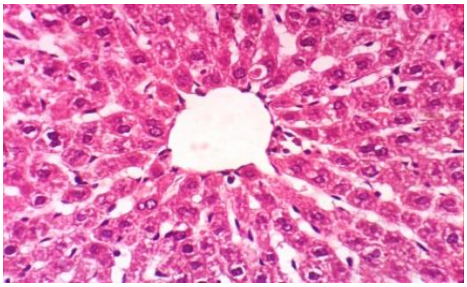

Photo (1): Liver of rat from group 1 showing the normal histological structure of hepatic lobule (H & E X 400).

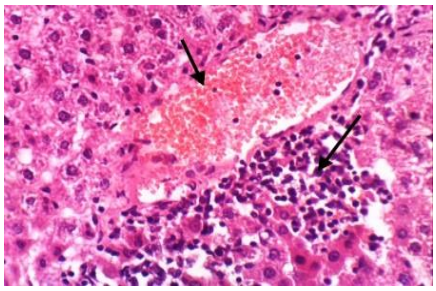

Photo (2): Liver of rat from group 2 showing congestion of central vein and focal necrosis of hepatocytes associated with inflammatory cells infiltration (H & E X 400).

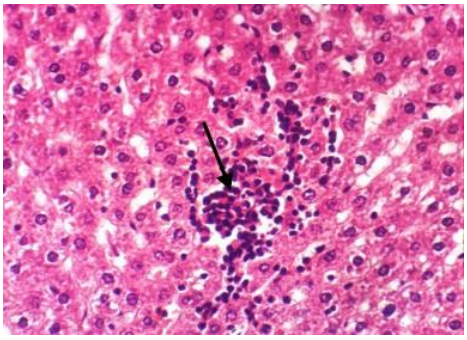

Photo (3): Liver of rat from group 3 showing focal necrosis of hepatocytes associated with inflammatory cells infiltration (H & E X 400).

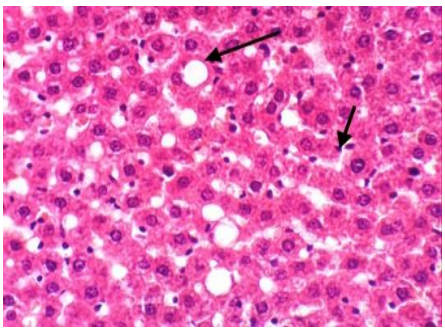

Photo (4): Liver of rat from group 4 showing steatosis of sporadic hepatocytes and activation of Kupffer cells (H & E X 400).

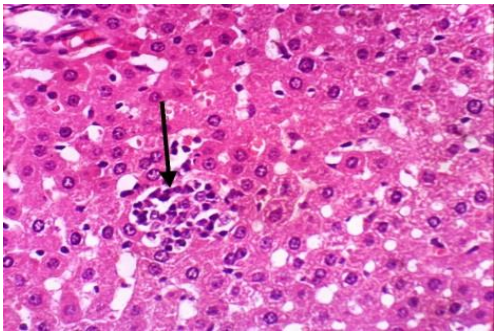

Photo (5): Liver of rat from group 5 showing focal necrosis of hepatocytes associated with inflammatory cells infiltration (H & E X 400).

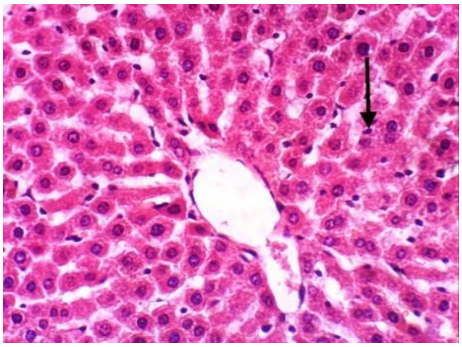

Photo (6): Liver of rat from group 6 showing Kupffer cells activation (H & E X 400).

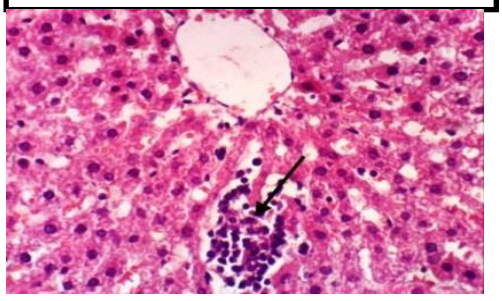

Photo (7): Liver of rat from group 7 showing hydropic degeneration of hepatocytes (H & E X 400).

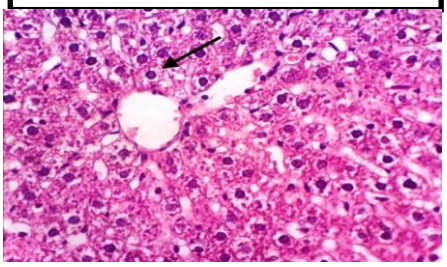

Photo (8): Liver of rat from group 8 showing no histological changes (H & E X 400).

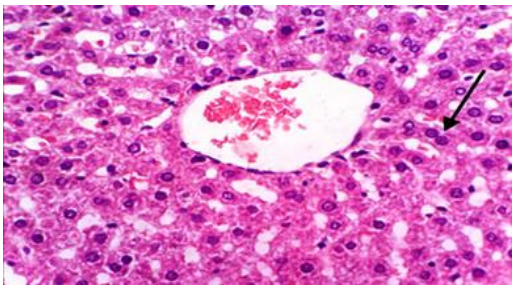

Photo (9): Liver of rat from group 8 showing no histological changes (H & E X 400).

Conclusion

From the obtained results, it could be concluded that 10%mixture, from 5%saffron and 5%oat recorded the best results. Saffron at different levels gave high effect when compared the results which recorded in groups fed on different levels of oat.

References

Allain, C.C.; Poon, L.S.; Chan, C.S.; Richmon,W.and Fu, P.C.(1974): Enzymatic determination of total serum cholesterol. Clin. Chem., 20:470-475.

Bazzano, L.A.; He, J.; Ogden, L.G.; Loria, C.M. and Whelton, P.K. (2003): Dietary fiber intake and reduced risk of coronary heart disease in US men and women. The National Health and Nutrition Examination Survey I Epidemiologic Follow-up Study. Archives of Internal Medicine, 163(16):1897-1904.

Benajiba, N. (2016): High fat diet intake among Saudi population: Alarming fact, Am. J. Food Nutr., 6(2):44–48.

Bergmeyer, H. and Harder, M. (1986): A colorimetric method of the determination of serum glutamicoxaloacetic and glutamic pyruvic transaminaseClin. Biochem.,24: 28-34.

Biel, W.; Bobko, K. and Maciorowski, R. (2009): Chemical composition and nutritive value of husked and naked oats grain. Journal of Cereal Science, 49(3):413-418.

Blaisdell, A.P.; Lau, Y.L.; Telminova, E.; Lim, H.C.; Fan, B. and Fast, C.D. (2014): Food quality and motivation: A refined low-fat diet induces obesity and impairs performance on a

progressive ratio schedule of instrumental lever pressing in rats. Physiol. Behav.,128: 220–225.

Camila, P.; Almeida-Suhett, C.P.; Graham A.; Scott, J.M. and Patricia A. (2017): Control diet in a high-fat diet study in mice: Regular chow and purified low-fat diet have similar effects on phenotypic, metabolic, and behavioral outcomes. Nutritional Neuroscience, 22(1):1-10.

Carmona, M.; Zalacain, A.; Sanchez, A.M.; Novella, J.L. and Alonso, G.L. (2006): Crocetin esters, picrocrocin and its related compounds present in *Crocus sativus* stigmas and *Gardenia jasminoides* fruits .Tentative identification of seven new compounds by LC-ESI-MS. J .Agric. Food Chem., 54(3):973–979.

Chang, H. C.; Huang, C. N.; Yeh, D. M.; Wang, S. J.; Peng, C. H.; Wang, C. J.(2013): Oat prevents obesity and abdominal fat distribution, and improves liver function in humans .Plant Foods Hum. Nutr., 68(1): 18-23.

Chapman, D.G.; Castilla, R. and Champbell, J.A. (1959): Evaluation of protein in food. I.A. Method for the determination of protein efficiency ratio:Can. J. Biochemistry, Physiology, 37: 679-686.

Chen, C.Y.; Milbury, P.E.; Kwak, H.K.; Collins, F.W.; Samuel, P. and Blumberg, J.B. (2004): Avenanthramides and phenolic acids from oats are bioavailable and act synergistically with vitamin C to enhance hamster and human LDL resistance to oxidation. Journal of Nutrition, 134(6): 1459–1466.

Dong, J.; Cai, F.; Shen, R. and Liu, Y. (2011): Hypoglycaemic effects and inhibitory effect on intestinal disaccharidases of oat beta-glucan in streptozotocin-induced diabetic mice. Food Chem., 129 (3):1066-1071 .

Drury, R.A.and Wallington, E.A. (1980): Carlton's Histological Technique. 5th Ed., Oxford University.

Fossati, P. and Prencipe, L. (1982): Triglyceride enzymatic colorimetric method. J. Clin. Chem., (28):2077-2078.

Fu, Z.; Wu,J.; Nesil, T.;Li, M.D.; Aylor, K.W. and Liu, Z.(2017): Long-term high-fat diet induces hippocampal microvascular insulin resistance and cognitive dysfunction. Am. J. Physiol. Endocrinol. Metab., 312(2):89 -97.

Friedwald, W.T. and Levy, R.I. (1972): Estimation of the concentration of low density lipoprotein separated by three different methods. Clin. Chem., 18 : 499 – 50.

Goldbart, A.D.; Row, B.W.; Kheirandish–gozal, L.; Chen, Y.; Brittian, K.R.andGozal, D. (2006): High fat/refined carbohydrate diet enhances the susceptibility to spatial learning deficits in rats exposed to intermittent hypoxia. Brain. Res., 1090(1):190–196.

Hopping, B.N.; Erber, E.; Mead, E.; Sheehy, T.; Roache, C. and Sharma, S. (2010): Socioeconomic indicators and frequency of traditional food, high fat diet and fruit and vegetable consumption amongst Inuit adults in the Canadian Arctic. J. Hum. Nutr. Diet., 23: (1) 51–58.

Inglett, G.E. and Chen, D. (2012): Antioxidant and pasting properties of oat β-glucan hydrocolloids. Food and Nutrition Sciences, 3(6): 827–835.

Jan, S.;Wani,A.A.; Kamili, A.N. and Khastwari, M. (2014): Distribution, chemical composition and medicinal importance of saffron (*Crocus sativus, L.*). African. J. Plant Sci., 8(12):537–545.

Ji, L.L.; Lay, D.; Chung, E.; Fu, Y. and Peterson, D.M. (2003): Effect of avenathramides on oxidant generation and antioxidant enzyme activity in exercised rats. Nutr. Res., 23: 1579–1590.

Kachmar, J. F. and Moss, D. W. (1976). Enzymes, In**:** Fundamentals of Clinical(edited by Tiez N). Philadelphia PA. W.B. Saunders Co. pp. 666-672,

Khazdair, M.R.; Boskabady, M.H, Hosseini, M.; Rezaee, R.andTsatsakis A.M. (2015): The effects of *Crocus sativus* (saffron) and its constituents on nervous system:A review. Avicenna J. Phytomed., 5(5):376–391.

Lan, W.; Minmin, Y.;Zhimeng, Z.;Hui, J. and Shengjin, G. (2018) : High-fat diet aggravates postoperative cognitive dysfunction in aged mice. B.M.C. Anesthesiology, 18:20.

Last, A.R. and Wilson, S.A. (2006): Low-carbohydrate diets. Am .Fam. Physician., 73(11): 1942–1948.

Lee, R. and Nieman, D. (1996): Nutritionalassessment.2nd Ed, Mosby Missouri, USA.

Liu, L.; Zubik, L.;Collins, F.W .;Marko, M.andMeydani, M. (2004): The antiatherogenic potential of oat phenolic compounds. Atherosclerosis, 175(1):39-49.

Lopez,M.F.(1997):DL- Cholestrolcolorimetric method .J. Clin . Chem ., (23) :882.

Malik, V.S.; Popkin, B.M.; Bray, G.A.; Després, J.P. and Hu, F.B. (2010): Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk.Circulation, 121(11): 1356–1364.

Marriott, B.P.; Olsho, L.; Hadden, L. and Connor, P.(2010): Intake of added sugars and selected nutrients in the United States, National Health and Nutrition Examination Survey (NHANES) 2003–2006, Crit. Rev. Food Sci. Nutr., 50(3): 228–258.

Mashmoul, M.; Azlan, A.; Khazaai, H.; Yusof, B.N. and Noor, S.M. (2013): Saffron: A natural potent antioxidant as a promising anti-obesity drug. Antioxidants, 2(4):293–308.

Minhwa, S. and Yuna, S. (2015): Effect of high-intensity exercise and high-fat diet on lipid metabolism in the liver of rats. J. Exerc. Nutrition. Biochem., 19(4): 289–295.

Molteni, R.; Barnard, R.J.; Ying, Z.; Roberts, C.K. and Gomez-Pinilla, F.A (2002): High-fat, refined sugar diet reduces hippocampal brain-derived neurotrophic factor, neuronal plasticity, and learning. Neuroscience .,112(4): 803–814.

Myung,S. C.; Young,J. K.; Eun,Y. K.; Jae Y. R.; Sang, R.K .and Un J. J. (2015): High-fat diet decreases energy expenditure and expression of genes controlling lipid metabolism, mitochondrial function and skeletal system development in the adipose tissue, along with increased expression of extracellular matrix remodeling and inflammation-related genes. Br. J. Nutr.,1 -11.

Saeed, S.; Mohsen A.N.andTahereh, F. (2017): Immunomodulatory and antioxidant effects of saffron aqueous extract (*Crocus sativus, L.*) on streptozotocin - induced diabetes in rats. Indian. Heart Journal, 69(2):151–159.

Sah, S.K.; Lee, C.; Jang, J.H.and Park, G.H. (2017): Effect of high-fat diet on cognitive impairment in triple-transgenic mice model of Alzheimer's disease. Biochem.Biophys. Res. Commun., 493(1): 731-736.

Savastano, D.M .and Covasa, M. (2005): Adaptation to a high-fat diet leads to hyperphagia and diminished sensitivity to cholecystokinin in rats. J. Nutr., 135:1953 - 1959.

Singh, R.; De, S. and Belkheir, A. (2013):*Avenasativa* (oat) a potential neutraceutical and therapeutic agent: An overview. Crit. Rev. Food Sci. Nutr., 53(2):126–134.

Snedecor, G. W. and Cochran, W. G. (1967): Statistical Methods. 6th Ed., Ames, Iowa State's Univ. Press, 298.

Solfrizzi ,V.; Dintrono ,A.;Colacicco, A.M.; Capurso, C.; Del, P.A.; Capurso, S.; Gadaleta, A.; Capurso, A. and Panza, F.(2005): Dietary fatty acids intake: Possible role in cognitive decline and dementia. Exp. Gerontol., 40(4):257–70.

Strasser, B.and Fuchs, D. (2015): Role of physical activity and diet on mood, behavior, and cognition. Neurol. Psychiatr. Brain. Res., 21(3):118-126.

Tang, F.Y.; Pai, M.H. and Chiang, E.P. (2012): Consumption of high-fat diet induces tumor progression and epithelial-mesenchymal transition of colorectal cancer in amousexenograft model. J. Nutr. Biochem., 23(10): 1302-1313.

Thies, F.; Masson, L. F.; Boffetta, P. and Kris-Etherton, P. (2014): Oats and CVD risk markers: A systematic literature review. Br. J. Nutr., 112(2):S19-S30.

Varley, H.; Gewenlock,A. and Bell, M. (1980): Practical Clinical Biochemistry.Vol.1,5thEd. London; Williams Heinemen Medicalbooks, Ltd. pp.741:897.

Zhang, J.; Zhihong, W.; Huijun, W. and Wenwen, D. (2016): Association between dietary patterns and blood lipid profiles among Chinese women. Publ. Health. Nutr., 19(18): 3361-3368.

Journal of Home Economics

المؤتمر الدولى السابع- العربى الحادى والعشرون للإقتصاد المنزلى

" الإقتصاد المنزلى والتنمية المستدامة 2030 "

15 ديسمبر 2020م

http://homeEcon.menofia.edu.eg ISSN 1110-2578

دراسة تأثيرالشوفان والزعفران على زيادة وزن الجسم في الفئران المغذاة علي وجبات عالية الدهون

أية محمد رشاد- نهاد رشاد الطحان، عادل عبد المعطي احمد،

كلية الاقتصاد المنزلي- جامعة المنوفية - قسم التغذية وعلوم الأطعمة

الملخص العربى:

أجريت هذه الدراسه لدراسة تأثير الشوفان والزعفران على زيادة وزن الجسم في الفئران المغذاة علي وجبات عالية الدهون . لذلك تم استخدام 45فأرمن أناث فئران الألبينو تم تقسيمها بالتساوى الى9مجموعات لكل منها خمس فئران. كانت المجموعة الاولي هي مجموعة الضابطة السالبة التي تتغذي علي النظام الغذائي الاساسي . وكانت المجموعة الثانية هي المجموعة الضابطة الموجبة التي تغذت علي وجبات عالية الدهون فقط. وتمت تغذية المجموعة الثالثةعلي 5%شوفان. وتمت تغذية المجموعة الرابعةعلي 10%شوفان.وتمت تغذية المجموعة الخامسةعلي 15%شوفان. وتمت تغذية المجموعة السادسةعلي 5%زعفران. وتمت تغذية المجموعة السابعة علي 10%زعفران. وتمت تغذية المجموعة الثامنة علي 15%زعفران. وتمت تغذية المجموعة التاسعة علي 10%خليط من الشوفان والزعفران(1:1). وبعد انتهاء مدة الدراسة (4 اسابيع) تم تجميع عينات الدم من الفئران بعد فترة صيام مقدارها 12 ساعة وذلك لقياس (الدهون، مؤشر تصلب الشرايين ، ووظائف الكلى (اليوريا، الكرياتينين و حمض اليوريك) ووظائف الكبد (الجلوتاميك أوكسالوأسيتك ترانس أمينيز، الجلوتاميك بيرو فيك تر انس أمينيز و الألكالين فوسفاتيز) هذا بالإضافة إلى استخراج الأعضاء الداخلية لكل فأر ووزنها وحفظها في فورما لين 10% لإجراء الفحوص الهستولوجية.كما تم اجراء الفحص الهستولوجي للكبد. كشفت النتيجة التي تم الحصول عليها أن الزعفران أدي الي أنخفاض معنوي لكل من الدهون الثلاثية، الليبوبروتين منخفض الكثافة، الليبوبروتين المنخفض جدا في الكثافة، بينما تليها الخليط والشوفان بينما زاد بشكل معنوي الليبوبروتين مرتفع الكثافة. كما أدي أنخفاض ملحوظ في وظائف الكبد مثل الجلوتاميك أوكسالوأسيتك ترانس أمينيز، الجلوتاميك بيرو فيك تر انس أمينيز.

الكلمات المفتاحية : الحبوب والنباتات، التحاليل الكيميائية الحيوية - الفحوصات الهيستوباثولوجيه.