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Study The Effect Of Tea Types (*White, Black, Green And Oolong*) On White Mice Infected With Diabetes

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Abstract: The main target of the present investigation was to study the effect of Tea Types extracts (White, Black, Green and Oolong tea) on hyperglycemic male albino rats. Thirty adult male albino rats, weighting (150-160g) each were divided into six groups, five rats each. One of them was kept as a control –ve group, while the other five groups were diabetic by alloxan injection and fed on basal diet +2cm daily of 5% tea extract for 28 days. Body weight gain, feed intake, feed efficiency ratio, internal organs ,serum glucose, serum liver enzymes activities (ALT, AST, & ALP), kidney function parameters (creatinine, uric acid, & urea levels), serum lipid profiles (TG, TC LDL-c, VLDL-c&HDL-c,) were assessed. From the obtained results it was showed that feeding on Tea types extracts caused significant ($P \leq 0.05$) decrease in body weight gain, feed intake, feed efficiency ratio, and increase of HDLc ,but with significant ($P \leq 0.05$) decreases in the rest of the analyses parameters as compared with control (+ve) group, and enhanced the kidney and liver functions with the decrease of ALT, AST, ALP, serum glucose, creatinine, uric acid, urea which reflects the potent nutraceutical therapeutic effect for feeding on tea types for coping hyperglycemia in rats. All treatments seems to be valuable to cope diabetes 2 (tea 5% extraction).

Key words: hyperglycemic, lipid profile, TeaTypes (White, Black, Green and Oolong tea).

Introduction:

Diabetes mellitus (DM), commonly known as diabetes, is a group of metabolic disorders characterized by high blood sugar levels over a prolonged period. (WHO, 2014). Symptoms of high blood sugar include frequent urination, increased thirst, and increased hunger. (WHO, 2013-a). If left untreated, diabetes can cause many complications (WHO, 2013-a). Acute complications can include diabetic ketoacidosis, hyperosmolar, hyperglycemic state, or death (Fisher et al, 2009). Moreover serious long-term complications include cardiovascular disease, stroke, chronic kidney disease, foot ulcers, and damage to the eyes.

Diabetes is due to either the pancreas not producing enough insulin, or the cells of the body not responding properly to the insulin produced (Shoback and Gardner, 2011). There are three main types of diabetes mellitus (WHO, 2013-a):

- Type 1 DM results from the pancreas' failure to produce enough insulin due to loss of beta cells. This form was previously referred to as "insulin-dependent diabetes mellitus" (IDDM) or "juvenile diabetes". The cause is unknown (WHO, 2013-a).
- Type 2 DM begins with insulin resistance, a condition in which cells fail to respond to insulin properly (WHO, 2013-b). As the disease progresses, a lack of insulin may also develop (Jaypee, 2012). This form was previously referred to as "non insulin-dependent diabetes mellitus" (NIDDM) or "adult-onset diabetes". The most common cause is a combination of excessive body weight and insufficient exercise.
- Gestational diabetes is the third main form, and occurs when pregnant women without a previous history of diabetes develop high blood sugar levels (WHO, 2013-b).

Prevention and treatment involve maintaining a healthy diet, regular physical exercise, a normal body weight, and avoiding use of tobacco. Control of blood pressure and maintaining proper foot care are important for people with the disease (WHO, 2013-b). Type 1 DM must be managed with insulin injections. Type 2 DM may be treated with medications with or without insulin (WHO, 2013-b). Insulin and some oral medications can cause low blood sugar (Rippe and Irwin, 2010). Weight loss surgery in those with obesity is sometimes an effective measure in those with type 2 DM (Clegg et al., 2009).

Gestational diabetes usually resolves after the birth of the baby (Cash, 2014).

Hyperglutamic is an abnormal condition characterized by high blood sugar, which could lead to cardiovascular diseases due to development and increase sugar (Tanaka et al., 2013).

Tea types (Black, White, Green and Oolong tea) (Chen et al., 2001, Jiang et al., 2011 & Caffin et al., 2006) were important herbs and medical plants around the world. One or two of them are famous in one country and the other in other country, as in Egypt Black and Green tea are the famous. A comprehensive of the chemical constituents, clinical uses, side effect, how to do and their effect for diabetes especially were mentioned before by (Tanaka et al., 2013). All tea types come from *Camellia sinensis* but vary from tea to tea and it depends upon the origin of the tea and the type of processing it has gone through (Fig. 1)



Fig. (1): Tea types processing.

Every type is good for something, as white tea prevents cancer, helps in losing weight, protects the body from harmful diseases, reduces heart disease risk, lowers diabetes risk, improves oral health, prevents osteoporosis, protects against Alzheimer's and Parkinson's disease, benefits the kidneys, improves reproductive health and keeps your skin healthy. Green tea (Gimenez et al., 2006 and Kyoto Prefectural

University of Medicine, 2009) is good for cancer, heart, blood pressure, type 2 diabetes, weight loss, arthritis, longevity, boosts immunity, brain health, digestive health, tooth, depression, treats down syndrome and helps cure hangovers.

Black Tea (**li et al. ,2003**) have some benefits like fights free radical damage, tackles high cholesterol problems, helps manage high blood pressure, fights cavities, promotes weight loss, boosts immunity and fights infections, helps fend off diabetes, good for the heart, reduces the risk of stroke, improves focus, tones skin, protect against parkinson's disease and offer some protection against cancer.

Oolong Tea advantages (**Jiang et al . ,2011**) prevent diabetes, improve heart health, lose weight, improve brain function, protect against certain cancers, promotes tooth and bone strength and help relieve eczema. As these good things of tea types for our health and good price there, we should use their and make more study for this types.

Material and Methods

Materials:

The used plants :

Tea types (Black, White, Green and Oolong tea) (*Camellia sinensis*) were purchased from the local market.

Rats:

Thirty adult male albino rats, weighing 150-160g were obtained from Menoufia Faculty of Home Economics(animal Lab.) to be used in this study.

Rats were housed in wire cages under the normal laboratory condition(25⁰C) and fed on basal diet for a week as an adaptation period .Diet was offered to rats in special cups to avoid looser conditions of feed, water was provided to the rats from bottles supported to on side of the cage . Feed and water provided ad –libitum and checked daily. Rats take extracts of tea types (Black ,White ,Green and Oolong tea) as oral .

Alloxan:

Alloxan obtained from El-Gomhoria Company, Cairo .Egypt, and used at dose of 150 mg /kg body weight.

Methods:

Preparation of materials:

All tea types (Black ,White ,Green and Oolong tea) as 5% water extracts given to rats every day (2cm/day) orally .

Biological experiments :

The composition of basal diet is shown in the following table

Compounds	Amount
Protein	10%
Corn oil	10%
Mineral mixture	4%
Vitamin mixture	1%
Cellulose	5%
Choline chloride	0.2%
Methionine	0.3%
Corn starch	UP to 100% (69.5%)

AIN (1993)

Experimental design:

The experimental work was done in the Faculty of Home Economics, Menoufia University, Shebin El-kom .

Rats were distributed among the following groups (5rats each):

Group(1) (-): Negative control group (untreated group) 5 rats .In this group rats were kept on basal diet and tap water.

Diabetes induced in (25 rats).All these rats fed on the different diets for 28 day after treatment with alloxan according to following :

Group (2)(+): 5 rats positive control group (fed on basal diet)

Group (3): 5 diabetes rats treated with 5% Black tea extract (2cm\day orally).

Group (4): 5 diabetes rats treated with 5% Green tea extract (2cm\day orally).

Group (5): 5 diabetes rats treated with 5% White tea extract (2cm\day orally).

Group (6): 5 diabetes rats treated with 5% Oolonge tea extract (2cm\day orally) .

Biological evaluation :

During the experimental period (28 day),the diet consumed was recorded every day and body weight was recorded every week . The body weight gain (BWG),feed efficiency ratio (FER),and organ weight were determined according to **Chapman et al ., (1959)**

Blood sampling and organs :

Blood samples were collected after 12 hours fasting at the end of the experiment using the abdominal aorta in which the rats were scarified under ether anetheized .Blood samples were received into clean dry centerfuge tubes and left to clot at room temperature, then centrifuged for 10 minutes at 3000 rpm to separated the serum. Serum was carefully separated, transferred into clean cuvette tubes, and stored frozen at -20°C for analysis . All serum samples were analyzed for determination the following parameters :

Lipid profile :Cholesterol, triglycerides (TG), high density lipoprotein cholesterol (HDLc), low density lipoprotein cholesterol (LDLc), very low density lipoprotein (VLDLc), urea, creatinine , Uric Acid , Glutamic oxaloacetic transaminase (GOT) , Glutamic pyruvic transaminase (GPT) , Alkaline phosphatase (ALP), glucose (SG) .

At the same time, organs: Heart, Spleen, Lungs, Kidney and Liver were removed, washed in saline solution, wiped by filter paper and weighted.

Analytical Methods:

The following techniques were used for determination of different parameters in serum.

Estimation of serum lipid:

Triglycerides:

Enzymatic colorimetric determination of triglycerides was carried out according to (Fossati and Prencipe, (1982).

Total cholesterol:

The principale used for total cholesterol determination was according to (Allain, 1974).

HDL cholesterol:

HDL fraction-cholesterol present in supernatant can be determined by the same method used for total cholesterol, according to Lopez (1977).

LDL and VLDL cholesterol:

The determination of VLDL (very low density lipoprotein)and LDL(low density lipoprotein) carried out according to method of Lee and Nieman (1996) as follows :

$$\text{VLDL (mg/dl)} = \text{Triglycerides}/5$$

$$\text{LDL (mg/dl)} = (\text{Total cholesterol} - \text{HDL}) - \text{VLDL}$$

*** Determination of renal functions:**

Estimation of Urea in serum:

Urea determination was according to kinetic method of **Patton and Crouch (1977)**.

Estimation of Creatinine in serum:

Creatinine was determined according to kinetic method of **Henry (1974)**.

Determination of Uric acid:

The intensity of the red color formed during determination is proportional to the uric acid concentration in the sample (**Patton and Crouch 1977**).

*** Determination of Liver functions:**

Determination of serum alkaline phosphatas (ALP):

Enzymatic colorimetric determination of alkaline phosphatas was carried out according to **Belfield and Goldberg, (1971)**.

Estimation of serum Glutamic oxaloacetic transaminase (GOT) and Glutamic Pyruvic Transaminase (GPT) carried out according to method described by **Yound (1975) and (IFCC,1986)**.

*** Determination of Fasting plasma Glucose:**

Quantative determination of glucose was carried out according to the method of (**Young,2001**)

Statistical analysis:

The data were statistically analyzed using a computerized costat program by one way ANOVA. The results presented as mean \pm SD. Differences between treatments at ($p \leq 0.05$) were considered significant (**S.A.S.,1985**).

Results and Discussion:

A- Biological changes:

a- Internal organs weights:

Data of table (1) revealed the mean value of internal organs weights of hyperglycemic rats fed on various diets. It could be noticed that the mean value of internal organs weight (g) of control (+) was higher than control (-) group. Hyperglycemic rats fed on various diets showed significant decreases in mean values as compared to control (+) group. The lowest internal organs weight was recorded for group mostly for black tea diet, when compared to control (+) group.

Green tea appears to support healthy liver and protect it from the damage by toxic substances such as alcohol. Men who drink more than 10 cups

of green tea per day are less likely to develop disorders of the liver(**Imai and Nakachi , 1995**).

Table (1): Effects of tea types (Black ,White, Green & Oolonge tea) on organs weight of hyperglycemic rats

Parameters Groups	Liver(g) Mean±SD	Heart(g) Mean±SD	Lungs(g) Mean±SD	Spleen(g) Mean±SD	Kidney(g) Mean±SD
G1 (c-) Negative control	4.80^e±0.3	0.71^c±0.02	1.38^{cd}±0.03	0.44^e±0.01	1.14^e±0.01
G2 (c+) Positive control	8.26^a ±0.06	0.87^a ±0.03	2.21^a ±0.01	1.31^a ±0.01	2.8^a ±0.01
G(3) BlackTea(5%)	5.16^d±0.03	0.64^e±0.004	1.43^{cd}±0.03	0.51^d±0.002	1.42^d±0.006
G(4) Green Tea(5%)	5.85^c ±0.05	0.67^d ±0.02	1.45^c±0.05	0.59^c±0.005	1.37^d ±0.02
G (5) White Tea(5%)	5.95^c ±0.03	0.62^e±0.002	1.36^d±0.06	0.64^c±0.02	1.49^c±0.09
G (6) Oolonge Tea(5%)	7.98^b±0.01	0.78^b±0.01	1.64^b±0.01	0.96^b±0.06	2.17^b±0.02
LSD (p≤0.05)	0.227	0.030	0.065	0.047	0.069

Means in the same column with different litters are significantly different.

a-Effects of tea types (Black,White,Green and Oolonge tea) on body weight gain (BWG),feed intake (FI)&feed efficiency ratio(FER)of hyperglycemic rats

Data illustrated in table (2), show the effect of tea types (Black, White, Green and Oolonge tea) on FI, BWG, and FER of hyperglysemic rats. It could be noticed that the mean value of BWG, and FER of control (-) was lower than control (+) group being (2.25 ±0.03,2.9 ±0) g and (0.08±0.03,0.120 ±0.002) respectively. Hyperglycemic rats fed on various diets showed significant decreases in mean values as compared to control (+) group.

B- Biochemical data changes:

Serum glucose

Table (3)show the mean value of serum glucose (mg/dl) of hyperglycemic rats fed on different diets. It could be noticed that the

mean value of glucose of control (+)group was higher than control (-)group, being 213±0.6 & 69±0.5 mg/dl, respectively, showing significant difference with percent of decrease -67.605% of control (-)group as compared to control (+). All hyperglycemic rats fed on various diets indicated significant decreases in mean values as compared to control (+)group. The values were 105.6± 0.3, 152±0.1, 158±0.8 & 162.3±0.3 for groups 3, 4, 5 & 6 respectively. The percent of decreases were -50.42, -28.63, -25.82 & -23.802% for groups 2, 3, 4 & 5 respectively. The superior serum glucose was recorded for group 3 (take black tea 5%), when compared to control (+) group. The polyphenol antioxidants found in tea are thought to help reduce blood sugar and insulin levels. They're also thought to increase insulin sensitivity (**Jiang et al., 2011 & Pinto, 2013**) Accordingly, several studies report links between regular tea consumption, improved blood sugar control and a lower risk of developing type 2 diabetes (**Tanaka et al., 2013 & Caffin et al., 2006 & Chen et al., 2001 & Gimenez et al., 2006**).

Table (2): Effect of tea types (Black, White, Green and Oolong tea) on body weight gain (BWG), feed intake (FI) & feed efficiency ratio (FER) of hyperglycemic rats

Parameters	FI (g/day) Mean±SD	BWG (g/day) Mean±SD	FER Mean±SD
Groups			
G1 (c-) Negative control	25.08^a ±0.04	2.25^b ±0.03	0.08^b ±0.03
G2 (c+) Positive control	24.12^b ±0.02	2.90^a ±0	0.12^a ±0.002
G (3) Black Tae (5%)	15.51^d ±0.03	1.12^c ±0.02	0.07^b ±0.01
G (4) Green tea (5%)	16.41^c ±0.001	-0.15^d ±0.01	-0.01^c ±0.0
G (5) White tea (5%)	16.60^c ±0.3	-0.39^e ±0.03	-0.02^c ±0.001
G (6) Oolong tea (5%)	24.24^b ±0.02	-0.12^d ±0.002	-0.01^c ±1.04
LSD (p≤0.05)	0.221	0.034	0.023

Means in the same column with different litters are significantly different.

Table (3) :Effect of tea types (Black, Green , White & Oolonge) on serum glucose (ml/dl) of diabetic rats

Groups	Glucose (ml/dl) (Mean \pmSD)	Change of (+ve) Group %
G1 (c-) Negative control	69^f\pm0.5	-67.605
G2 (c+) Positive control	213^a \pm0.6	00.00
(G3) Black Tea (5%)	105.60^e\pm0.3	-50.42
(G4) Green Tea (5%)	152^d\pm0.1	-28.63
(G5) White Tea (5%)	158^c\pm0.8	-25.82
(G6) Oolonge Tea (5%)	162.30^b\pm0.3	-23.80
LSD: p \leq 0.05	0.871	

Means in the same column with different litters are significantly different.

Liver enzymes activities:

Data presented in table (4). indicate the mean value of serum AST, ALT (U\L)and ALP of hyperglycemic rats fed on various diets. It could be noticed that the mean value of liver enzymes of control (+) was higher than control (-) group being (168 \pm 0.5 & 98 \pm 0.5), (86 \pm 0.5 & 43 \pm 0.6) and (261 \pm 0.5 & 179 \pm 0.5) respectively. All hyperglycemic rats fed on various diets showed significant decrease in mean values as compared to control (+) group .Actually all extracts of tea resulted in lower liver enzymes activities.

Table (4):Effect of tea types on liver enzymes (U\L) of hyperglycemic rats

Parameters	AST (U\L) Mean±SD	ALT (U\L) Mean±SD	ALP (U\L) Mean±SD
G1(C-) Negative control	98 ^f ±0.50	43 ^e ±0.60	179 ^f ±0.50
G2 (C+) Positive control	168 ^a ±0.5 ⁰	86 ^a ±0.50	261 ^a ±0.50
G (3) Black Tea(5%)	160 ^d ±0.50	66.3 ^c ±0.30	233.6 ^b ±0.30
G (4) GreenTea(5%)	138 ^e ±0.6 ⁰	62.5 ^d ±0.30	204.75 ^d ±0.04
G (5) White Tea (5%)	164.25 ^b ±0.05	67 ^c ±0.50	223.75 ^c ±0.75
G (6) Oolong Tea (5%)	162.5 ^c ±0.40	69 ^b ±0.30	203.5 ^e ±0.20
LSD (p≤0.05)	0.819	0.772	0.793

Means in the same column with different litters are significantly different.

Lipids fraction of serum:

1- Serum total cholesterol (TC) and triglyceride (TG) (mg\dl).

Data presented in table (5), illustrate the mean value of serum (TC) and (TG) (mg\dl) of hyperglycemic rats fed on various diets. It could be noticed that the mean value of (TC) and (TG) of control (+) was higher than control (-) group being (103±0.6 & 92±0.2) ,and (76.25±0.05 & 58±0.75) mg\dl. All hyperglycemic rats fed on various diets showed significant decreases in mean values as compared to control (+) group.

Green tea lowers total cholesterol and TG levels. People who drink green tea daily have lower cholesterol levels than those who do not drink it **Erba et al.,(2005)**.

One of the underlying mechanisms by which green tea lowers blood cholesterol levels is by reducing lipids absorption in the digestive tract and promoting their excretion from the body(**Koo and Noh , 2007**).

2- Serum (HDL_C), (LDL_C), (VLDL_C), and (AI) (mg\dl):

Data of table (6) indicate the mean values of serum (HDL_C), (LDL_C), (VLDL_C), (mg\dl) of hyperglycemic rats fed on various diets. It could be noticed that the mean value of (HDL) of control (-) was higher than control (+) group. All hyperglycemic rats fed on various diets showed significant increase in mean values of HDL and decreases of LDL & VLDL as compared to control (+) group. On the other hand the mean value of serum (LDL_C) & (VLDL_C) of control (+) was higher than control (-). Drinking black tea helped reduce LDL cholesterol by 11.1% and total cholesterol levels by 6.5%. (**Shirley *et al.*, 2003**). Regular consumption of tea may also help inhibit the oxidation of LDL and reduce the risk of atherosclerosis. Tea catechins, specifically, gallate esters, are thought to counter cholesterol disorders by limiting the absorption of cholesterol in the intestine (**Nakamura *et al.*, 1997**).

Kidney function:

1- Urea, creatinine, and uric acid:

Data of table (7) illustrate the mean values of serum urea, creatinine, and uric acid (mg\dl) of hyperglycemic rats fed on various diets. It could be noticed that the mean value of serum urea, creatinine, and uric acid of control (+) was higher than control (-) group. All hyperglycemic rats fed on various diets showed significant decrease in mean values as compared to control (+) group. Selected best serum urea, creatinine and uric acid values recorded for black tea, when compared to control (+), provided that all kinds of tea extract were valuable for improving the kidney function.

Polyphenols like the aflavins, thearubigins, and catechins in black tea give it potent antioxidant properties, helping fight the damaging effects of free radicals (**Łuczaj and Skrzydlewska, 2005**)

The presence of catechins in white tea prevent the formation of calcium oxalate in the kidneys .A study found that drinking white tea could reduce the adverse effects of environmental pollution that harm the kidneys, heart, liver, lungs and brain (**Winiarska-Mieczan, 2015**).

Table (5): Effect of tea types on serum total cholesterol (TC) and triglyceride (TG) (mg\dl) of hyperglycemic rats

Parameters	TC (mg\dl) Mean±SD	TG (mg\dl) Mean±SD
G1 (C-) Negative control	92^c±0.20	58^e±0.75
G2 (C+) Positive control	103^a ±0.60	76.25^a ±0.05
G (3) Black tea (5%)	97.3^b±0.70	65.6^c±0.30
G (4) Green tea (5%)	87.5^d±0.20	62^d±0.60
G (5) White tea (5%)	79.25^f±0.05	62.75^d±0.05
G (6) Oolonge tea (5%)	81^e±0.60	66.5^b±0.40
LSD (p≤0.05)	0.825	0.788

Means in the same column with different litters are significantly different.

Table (6): Effect of tea types on serum (HDL_C), (LDL_C), (VLDL_C), and (mg\dl) of hyperglycemic rats

Parameters	HDL_C (mg\dl) Mean±SD	LDL_C (mg\dl) Mean±SD	VLDL_C (mg\dl) Mean±SD
G1 (C-) Negative control	56^a±0.50	24.40^e±0.40	11.6^d±0.20
G2 (C+) Positive control	42^d ±0.20	45.75^a ±0.05	15.25^a ±0.05
G (3) Black tea(5%)	47.30^c±0.20	36.88^b±0.03	13.12^b±0.02
G (4) Green tea (5%)	50^b±0.60	25.01^d±0.1	12.4^c±0.30
G (5) White tea(5%)	42^d±0.00	24.70^e±0.1	12.55^c±0.05
G (5) Oolonge tea (5%)	42^d±0.50	25.70^c±0.2	13.3^b±0.30
LSD (p≤0.05)	0.704	0.704	0.344

Means in the same column with different litters are significantly different.

Table (7):Effect of tea types on serum urea, creatinine, and uric acid (mg\dl) of hyperglycemic rats

Parameters	Urea (mg\dl)	Creatinine (mg\dl)	Uric acid (mg\dl)
Groups	Mean±SD	Mean±SD	Mean±SD
G1 (C-) Negative control	29^d±0.50	0.60^f±0.01	1.8^d±0.1⁰
G2 (C+) Positive control	36^a ±0.80	1.06^a ±0.03	2.9^a ±0.40
G (3) Black tea (5%)	33.3^c±0.30	0.72^e±0.01	2.2^c±0.10
G (4) Green tea (5%)	34.75^b±0.04	0.78^d±0.03	2.35^{bc}±0.02
G (5) White tea(5%)	35.5^{ab}±0.10	0.815^c±0.02	2.47^{bc}±0.07
G (6) Oolonge tea (5%)	35.15^{ab}±0.15	0.87^d±0.01	2.72ab±0.02
LSD (p≤0.05)	0.032	0.032	0.321

Means in the same column with different litters are significantly different.

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دراسة تأثير أنواع الشاي (ابيض ،اسود ،اخضر ،اولونج)علي الفئران البيضاء المصابة بمرض السكر

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المستخلص العربي

تم إجراء الدراسة الحالية لمعرفة التأثيرات التغذوية العلاجية المحتملة لمستخلصات أنواع الشاي علي الفئران المصابة بارتفاع السكر. تم استخدام 30 فأر أبيض ذكر بالغ يتراوح وزن الفأر (150-160) جرام، تم تغذيتها على الوجبة الأساسية لمدة أسبوع ثم قسمت بعد ذلك إلى ستة مجموعات متساوية وتركزت إحداها كمجموعة ضابطة سالبة، أما المجموعات الخمسة الأخرى فتم إصابتها تجريبيا بارتفاع السكر بالحقن بالالوكسان. واعطيت أنواع الشاي (5%) بمعدل 2مليلتر يوميا ف الفم . استمرت التجربة لمدة 28 يوم وفي نهاية التجربة تم وزن الفئران ثم تجميع عينات الدم بعد صيام 12 ساعة و فصل السيرم لتقدير مستوى السكر في الدم ، وظائف الكبد (الجلوتاميك أوكسالو أستيك ترانس أمينيز، الجلوتاميك بيرفيك ترانس أمينيزوالألكالين فوسفاتيز) ، ووظائف الكلى والجلوكوز و الكولسترول الكلى و الجلوسريدات الثلاثية، (HDL_C, LDL_C, VLDL_C)، ثم تم فصل الأعضاء الداخلية (الكبد والكلى والطحال والرئتين والقلب) ووزنها وأيضا تم تقدير وزن الجسم المكتسب، والمأخوذ من الغذاء ونسبة الاستفادة من الغذاء. وقد أظهرت نتائج هذه الدراسة أن تناول مستخلصات أنواع الشاي (5%) قد نتج عنه نقص معنوية في كل من وزن الفئران وكذلك المأخوذ من الغذاء ونسبة الاستفادة من الغذاء وكذلك زيادة نسبة البروتين الدهني عالي الكثافة و تحسن في مستوى سكر الدم و كذلك تحسن في وظائف الكبد و الكلى وبعض الخصائص الفسيولوجية الأخرى في الفئران. مما يعكس التأثير التغذوي العلاجي لأنواع الشاي ولذلك يمكن استخدام هذه الأنواع لتحسين مستوى السكر في الدم. ويبدو أن كل معاملات الشاي تفيد في مقاومة مرض السكر

الكلمات المفتاحية:

مرض ارتفاع السكري، دهون الدم ، أنواع الشاي ، المستخلص المائي
لأنواع الشاي (الأبيض ، الأسود ، الأخضر والأولونج)