

Improvement of diabetic rats using green tea wealthy with catechin and inulin

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ABSTRACT

This study aimed to investigate the effects of Green tea wealthy with catechin and inulin to improve diabetics' rats. The results showed that the green tea enriches with catechin and inulin counteracted improved the BWG and FER in diabetics' rat groups. It could be noticed that the significant results for BWG and FER were recorded for rats of group 8 which treated by a high dose of green tea enriched with catechin and inulin. Also, this treated group of rats had the lowest total cholesterol, triglycerides LDL cholesterol and serum VLDL cholesterol also. However, HDL cholesterol was the minimum in animals of this group.

The Kidney and liver function in the diabetics' different rat groups fed on basal diet and taken orally 1.5ml/kg/ body weight/day of green tea enriched with catechin and inulin were improved. On the other hand, green tea, it was found that catechin and inulin decreased the serum glucose in the different diabetics rat groups and improved their atherogenic index (A.I) and cardiovascular disease risk (CVD risk). The observed improvement in diabetics' different rat groups taking the green tea and catechin may be due to the presence of natural antioxidant in catechin which scavenging the free radical in the blood. Also, inulin is used as dietary fiber in functional foods which loss the gain body weight.

It could be recommended from the above results that orally taking 1.5ml/kg/ body weight/day from green tea enriched with catechin and inulin (extract from boiling 20 g of green tea leaves/liter of water with 0.5 mg catechin plus 18 g of inulin) improved diabetics' rats.

Keywords: Green tea, catechin, inulin, kidney and liver function.

INTRODUCTION

Diabetes is a national health priority. The number of people with type 2 diabetes is growing, most likely the result of rising overweight and obesity rates, lifestyle and dietary changes, and an ageing population (Shaw and Tanamas, 2012). In the liver, insulin normally suppresses glucose release. However, in the setting of insulin resistance, the liver inappropriately releases glucose

into the blood (Imperatore *et al.*, 2012). Diabetes is a long term metabolic disorder that is characterized by high blood sugar, insulin resistance, and relative lack of insulin (National Institute of Diabetes, 2014). Diagnosis of diabetes is by blood tests such as fasting plasma glucose, oral glucose tolerance test (Pasquel and Umpierrez, 2014).

Type 2 diabetic mellitus (T2DM) as one of the main causes of morbidity and mortality is associated with immune system disturbances and metabolic abnormalities (Farhangi *et al.*, 2016). It is primarily occurs as a result of obesity and not enough exercise and it is partly preventable by staying a normal eight, exercising regularly and eating properly (WHO, 2015). It is due to insufficient insulin production from beta cells in the setting of insulin resistance (Maruthur *et al.*, 2016). The proportion of insulin resistance versus beta cell dysfunction differs among individuals, with some having primarily insulin resistance and only a minor defect in insulin secretion and others with slight insulin resistance and primarily a lack of insulin secretion. However, not all people with insulin resistance develop diabetes, since an impairment of insulin secretion by pancreatic beta cells is also required (Maruthur *et al.*, 2016).

Green tea phenolic constituents are able to stimulate pancreatic beta cells to increase postprandial insulin, consequently improving pancreas action (Ortsäter *et al.*, 2012; Sundaram *et al.*, 2013). Its beneficial effects are attributed to the polyphenols, particularly the catechins, which make up to 30% of the dry weight of green tea leaves (Wan *et al.*, 2009). These catechins are present in higher quantities in green tea than in black or oolong tea, because of differences in the processing of tea leaves after harvest (Klaus *et al.*, 2005).

In green tea, aerobic oxidation of the tea leaf polyphenolics is allowed to occur and the catechins are enzymatically catalyzed to form theaflavins and

thearubigins. As catechins can donate hydrogens from the hydroxyl groups in their structure, they have been found to have excellent antioxidant activities, expressed through their free radical scavenging ability being more powerful than vitamin C, vitamin E, or b-carotene (Wong *et al.*, 2009).

Inulin and oligofructose are used as dietary fiber and prebiotics in functional foods. Its longer chain length makes inulin more useful pharmaceutically than oligofructose (Ronkart *et al.*, 2007).

The present study aimed to investigate the effect of green tea enriched with catechin and inulin on body weight gain, lipid profile, cholesterol fraction, liver and kidney functions and the histopathological characteristics of pancreas organ in the experimental rats.

MATERIALS AND METHODS

Materials

Green tea was obtained from local market. Inulin, casein, cholesterol, vitamins and minerals were obtained from Elgomhoriya Company for Chemicals, Cairo, Egypt. Also, Streptozotocin was purchased from El-Gomhoryia Company for Chemicals as a white powder packed in brown bottles each containing 25 g alloxan monohydrate.

Glucose enzymatic kits for estimating blood glucose (BG) and radioimmunoassay kits for leptin and insulin hormones were procured from Gamma Trade Company, Egypt. The other biochemical kits were obtained from Biodiagnostics Company, Dokki, Egypt.

Methods

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Male Wister albino weaning rats (48 rats) with weight ranging from 200-210g were purchased from National Organization For Drug and Control Research, Giza, Egypt. They were housed in individual cages with screen bottoms and fed *ad libitum* on a basal diet for one-week for acclimatization, which containing casein (20 %), corn oil (8%), corn starch (31%), sucrose (32%), cellulose (4%), salt mixture (4%) and vitamin mixture (1%) according to the method Pell *et al.* (1992).

Experimental rats were fed on fat and basal diet for 15 days and randomly divided into eighth groups, six rats for each.

- Group (1) (control negative) rats were fed on basal diet for 4 weeks.

The other seven rat groups were rendered diabetic by subcutaneous injection of alloxan (120 mg/kg) for 5 days to induce acute diabetes (Chougale *et al.*, 2007). These groups were reclassified into:

- Control positive (group 2) and were fed on basal diet.
- Groups (3 and 4) were fed for four weeks on basal diet and taken separately orally 1.5 ml/kg body weight/ day green tea (extract from boiling 20.0 g of green tea leaves /l of water supported with 0.2 and 0.5 mg of catechin, respectively).
- Groups (5 and 6) were fed for four weeks on basal diet and taken separately orally 1.5 ml/kg body weight/ day green tea (extract from boiling 20 g of green tea leaves / l of water tea supported with 14.0 and 18.0g of inulin, respectively).
- Group (7) was fed on basal diet and taken orally 1.5 ml/kg body weight/ day green tea (extract from boiling 20 g of green tea

leaves / l of water supported with 0.2 mg catechin plus 14.0 g inulin.

- Group (8) was fed on basal diet and taken orally 1.5 ml/kg body weight/ day green tea supported with catechin and inulin (extract from boiling 20 g of green tea leaves / l of water with 0.5 mg catechin plus 18 g of inulin).

The body weight and food consumption were recorded every three days for four weeks. At the end of experiment, blood samples were taken from the orbital plexus and centrifuged at 3000 rpm to obtain the sera after which were kept in a deep freezer at -20°C until their analysis. Liver and kidney were immediately removed from the scarified rats and they were gently pressed during filter paper to free it from surface blood, then their weight was taken.

Blood samples were collected from the retro-orbital plexus from all animals of each group into clean, dry and labeled tube. Blood was centrifuged to separated plasma which was tightly kept in sealed aliquot tubes at -20 °C until biochemical assays according to Ilwy (2003).

Enzymatic colorimetric determination of triglycerides and total cholesterol were carried out according to William *et al.* (2004). HDL and LDL cholesterol were carried out according to the method given by Gordon and Amer (1977), Lee and Nieman (1996) and VLDL were also calculated.

Kidney function (urea and uric acid) were determination according to the enzymatic method of Gill *et al.* (2000). Creatinine determination was according to kinetic method of Denise (2007). Atherogenic index and CVD Risk factor

were calculated according to Nakabayashi *et al.* (1995) and Kannel (1976). Liver function as Alanine (ALT) and Aspartate (AST) transaminoferase were determined according to the method described by Nicoll *et al.* (2003).

Histological examination of pancreas

Pancreas organ was fixed in 10% natural formalin dehydrated cleared and embedded in paraffin then sectioned at 6 μ m and stained with harries hematoxylin and eosin for histopathological examination according to Panchal *et al.* (2011).

Statistical analysis

The obtained data were exposed to the analysis of variance. Duncan's multiple range tests at ($P \leq 0.05$) level was used to compare between means. The analysis was carried out using the ANOVA procedure of Statistical Analysis System (SAS, 2004).

RESULTS AND DISCUSSION

Effect of green tea enriched with catechin, inulin on feed efficiency ratio (FER) and body weight gain (BWG)

Results in Table (1) for groups of diabetic rats fed on basal diet plus green tea

that the mean value of BWG% of control positive group was higher than the control negative one, being 5.1 ± 0.75 and -0.2 ± 0.83 , respectively. The significant decreasing of BWG% were recorded for group 8 which treated by a high dose of green tea enriched with catechin and inulin being 1.2 ± 1.60 .

It is evident that diabetic rats feeding on basal diet plus green tea enrich with catechin and inulin resulted in their decline of FER. It could be noticed that the mean value of FER of control positive group was higher than the control negative group, being 0.4 ± 0.05 and 0.0 ± 0.08 respectively. The significant results for decreasing FER were recorded for group 8 which treated by a high dose of green tea enriched with catechin and inulin being -0.2 ± 0.20 . These results agreed with Yang *et al.* (2012) who found that catechin-rich green tea decreased fat mass and BMI. However, Babu *et al.* (2007), Renno *et al.* (2008) and Juśkiewicz *et al.* (2008) reported that green tea catechin treatment did not improve weight gain in STZ-treated animal. However, the contractor results could be due to the differences in dosage and methods used in dietary treatment (Rains *et al.*, 2011).

enriches with catechin and inulin showed lowering in their BWG. It could be noticed

Table (1): The effect of green tea enriched with catechin, inulin on FER, BWG, initial body weight, final body weight and food consumed for rats induced to diabetes.

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Parameter		Initial body weight (g)	Final body weight (g)	Food consumed (g)	Feed efficiency ratio	Body weight gain %
Control (-) group 1		183.6±1.52 ^a	183.2±2.05 ^b	19.8±1.10 ^b	0.0±0.08 ^b	-0.2±0.83 ^b
Control (+) group 2 Diabetic rats		180.0±0.71 ^a	189.2±0.84 ^a	22.6±1.52 ^a	0.4±0.05 ^a	5.1±0.75 ^a
Green tea enrich with catechin	Group 3 (0.2mg catechin)	185.8±3.27 ^b	187.8±2.17 ^a	21.4±1.14 ^a	0.1±0.11 ^b	1.1±1.26 ^b
	Group 4 (0.5mg catechin)	187.4±1.67 ^b	186.4±2.97 ^a	21.0±1.00 ^a	0.0±0.12 ^b	-0.5±1.41 ^b
Green tea enrich with inulin	Group 5 (14 g inulin)	186.4±2.41 ^b	185.2±3.35 ^b	19.0±1.00 ^b	-0.1±0.22 ^b	-0.6±2.26 ^b
	Group 6 (18 g inulin)	187.4±1.14 ^b	184.2±1.10 ^b	18.4±0.89 ^b	-0.2±0.04 ^b	-1.7±0.44 ^b
Green tea enrich with catechin+ inulin	Group 7 (0.2mg catechin +14 g inulin)	185.2±1.48 ^b	182.6±2.19 ^b	17.6±0.55 ^b	-0.1±0.16 ^b	-1.4±1.51 ^b
	Group 8 (0.5mg catechin +18 g inulin)	182.0±3.39 ^a	179.8±1.10 ^b	15.2±1.10 ^b	-0.2±0.20 ^b	-1.2±1.60 ^b
ANOVA		7.626	9.913	24.487	9.463	13.094
p-value		<0.001	<0.001	<0.001	<0.001	<0.001

Values are mean ± SD (n = 6); where: Mean values with the same letter are significantly different at 0.01 levels.

Serum lipid profile in diabetics' rat

It was obvious from data presented in Figures (1, 2, 3 and 4) that serum cholesterol (mg/dl), Serum triglycerides (mg/dl), Serum HDL cholesterol, Serum LDL cholesterol (mg/dl) of diabetic rats were affected by ingested green tea enriched with catechin and inulin. These results revealed that serum lipid profile (mg/dl) showed significant differences among all studied groups at (p<0.01). Diabetic rats feeding on basal diet plus green tea enriched with catechin and inulin showed reduction in their lipid profile. It could be observed that the mean value of lipid profile (mg/dl) of control positive group was higher than that of control negative one, being 200.2±13.74 and 176.4±7.54 mg/dl for total cholesterol and 96.4±13.96 and 77.2±3.03 mg/dl for triglycerides. Also, the mean value of serum LDL cholesterol and serum VLDL cholesterol (mg/dl) of control positive group was higher than control negative group,

being 138.9±13.11 and 116.2±6.38 mg/dl for serum LDL cholesterol and 19.3±2.79 and 15.4±0.61 mg/dl for serum VLDL cholesterol, respectively. The mean value of serum HDL cholesterol (mg/dl) of control positive group was lower than control negative group, being 42.0±2.45 and 44.8±3.83. These results agreed with Chen *et al.* (2009) who observed that the chronic development of diabetes in mice, hyperlipidemia was also generally observed, since the most critical problem in hyperlipidemia increases of serum TG and TC levels (Kim *et al.*, 2013).

The best results for decreasing serum LDL cholesterol and serum VLDL cholesterol (mg/dl) were recorded for group 8 which treated by a high dose of green tea enriched with catechin and inulin being 106.9±10.43 and 14.7±0.63 mg/dl, respectively and increase in serum HDL cholesterol being 49.4±2.19 mg/dl. Similarly, the best results for decreasing

total cholesterol and triglycerides were recorded for group 8 which treated by a high dose of green tea enriched with catechin and

inulin being 171.2 ± 10.69 and 73.6 ± 3.13 mg/dl, respectively.

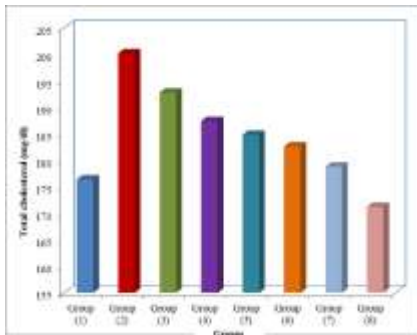


Fig. (1): Total cholesterol (mg/dl) in diabetic groups

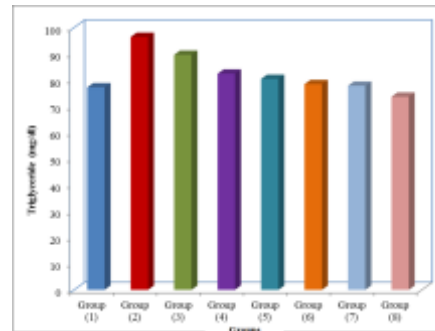


Fig. (2) Triglyceride (mg/dl) in diabetic groups

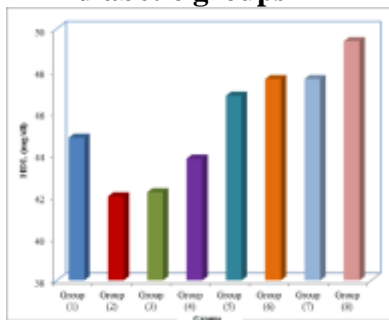


Fig. (3): HDL (mg/dl) in diabetic groups

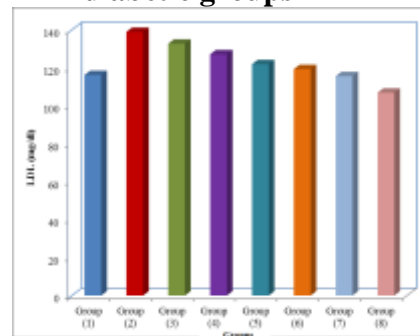


Fig. (4) LDL (mg/dl) in diabetic groups

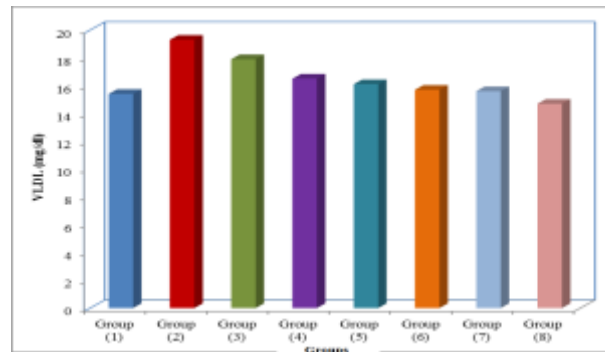


Fig. (5): VLDL (mg/dl) in diabetic group.

Kidney function indicators:

Data presented in Table (2) for the kidney function of diabetic rats taken orally green tea enriched with catechin and inulin revealed significant differences among all studied groups at ($p < 0.01$). Diabetic rats fed on basal diet and taken orally 1.5 ml/kg body weight rat / day of green tea enriched

with catechin and inulin resulted in the reduction of kidney function (mg/dl). It could be noticed that the mean value of kidney function of control positive group was higher than control negative group, being 28.0 ± 5.52 and 22.2 ± 4.21 mg/dl for urea, 0.7 ± 0.10 and 0.6 ± 0.05 mg/dl for creatinine and 4.8 ± 0.16 and 3.3 ± 0.33 for

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uric acid, respectively. These results were in agreement with Kang *et al.* (2014) who observed that due to the increases in kidney weights due to swelling, inflammation and necrotic processes caused elevation of serum BUN and creatinine levels so-called diabetic nephropathy and improvement of these

abnormal developments have been considered direct evidence of improved diabetic nephropathies. In addition, the treatment of green tea effectively and dose-dependently inhibited the increases in kidney weights, serum BUN and creatinine elevation (Lee *et al.*, 2015).

Table (2): The effect of green tea enriched with catechin, inulin on kidney function indicators for diabetic rats.

Parameter Groups		Urea (mg/dl)	Creatinine (mg/dl)	Uric acid (mg/dl)
Control (-) group 1 fed on BD		22.2±4.21 ^b	0.6±0.05 ^b	3.3±0.33 ^b
Control (+) group 2 Diabetic Rats fed on BD		28.0±5.52 ^a	0.7±0.10 ^a	4.8±0.16 ^a
Green tea enrich with catechin	Group 3 (0.2mg catechin)	27.0±3.39 ^a	0.5±0.11 ^b	3.5±0.50 ^b
	Group 4 (0.5mg catechin)	23.6±3.44 ^b	0.5±0.04 ^b	3.3±0.37 ^b
Green tea enrich with inulin	Group 5 (14 gm inulin)	22.2±3.11 ^b	0.5±0.07 ^b	3.3±0.45 ^b
	Group 6 (18 gm inulin)	21.0±1.41 ^b	0.5±0.05 ^b	3.2±0.40 ^b
Green tea enrich with catechin+ inulin	Group 7 (0.2mg catechin +14 gm inulin)	19.4±1.34 ^b	0.5±0.03 ^b	3.2±0.31 ^b
	Group 8 (0.5mg catechin +18 gm inulin)	18.8±1.64 ^b	0.5±0.03 ^b	3.1±0.40 ^b
ANOVA		5.006	4.805	10.566
p-value		<0.001	<0.001	<0.001

Values are mean and SD (n = 6); where: Mean values with the same letter are significantly different at 0.01 levels.

Liver function indicators:

Data presented in Table (3) show the liver enzymes of diabetic rats affected by ingested green tea enriched with catechin and inulin. The results showed that diabetic rats have increased liver enzymes (U/L). Meanwhile feeding on basal diet plus green tea enriched with catechin and inulin resulted in the reduction of liver function (U/L). Nevertheless, green tea enriched with the combination of inulin and catechin counteracted the effect of liver enzymes concentration leading to a decrease of liver

enzymes (U/L). It could be noticed that the mean value of the liver function of control positive group was higher than control negative group, being 32.4±3.97 and 22.6±2.61 U/L for AST and 36.2±3.70 and 28.2±2.28 U/L for ALT, respectively.

The pronounced discrepancy in toxicity between consumption of green tea catechin extracts and green tea itself may be caused by the beneficial effects of other ingredients in green tea on the pro-oxidant effects of high-dose catechins, a major mechanism involved in the toxicity of tea

catechins (Wang *et al.*, 2015). In addition to tea catechins, green tea also contains L-theanine and polysaccharides, which are

well known for hepatoprotective activity (Nagai *et al.*, 2015).

Table (3): The effect of green tea enriched with catechin, inulin on liver function indicators for rats induced to diabetes.

Group		Parameter	AST (U/L)	ALT (U/L)
Control (-) group 1 fed on BD			22.6±2.61 ^b	28.2±2.28 ^b
Control (+) group 2 Diabetic Rats fed on BD			32.4±3.97 ^a	36.2±3.70 ^a
Green tea enrich with catechin	Group 3 (0.2mg catechin)		26.0±3.61 ^b	31.2±3.42 ^b
	Group 4 (0.5mg catechin)		23.2±1.79 ^b	26.8±1.30 ^b
Green tea enrich with inulin	Group 5 (14 g inulin)		23.2±2.05 ^b	26.8±1.64 ^b
	Group 6 (18 g inulin)		21.6±1.34 ^b	25.8±1.30 ^b
Green tea enrich with catechin+ inulin	Group 7 (0.2mg catechin +14 g inulin)		21.0±0.71 ^b	24.8±1.79 ^b
	Group 8 (0.5mg catechin +18 g inulin)		19.0±2.00 ^b	23.0±2.00 ^b
ANOVA			13.496	15.659
p-value			<0.001	<0.001

Values are mean and SD (n = 6); where: Mean values with the same letter are significantly different at 0.01 levels.

Serum glucose, atherogenic index (AI) and cardiovascular disease risk (CVD) of diabetic rats:

Data presented in Table (4) show the blood sugar (BS) (mg/dl) of diabetic rats affected by ingested green tea enriched with catechin and inulin. The results revealed that serum blood glucose showed significant differences among all studied groups at ($p < 0.01$). It is evident that diabetic disease increased BS (mg/dl). Meanwhile, feeding on basal diet plus green tea enriched with catechin and inulin resulted in the reduction of BS (mg/dl).

Nevertheless, the green tea enriched with catechin and inulin counteracted the effect of blood glucose concentration leading to a decrease of FBS (mg/dl). It could be noticed that the mean value of FBS of control positive group was higher than the control negative group, being 212.6±30.63 and 83.0±13.58 mg/dl, respectively. The best results for decreasing of FBS were recorded for group 8 which treated by a high dose of green tea enriched with catechin and inulin being 172.2±22.62mg/l. Green tea phenolic constituents are able to stimulate pancreatic

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beta cells to increase postprandial insulin, consequently improving pancreas action (Sundaram *et al.*, 2013). It is evident that diabetic disease increased atherogenic index (A.I) and cardiovascular disease risk (CVD risk). The atherogenic index (A.I) and cardiovascular disease risk (CVD risk) of diabetic rats fed on basal diet plus green tea enriched with catechin and inulin showed reduction in their mean values (Table 4). It could be noticed that the mean value of the atherogenic index (A.I) and cardiovascular disease risk (CVD risk) of control positive group was higher than control negative group, being 3.8 ± 0.16 & 3.0 ± 0.30 for atherogenic index (A.I) and 4.8 ± 0.54 and 3.9 ± 0.08 for cardiovascular disease risk (CVD risk), respectively.

The best results for decrease atherogenic index (A.I) and increase

cardiovascular disease risk (CVD risk) were recorded for group 8 which treated by a high dose of green tea enriched with catechin and inulin being 2.5 ± 0.25 and decrease cardiovascular disease risk (CVD risk) being 3.5 ± 0.33 . Diepvens *et al.* (2005) suggested that hypertension is also a CVD risk, and habitual green tea drinkers have a lower risk of developing hypertension. The current popular mode of treatment and prevention are pharmacological drugs and these drugs are not free from side effects. Therefore, there is a need for a food-based strategy and development of an advocacy tool which is easily adaptable and can help in improving the cardiovascular health and reduce the prevalence of diabetes with hypertension (Dehghan *et al.*, 2014).

Table (4): The effect of green tea enriched with catechin, inulin on serum glucose, atherogenic index (AI) and cardiovascular disease risk (CVD) diabetics rat.

Groups	Parameter	Atherogenic index (AI)	CVD risk%	Glucose
Control (-) group 1 fed on BD		3.0 ± 0.30^b	3.9 ± 0.08^b	83.0 ± 13.58^b
Control (+) group 2 Diabetic Rats fed on BD		3.8 ± 0.16^a	4.8 ± 0.54^a	212.6 ± 30.63^a
Green tea enriched with catechin	Group 3 (0.2mg catechin)	3.6 ± 0.40^a	4.6 ± 0.20^a	210.0 ± 31.25^a
	Group 4 (0.5mg catechin)	3.3 ± 0.46^b	4.2 ± 0.34^a	202.6 ± 29.20^a
Green tea enriched with inulin	Group 5 (14 gm inulin)	3.0 ± 0.43^b	3.9 ± 0.36^b	199.4 ± 29.90^a
	Group 6 (18 gm inulin)	2.9 ± 0.30^b	3.8 ± 0.21^b	192.0 ± 25.02^a
Green tea enriched with catechin + inulin	Group 7 (0.2mg catechin +14 gm inulin)	2.8 ± 0.23^b	3.8 ± 0.51^b	183.6 ± 21.48^a
	Group 8 (0.5mg catechin +18 gm inulin)	2.5 ± 0.25^b	3.5 ± 0.33^b	172.2 ± 22.62^b
ANOVA		8.515	8.515	13.062
p-value		<0.001	<0.001	<0.001

Values are mean \pm SD (n = 6); where: Mean values with the same letter are significantly different at 0.01 levels.

Histopathological examination of the pancreas:

Microscopically, the pancreas of rats from group 1 revealed no histopathological changes (photo 1). However, the pancreas of rats from group 2 showed vacuolations and necrosis of cells of islets of Langerhan's (photo 2). This result agreed with Noriega-López *et al.* (2007) who observed that the presence of type II diabetes causes increased of islets of the pancreas in area and number in order to secrete more insulin to try to maintain glucose homeostasis with noticeable hypertrophy or hyperplasia in

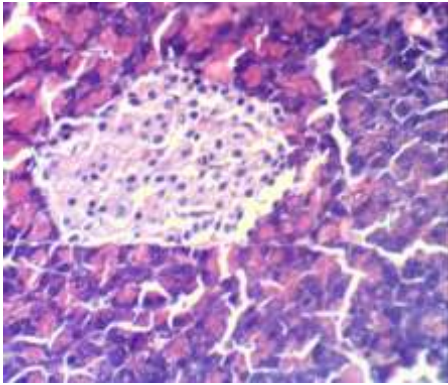


Photo (1):Section of Pancreas of rat from group 1 showing no histopathological changes (H & E X 400).

endocrine pancreas cells and this lead to abnormal endocrine pancreas histopathological changes. Moreover, sections from group 3 showed congestion of pancreatic blood vessels (photo 3) and necrosis of sporadic cells of islets of Langerhan's. Meanwhile, the pancreas of rats from groups 4, 5 & 6 revealed no histopathological changes (photo 4, 5, 6). The pancreas of rats from group 7 revealed no changes except congestion of pancreatic blood vessel (photo 7). However, the pancreas of rats from group 8 revealed no histopathological changes (photo 8).

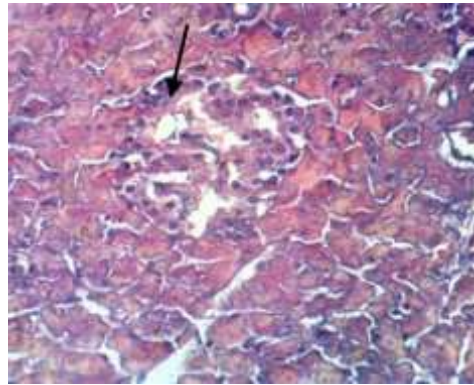


Photo (2): Section of Pancreas of rat from group 2 showing Langerhan's necrosis of cells of Islets (H & E X 400).

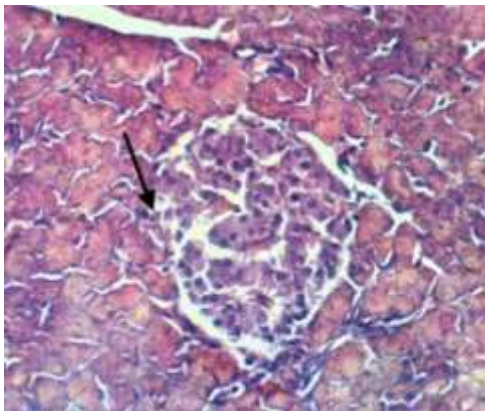


Photo (3): Section of Pancreas of rats From group 3 showing necrosis of sporadic cells of islets of Langerhan's (H & E X 400).

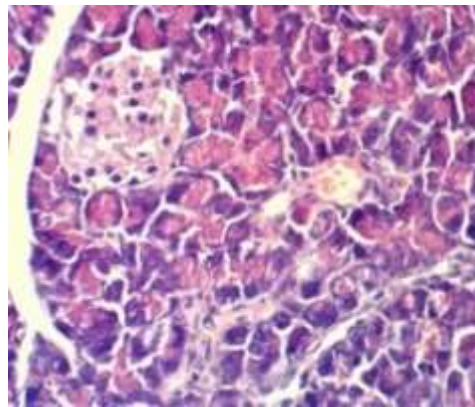


Photo (4): Pancreas group 4 showing no histopathological changes (H & E X 400).

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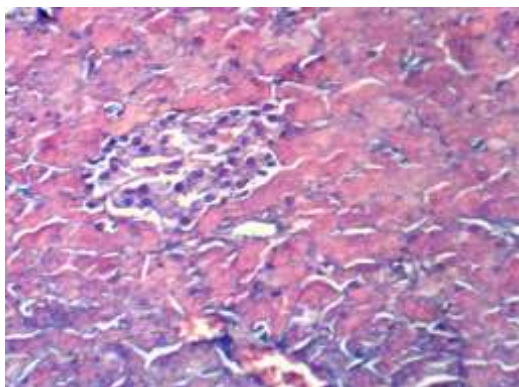


Photo (5): Section of Pancreas of rats from group 5 showing no histopathological changes (H & E X 400).

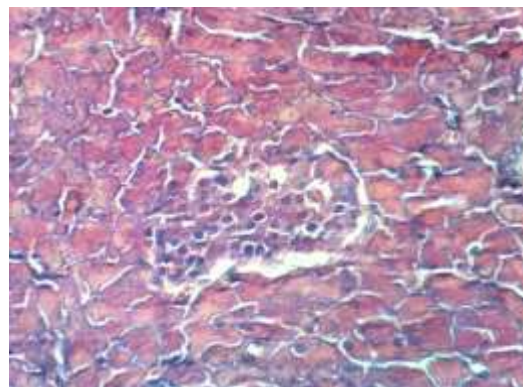


Photo (6): Section of Pancreas of rats from group 6 showing no histopathological changes (H & E X 400).

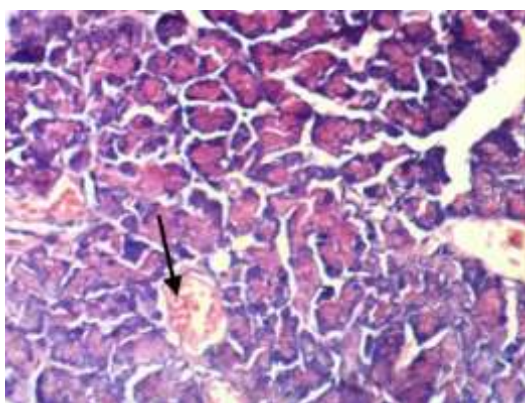


Photo (7): Section of Pancreas of rats from group 7 showing slight congestion of pancreatic blood vessel (H & E X 400).

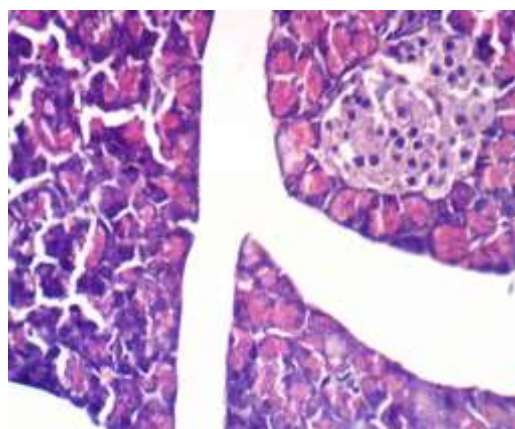


Photo (8): Section of Pancreas of from group 8 showing no histopathological changes (H & E X 400).

CONCLUSION

Diabetes mellitus are important public health concerns throughout the world because of their increasing incidence and prevalence. There were significant differences among all studied groups of experimental rats in feed intake. In the group diabetic rats, the results revealed that with increasing the doses of taken orally green tea plus catechin and inulin the feed

intake was significantly decreased and improvement the serum glucose, lipids profile, liver and kidney functions. The histological examination of the pancreas has confirmed the results from biological experiment.

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تحسين الفئران المصابة بداء السكري باستخدام الشاي الأخضر الغني بالكاتشين والإينولين

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المستخلص

ته دفت هذه الدراسة إلى بحث آثار الشاي الأخضر الغني بالكاتشين والإينولين لتحسين الجرذان المصابة بمرضى السكري. وأظهرت النتائج أن الشاي الأخضر غني بمضادات الكاتشين والإينولين ويعمل على تحسين FER و BWG في مجموعات الفئران لمرضى السكري. يمكن ملاحظة أن أهم النتائج لـ BWG و FER تم تسجيلها لجرذان المجموعة 8 التي عولجت بجرعة عالية من الشاي الأخضر الم دعم بالكاتشين والإينولين. أيضا ، هذه المجموعة من الفئران المعالجة لديها أقل كوليسترول كلي ، الدهون الثلاثية كوليسترول LDL والكوليسترول المصل VLDL أيضا. ومع ذلك ، كان الكوليسترول الحميد هو الحد الأدنى في الحيوانات من هذه المجموعة.

تم تحسين وظائف الكلى والكبد في مجموعات الفئران المختلفة لمرضى السكري الذين تم تغذيتهم على النظام الغذائي الأساسي وأخذوا عن طريق الفم 1.5 مل / كغ / وزن الجسم / يوم من الشاي الأخضر الم دعم بالكاتشين والإينولين. من ناحية أخرى ، الشاي الأخضر ، وجد أن الكاتشين والإينولين يقللان الجلوكوز في الدم في مجموعات الفئران المصابة بداء السكري ويحسنان من مؤشر التصلب العصبي (AI) ومخاطر أمراض القلب والأوعية الدموية (خطر الأمراض القلبية الوعائية). قد يكون التحسن الملحوظ في مجموعات الفئران المختلفة لمرضى السكر الذين يتناولون الشاي الأخضر والكاتشين بسبب وجود مضادات الأكسدة الطبيعية في الكاتشين التي تهاجم الجذور الحرة في الدم. أيضا ، يستخدم الأنسولين كألياف غذائية في الأطعمة الوظيفية التي تفقد الوزن الزائد.

يمكن التوصية من نتائج الدراسة أن تناول 1.5 مل / كغم / وزن الجسم / يوميا من الشاي الأخضر الم دعم بالكاتشين والإينولين (مستخلص من غلي 20 جم من أوراق الشاي الأخضر / لتر من الماء مع 0.5 مجم كاتشين بالإضافة إلى 18 جم من inulin) تحسين الفئران المصابة بداء السكري.