JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2016, 22(4), 253-262

Journal of Agroalimentary Processes and Technologies

Hypoglycemic effect of *Artemisia absinthium* and Green Tea (*Camellia sinensis*) mixture on alloxan-induced diabetic rats

Hesham Z. Tawfeuk

Food Sci. Dept.; Fac. Agriculture and natural resources; Aswan University; Aswan, Egypt.

Received: 15 September 2016; Accepted: 20 November 2016

Abstract

This study aims to inspect the effects of green tea extract, A. absinthium extract, and mixture of them in diabetic rats. Forty adult male albino rats were divided into 5 experimental groups: The first group was considered as negative control group. The second group was positive control diabetic rats receiving normal diet with no treatment. The third group was diabetic rats receiving normal diet and receiving oral 50 ml of green tea extract, the fourth group was diabetic rats receiving normal diet and receiving oral 50 ml of A. absinthium extract. And the fives group was diabetic rats receiving normal diet and receiving oral 50 ml of green tea extract plus 50 ml of A. absinthium extract. The results showed decrease of serum glucose in groups (3, 4, and 5) but group No. 5 recorded the better reduction of blood glucose as compared with negative control. Treating diabetic groups fed on basal diet with different extract of green tea, A. absinthium led to a significant decrease in the mean value of serum cholesterol, triglyceride as compared to the positive control group. We can recommend that the extract of green tea plus A. absinthium has a hypoglycemic effect on alloxan-induced diabetes in rats.

Keywords: Bakery, Hypoglycemic, *Artemisia absinthium*, Green Tea, alloxan, glucose

1. Introduction

Diabetes mellitus is defective or deficiency in Insulin secretion which occurs due to a chronic metabolic disorder and it unearths by too much glucose in the blood and urine. Insulin, a hormone produced by the beta cells of the Islets of langerhans of the pancreas helps to utilize glucose for the production of energy by the body. Insulin helps in glucose uptake by the cells, prevents rise in blood sugar and maintains its level within normal limits [19, 37].

Tea is the second most consumed beverages in the world, next to water and well ahead of coffee, beer, wine, and carbonated soft drinks and its habitual consumption has long been associated with health benefits [6,28].

Tea is an infusion made by steeping processed leaves, buds, or twigs of tea bush, Camellia sinensis, in hot water for several minutes after, which it is drunk [23]. More than 300 different kinds of tea are produced from the leaves of Camellia sinensis by different manufacturing processes. Generally, they are divided into three types: green tea (non-fermented), oolong tea (semi fermented) and black tea (fermented). To produce green tea, freshly harvested leaves are immediately steamed to prevent fermentation, yielding a dry, stable product. This steaming process destroys the enzymes responsible for breaking down the color pigments in the leaves and allows the tea to maintain its green color during the subsequent rolling and drying processes. These processes preserve natural polyphenols with respect to the health- promoting properties [4].

Corresponding author: *e-mail:* heshamzakaria2013@gmail.com

The scientific community and the popular press have recently pondered that there might be beneficial properties of green tea. Its consumption has been associated with anti-inflammatory, anti-oxidative, anti-mutagenic, and anti-carcinogenic effects [20].

The constituents of *C. sinensis* leaves include a complex mixture of polyphenolic compounds (30% to 35%), methylxanthines such as caffeine and theobromine (2.5% to 4.0%), proteins (15% to 20%), amino acids (1% to 4%), carbohydrates (5% to 7%), and lipid components (2%); organic acids (1.5%), ash (5%), minerals and trace elements (10% to 15%); and pigments such as chlorophyll (0.5%) [3].

Among the polyphenolic compounds, flavonoids are the most abundant (80% to 90%). The largest proportion of flavonoids are catechin polyphenols (condensed tannins), which make up 30% to 40% of green tea solids. Catechin polyphenol content depends on the maturity and the processing of the *C. sinensis* leaves during preparation of tea. The catechin polyphenol composition of the leaves also varies with geographic location, season, and cultivation procedures [11]. Catechin polyphenols are colorless, water soluble compounds and are very stable in acidic solutions (pH less than 4). However, their solubility progressively decreases as the pH is increased from 4 to 8. A typical tea beverage, prepared in a proportion of 1 g leaf/100 mL water in a 3-minute brew, usually contains from 250 to 300 mg tea solids, composed of 30% to 42% catechins and 3% to 6% caffeine [3]. Dried concentrated extracts from green tea containing high amounts of catechins are a popular source for nutraceutical and medicinal uses.

Al-Hilfy (2012) [1] concluded that the taken doses of green tea extract are affected positively in reducing glucose level and improving the impaired kidney functions in diabetic rats. When Salim (2014) [31] showed that Zingiber officinale (ginger) and Camellia sinensis (green tea) plants share some possible mechanisms to lower glucose levels in type 1 and 2 of diabetes mellitus. Although Mostafa (2014) [22] investigated that green tea rich with catechins, especially in high amounts, reduces serum cholesterol levels, and blood glucose.

Artemisia absinthium is an aromatic plant of the family *Asteraceae*, subfamily *Asteroideae*, tribe Anthemideae and is known by the common names wormwood. *Artemisia absinthium* (wormwood) is an aromatic, perennial small shrub distributed in Europe and Asia [36]. *Artemisia absinthium*, also known as common wormwood, is a member of the *Asteraceous* family, which is an herbaceous perennial plant with strong sage odor [25]. The wormwood (*A. absinthium*) contains the monoterpene (thujone) active component and absinthen, [18,26] beside azulenes, phenolic compounds, and flavonoids, which give antiradical and antioxidative activity [17].

Daradka *et al*., 2014 [8] concluded that the extract of A. absinthium has a hypoglycemic effect on alloxan-induced diabetes in rats prevents the sever reduction in body weight and improvement biochemical parameters associated with (DM) such as total cholesterol, serum protein, urea, and creatinine, and will be supportive in projecting the A. absinthium as a therapeutic agent in diabetes. Although Haidari *et al*., (2012) [12] concluded that green tea extract had both antihyperglycemic and hypocholesterolmic effects in diabetic rats.

Therefore, the aim of this research was to assay the effect of green tea extract and A. absinthium extract to improve glycaemic control in type 2 diabetic patients.

2. Materials and Methods

2.1. Materials

Plants:

1. *A. absinthium* plants were obtained from Directorate of Agriculture in Aswan, Egypt. It was left to air dry partially for 2–3 days at room temperature. It was chopped then grinded using an electrical grinder until obtained powder. Each 500 g of this powder was extracted by ethanol-water mixture (70/30V/V) for 48 h. This step was repeated for three times then the filtrate was then refluxed in 70% ethanol at 50 °C using a rotary evaporator for 36 h in continuous extraction (Soxhlet) apparatus, Pooled and concentrated ethanol extract was filtered, and it was re-concentrated under reduced vacuum pressure [8].

2. Green tea (*Camellia sinensis*) leaves used in this study were purchased from a local market in Aswan, Egypt. The dry green tea leaves were powdered by electrical mill. In order to prepare the extract, 150 g of powdered green tea leaves was mixed with 1000 ml 95% ethanol and was shaken constantly for 48 hours. After filtration (Whatman filter paper No. 1), the suspension was evaporated in a rotary evaporator. The extracts were stored in 4°C refrigerator until usage [12].

2.2. Chemicals:

Alloxan monohydrate (used for diabetes induction in rats) and kits for biochemical analysis (used for biological evaluation) were obtained from Sigma Chemicals Co. (USA). The other chemicals used in this work were of analytical grade.

2.3.Experimental animals:

Healthy male albino rats weighting 200-220 g were obtained from the farm of the National Research Center, Giza, Egypt.

2.4.Induction of diabetes in experimental rats.

Rats were fasted overnight and diabetes was induced by a single intraperitoneally injection of freshly prepared solution of alloxan at a dose of (150 mg / kg body weight) in sterile saline [9]. Rats get diabetes by raise the proportion of hyperglycemia gradually during fed on basal diet and injection of Alloxan for three days. Development of diabetes was confirmed by measuring fasted blood glucose levels. Only rats with fasting blood glucose levels greater than 250 mg/ dl were considered diabetic and then included in the experiment.

2.5.Experiment design:

Forty male albino rats were randomly divided into five groups each of eight rats as following:

- *Group $_1$:* Negative control, normal healthy rats, receiving normal diet with no treatment.
- *Group $_2$:* positive control, diabetic rats receiving normal diet with no treatment.
- Group $_3$: diabetic rats receiving normal diet and receiving oral 50 ml of green tea extract.
- *Group $_4$:* diabetic rats receiving normal diet and receiving oral 50 ml of A. absinthium extract.
- *Group $_5$:* diabetic rats receiving normal diet and receiving oral 50 ml of green tea extract plus 50 ml of A. absinthium extract.

2.6.Body weight:

Rats were recorded changes of body weight during the experimental period (4 weeks). Blood samples were collected sequentially from the eye plexuses of rats before and during the experimental period.

2.7.Biochemical parameters:

Blood samples were collected from the eye plexuses of animals by a fine capillary glass tubes during the first day, 10 days, 20 days and at the end of experimental period,. Blood serum samples were separated by centrifugation for 10 min at 1500 xg and kept at –20 oC until analysis [33].

Serum glucose (mg/dL) concentration was determined according to the methods described by Young and Friedman (2001) [38] using Spectrophotometer adjusted at 500 nm.

Total triglyceride and Cholesterol were determined according to, Fossati and Prencipe (1982) [10] and Roeschlau *et al*., (1974) [29], respectively.

2.8.Statistical analysis

The results were statistically analyzed according to statistical analysis system SAS (1999) [32]. Duncan's at 5% level of significance was used to compare between means according to Snedecor and Cochran, (1980) [35].

3.Results and discussions:

3.1.Changes in body weight

Table (1), illustrates that the average body weight (BW) of diabetic rats was significantly ($p< 0.05$) lower than that of the normal control (group$_1$), Drastic reduction was obtained in the BW of diabetic rats group$_2$ (control+), the body weight of the diabetic rats (group$_3$ and group$_4$) treated with green tea extract and A. absinthium extract, respectively, was significantly ($p< 0.05$) lower than the normal control (group$_1$). On the other hand (group$_5$) diabetic rats treated with 50 ml of green tea extract plus 50 ml of A. absinthium extract improved their body weight loss when compared to the diabetic control (group$_2$).

Body weight gain of rats on group5 recorded (36.83g) was slightly lower than group1 control (-) (41.15 g), this indicates that group5 diabetic rats treated with 50 ml of green tea extract plus 50 ml of A. absinthium extract was slightly less efficient than control (-) in promoting growth.

These results are consistent to those obtained by Al-Hilfy (2012) [1], Mostafa (2014) [22], and Daradka *et al*., (2014) [8].

3.2.Serum glucose

Groups of rats recorded different level of serum glucose in Table (2). Results illustrates that induction of diabetic in rats with alloxan (150 mg /kg body weight) significantly increased serum glucose from 89.12- 108.88 mg/dl to 234.12 – 250.23 mg/ dl after 10 days of alloxan injection. Kumar *et al*. (2011) [21] reported that alloxan acts as diabetogenic by destruction of β-cell of the islets of langerhans and causes massive reduction in insulin release, thereby inducing hyperglycemia. Serum glucose of diabetic rats in $group_2$ (control +) was significantly ($p \leq 0.05$) increased to 299.22 mg/ dl at the end of experiment. Diabetic rats on different groups (control -, $group_3$, $group_4$, and $group_5$) significantly reduced serum glucose gradually, The lowest serum glucose level was significantly obtained in the group of rats number 5 (154.11 mg/ dl), followed by $group_3$, then $group_4$ (192.11, 198.10 mg/ dl), respectively, as compared with the control positive due to alloxan producing oxygen radicals that destroy pancreatic β-cells and cause severe hypoinsulinaemia that is responsible for the hyperglycemia seen in alloxan-treated animals [16].

Group5 diabetic rats which treated with 50 ml of green tea extract plus 50 ml of A. absinthium extract were recorded low of glucose level significantly in alloxan-induced rats during experimental period. These observations may be due to the high level catechin on glucose tolerance which may be mainly due to the two epicatechin (EC), Epigallocatechin-3-gallate (EGCG) and epicatechin-3-gallate (ECG) [27]. The significant antihyperglycemic may be due to the presence of active components of A. absinthium like α- and β thujones, thujyl alcohol, azulenes, bisabolene, cadinene, sabinene, pinene, and phellandrene [2,7,24].

Several studies have proved that the hypoglycemic effect of green tea attributed to the presence of polyphenols, catechins and a water-soluble polysaccharide fraction Sabu *et al*., (2002) [30] and Shimizu *et al*., (2000) [34]. It has been reported that green tea polyphenols increase insulin activity in diabetic rats [6]. It also is documented that the water-soluble polysaccharides fraction of green tea is responsible for its anitdiabetic effect Isigaki *et al*., (1991) [15]. Other studies also confirmed that green tea epigallocatechin gallate promotes pancreatic β-cells regeneration in alloxan-treated rats, has insulin-like and insulinotropic activities, and inhibits gluconeogenesis through inhibition of liver phosphoenolpyruvate kinase synthesis Chemler *et al*., (2007) [5].

Similar results were obtained by Chemler *et al*., (2007) [5], Park *et al*., (2009) [27], Al-Hilfy (2012) [1], Mostafa (2014) [22], and Daradka *et al*., (2014) [8].

3.3.Serum Triglycerides (TG)

Induction of diabetic in rats significantly ($p \leq 0.05$) raised triglycerides to 88.08 - 128.00 mg/ dl compared to 63.13 - 68.22 mg/dl in the control negative group (Table 3). The best results in serum triglycerides were observed in hyperglycemic group ($group_5$) fed on basal diet and treated with 50 ml of green tea extract plus 50 ml of A. absinthium extract, because this treatment showed no big significant differences in serum triglyceride as compared to the negative control group. The lowering of triglyceride observed in all groups, the more pronounced lowering effect was observed in the groups No. 5 (71.01 mg/dl) then group No.4 (78.25 mg/dl), and group No. 3 (80.22mg/dl) as compared to the negative control group.

The reduction of triglycerides may be attributed to catechin suppress postprandial hypertriacylglycerolemia through the inhibition of pancreatic lipase, which, therefore, delayed the absorption of fat [14].

These results are close to which obtained by Ikeda *et al*., (2005) [14], Haidari *et al*. (2012) [12], and Mostafa (2014) [22].

Table 1. Body weight and body weight gain (g) of normal and diabetic rats.

Rats group	Body weight(g) during experimental period(days)				
	Initial weight	**10**	**20**	**28**	**Body weight gain**
control (-) Group1	219.25 ±7.55^{a}	235.11 ±10.33^{a}	245.66 ±11.08^{a}	260.40 ±10.00^{a}	41.15
control (+) Group2	211.22 ±5.4^{cd}	182.23 ±11.20^{c}	144.13 ±15.22^{e}	133.23 ±9.44^{d}	-77.99
Group3	204.22 ±11.05^{cb}	211.21 ±11.64^{b}	215.65 ±11.17^{b}	221.90 ±10.42^{b}	17.68
Group4	220.50 ±11.33^{cb}	219.13 ±11.22^{b}	225.20 ±14.22^{c}	228.11 ±10.00^{c}	7.61
Group5	215.50 ±14.00^{a}	217.34 ±21.17^{a}	234.22 ±13.45^{a}	252.33 ±12.62^{a}	36.83

Mean (n=8) ± SD in the same column with different letters are significantly different (p≤ 0 .05).

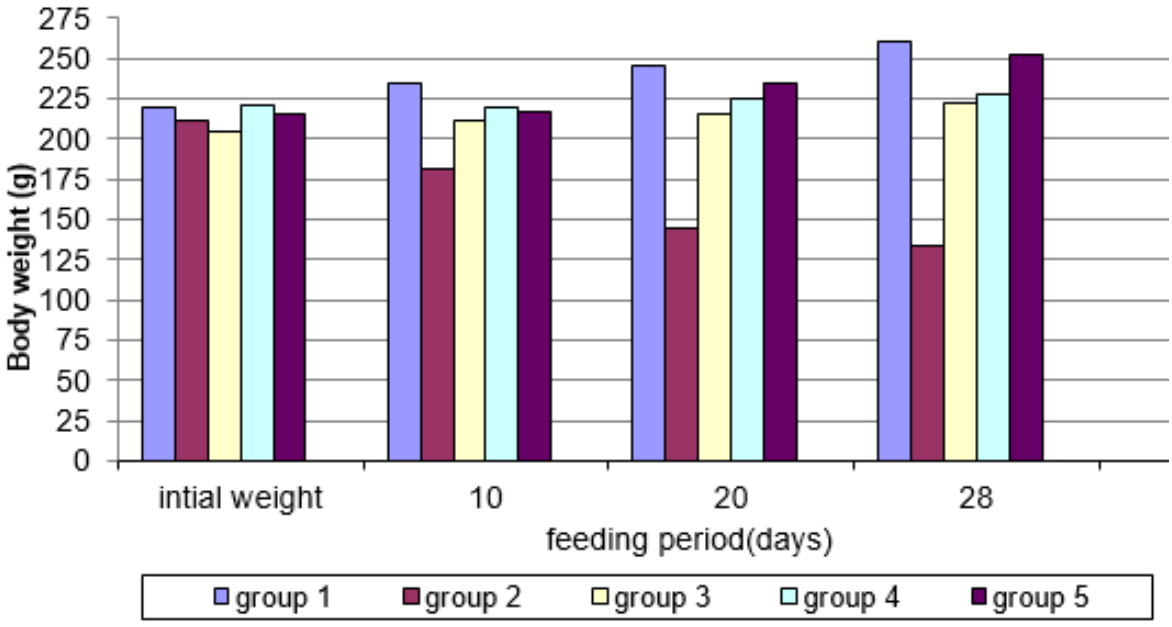

Figure 1. Body weight (g) of normal and diabetic rats.

Table 2. Serum glucose (mg/dL) of normal and diabetic rats.

Rats group	Serum glucose (mg/dL) during experimental period(days)			
	0	10	20	28
control (-) Group1	102.12 ± 0.60^{aB}	106.23 ± 0.63^{fA}	99.93 ± 1.12^{eC}	108.12 ± 0.85^{dA}
control (+) Group2	108.88 ± 0.50^{aE}	250.12 ± 3.33^{cD}	288.12 ± 3.15^{aC}	299.22 ± 4.15^{aA}
Group3	101.12 ± 0.11^{aE}	242.11 ± 1.60^{dA}	220.13 ± 1.23^{cB}	192.11 ± 2.52^{bD}
Group4	89.12 ± 0.15^{aE}	250.23 ± 1.47^{cA}	210.11 ± 2.03^{cC}	198.10 ± 1.12^{bD}
Group5	99.11 ± 0.25^{aE}	234.12 ± 2.00^{eA}	202.12 ± 1.00^{eC}	154.11 ± 1.11^{cD}

Mean (n=8) ± SD in the same column with different small letters are significantly different ($p \leq 0.05$) based on animal group.
Mean (n=8) ± SD in the same row with different capital letters are significantly different ($p \leq 0.05$) based on experimental period.

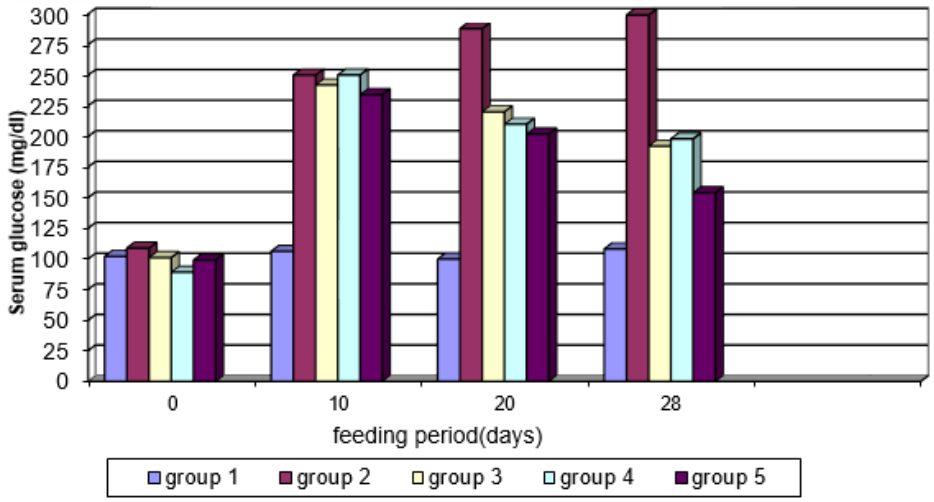

Figure 2. Serum glucose (mg/dL) of normal and diabetic rats

Table 3. Serum triglycerides (mg/dL) of normal and diabetic rats

Rats group	Serum triglycerides (mg/dL) during experimental period(days)			
	0	10	20	28
control (-) Group1	68.22 ± 0.00^{aA}	66.12 ± 2.12^{cA}	67.15 ± 2.11^{dA}	65.45 ± 2.78^{dA}
control (+) Group2	65.10 ± 0.10^{aC}	128.00 ± 2.11^{aB}	133.11 ± 1.11^{aA}	137.12 ± 2.12^{aA}
Group3	63.13 ± 0.20^{aD}	92.00 ± 2.78^{bA}	87.00 ± 1.10^{bB}	80.22 ± 2.00^{bC}
Group4	65.11 ± 0.50^{aC}	89.13 ± 1.00^{bA}	84.06 ± 1.29^{cA}	78.25 ± 2.66^{bB}
Group5	66.10 ± 0.12^{aD}	88.08 ± 3.17^{bA}	$80.45 \pm .1.98^{cB}$	71.01 ± 4.13^{cC}

Mean (n=8) ± SD in the same column with different small letters are significantly different ($p \leq 0.05$) based on animal group.
Mean (n=8) ± SD in the same row with different capital letters are significantly different ($p < 0.05$) based on experimental period.

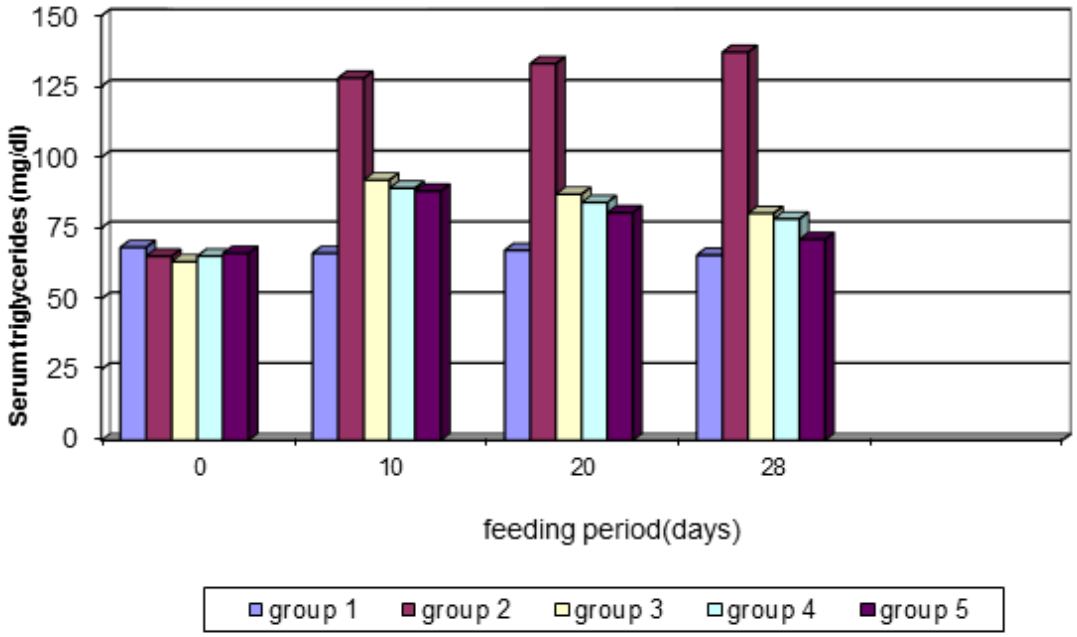

Figure 3. Serum triglycerides (mg/dL) of normal and diabetic rats.

Table 4. Serum cholesterol (mg/dL) of normal and diabetic rats.

Rats group	Serum cholesterol (mg/dL) during experimental period(days)			
	0	10	20	28
control (-) Group1	109.01 ±0.00^{aA}	112.06 ±3.12^{dA}	105.11 ±3.00^{dA}	108.04 ±1.14^{dA}
control (+) Group2	109.01 ±0.00^{aC}	153.00 ±5.15^{aB}	161.13 ±4.60^{aA}	166.67 ±1.46^{aA}
Group3	109.01 ±0.00^{aD}	14.00 ±2.12^{bA}	136.66 ±4.12^{bB}	126.12 ±1.31^{bC}
Group4	109.01 ±0.00^{aD}	134.00 ±2.14^{cA}	122.45 ±3.46^{cB}	128.00 ±5.11^{bC}
Group5	109.01 ±0.00^{aD}	133.02 ±3.15^{cA}	126.06 ±2.23^{cB}	116.55 ±3.55^{cC}

Mean (n=8) ± SD in the same column with different small letters are significantly different (p≤ 0 .05) based on animal group.
Mean (n=8) ± SD in the same row with different capital letters are significantly different (p≤ 0 .05) based on experimental period.

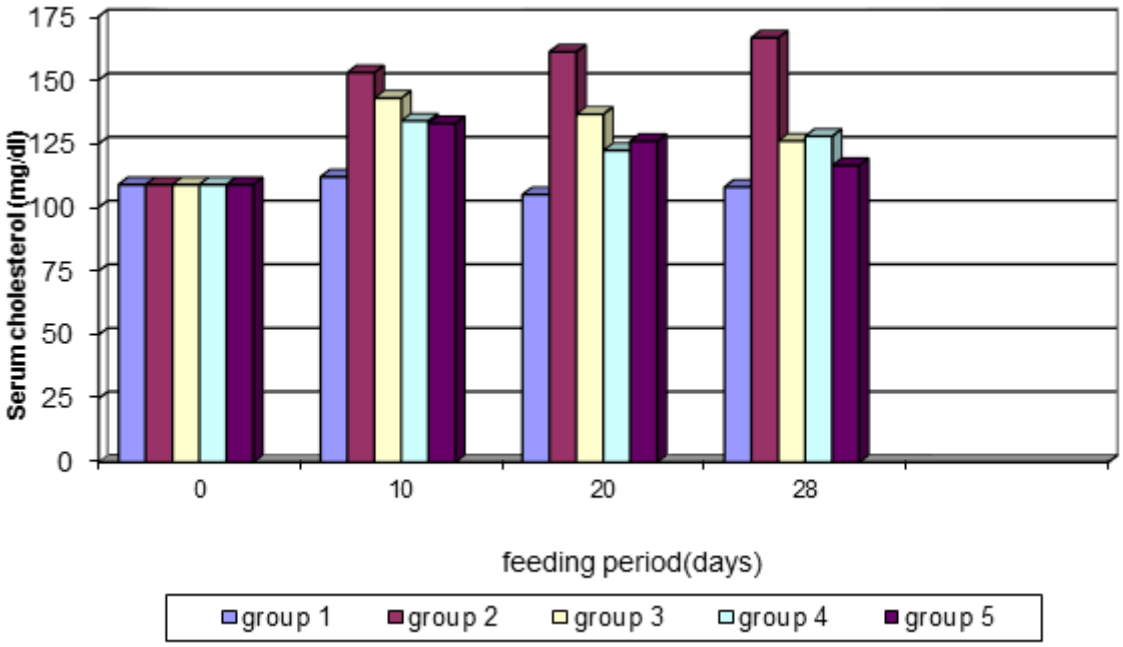

Figure 4. Serum cholesterol (mg/dL) of normal and diabetic rats.

3.4.Serum cholesterol.

Data in (Table 4) revealed that treating diabetic groups fed on basal diet with different levels of green tea extract, A. absinthium extract, and green tea extract plus A. absinthium extract led to a significant decrease in the mean value of serum cholesterol as compared to the positive control group. The value of total serum cholesterol in rats suffering from hyperglycemia decreased gradually with increasing the level of green tea extract and A. absinthium extract. Statistical analysis in this table showed that no significant change in serum cholesterol was observed between the groups treated with 50 ml of green tea extract plus 50 ml of A. absinthium extract as compared to the negative control group.

Ikeda, 2008 [13] confirmed that the reasons of reduction of serum cholesterol may be attributed to the inhibition of intestinal absorption of cholesterol by green tea and catechin, resulting, therefore, to reducing the serum cholesterol concentrations.

4. Conclusion

The extract of green tea plus A. absinthium has more a hypoglycemic effect on alloxan-induced diabetes in rats. It has prevents the reduction of body weight and improvement biochemical parameters associated with diabetes such as total cholesterol, triglycerides, and will be supportive mixture as a therapeutic agent in diabetes. This work suggests that green tea plus A. absinthium mixture could be used as therapeutic nutritional supplement for the management of diabetes.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

References

1. Al-Hilfy J.H.Y., Effect of Green Tea Aqueous Extract on Body Weight, Glucose Level, and Kidney Functions in Diabetic Male Albino Rats. *Journal of Al-Nahrain University Science*, **2012**, *15*(3), 116-166.
2. Alkhateeb, H., and A. Bonen, Thujone, a component of medicinal herbs, rescues palmitate-induced insulin resistance in skeletal muscle. *Am J Physiol Regul Integr Comp Physiol*, **2010**, *299*, 804–812.

3. Balentine, D.A., S.A. Wiseman., and L.C. Bouwens, The chemistry of tea flavonoids. *Crit. Rev. Food Sci. Nutr.* **1997**, *37*, 693–704.
4. Chacko, S.M., P.T. Thambi., R. Kuttan., and I. Nishigaki, Beneficial effects of green tea: A literature review, *Chinese Medicine*, **2010**, *5*, 13.
5. Chemler, J. A., L.T. Lock., and M.A. Koffas, "Standardized biosynthesis of flavan-3-ols with effects on pancreatic b-cell insulin secretion"; *Appl. Microbiol. Biotechnol*. **2007**, *77*, 797 - 807.
6. Cheng, O.T., All teas are not created equal—the Chinese green tea and cardiovascular health. *Int J Cardiol*, **2006**, *108*, 301–8.
7. Cordoba, J., K. O'Riordan., J. Dupuis., J. Borensztajin., and A.T. Blei, Diurnal variation of serum alanine transaminase activity in chronic liver disease. *Hepatology*, **1999**, *28*, 1724–1725.
8. Daradka, H.M., M.M. Abas., M.A.M. Mohammad., and M.M. Jaffar, Antidiabetic effect of Artemisia absinthium extracts on alloxan-induced diabetic rats. *Comp Clin Pathol*., **2014**, *23*, 1733–1742.
9. El-Shourbagy, G.A., I.S. Ashoush, Antihyperglycemic effects of stevioside on diabetic rats. *Pak. J. Bio*. **2008**, *5*(1-2), 21-26.
10. Fossati, P. and L. Prencipe, The determination of triglyceride using enzymatic methods. *Clin. Chem*, **1982**, *28*, 2077-2080.
11. Graham, H.N., Green tea composition, consumption, and polyphenol chemistry. *Prev Med*, 1992, *21*, 334-350.
12. Haidari, F., M.M. Shahi., M. Zarei, H. Rafiei., and K. Omidian, Effect of green tea extract on body weight, serum glucose and lipid profile in streptozotocin-induced diabetic rats. *Saudi Med J*; **2012**, *33*(2), 128-133.
13. Ikeda, I., Multifunctional effects of green tea catechins on prevention of the metabolic syndrome. *Asia Pac J Clin Nutr*., **2008**, *17*(S1), 273-274.
14. Ikeda, I., K. Tsuda., Y. Suzuki., M. Kobayashi., T. Unno., H. Tomoyori., H. Goto., Y. Kawata., K. Imaizumi., A. Nozawa., and T. Kakuda, Tea catechins with a galloyl moiety suppress postprandial hypertriacylglycerolemia by delaying lymphatic transport of dietary fat in rats. *J Nutr*., **2005**, *135*, 155-159.
15. Isigaki, K., T. Takakuwa., and T. Takeo, "Anti-diabetes mellitus effect of water-soluble tea polysaccharide"; *The Organizing Committee of ISTS*., **1991**, 240- 241.
16. Jabber, H.Y., Effect of green tea extract on histological structure of kidney, pancreas and adrenal gland in alloxan-induced diabetic male albino rats. *J Al-Nahrain University*, **2013**, *16*(1), 156-165.
17. Jasna, M.C., M. D. Sonja., S.C. Gordana., and T.T. Vesna, Free-radical scavenging activity of wormwood (Artemisia absinthium) extracts. J Sci Food Agric., (2004), 85:265–272.
18. John, S., A. Wilfred., and P. Timothy, Absinthe: what's your poison? Though absinthe is intriguing, it is alcohol in general we should worry about. *Br Med J.* **1999**, *319*, 1590–1592.
19. John, S., S.R. Parimalam., S. Karthiga, and A.R. Chellappa, Nutrition and dietetics. Higher secondary–second year. Government of Tamilnadu. First Edition. Chapter 14, *Diet in Diabetes Mellitus*, **2005**, 187-205.
20. Kaszkin, M., K. Beck., W. Eberhardt., J. Pfeilschifter, Unravelling green tea's mechanisms of action: more than meets the eye. *Mol Pharmacol*. **2004**, *65*, 15–17.
21. Kumar, S., V. Kumar and O. Prakash, Antidiabetic, hypolipidemic and histopathological analysis of Dillenia indica (L.) leaves extract on alloxan induced diabetic rats. *Asian Pacific J. Tropical Medicine*, **2011**, *1*, 347-352.
22. Mostafa, U. E., Effect of Green Tea and Green Tea Rich with Catechin on Blood Glucose Levels, Serum Lipid Profile and Liver and Kidney Functions in Diabetic Rats. *Jordan Journal of Biological Sciences*. **2014**, *7*, 1. 7-12.
23. Mughal, T., A. Tahir., S. Qureshi., T. Nazir., M. Rasheed, Antibacterial activity of black tea against streptococcus mutans and its synergism with antibiotics. *J Appl. Pharm*., **2010**, *2*, 60–67.
24. Muto, T., T. Watanabe., M. Okamura., M. Moto., Y. Kashida., and K. Mitsumori, Thirteen-week repeated dose toxicity study of wormwood (artemisia absinthium) extract in rats. *J Toxicol. Sci*., **2003**, *28*, 471-478.
25. Nezhadali, A. and M. Parsa, Study of the volatile compounds in Artemisia absinthium from Iran using HS/SPME/GC/MS. *Adv. Appl. Sci. Res*., **2010**, *1*(3), 174–179.
26. Olsen, R.W., Receptors. Absinthe and gamma-amino butyric acid type A receptor modulation and metabolic detoxification. *Proc Natl Acad Sci U S A*. **2000**, *97*, 4417–4418.
27. Park, J.H., J.Y. Jin., W.K. Baek., S.H. Park., H.Y. Sung., Y.K. Kim., J. Lee and D.K. Song, Ambivalent role of gallated catechins in glucose tolerance humans: A novel insight into non-absorbable gallated catechin-derived inhibitors of glucose absorption. *J Physiol Pharmacol*., **2009**, *60*(4), 101-109.

28. Rietveld, A., and S. Wiseman, Antioxidant effects of tea: evidence from human clinical trials. *J Nutr*, **2003**, *133*(10), 3285S–3292S.
29. Roeschlau, P., E. Bernt and W.J. Gruber, Serum cholesterol determination procedure. *Clin. Biochem.*, **1974**, *12*, 403-410.
30. Sabu, M.C., K. Smitha., and R. Kuttan, "Anti-diabetic activity of green tea polyphenols and their role in reducing oxidative stress in experimental diabetes"; *J. Ethnopharmacol*., **2002**, *83*, 109-116.
31. Salim K.S., Hypoglycemic Property of Ginger and Green Tea and their Possible Mechanisms in Diabetes Mellitus. *The Open Conference Proceedings Journal*, **2014**, *5*, 13-19.
32. SAS, (1999): Statistical Analysis System, SAS Users Guide: Statistics. SAS Institute Inc. Editor, Cary. NC.
33. Schermer, S., The blood morphology of the laboratory animals. 3rd ed., PP. 42. F.A. Davis Co., Philadelphia, U.S.A (1967).
34. Shimizu, M., Y. Kobayashi., and M. Suzuki, "Regulation of intestinal glucose transport by tea catechins"; *Biofactors*, **2000**, *13*, 61–65.
35. Snedecor, G.W. and W. Cocharn, Statistical Methods 7 th (ed)., Aiwa sate univ., Press. Ames Aiwa,USA. (1980) P. 507.
36. Tan, R.X., W.F. Zheng., and H.Q. Tang. *J. Planta Mod*, **1998**, *64*, 295.
37. Vidro, E., T.K. Basu, A.T. sin, Insulin dependent diabetes mellitus and vitamin A metabolism, Special Issue: Diet, nutrition and health. *J. Clin. Biochem. Nutrition*, **1999**, *26*, 155-160.
38. Young, D.S. and R.B. Friedman, Effects of Disease on Clinical Labratory Tests, 4th ed, Washington, (2001) AACC Press.