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Biological and Nutritional Benefits of Capsules and Aqueous Extract of (*Ginkgo*) Ginkgo biloba Herb on Rats with Diabetes

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ABSTRACT:

Ginkgo extract (GE) has been notified of various health benefits. This study aims to study the biological and nutritional benefits of capsules and aqueous extracts of the Ginkgo herb on rats with high diabetes. Forty rats weighing (10±150g) were separated into two primary groups: the initial group(n=five rats) served as a positive control group, the second group (n=35 rats) was injected with alloxan (150 mg/kg BW), then separated into seven groups (5 rats each), one of them kept as a positive control group, The three groups on the left received orally three doses (100-200 & 300 mg/kg BW) of GE, respectively. The other two groups were given orally 2 doses (4.68 and 9.36 mg/day) of capsules, while the last group was given the mixture. At the end of the experiment, glucose levels, insulin, AST, ALT, ALP, and lipid profile (TG- TC-VLDL-LDL and HDL) were assessed. The obtained result showed that treating rats with GBE, capsules, and the mixture demonstrated a significant decrease in the level of serum glucose, VLDL, LDL, ALP, AST, and ALT. and significant increases ($p \leq 0.05$) in HDL, Insulin, BWG, FI, and FER. The capsules showed the best results in reducing blood sugar, followed by the mixture.

Keywords: Diabetes, Ginkgo , Capsules, Alloxan, Rats

1. INTRODUCTION

Diabetes mellitus is a metabolic disease brought on by a malfunction in the secretion, action, or combination of both of insulin. In turn, a lack of insulin causes persistent hyperglycemia, which disrupts the metabolism of fat, protein, and carbohydrates, Chronic hyperglycemia caused by diabetes is linked toTO the long run harm, malfunction, and failure of different organs, including the heart, blood vessels, kidneys, eyes, and nerves. The etiology of diabetes involves multiple pathogenic mechanisms [1]. Patients with diabetes mellitus exhibit varying degrees of insulin resistance and deficiency; If these patients do not respond to diet, exercise, and hypoglycemic medications,

alternative forms of treatment must be used. While insulin and hypoglycemic medications are now thought to be the primary and most successful treatments for diabetes mellitus, they can have varied adverse effects [2]. Diabetes problems and harmful effects are caused by free radicals. Without a doubt, the quickest effect of hyperglycemia is the production of reactive oxygen species (ROS). In diabetic patients, disruptions in ROS and antioxidant defense mechanisms promote the build-up of renal oxidative stress [3]. Marker of diabetes most significant is hyperglycemia. It can be treated with a variety of pharmacological and herbal treatments. The therapeutic benefits of chemical medications can be improved or diminished by some medicinal plants.

Because of their ability to prevent oxidative damage and reduce inflammation, medicinal plants have been used to reduce the occurrence of many diseases [4]. Thus, to provide researchers with some strategies for creating new and more effective herbal medications, the goal of this study is to identify one of the medicinal plants to prevent and treat diabetes [5]. Among these, G. biloba is one that is currently growing in Asia, New Zealand, Argentina,Europe and North America . It has been used for over 2,000 years ago in China and other areas of the world as a traditional medicinal herb. Numerous scientific studies on this plant have revealed promising medicinal benefits, including the treatment of tuberculosis, diabetes mellitus, arteriosclerosis, thrombus formation, hearing loss, skin issues, stomach discomfort, bronchitis, and asthma [6]. Ginkgo biloba include (polyphenols, terpenoids, allyl phenols, carbohydrates, organic acids, amino acids, lipids, inorganic salts, and fatty acids) [7]. A standardized leaf extract of Ginkgo. biloba, recognised as EGb 761, Its leaf extract includes active antioxidant constituents contains 20-27% flavonoids (major ofthem quercetin, isorhamnetin, proanthocyanidins and kaempferol), 5-7% terpenoids (major of them bilobalide and ginkgolides A, C, B, J, and M,) and 5-10% organic acids [8, 9]. In STZ-induced chronic diabetic rats, GBE has antihyperglycemic, antioxidant, and antihyperlipidemic properties, which suggest that GBE may be used as a dietary supplement or adjunctive therapy for diabetics [10]. The flavonoids present in G. biloba leaves extract, exert their action by scavenging process in antioxidant mechanism or chelating and terpenes inhibit platelet activation factor [11]. several of substances found in leaf can lessen the negative effects and inhibition of hyperglycemic rats [12].

2. Materials and Methods

2.1. Materials

2.1.1 Plant and capsules:

The dry ginkgo biloba leaves were obtained in 2023 from local markets in Menoufia, Egypt. Capsules of ginkgo

biloba obtained in 2023 from pharmacy in Berket El-Saba.

2.1.2 Alloxan:

The compound has the molecular formula, CHNO and a relative molecular mass of 160.07. Alloxan was obtained from El-Gomhoriya Company, Cairo, Egypt.

2.1.3 Diets:

Protein, Corn starch, Cellulose, Choline chloride, El- Methionine, vitamins and Mineral mixturecame from Morgan Company in Cairo, Egypt.

2.1.4 Experimental animals:

Forty male albino ratsweight ranges between (150g±10) were purchased from the Egyptian company for the production of serums, vaccines and medicines, Helwan farm, Cairo, Egypt. They will be fed on basal diet for a week under laboratory conditions as an adaptation period.

2.1.5 Chemical kits:

Chemical kits used for the study (ALT, AST, ALP, TC, TG, HDL) were obtained from Cairo, Egypt's Al-Gomhoria Company for Selling Drugs, Chemicals, and instruments for medicine.

2.2 Methods:

2.2.1 Preparation of Ginkgo biloba extract:

Ginkgo biloba aqueous extracts was prepared according to [13], as follows: Two liters of distilled water were used to soak two hundred grams of ginkgo biloba powder, and stored in room temperature for 3 hours, then heated at 60-65°C for 30 minutes. The extract was then left to cool and filtered using muslin cloth, and filtered again with whatman filter No.1. Routary Evaporator (HS-2005S Hahnshhin Scientific Korea) was used to remove the excess of water from extract under pressure with heating at 55°C to evaporate one liter to 100 g concentrated extract. The extract is stored in refrigerate at 4°C until use.

2.2.2 Analytical methods:

Moisture, protein, fat, ash and fiber contents of ginkgo biloba leaves were resolved according to the methods of [17]. Carbohydrates content: The carbohydrates were calculated by the difference as follows: % carbohydrate = 100- (% protein + % ash+% moisture % fat + % fiber) [18].

2.2.3 The induction of diabetes

According to the technique reported by [14], normal, healthy male albino rats were given an within the abdomen injection of new preparation of alloxan (150 mg/kg B.W) to induce hyperglycemia. To confirm the development of diabetes, level of blood glucose was tested before and 72 hours after the injection with alloxan. Diabetes was clarified as having a fasting blood glucose level above 200 mg/dl, and diabetic rats were employed in this study.

2.2.4 Experimental design:

Forty adult male white albinos rat, 10 weeks age, weighting (150±10g) were used . All rats were fed on basal diet prepared according to [15] for 7 days in a row. (n = 40 rats) were kept in cages made of wire in a room . After this

adjustment period, 40 rats are divided into 8 groups, each group which consists of 5 rats as follows:

G1 (-ve): were fed on basal diet throughout the experiment period as a negative control group.
G2 (+ve): were fed on basic diet throughout the experiment and injected with alloxan 150 mg/kg of rats' weight as a positive control group.
G3: Diabetic group were fed on the aqueous extract of ginkgo biloba 100 mg/kg of B.W.
G4: A group with diabetes and fed on the aqueous extract of GB 200 mg/kg of B.W.
G5: Diabetic group fed on the aqueous extract of G.B 300 mg/kg of B.W.
G6: Diabetic group were fed the basal diet +4.5 mg/day of ginkgo capsules.
G7: Diabetic group is fed the basal diet +9.5 mg/day of ginkgo capsules.
G8: A group with diabetes and is fed the basal diet +100 mg/kg of body weight of aqueous extract of ginkgo biloba herb +4.5 mg/day of ginkgo capsules.

2.2.5 Blood sampling:

The experiment period took 28 days, at the end of the experimental period each rat weighted separately then, rats were slaughtered. After being placed into sterile, dry centrifuge tubes and allowed to clot at room temperature, the blood samples were spun for ten minutes at 3000 rpm in to separate extract the serum. serum was meticulously extracted, moved into sterile cuvette tubes, and frozen at -20°C in preparation for analysis using the procedure outlined by [16].

2.2.6 Biological evaluation:

A biological assessment of the various diets was conducted. Out by calculation of body weight gain (BWG), food efficiency ratio (FER) according to [19]. using the following formulas:

BWG= Final weight - Initial weight
FER=(body weight gain (g) ÷ food intake (g))×100.

2.2.7 Biochemical analysis:

Serum insulin and serum glucose were estimated according to [20]. and [21] respectively. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) according to the methods described by [22]. Alkaline phosphatase (ALP) was determined according to [23]. High-density lipoprotein (HDLc)-Total cholesterol (TC) and triglycerides (TG) were determined according to [24]. Very low-density lipoproteins (VLDL-c) and low-density lipoproteins (LDL-c) were determined according to [25], as the following equations: LDL-c (mg/dl) = total cholesterol - (HDL-c + VLDL-c). VLDL-c (mg / dl) = triglycerides / 5.

2.2.8 Statistical Analysis:

The SPSS program was used to determine whether differences between treatments of ($p \leq 5$) were significant. The biological outcomes were evaluated using One Way ANOVA[26].

2.2.9 Ethical Approval

The strategy for this experiment was accepted by the Research Ethics Committee of the Faculty of Science, Menoufia University, Egypt (Approval No S / NFS / 24 / 23.

3. Results and Discussion

Data found in Table (1) demonstrated the composition chemical of dry leaves of ginkgo biloba powder (%). The results

demonstrated that leaves of ginkgo biloba content 10.6% moisture - 12.95% protein - 4.9% fat - 0.72% Ash - 10.48% Fiber -60.35% Carbohydrates. These results agree with Kaushik et al., [27] indicated that ginkgo biloba leaves contain total fat 4.75 g/100g, Carbohydrate by difference 72.97 g/100g, Protein 12.27 g/100g, Ash 10.01 g/100g.

Table (1) Chemical composition of G.B leaves

Constitutes %	Ginkgo biloba powder
Moisture	10.6
Protein	12.95
Fat	4.9
Ash	0.72
Fiber	10.48
Carbohydrates	60.35
Total	100%

Data in Table (2) showed the mean value of BWG, FI, FER of positive control group was lower than that of a negative control group with significant difference (P≤0.05), Regarding to the three different concentrations of GBE,the BWG, FI and FER has improved slightly at (P≤0.05) when compared with positive control group. It should be noted that the lowest result recorded for G3 treated with (100 mg/kg B.W), the highest result recorded for G5 treated with (300 mg/kg B.W), while the two different concentrations of capsules have shown a clear significant increase , in particular the low dose recorded for (G6). These results agree with Abd El-Azeem et al., [28] They demonstrated that, in comparison to the group controlling nephrotoxicity, ginkgo biloba leaf powder administered to rats that are nephrotoxic resulted in a significant (P≤0.05) increse in BWG at the three dose 1,4 and 2% . Also, in Khattab [29] Regarding the effect of Ginkgo biloba extract on rats,There was no discernible difference between the ingestion and the negative control group in terms of food intake, FER, or weight gain percentage, although there was a minor rise. Rats treated with GbE initially showed a substantial increase in food intake (p≤0.001), FER (p≤0.01), and weight gain percent (p≤0.001) when compared to the nephrotoxicity group.

Table (2): The effect of capsules and aqueous extract of ginkgo biloba (BWG), (FI) and(FER) of diabetic rats

	FI (g)	BWG (g)	FER (%)
	Mean±SD	Mean±SD	Mean±SD
G1	16a±1.00	41a±1.7	0.09a±0.01
G2	11.20d±1.05	19e±1.32	0.060e±0.02
G3	12.53d±0.60	23.9d±1.21	0.068d±0.02
G4	13.1bc±1.15	26.4d±1.11	0.07cd±0.01
G5	13.9bc±0.96	29.5c±1.04	0.07bcd±0.03
G6	14.50ab±0.50	33.0b±1.00	0.081b±0.01
G7	14.00bc±1.00	30.1c±.85	0.076bc±0.02
G8	14.20bc±0.72	31.2bc ±1.6	0.078bc±0.02

G1: Control -ve, G2: Control +ve, G3: 100mg/kg B.W. (GBE), G4: 200 mg/kg B.W.(GBE), G5: 300 mg/kg B.W. (GBE), G6: Capsules 4.68 mg/day, G7: Capsules 9.36 mg/day, G8: 100mg/kg B.W. (GBE)+ Capsules 4.68 mg/day. BWG: body weight gain; FER: Feed efficiency ratio and FI: Feed intake, Values are expressed as mean ±SD, Significant at p≤0.05, mean differ substantially at (p≤0.05) when there mean there are distinct letters.

The data shown in Table (3) demonstrated that the mean value of serum glucose There was a significant difference (P≤0.05) between the positive and negative control groups. which was

212.47±5.31 and 113.8±3.70 (mg/dl) respectively. Regarding the three different concentrations of GBE, the blood sugar has improved slightly at (P≤0.05) when compared with positive control group.it be noted that the lowest result was recorded for (G3) treated with (100 mg/kg B.W), while the highest result was recorded for (G4) treated with (200 mg/kg B.W), the mean values were 167.0±5.7, 198.0±1.40 (mg/dl) respectively. These results agree with The results of Shankar et al., [30] who stated that Ginkgo biloba at dose (100 mg/kg B.W) has shown a significant decrease in fasting blood glucose levels which was comparable to that of troglitazone. While the two different concentrations of capsules, the blood sugar levels have shown a clear significant reduction , in particular the low dose recorded for(G6) . It be noted that (G8) which was treated with the mixture wasn't found a significant difference when compared to high dose of capsules recorded for (G7). For Insulin, the mean value of Insulin of positive control group was significantly lower than that of the negative control group at (P≤0.05), which was 3.16±0.36, 13.12±0.50 (mlu/ml), respectively. Regarding to the three different concentrations of GBE, the insulin level has improved slightly at (P≤0.05) when compared to the positive control group.

It be noted that the highest result was recorded for (G3) treated with (100 mg/kg B.W), it be noted that G5 was found a non-significant difference when compared to positive control group.Regarding to the two different concentrations of capsules, insuline levels have shown a clear significant increase , in particular the low dose recorded for (G6) . It be noted that G8 which was treated with the mixture wasn't found a significant difference when compared to high dose of capsules recorded for (G7).These result agree with Lai et al., [31]who mentioned that, GbE create a significant increase after oral administration, the amount of insulin in diabetic rats was increased by stimulating the pancreatic Langerhans beta cells. Also, Aziz et al., [32] stated that ginkgo biloba extract placebo (starch, 120 mg/day)or ginkgo biloba extract(120 mg/day)for 90 days. significantly decreased blood fasting serum glucose (baseline194.4±66.1 mg/d vs 154.7±36.1 mg/dl P<0.001). Hideaki et al., [33] suggested that ginkgo biloba particularly the flavonoid component, Vitamin C and E, and lipoic acid, are the natural antioxidants recognised as effective in scavenging the highly superoxide anion and reactive hydroxyl radical . Priyanka et al., [34] have shown that GBE possesses anti-diabetic properties. By increasing secretion of adiponectin, preventingthe insulin signaling cascade's serine Insulin receptor substrate 1 (IRS-1) receptor phosphorylation, reducing the creation of inflammatory adipokines, bilobalide protected lipid cells against insulin resistance brought on by oxygen shortage and decreased inflammation.

Elhassaneen et al., [35]All treated groups could be principally attributed to the bioactive compounds in these plant.

Table (3): The effect of capsules and aqueous extract of ginkgo biloba on serum glucose and insulin of diabetic rats

	Serum Glucose (mg/dl)	Insulin (mlu/ml)
	Mean±SD	Mean±SD
G1	113.80g ± 3.70	13.12a±.50
G2	212.47a±5.31	3.16f±0.36
G3	167.00d± 5.70	5.42d± 1.51
G4	198.00b± 1.40	4.36e±0.59
G5	181.81c±7.6	3.50f±0.59
G6	132.61f± 3.91	8.88b±0.57
G7	143.55e± 8.70	8.01c±0.73
G8	140.80e± 3.70	7.56c±0.62

G1: Control -ve, G2: Control +ve, G3: 100mg/kg B.W. (GBE), G4: 200 mg/kg B.W.(GBE), G5: 300 mg/kg B.W. (GBE), G6: Capsules 4.68 mg/day, G7: Capsules 9.36 mg/day, G8: 100mg/kg B.W. (GBE)+ Capsules 4.68 mg/day. Values are stated as mean±SD, Significant at p≤0.05, meandiffer substantially at (p≤0.05) when there are distinct letters.

According to data present in the table (4), the mean value of ALT of positive control group was higher than that of the negative control group at (P≤0.05), which was 68.76±3.49 & 38.36±2.95 (mg/dl),respectively.Regarding to the three different concentrations of GBE, the ALT serum has improved slightly. It should be noted that the lowest result recorded for (G5) treated with (300 mg/kg B.W), while the highest result recorded for G3 treated with (100 mg/kg B.W) at (P≤0.05), while the two different concentrations of capsules,ALT levels have shown a clear significant reduction, in particular the low dose recorded for (G6) . It be noted that G8 which was treated with the mixture wasn't found a significant difference when compared to (G6 and G7).These results agree with Abd El-Azeem et al., [28]. It demonstrates that, in comparison to the nephrotoxicity control group, the administration of powdered nephrotoxicity in rats using ginkgo biloba leaves reduced serum concentrations of AlT and AST in the three levels, 4.1 and 2%, significantly (P ≤ 0.05). In the same table AST value of positive control group was higher than that of the negative control group at (P≤0.05), which was 61.60±4.1 & 30.58±3.84 (mg/dl), respectively. Regarding to the three different concentrations of GBE, the AST serum has improved slightly at (P≤0.05). it be noted that the lowest result recorded for G5 treated with (300 mg/kg B.W),while the highest result recorded for G3 treated with (100 mg/kg B.W) at significant difference (P≤0.05), while there were two different concentrations of capsules, AST levels have shown a clear significant reduction, in particular the low dose recorded for (G6). It be noted that G8 which was treated with the mixture wasn't found a significant difference when compared to (G5,G6 and G7).These results agree with Cha´vez-Morales et al., [36] observed that the elevated serum ALT and AST activity generated by the tetrachloride of carbon (CCl4) group is decreased by ginkgo biloba extract (GbE). For the ALP, the mean value of ALP in the positive control group was higher than negative control group with significant difference (at P≤0.05), which

was 165.94±7.82 & 119.56±5.41 (mg/dl), respectively. Regarding to the three different concentrations of GBE, the ALP serum has improved slightly at (P≤0.05) .it be noted that the lowest result was recorded for G5 treated with (300 mg/kg B.W, the highest result recorded for G3 treated with (100 mg/kg B.W) at (P≤0.05), the mean values were 143.88±6.06, 154.08±4.13 (U/L), respectively. while the two different concentrations of capsules, ALP levels has shown a clear significant reduction , in particular the low dose recorded for G6 . It be noted that G8 which was treated with the mixture wasn't found a significant difference when compared to (G5,G6 and G7). Also, Shenoy et al., [37] said that in rats given CCl4, the mean±SEM serum levels of ALP, ALT, and AST were 319.6±22.7, 192.8±16.0, and 809.3±65.3 IU/L, respectively, while in control they were 66.8±4.2, 31.1±2.0, and 445.3±23.1 IU/L. The corresponding amounts of AST, ALT, and ALP were lowered by GB to 55.5±5.3, 36.5±3.6, and 489.6±43.9 IU/L. Yan et al., [38] reported that blood levels of ALP, ALT, and AST were found to be higher in the non-alcoholic fatty liver disease (NAFLD) rats' group than in the normal control group, the higher levels in the GBLP- dministered groups—particularly at 400 mg/kg. Additionally, the ALT level was marginally lower in the GBLP - administered groups than in the model group (P≤0.05). These findings showed that GBLP therapy lessened the liver damage brought on by HFD. Omar et al., [39]The results indicated that plant used improved liver function.

Table (4): Effect of capsules and aqueous extract of ginkgo biloba on serum on liver function of diabetic rats

	ALT(U/L)	AST(U/L)	ALP(U/L)
	Mean±SD	Mean±SD	Mean±SD
G1	38.36f±2.95	30.58f±3.84	119.56e±5.41
G2	68.76a±3.49	61.60a±4.12	165.94a±7.82
G3	61.65b±5.49	54.42b±5.83	154.08b±4.13
G4	57.28bc±4.19	49.12bc±6.58	147.56bc±6.12
G5	55.06cd±4.13	46.67cd±5.38	143.88cd±6.06
G6	45.20e±4.14	39.30e±3.12	136.01d±4.79
G7	50.89de±5.00	44.1cde±6.28	140.66cd±5.47
G8	47.71e±3.54	41.09de±4.30	138.34d±4.52

G1: Control -ve, G2: Control +ve, G3: 100mg/kg B.W. (GBE), G4: 200 mg/kg B.W.(GBE), G5: 300 mg/kg B.W. (GBE), G6: Capsules 4.68 mg/day, G7: Capsules 9.36 mg/day, G8: 100mg/kg B.W. (GBE)+ Capsules 4.68 mg/day. Values are stated as mean±SD, Significant at P≤0.05, mean differ substantially at (p≤0.05) when there are distinct letters.

According to data present in table (5) the mean value of T.C &T.G of positive control group was higher than negative control group significant difference. Regarding to the T.C and T.G, the three different concentrations of GBE has improved T.C and T.G slightly at (P≤0.05). it be noted that the lowest result was recorded for (G4) treated with (200 mg/kg B.W), while the highest result was recorded for G3 treated with (100 mg/kg B.W), Regarding to the two different concentrations of capsules, the T.C and T.G levels have shown a clear significant reduction , in particular the low dose recorded for (G6). It be noted that G8 which was treated with the mixture wasn't found a significant difference when compared to high dose of the capsules

(G7)and (G6). These results agree with Cheng et al., [10] who showed that GE showed a significant decrease in the levels of serum TC, TG, after 30-day treatment when compared with D group. Zhang et al., [40] proved that the trilactone terpenes (bilobalide and ginkgolides A, B,) which are critical bioactive components in ginkgo. biloba leaves extract, are regarded as potential PL inhibiter. This might explain the action of ginkgo biloba on triglyceride. Pancreatic cholesterol esterase is responsible for catalyzing the hydrolysis of cholesterol esters in the small intestine lumen, an action that releases free cholesterol.[41].

Table (5): The effect of capsules and aqueous extract of ginkgo biloba on T.C, T.G diabetic rats

	Total Cholesterol (mg/dl)	Triglyceride (mg/dl)
	Mean±SD	Mean±SD
G1	104.60a±3.20	65.20f ±3.03
G2	169.34f±4.35	105.40a±3.13
G3	151.04e±3.69	99.00b±2.91
G4	140.40d±6.80	87.40c±2.70
G5	149.4e±5.12	91.20c±4.76
G6	121.08bc±2.54	73.20e±2.58
G7	127.40b±4.21	79.40d±2.35
G8	125.50c±4.03	76.00de±4.32

G1: Control -ve, G2: Control +ve, G3: 100mg/kg B.W. (GBE), G4: 200 mg/kg B.W.(GBE), G5: 300 mg/kg B.W. (GBE), G6: Capsules 4.68 mg/day, G7: Capsules 9.36 mg/day, G8: 100mg/kg B.W. (GBE)+ Capsules 4.68 mg/day. Values are stated as mean±SD, Significant at p<0.05 , Mean with different letters f)differ significantly at (p≤0.05).

According to data present in the table (6) the mean value of LDL&VLDL There was a significant difference (P≤0.05) between the positive and negative control groups. while, serum HDL-C level in positive control group was significantly lowered than negative control group. All diabetic rats treatments revealed a significant decrease in mean values of LDL, VLDL. while showed an increase in serum HDL level when compared to positive control at(P≤0.05). The three different concentrations of GBE have improved LDL and VLDL slightly at (P≤0.05). it should be noted that the lowest result was recorded for G5 treated with (300 mg/kg.B.W), while the highest result was recorded for G3 treated with (100 mg/kg.B.W) with significant difference (P≤0.05). Regarding to the two different concentrations of capsules, it have shown a clear significant reduction in reducing LDL and VLDL levels, in particular the low dose recorded for G6, It be noted that (G8) which was treated with the mixture was found a non-significant difference when compared to (G6 and G7), for LDL, (G6)for VLDL. For the HDL, the mean value of HDL was significantly lower in the positive control group than the negative control group. Regarding to the three different concentrations of GBE, have improved HDL slightly at (P≤0.05). It be should noted that The lowest result was recorded for G3 treated with (100 mg/kg.B.W),while the highest result was recorded for G5 treated with (300 mg/kg.B.W) with significant difference (P≤0.05).

For the two different concentrations of capsules, it have shown a clear significant increase , in particular the low dose

recorded for G6 . It be noted that G8 which was treated with the mixture wasn't found a significant difference when compared to G7,G6 and G5. These results agree with Al-Zakaria et al., [42]. They shown that, when GBLP supplementation was combined with a high-fat diet, serum levels of FFA, TG, TC and LDL-C were significantly lower or HDL-C was significantly higher than in the model group.

Table (6): The effect of capsules and aqueous extract of ginkgo biloba LDL,VLDL and HDL of diabeticrats

	HDL (mg/dl)	LDL (mg/dl)	VLDL (mg/dl)
	Mean±SD	Mean±SD	Mean±SD
G1	48.80a±4.49	42.76f±3.66	13.04f±1.60
G2	29.10e±2.19	120.16a±2.9	21.08a±1.61
G3	31.14e±2.8	100.1b±1.23	19.80b±0.57
G4	34.80d±1.58	96.36b±5.05	18.24c±1.40
G5	38.0cd±3.34	84.92c±3.18	17.48c±0.95
G6	43.60b±2.07	62.84e±3.42	14.64e±0.86
G7	41.0bc±1.81	70.52d±2.25	15.88d±0.53
G8	42.40b±2.73	68.1de±2.31	15.00e±0.62

G1: Control -ve, G2: Control +ve, G3: 100mg/kg B.W. (GBE), G4: 200 mg/kg B.W.(GBE), G5: 300 mg/kg B.W. (GBE), G6: Capsules 4.68 mg/day, G7: Capsules 9.36 mg/day, G8: 100mg/kg B.W. (GBE)+ Capsules 4.68 mg/day. Values are stated as mean±SD, Significant at p ≤0.05 , Mean with different letters, differ significantly at(p≤0.05).

Also, Hussain et al., [43]. Comparing the GKB extract to baseline data, there was a significant rise in HDL-c and a significant reduction in TG and LDL-c . Adisakwattana et al., [44] stated that polyphenol rich plants like Ginkgo biloba inhibited the absorption of dietary lipids and intestinal digestion by inhibition of pancreatic cholesterol esterase activity. In another study done on rats by Xie et al., [45]. has mentioned that GB influenced the absorption of triglyceride and cholesterol, metabolism of cholesterol and This could help to explain how ginkgo biloba lowers cholesterol .Atef and Ibrahim,[46] Leaves powder improved blood lipid levels.

4. Conclusion

This study demonstrated that ginkgo biloba extracts, Capsules, and the mixture treatment had significantly improved hyperglycemia; the best result of serum glucose was recorded for capsules (G6) at a dose of (4.68 mg/day).In the long term, the mixture(G8) may have an effect similar to a capsule dose in lowering blood sugar.

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التغذية وعلوم الاطعمة

الاستفادة البيولوجية والغذائية للكبسولات والمستخلص المائي لعشبة الجنكو على الفئران المصابة بالبول السكري

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الملخص العربى:

وجد ان لمستخلص الجنكة بيلوبا مجموعة واسعة من الفوائد الصحية، لذالك هدفت هذة الدراسة إلى دراسة الفائدة البيولوجية والغذائية للكبسولات والمستخلص المائي لعشب الجنكة بيلوبا على الفئران المصابة بارتفاع مرض السكري.حيث تم تقسيم (40) ذكور الفئران البيضاء التى تزن (150±10جم) إلى مجموعتين رئيسيتين: الأولى (ن = 5 فئران) كانت بمثابة مجموعة ضابطة سالبة، الثانية (ن = 35 فئران) تم حقنها بالألوكسان (150 مجم/كجم من وزن الجسم)، ثم قسمت إلى سبع مجموعات (5 فئران لكل منهما)، تم الاحتفاظ بإحداها كمجموعة ضابطة موجبة، وأعطيت المجموعات الثلاث المتبقية عن طريق الفم ثلاث جرعات (100-200 و300 ملغم/كجم وزن الجسم) من مستخلص الجنكة بيلوبا، على التوالى، وأعطيت المجموعتان الأخريان عن طريق الفم جرعتين (4.68 و9.36 ملغ/يوم) من كبسولات الجنكو وتم إعطاء المجموعة الأخيرة الخليط ,فى نهاية التجربة تم قياس مستويات الجلوكوز,الانسولين,انزيمات الكبد ,ودهون الدم. أظهرت النتائج انخفاضا معنويا (عند مستوى معنوية أقل من 0.05) فى مستوى جلوكوز الدم، الدهون الثلاثية، الكوليسترول الكلى، الكوليسترول الضارة، الكوليسترول الضار جدا، الكوليسترول النافع، ومستوى إنزيم الألانين ترانسفيريز والاسبرتات ترانس أمينيز، الفوسفاتيز القلوي، بينما أظهرت زيادة معنوية (عند مستوي معنوية أقل من 0.05) فى مستوي الأنسولين، زيادة وزن الجسم، والمأخوذ الغذائي ومعدل الاستفادة من الغذاء.فلقد توصلت هذه الدراسة الى أن مستخلص الجنكة والكبسولات والمزيج حسنوا بشكل ملحوظ ارتفاع سكر الدم، بينما أظهرت الكبسولات أفضل النتائج فى تقليل سكر الدم .

الكلمات الكاشفة: داء السكري، الجنكة بيلوبا، الكبسولة، الألوكسان، الفئران