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Effects of *Cucumis melo* and *Citrullus lanatus* extracts on glucose level, lipid profile and hepato-renal performance of streptozotocin-induced diabetic albino rats

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Abstract: Diabetes mellitus, recognized by elevated glucose level in the body fluids is commonly caused by less insulin production or its action. To overcome the complications of diabetes, chemical drugs are never preferred over herbal medicines. Present study was designed to find out the anti-diabetic and health-promoting effects of ethanolic leaf extracts of *Cucumis melo* and *Citrullus lanatus* in induced-diabetic albino rats. Thirty male albino rats were bought from the animal house of the university and divided randomly into five feeding groups (n=6). Diabetes was induced in rats of groups A, B, C & D by a single dose of intra-peritoneal injection of streptozotocin (55 mg/Kg), whereas, the rats of group E were considered as control. The rats of groups A, B & C were fed basal diet supplemented with plant extracts (150mg/Kg body weight), whereas; only basal diet was offered to rats of groups D & E. After 28 days of the experiment, blood was collected for biochemical analysis. Results revealed that body weight, glucose, AST, ALB, GGT, HDL, cholesterol, triglyceride, urea, and creatinine level differed significantly among treatment groups. It was therefore concluded that ethanolic leaf extracts of *Cucumis melo* and *Citrullus lanatus* can be used separately or in combination for the management of diabetes.

Keywords: *Cucumis melo, Citrullus lanatus,* streptozotocin, ethanol.

INTRODUCTION

Diabetes mellitus is a worldwide disease that badly affects the human population (Ramos *et al.,* 2021). It is a metabolic disorder and is recognized by the elevated glucose level in body fluids. It may be caused by less production or action of insulin. In this disease blood glucose level increase and promotes the lesion's appearance in various organs of the body like; eyes, kidneys, blood vessels, and nerves (American Diabetes Association, 2017). It is a disease in which alteration occurs in protein, carbohydrates, or fat metabolism (Roa *et al.,* 2003). Many people are suffering from diabetes worldwide and the number of patients increasing day by day at an alarming rate. It has been estimated that in 2030 the number of diabetic persons could reach up to 366 million (Oyedemi *et al.,* 2011). During the last century, the food habits and lifestyle of humans have changed severely due to various persistent diseases. One of which is diabetes mellitus which causes severe harm to human health (Kumar *et al.,* 2008). It is observed that the most important cause of mortality and morbidity is diabetes in the world. It has been observed that among the world's population, about 2.5-7% of individuals are affected with diabetes mellitus, and expected to increase in the future (Abo *et al.,* 2008).

For glucose uptake to occur in insulin-responsive tissues including skeletal muscles and adipose tissues in the human body, glucose homeostasis must be maintained (Lim *et al.,* 2021). To cure diabetes, various therapeutic methods are being used like; homeopathy, allopathy, and herbal therapy. Many of the plant extracts are being used worldwide for the treatment of diabetes mellitus (Teugwa *et al.,* 2013). During plants' secondary metabolism, small molecules with high structural diversity are formed that support glycemic normalization and help in releasing insulin (Li *et al.,* 2004). Some of the plants' proteins are also helpful in the reduction of glycemia (Rajasekhar *et al.,* 2010). According to different experiments, different parts of plants retain different medicinal properties that are related to hypoglycemic activity, anti-inflammatory effects (Pereira *et al.,* 2017), protection against oxidative stress, and hypo-lipidemic activity (Sinha *et al.,* 2014).

Olea ferruginea bark extracts in chloroform and ethanol were comparable to conventional medications in terms of the non-enzymatic glycosylation of hemoglobin assay, alpha-amylase inhibition assay and glucose uptake by yeast cells, according to the in vitro antidiabetic and anticancer activity findings. The ethanol extract was also

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sufficiently effective in comparison to the other extracts to demonstrate cytotoxic potential against the HepG2 cells; this was attributed to the Akt and BAX expression levels being higher and lower, respectively. *In vivo* antidiabetic and anticancer experiments were conducted after this study's baseline data were obtained for a more thorough characterization of the isolated ingredients (Liaqat *et al.*, 2021).

Cucumis melo commonly known as Muskmelon is a traditional herb with edible, (polymorphous) fruits. *C. melo* is used for the treatment of kidney stones (flatulence, fever, jaundice, obesity, cough, bronchitis, anemia,) diabetes, and other abdominal disorders (Kirtikar *et al.*, 1984). It is also a good source of Vitamins (A, and C), Magnesium & Potassium. Traditionally they are used as a medicine in many continents including Asia and Africa to cure harmful diseases (Parle *et al.*, 2011). A recent study has concluded that muskmelon possessed some medicinal characteristics anti-microbial (anti-diabetic, anti-inflammatory, anti-oxidant, anti-cancer, diuretic) analgesic, and anti-ulcer (Krishnamachar *et al.*, 2017).

Citrullus lanatus commonly known as watermelon is a vine-like flowering plant that is mostly cultivated in West Africa or all around the world (Abu-Reidah *et al.*, 2013). They are mostly grown in temperate and tropical regions (Naz *et al.*, 2014). Watermelon contains high water content including 55.3% juice, 10.4% pomace and 31.5% rind (Romdhane *et al.*, 2017)**.**

Many researchers have reported that extracts of *C. lanatus* leaves have significantly lower blood glucose. Proteins of herbal plants have been shown significant role in the reduction of hyperglycemia (Maddirela *et al.*, 2010). Many researchers observed that phytochemicals act as an antimicrobial agent. Watermelon also contains some phytochemicals like alkanoids, tannis, flavonoids, and phenols. These seeds and leaves of *C. lanatus* also contain some phytochemicals ingredients (Mahdi, 2010; Godwin, 2015). Arginine increases the oxidation of fats and glucose, reduces hyperglycemia, improves dyslipidemia, and reduces fat mass in obese diabetic animals (Fu *et al.*, 2005). Citrulline is converted into arginine, thus highlighting the potential for exploring the effects of the consumption of watermelon on regulating the metabolism of energy substrates, improving cardiovascular and immunological functions, and avoiding increased oxidative stress (Massa *et al.*, 2016).

Researchers investigated the effects of methanolic extract of *C. lanatus* on antioxidant and hepatoprotective by combining a fixed dose of this herb with an ordinary oral hypo-glycemic agent metformin in AIDRs. Scientists have acknowledged 3 groups of constituents are responsible for the blood sugar-lowering action of bitter melon; first charantin is a compound composed of sitosteryl glucoside and stigmasteryl glucoside and can be potentially replaced with the treatment by insulin (Pitipanapong *et al.*, 2007). The second compound which is found in seeds and fruit of bitter melon called polypeptide is similar to insulin in composition, so it is beneficial in therapy of type 1 diabetes (Paul and Raychaudhuri, 2010). The third compound which has also been noted to have a blood sugar-lowering effect called alkaloid. Compounds known as oleanolic acid glycosides are found to improve glucose resistance in type-II diabetes (Cheng, 2009). The principal focus of our research work is to design and develop a cost-effective, more effectual, and less toxic combination therapy that gives valuable possessions in the supervision of diabetes mellitus and its associated complications.

From the above discussion, it is clear that medicinal plants have a great impact on the metabolic activity of living organisms due to the presence of various metabolites. Many researchers have observed that these plants have anti-hyper-cholesterolemic, anti-depressive, and anti-diabetic effects. Plenty of data is available on these topics but a few researchers have worked on the comparative and synergetic effects of two or more medicinal plants' extracts over the antiglycemic activity. So the present study was designed to find out the anti-diabetic and hepato-renal protective effects of *C. melo* and *C. lanatus* extracts in streptozotocin-induced diabetic albino rats.

MATERIALS AND METHODS

Collection of plants' materials

Dry leaves of *C. melo* and *C. lanatus* were bought from the local market and submitted in Botany department for identification and identified as *C. melo* (17/2020/TC/GU) and *C. lanatus* (18/2020/TC/GU). The plant material was washed in distilled water, dried in open fresh air for a few weeks until endless weight was achieved. After drying, the leaves were grinded into a fine powder using a mechanical grinder. Finally, the prepared leaves powder was mixed in ethanol to get extracts. For this purpose, 250g of leaf powder from each plant was mixed with 750 mL of ethanol in a ratio of 1:3. The mixture was mixed thoroughly and kept for 72 hours in the laboratory. After 72 hours, the extract was filtered by Whatman filter paper No.1 and evaporated using a rotary evaporator (model: RE-301; ZZKD, China) The extracts were collected in Petri dishes, and placed in open air at room temperature for further drying to get extracted in solid and soft pellets (Tehseen *et al.*, 2022).

Experimental rats and dietary plan

Thirty male albino rats, weighing 150 to 200g were bought from the University of Lahore. One week after the start of the experiment, following the guidelines of OCDE

(2008), these rats were kept in the animal house in natural conditions for adaptation to the new environment. All rats were divided into 5 feeding groups (A, B, C, D & E) containing 6 in each. Rats of Group A were orally administered with an extract of *C. melo* (150mg/ Kg BW), of Group B with an extract of *C. lanatus* (150mg/Kg BW), of Group C with an extract of both plants (150mg/ Kg BW extract of each plant), whereas, the rats of groups D & E were given only normal basal diet and thus called as a diabetic and normal control group. The plants' extracts were orally given to experimental rats via gavage. All the rats were provided feeding and drinking facility *ad-labitum* for 28 days (Okorie *et al.*, 2019; Satyanarayana *et al.*, 2022).

Diabetes induction in experimental rats

A total of 30 male albino rats were bought from the animal house of the University of Lahore. Diabetes was induced in 24 overnight fasted rats by intra-peritoneal injection of freshly prepared solution of STZ (55mg/Kg) in 0.5ml of physiological saline. After 24 hours, this single dose of STZ caused severe diabetes in rats, raising the blood glucose level to 250mg/dL. This diabetic condition was maintained throughout the experimental duration (Francis *et al.*, 2019).

Dissection and sampling

After the completion of the experimental period of 28 days, all the surviving rats were weighed and anesthetized using chloroform. Firstly the glucose level of the rats was observed using a Certeza glucometer (Certeza GL-110). After recording the sugar level, the rats were fixed on dissecting boards and dissected. Blood samples were collected by heart puncturing and stored in heparinized vacutainers. To collect serum, the collected blood was transferred to the laboratory and centrifuged for 15 minutes at 5000 rpm. The collected serum samples were then stored at -20^{O}C in aseptic plastic tubes. On the last day of the experiment, after the collection of blood from the heart, liver, kidney, and pancreas the experimental rats were separated and weighed using the digital weighing machine (Okorie *et al.*, 2019; Satyanarayana *et al.*, 2022).

Blood chemistry analysis

From the collected and stored serum samples, hepatic and renal parameters were assessed following biochemical compounds determined by a chemistry analyzer, using available commercial chemical kits following standard protocols (Siyem *et al.*, 2012).

STATISTICAL ANALYSIS

One-way Analysis of Variance (ANOVA) was performed for all the recorded data and then interpreted by General Linear Model (GLM) procedures. The analyzed data is presented as Mean ± SEM and *p*-value ≤0.05 considered as significant. The means of the values were compared by Duncan's Multiple Range test (DMR) with SAS version 9.1 for Windows.

Ethical approval

Prior permission was taken from the Departmental Animal Welfare and Ethical Committees of the University under No.07/2020/TC/GU to use rats in the experiment.

RESULTS

Body weight (g) and glucose level

The present study revealed that the initial body weight of the supplemented group was non-significantly decreased as compared to the normal control group, whereas, it was observed that the glucose level of the supplemented groups was decreased significantly (P<.0001) as compared to the normal control group (table 1).

Organs' weight (g)

The current study revealed that at the end of the experiment, the organs' weight of rats was different. The weight of the liver of the supplemented groups was increased significantly (P=0.0407) as compared to the normal control group. However, the weight of the pancreas and kidney differed non-significantly among the experimental groups (table 2).

Liver performance

The concentration of the liver parameters was measured after the experiment. The serum level of ALT, AST, ALP, TP, ALB, GGT and BIL in experimental groups is shown in table 3. According to the present study it was observed that the level of ALT (U/L), ALP (U/L), GGT (U/L), albumins (g/L), TP (g/dL) and bilirubin (mg/dL) of supplemented group was different significantly as compared to normal control group, whereas; the results showed non-significant changes in the level of AST (U/L) among all treatment groups.

Renal performance

After the experiment, the serum urea (mg/dL) and creatinine (mg/dL) level of experimental rats was measured and the results showed that the concentration of urea and creatinine was different significantly among treatment groups (table 4).

Effect on lipid profile

By a single dose of STZ (streptozotocin) diabetes was induced in rats which are accompanied by hyperlipidemia. According to the present study, with the extract of *C. lanatus* and *Cucumis melo*, it was observed that the level of cholesterol and triglyceride was significantly (P<0.05) decreased in all treated groups as compared to the diabetic control group. The level of LDL-C and VLDL-C was non significantly (P<0.05) decreased, while on the other hand, the level of HDL was significantly (P<0.05) increased in all treated groups as compared to the diabetic control group. The present result shows the beneficial effect of *Citrullus lanatus* and *Cucumis melo* in the maintenance of hyperlipidemia (table 5).

DISCUSSION

According to the results of the present study, it was observed that the initial body weight of the rats was not significantly different during the initiation of the experiment, but after the injection of STZ, the body weight of the rats of supplemented groups was lowered non-significantly as compared to the normal control group (P = 0.1858), however, the final body weight of the rats was differed significantly (P = 0.0387) among the supplemented groups. The highest body weight was recorded in the diabetic rats that were fed only basal diet, whereas, the lowest body weight was recorded in the rats that were offered basal diet supplemented with extracts of *C. melo*. These results follow the early findings of various researchers. Hong *et al.* (2019) reported that the compound grain of the plants improves the obesity and lipid profile of diabetic rats, thus lowering the body weight.

According to the present findings, it was observed that there was no significant difference in the initial glucose level of the diabetic rats; however, a significant difference appeared when compared with the normal control group. The final glucose level of the supplemented groups differed significantly (P<.0001) as compared to the diabetic control group. The highest sugar level was recorded in the diabetic rats that were fed only a basal diet, whereas, the lowest level was recorded in the rats that were offered a basal diet supplemented with extracts of both plants; *C. melo* and *C. lanatus.* The results are similar to the findings of some early research. Santana *et al*. (2019) reported that the seed and leaf extracts of *Carica papaya* provide an anti-oxidant, anti-hypertensive, hypoglycemic, and hypolipidemic activity which can lead to prevention and control of obesity and related metabolic disorders. Similarly, Toluwani *et al.* (2019) also reported that blood glucose level is reduced significantly by the anti-diabetic effects of plant extracts. Similarly, Farsani *et al*. (2016) reported that the aqueous alfalfa extract had beneficial effects on blood lipids and glucose levels in diabetic rats and was also functional in the prevention and treatment of diabetes.

Al-Snafi *et al*. (2019) conducted a study to describe some medicinal plants with anti-diabetic effects. Diabetes mellitus is one of the most common endocrine metabolic diseases. Due to its complications, it may cause death. Oral anti-diabetic drugs and insulin are related to several severe adverse effects. This study is designed to search for different types of more effective herbals used as medicine for anti-diabetic activity. Many medicinal plants retained the hypoglycemic effects through different mechanisms. The present study describes different medicinal plants that have anti-diabetic effects. Aljohi *et al.* (2016) and Mehwish *et al.* (2017) proved that extract of plant extracts significantly lower glucose levels which might be due to pharmacological, physiological and biochemical modes as they show anti-diabetic properties by increasing the level of hepatic glycogen and (GLUT-4), lowering the glycated hemoglobin, lactate dehydrogenase, glucose-6phosphatase, increase in glycogen contents, glycogen synthase and hexokinase activities.

The current study results showed that the weight of the liver changed significantly during the experiment, whereas, pancreas and kidney weight have not shown a significant change among treatment groups. The lowest liver weight was recorded in the rats that were offered a basal diet supplemented with extracts of plants, *C. melo* and *C. lanatus.* These results follow Ahmad *et al*. (2019)**,** who reported that *Momordica charantia* was able to reduce liver weight as compared with the control diabetic group. Histo-pathologically, alloxan resulted in severe necrosis, especially in the central area of the pancreatic islets. Histological sections of the pancreas in the treated rats exhibited enhanced regeneration of β cells and enlarged pancreatic islets. Liver examination of the treated diabetic rats revealed significant improvement of the hepatic tissue compared to those of the untreated diabetic rats. The reduction in the weight of the liver might be due to the improvement in the damaged hepatic tissue by the treatment of plant extracts. This study indicated significant hepatic anti-inflammatory effects of *C. melo* and *C. lanatus* in diabetic rats, hence has significant importance in its medicinal usage in the treatment of diabetes mellitus.

In the present study, it was observed that the concentration level of ALT, ALP, TP, and BIL in experimental groups increased significantly as compared to the normal control group. Whereas the concentration levels of AST, ALB, and GGT differ significantly as compared to the normal control group. The results follow the early researchers. Farsani *et al*. (2016) reported that it is observed that aqueous alfalfa extract significantly decreased glucose, AST, and ALT levels as compared with the control group and diabetic control group. They concluded that the aqueous alfalfa extract had beneficial effects on blood lipids and glucose levels in diabetic rats and was also functional in the prevention and treatment of diabetes. Similarly, Radwan *et al*. (2018) reported that Streptozotocin induced a major increase in the activities of ALP, ALT, and AST and also greater levels of creatinine, bilirubin, uric acid, and urea. There is also change in immunology and histopathology and changes in the pancreatic tissue. The data revealed that insulin levels decreased by aqueous leaf extract of guava. They concluded that the aqueous leaf extract of guava has a

Table 1: Mean ± SEM value of body weight (g) and serum glucose (mg/dL) of albino rats fed with basal diet and basal diet supplemented with different plant extracts.

Parameters	Feeding groups					
	C. melo	*C. lanatus*	*C. melo + C. lanatus*	Diabetic control	Normal control	P. Value
IBW	169.66±6.98[a]	175.83±6.79[a]	178.33±8.83[a]	191.75±7.87[a]	194.25±7.05[a]	0.1858
FBW	190.50±13.87[b]	209.33±8.87[ab]	220.16±12.23[ab]	243.50±12.86[a]	237.25±8.67[a]	0.0387
IG	247.50±6.97[a]	251.00±12.64[a]	269.16±21.31[a]	278.00±4.20[a]	101.25±7.26[b]	<.0001
FG	92.50±2.65[b]	89.16±2.98[b]	78.50±2.40[b]	162.25±14.67[a]	82.00±3.31[b]	<.0001

Mean ± SEM values within rows with different alphabets are significantly ($p \leq 0.05$) different. IBW: Initial body weight, FBW: Final body weight, IG: initial glucose and FG represent the final glucose level of streptozotocin-induced diabetic albino rats. Different superscripts (a, b) within the rows represent significantly different results.

Table 2: Mean ± SEM values *of liver, pancreas, and kidney* weight (g) of male albino rats fed with basal diet and basal diet supplemented with different plant extracts.

Parameters	Feeding groups					
	C. melo	*C. lanatus*	*C. melo + C. lanatus*	Diabetic control	Normal control	P. Value
Liver	7.45±0.45[a]	7.76±0.27[a]	5.85±0.06[b]	7.87±0.76[a]	6.80±0.52[ab]	0.0407
Pancreas	0.55±0.08[a]	0.52±0.02[a]	0.50±0.04[a]	0.45±0.02[a]	0.50±0.09[a]	0.9058
Kidney	1.70±0.09[a]	1.80±0.05[a]	1.40±0.10[a]	1.80±0.16[a]	1.78±0.17[a]	0.2833

Mean ± SEM values within rows with different alphabets are significantly ($p \leq 0.05$) different. Different superscripts (a, b) within the rows represent significantly different results.

Table 3: Mean ± SEM values of Liver function parameters *(ALT, AST, ALP, TP, ALB, GGT, and BIL)* of albino rats fed with basal diet and basal diet supplemented with different plants extracts.

Parameters	Feeding groups					
	C. melo	*C. lanatus*	*C. melo + C. lanatus*	Diabetic control	Normal control	P. Value
ALT	52.16±2.24[b]	60.66±6.08[b]	51.50±7.09[b]	97.25±5.20[a]	48.75±6.84[b]	0.0001
AST	179.33±16.62[a]	181.83±9.79[a]	160.83±6.53[a]	167.75±21.13[a]	164.50±1.93[a]	0.6863
ALP	161.81±16.09[ab]	192.36±24.42[a]	157.75±15.11[ab]	199.72±9.33[a]	128.57±4.72[b]	0.0434
TP	7.30±0.21[ab]	7.21±0.30[ab]	7.56±0.43[ab]	8.00±0.59[a]	6.65±0.17[b]	0.2449
ALB	41.81±1.73[ab]	37.80±3.00[b]	39.55±1.58[b]	48.05±2.30[a]	40.75±0.69[b]	0.0488
GGT	1.73±0.07[b]	1.46±0.14[b]	1.41±0.10[b]	2.55±0.06[a]	2.37±0.36[a]	0.0001
BIL	0.04±0.01[b]	0.04±0.01[b]	0.04±0.00[b]	0.08±0.00[a]	0.03±0.00[b]	0.0280

Mean ± SEM values within rows with different alphabets are significantly ($p \leq 0.05$) different. ALT: alanine aminotransferase, AST: aspartate aminotransferase, ALP: alkaline phosphatase, TP: total proteins, ALB: albumins, GGT: gamma-glutamyle transferase and BIL represent the bilirubin of streptozotocin-induced diabetic albino rats. Different superscripts (a, b) within the rows represent significantly different results.

strong anti-hyperglycemic influence on the rat model of diabetes. According to the present result, it is observed that after the experiment the level of urea (mg/dL), creatinine (mg/dL), and HbA1C (%) of experimental rats was measured, and the results revealed that the concentration of urea, creatinine, and HbA1C differ significantly.

According to recent studies, abnormal concentrations of serum lipids such as increased levels of cholesterol, triglyceride, low-density lipoprotein (LDL), VLDL and decreased levels of high-density lipoprotein (HDL). Treatment with *Cucumis melo* and *Citrullus lanatus* leaf extracts shows improvement in the level of serum lipid profile through a significant ($P<0.05$) decrease in the level of triglyceride and an increase in HDL level. A significant increase in HDL level was observed. According to Olamide *et al.* (2011), high content of oil and unsaturated fatty acids are present in watermelon and these content help to decrease the level of cholesterol. This fatty acid helps to provoke cholesterol elimination in the intestine and then their cholesterol oxidizes into bile (Olamide *et al.*, 2011). The present result agreed with the report of Aziz *et al.* (2014) that the consumption of *C. lanatus* led

Table 4: Mean ± SEM values of urea and creatinine of male albino rats fed with basal diet and basal diet supplemented with different plant extracts.

Parameters	Feeding groups					
	C. melo	*C. lanatus*	*C. melo + C. lanatus*	Diabetic control	Normal control	P. Value
Urea	53.66 ± 7.09[a]	46.66 ± 2.69[a]	42.66 ± 2.77[a]	50.00 ± 9.80[a]	25.50±1.04[b]	0.0229
Creatinine	0.45 ± 0.03[ab]	0.46 ± 0.02[ab]	0.38 ± 0.03[b]	0.55 ± 0.08[b]	0.35 ± 0.02[b]	0.0368

Mean ± SEM values within rows with different alphabets are significantly ($p \leq 0.05$) different. Different superscripts (a, b) within the rows represent significantly different results.

Table 5: Mean ± SEM value of serum glucose (mg/dL) and body weight (g) of albino rats fed with different extracts of plants.

Parameters	Feeding groups					
	C. melo	*C. lanatus*	*C. melo + C. lanatus*	Diabetic control	Normal control	P. Value
CHOL	69.67[b]±4.81	63.33[b]±4.10	77.33[b]±3.28	93.50[a]±4.50	48.00[c]±1.00	0.0012*
HDL	32.20[a]±3.35	27.02[ab]±2.41	21.72[bc]±2.89	12.70[c]±0.50	20.60[bc]±1.30	0.0114*
LDL	17.63[ab]±2.30	19.37[ab]±1.33	15.77[ab]±1.77	21.25[a]±1.85	13.38[b]±0.18	0.1358
TRIGL	114.67[b]±3.48	124.33[b]±5.36	120.00[b]±8.62	161.50[a]±5.0	125.00[b]±2.0	0.0069*
VLDL	21.80[b]±1.34	23.87[b]±2.05	23.83[b] ± 2.21	31.15[a]±0.05	25.0[b]±0.40	0.0645

Data was analyzed using one-way ANOVA and the results mentioned in Mean ± standard were values are significantly ($p \leq 0.05$) different. CHOL: Cholesterol HDL: High-density lipoprotein LDL: Low-density lipoprotein, TRIGL: Triglycerides and VLDL: Very low-density lipoprotein. Different superscripts (a, b) within the rows represent significantly different results.

to decreased plasma cholesterol, triglyceride and LDL concentrations which was in agreement with the findings of this research work.

High-density lipoprotein (HDL) acts as a powerful endogenous defense mechanism against atherogenesis (Alex and Adekunle 2016). In treated groups, there was a non-significant decrease in the levels of LDL as compared to the diabetic control group. This finding is different and might be due to, changes in seasonal time, different experimental techniques, and dose. LDL is often called bad cholesterol; hence low levels are beneficial (Georgina *et al*. 2011). It has been shown that watermelon contains some anti-oxidant components (lycopene, citrulline and arginine). Consumption of watermelon helps to improve the dyslipidemia condition. It helps to reduce lipid peroxide formation or reduce the level of LDL (Kim *et al.,* 2012).

CONCLUSION

From the consideration of the results of this study, it appears that the extracts of *C. melo* and *C. lanatus* exert significant impact in streptozotocin-induced diabetic albino rats. Results revealed that body weight; glucose, AST, ALB, GGT, HDL, cholesterol, triglyceride, urea, and creatinine level differed significantly among treatment groups. It was therefore recommended that the extracts of *C. melo* and *C. lanatus* can be used separately or in combination for the management of diabetes.

REFERENCES

Abo KA, Fred-Jaiyesimi AA and Jaiyesimi AEA (2008). Ethnobotanical studies of medicinal plants used in the management of diabetes mellitus in South Western Nigeria. *J. Ethnopharm.,* **115**(1): 67-71.

Abu-Reidah IM, Arraez-Roman D, Segura-Carretero A and Fernandez-Gutierrez A (2013). Profiling of phenolic and other polar constituents from hydro-methanolic extract of watermelon (*Citrullus lanatus*) by means of accurate-mass spectrometry. *F. Res. Inter.,* **51**(1): 354-362.

Ahamad J, Mir SR and Amin S (2019). Antihyperglycemic activity of charantin isolated from fruits of *Momordica charantia*. *Int. Res. J. Pharm.,* **10**(1): 61-64

Ahmad O, Mohammad H, Ahmad-Reza H and Adel MA (2014). Effects of hydro-ethanol extract of *Citrullus colocynthis* on blood glucose levels and pathology of organs in alloxan-induced diabetic rats. *Asi. Paci. J. Tropi. Disease,* **10**(14): 1016/S2222-1808.

Ajiboye BO, Ojo OA, Akuboh OS, Abiola OM, Idowu O and Amuzat AO (2018). Anti-hyperglycemic and anti-inflammatory activities of polyphenolic-rich extract of *Syzygium cumini* Linn. leaves in alloxan induced diabetic rats. *J. Evid. Based Integr. Med.,* **23**(1): 1-8

Alex OD and Adekunle AA (2016). Effect of methanolic extract of Citrulus lanatus seed on lipid profile and oxidative stress in acetaminophen intoxicated rats. *Adv. Biomed. Pharm.,* **3**(2): 87-93.

Aljohi A, Matou-Nasri S, Ahmed N (2016) Antiglycation and antioxidant properties of *Momordica charantia*. *PLoS One*, **11**(8): e0159985.

Al-Snafi AE, Majid WJ and Talab TA (2019). Medicinal plants with antidiabetic effects: An overview (Part 1). *IOSR J. Pharm.,* **9**(3): 9-46.

American Diabetes Association ADA (2017): Standards of medical care in diabetes-2017. *Diabetes Care*, **40**(Supplement 1): S-1-135.

Aziz J, Messaoudi S, Alami M and Hamze A (2014). Sulfinate derivatives: Dual and versatile partners in organic synthesis. *Org. Biomolec. Chem.,* **12**(48): 9743-59.

Cheng C, Shen SC and Wu JSB (2009). Effect of guava (*Psidium guajava*) leaf extract on glucose uptake in rat hepatocytes. *J. Food Sci.*, **74**(5): H132-8.

Farsani MK, Amraie E, Kavian P and Keshvari M (2016). Effects of aqueous extract of alfalfa on hyperglycemia and dyslipidemia in alloxan-induced diabetic Wistar rats. *Interven. Medici. Appli. Sci.,* **8**(3): 103-108.

Francis D, Ani C, Nworgu C, Pamela O, Uzoma I, Uzoigwe J, Ugwu P, Anyaeji P and Daniel N (2019). The effect of ethanolic seed extract of *Citrullus lanatus* (watermelon) on blood glucose level and lipid profile of diabetic wistar rats. *Eur. J. Medici. Pla.,* **26**(4): 1-6.

Fu WJ, Haynes TE and Kohli R (2005) Dietary L-arginine supplementation reduces fat mass in Zucker diabetic fatty rats. *J. Nutr.,* **135**(4): 714-721

Godwin OO, Williams AU, Andrew NA, Atoyebi B, Ezeh PA and Udosen IJ (2015). An assessment of the phytochemicals and antibacterial activity of seed extract of *Citrullus lanatus* (Watermelon). *Inter. J. Res. Rev.,* **2**: 148-156.

Hong Z, Shu-Fen H, Wang J, Shao-Kang W, Gui-Ju S and Cheng-Kai Z (2019). Protective Effects of Compound Whole-Grain on High Fat and Cholesterol Diet-Induced Obesity and Lipid Accumulation in Rats. *Pak. J. Zool.,* 51(5): 1647-1654.

Kim JY, Shin JH and Lee SS (2012). Cardio protective effects of diet with different grains on lipid profiles and antioxidative system in obesity-induced rats. *Int. J. Vitam. Nutr. Res.,* **82**(2): 85-93.

Kirtikar KR and Basu M (1984). Indian medicinal plants. Vols I-IV, 2nd ed. Bishen 235 Singh, Mahendra Pal Singh, Dehra Dun, India, p.236.

Krishnamachari H and Nithyalakshmi V (2017). Phytochemical analysis and antioxidant potential of Cucumis melo seeds. *Int. J. Life. Sci. Sci. Res.,* **3**(1): 863-867.

Kumar, Ilavarasan R, Jayachandran T, Deecaraman M, Aravindan P, Padmanabhan N and Krishan MRV (2008). Anti-diabetic activity of *Syzygium cumini* and its isolated compound against streptozotocin-induced diabetic rats. *J. Med. P. Res.,* **2**(9): 246-249.

Li, WL, Zheng HC, Bukuru J and De Kimpe N (2004). Natural medicines used in the traditional Chinese medical system for therapy of diabetes mellitus. *J. Ethnopharm.,* **92**(1): 1-21.

Lim SH, Yu JS, Lee HS, Choi CI and Kim KH (2021). Antidiabetic flavonoids from fruits of *Morus alba* promoting insulin-stimulated glucose uptake via Akt and AMP-activated protein kinase activation in 3T3-L1 Adipocytes. *Pharm.,* **13**(4): 526.

Maddirela D, Badri KR, Rajasekhar, Kumar KV, Kassetti RB, Fatima SS, Kumar MTS and Rao CA (2010). Isolation and characterization of a novel antihyperglycemic protein from the fruits of *Momordica cymbalaria*. *J. Ethnopharm.,* **128**(1): 58-62.

Mahdi HJ and Andayani R (2010). Metabolic fingerprinting of three Malaysian ginger (*Zingiber officinale* Roscoe) using gas chromatography-mass spectromertry. *Ameri. J. Appli. Sci.,* **7**(1): 17-23.

Mahwish, Saeed F, Arshad MS, Nisa M, Nadeem MT and Arshad MU (2017). Hypoglycemic and hypolipidemic effects of different parts and formulations of bittergourd (*Momordica charantia*). *Lip. H. Dis.,* **16**(1): 211-216.

Massa NML, Silva AS, Oliveira CVC, Darlene CP and Carlos VS (2016). Supplementation with watermelon extract reduces total cholesterol and LDL cholesterol in adults with dyslipidemia under the influence of the MTHFR C677T polymorphism. *J. Am. Coll. Nutr.,* **35**(6): 514-520.

Naz A, Butt MS, Sultan MT, Qayyum MMN and Niaz RS (2014). *Watermelon lycopene* and allied health claims. *Excli. J.,* **13**(1): 650-666.

Okorie P, Agu F, Ani C, Alozie I, Nworgu C, Anyaeji P and Nwachukwu D (2019). The effect of aqueous leaf extracts of *Adansonia digitata* (baobab) on diabetes mellitus and the anterior pituitary of adult male wistar rats. *J. Diab. Endocrin.,* **10**(3): 18-29.

Olamide AA, Olayemi OO and Demetrius OO (2011). Effects of methanolic extract of *Citrullus lanatus* seed on experimentally induced prostatic hyperplasia. *Eur. J. Med. P.,* **1**(4): 171-179.

Oyedemi SO, Adewusi EA, Aiyegoro OA and Akinpelu DA (2011). Antidiabetic and haematological effect of aqueous extract of stem bark of *Afzelia africana* (Smith) on streptozotocin–induced diabetic Wistar rats. *Asi. Paci. J. Tropi. Biomed.,* **1**(5): 353-358.

Parle M and Singh K (2011). Musk melon is eat-must melon: A review. *Int. Res. J. Pharm.,* **2**(8): 52-57.

Paul A and SS Raychaudhuri (2010). Medicinal uses and molecular identification of two *Momordica charantia* varieties: A review. *Electr. J. Bio.,* **6**(2): 43-51.

Pereira DFF, Viana MP, Santos FO, Morais TC and Vasconcelos IM (2017). A protein isolate from moringa oleifera leaves has hypoglycemic and antioxidant effects in alloxan induced diabetic mice. *Molec.,* **22**(271): 2-5.

Pitipanapong J, Chitprasert S, Goto M, Jiratchariyakul W, Sasaki M and Shotipruk A (2007). New approach for extraction of charantin from *Momordica charantia* with pressurized liquid extraction. *Sep. Purifi. Tech.*, **52**(3): 416-22.

Radwan SA, Mohamed ONA, Khadrawy YA and Hafez GAA (2018). Effect of *Psidium guajava* leaf extract, glibenclamide and their combination on rat model of diabetes induced by streptozotocin. *Egypt. J. Hosp. Medici.*, **72**(6): 4610-4619.

Rajasekhar MD, Badri KR, Kumar KV, Kassetti RB, Fatima SS, Kumar MTS and Rao CA (2010). Isolation and characterization of a novel antihyperglycemic protein from the fruits of *Momordica cymbalaria. J. Ethnopharm.*, **128**(1): 58-62.

Ramos MJG, Esteves Pairazamán AT, Mocarro WMES (2021). Medicinal properties of *Morus alba* for the control of type 2 diabetes mellitus: a systematic review. *Res.*, **10**(1): 1022

Rao BK, Sudarshan PR, Rajasekhar MD, Nagaraju N and Rao CA (2003). Antidiabetic activity of *Terminalia pallida* fruit in alloxan induced diabetic rats. *J. Ethnopharm.*, **85**(1): 169-172.

Romdhane MB, Haddar A, Ghazala I, Jeddou KB, Helbert CB and Ellouz-Chaabouni S (2017). Optimization of polysaccharides extraction from watermelon rinds, structure, functional and biological activities. *F. Chem.*, **216**(1): 355-364.

Samra L, Islam M, Saeed H, qtedar M and Mehmood A. (2021) Investigation of *Olea ferruginea* Royle bark extracts for potential *in vitro* antidiabetic and anticancer effects. *Turk. J. Chem.*, **45**(1): 92-103

Santana LF, Inada CA, Santo BLSE, Filiú WFO, Pott A, Alves FM, Guimarães RCA, Freitas K and Hiane PA, (2019). Nutraceutical potential of *Carica papaya* in metabolic syndrome. *Nutr.*, **11**(7):1608.

Satyanarayana N, Suresh VC, Ramachawolran G, Paripelli S and Akula US (2022). Antidiabetic activity of *Solanum torvum* fruit extract in streptozotocin-induced diabetic rats. *Front. Nutr.*, **9**:987552

Sinha D, Dwivedi C, Dewangan MK, Yadav R, Rao SP, Chandrakar K and Roy A (2014). Anti-diabetic potential of herbal plants and polyherbal formulation. *Int. J. Phytother. Res.*, **4**(3): 28-49.

Siyem D, Syngai G, Khup PZ, Khongwir BS, Kayang H and Hypoglyceamic (2012). Effects of *Potentilla fulgens* L. in normal and alloxan diabetic mice. *J. Ethnopham.*, **83**(1-2): 55-61

Tehseen I, Haq TU, Ilahi I, Khan AA, Attaullah M, Zamani GY, Zaman S and Ismail I (2022). Antidiabetic and hepato-renal protective effects of medicinal plants in STZ induced diabetic rats. *Braz. J. Bio.*, **84**: e260189

Teugwa CM, Boudjeko T, Tchinda BT, Mejiato PC and Zofou D (2013). Antihyperglycaemic globulins from selected Cucurbitaceae seeds used as antidiabetic medicinal plants in Africa. *BMC Complem. Alter. Medici.*, **13**(1): 63.

Toluwani T, Bubuya M and Samson M (2019). The effect of *Psidium guajava* aqueous leaf extract on liver glycogen enzymes, hormone sensitive lipase and serum lipid profile in diabetic rats. *Biom. Pharmacother.*, **109**(1): 2441-2446.