



Evaluation of Antidiabetic Activity of Ethyl Linoleate Isolated from *Decalepis hamiltonii* Wight and Arn Seed

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Author's contributions

This work was carried out in collaboration between both authors. Author AR designed the study, performed the statistical analysis, managed the literature search and wrote the first draft of the manuscript. Then author RM supervised the work and reviewed all drafts of the manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

Aims: The main objective of the study was designed to screen the phytochemical constituents of the seed of *Decalepis hamiltonii* Wight & Arn and also to study its effect on blood glucose level of rats.

Study Design: Evaluation of Antidiabetic Activity of Ethyl Linoleate.

Place and Duration of Study: Department of Chemistry, Government Arts College (Autonomous), Kumbakonam, Tamilnadu State, India 612 001, between May 2014 and April 2015.

Methodology: The compound Ethyl Linoleate was isolated from *Decalepis hamiltonii* Wight and Arn seed by using Column chromatography. Structure of the compound was identified by GC-MS analysis, UV, IR, NMR spectroscopic methods and tested for alloxan induced diabetes in Male albino rats was evaluated.

Results: Biochemical parameters, including glucose (96.01±4.5), serum urea (26.01±0.01),

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creatinine (90.35±0.02), cholesterol (93.07±4.23) and protein (9.07±0.08), were also assessed. The isolated Ethyl Linoleate increased by body weight (200±1.32) and significantly reduced the glucose level (96.01±4.5) at 20 mg/kg was almost equally the reference standard, glibenclamide. The Ethyl Linoleate enhance insulin release from the pancreatic β cells which is glucose dependent and there by decrease the blood glucose level in alloxan induced diabetic rats. The Ethyl Linoleate enhance insulin release from the pancreatic β cells which is glucose dependent and there by decrease the blood glucose level in alloxan induced diabetic rats. Further biochemical investigations will clearly elucidate the mechanism of action and will be helpful this compound as a therapeutic target in diabetes research. The histopathological studies of the rat pancreas showed recovery of the alloxan induced damage of the insulin secreting β pancreatic cells, thus providing a hint for the mechanism of the test drug.

Conclusion: The compound Ethyl Linoleate was isolated from *Decalepis hamiltonii* Wight and Arn seed by using Column chromatography for the first time. The investigation of the mechanisms of this drug may contribute for the development of new drugs for the treatment of diabetes.

Keywords: Diabetes mellitus; hyperglycemia; asclepiadaceae; *Decalepis hamiltonii*; ethyl linoleate.

1. INTRODUCTION

Plants are an exemplary source of traditional medicine and pharmaceutical drugs for human kind since time immemorial. About 80% of world population still dependent upon the herbal drugs for their health care [1]. *Decalepis hamiltonii* Wight and Arn is an endangered climbing shrub belonging to the family Asclepiadaceae. It is an endemic and endangered medicinal plant is commonly known as Magali Kizhangu in Tamil. This plant roots are seasonal and grow wild, which contains pure form of antifungal compound 2-hydroxy-4-methoxybenzaldehyde (2H4MB) was isolated from volatile oil of in *Decalepis hamiltonii* roots [2]. Based on ethnopharmacological information. *Decalepis hamiltonii* has been used to treat diabetes by the tribals in and around tropical and subtropical areas. But there are no more scientific reports available about the antidiabetic activity of this plant. Hence the study was carried out to ascertain the activity. The plant extracts have not produced any toxic symptoms within the treated animals. In Vivo and In Vitro conservation methods have been standardized to this endangered plant by developing rapid micro propagation techniques.

The world wide prevalence of diabetes mellitus (DM) has risen dramatically over the past two decades; based on current trends, more than 360 million individuals will have diabetes by year 2030. Diabetes mellitus (DM) is caused by inherited and/or acquired deficiency in production of insulin by the pancreas, or by the ineffectiveness of the insulin produced [3]. It is a

metabolic disorder, characterized by chronic hyperglycemia, with disturbances of carbohydrate, fat and protein metabolism, resulting defects in insulin secretion, insulin action, or both [4]. This insulin deficiency results in increased concentration of glucose in the blood. Increase in blood glucose damages particularly blood vessels, nerves and many organs of the body. The hyperglycemia caused due to decreased insulin production is called Type-1 diabetes and hyperglycemia due insufficient insulin utilization is called Type-2 diabetes [5]. Out of these two types, Type -2 diabetes is a major problem of today and it account for nearly 95% of total diabetic population of about 246 million. The most common symptoms of Diabetes Mellitus are those of hypoglycemia, loss of weight, ketosis, and arteriosclerosis, pathologic changes in the eye, neuropathy, renal disease and coma [6]. In recent years, researchers turned attention specifically to oxidative stress and the key role it plays, as a common element in the pathogenesis of diabetes complications. Hyperglycemia generates reactive oxygen species which, in turn, causes membrane lipid peroxidation and degradation. The most important of these biologically active constituents of plants are alkaloids, flavonoids, tannins and phenolic compounds [7,8]. There are no systemic pharmacological studies to establish the anti diabetic effect of *Decalepis hamiltonii* Wight and Arn seed. Hence the present investigation was carried out to evaluate the In Vitro antidiabetic diabetic activity of Ethyl Linoleate isolated from the *Decalepis hamiltonii* Wight and Arn seed in alloxan induced diabetic rats.

2. MATERIALS AND METHODS

2.1 Plant Materials

The *Decalepis hamiltonii* Wight and Arn seed were collected from the market of Kumbakonam, Tamil Nadu state, India. They were identified and authenticated by Prof. N. Ramakrishnan, Head and Associate Professor and voucher specimens (Department of Botany) and voucher specimens (GACBOT-168) were deposited at the Herbarium of the Department of Botany, Government Arts College (Autonomous), Kumbakonam, Bharathidasan University, India.

2.2 Extraction and Isolation

The important stage in the experimental work includes first the isolation of chemical substances from the chosen plant and secondly, the characterization of those isolated compounds. Dried *Decalepis hamiltonii* Wight & Arn seeds (1.0 kg) were ground to a fine powder and successively extracted with n-hexane, EtOAc, and EtOH at 37°C. The fractions were collected such as n-hexane EtOAc and EtOH and the solvent recovered by simple distillation. The isolation of the n-hexane extract was dried by vacuum evaporation (22.00 g) and then subjected to column chromatography over silica gel (60-120 mesh, Merck, India) as the stationary phase. The charged column was then eluted with n-hexane and re-chromatographed on silica gel eluted with methylene chloride in n-hexane (10:90). These were grouped together and dried by vacuum evaporation and had taken up in acetone and dried by vacuum evaporation when a pale yellow liquid separated, Boiling point 222-2°C, soluble in ethanol and glacial acetic acid [9]. Structural elucidation of the compound isolated from n-hexane extract of *Decalepis hamiltonii* Wight & Arn seed was accomplished by GC-MS, UV, IR, ¹H- NMR and ¹³C- NMR spectroscopic methods.

2.3 Structural Identification

GC-MS analysis of Ethanolic extract of *Decalepis hamiltonii* Wight and Arn seed using Perkin Elmer Clarus 600 GC-MS revealed the presence of 15 compounds. The major constituent was Ethyl Linoleate with RT 26.00 minutes has peak area of 40.12%. UV spectral analyses were recorded using UV- Visible Spectrophotometer Lambda 35 from Perkin Elmer, UV (λ_{max}) 224-280 nm. IR spectrum was recorded with a Perkin

Elmer RX I FT-IR spectrometer as a thin film on KBr plate. IR spectra were recorded on a Perkin Elmer spectrum on spectrometer using KBr disc given in cm^{-1} 724, 1033, 1114, 1179, 1243, 1372, 1463, 1736, 2855, 2955 and 3008. Supporting evidence for the structure of the compound is provided by the ¹H (DMSO, 300 MHz) and ¹³C-NMR (100 MHz, DMSO) spectra were recorded on a Bruker AMX 300 NMR spectrometer. Chemical shifts values were recorded in δ is reported in parts per million (ppm) relative to the residual solvent signals. ¹H NMR (300 MHz, DMSO): δ 0.93-0.98 (t), 1.05-1.12 (p), 1.77-1.83 (q), 2.02-2.07 (t), 2.29-2.30 (q, 3J=1.8 Hz), 2.50-2.54 (t, 3J=6.0 Hz), 3.12-3.14 (d), 5.04-5.18 (m). ¹³C- NMR (100 MHz, DMSO): δ 13.83, 14.05, 21.93, 24.39, 25.16, 26.56, 28.36, 28.44, 28.69, 28.92, 30.87, 31.16, 32.25, 33.45, 59.55, 127.45, 127.70, 128.07, 129.64, 172.77. The data obtained by GC-MS, UV, IR, ¹H- NMR and ¹³C-NMR spectral analyses showed that the active molecule isolated from *Decalepis hamiltonii* Wight & Arn seed was Ethyl Linoleate.

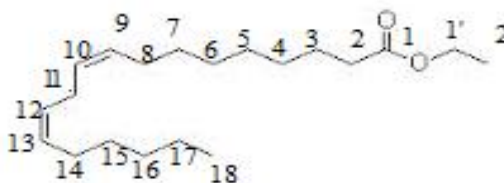


Fig. 1. Structure of ethyl linoleate

2.4 Acute Toxicity Study

Male albino rats were maintained under standard experimental conditions (Temperature 27±2°C, relative humidity 60±5 and 12 hours light/dark cycle) and they were fed with standard rate feed. Before starting the experiment on animals, the experimental protocol was subjected to the scrutiny of the Institutional Animal Ethics Committee (IAEC), Bharathidasan University, Trichirappalli, Tamilnadu, India (Approval No. BDU/IAEC/2011/31/29.03.2011).

2.5 Induction of Diabetes

Rats were made diabetic by a single intraperitoneal injection of alloxan monohydrate (Loba Chemie, Bombay: 150 mg/kg). Alloxan was first weighed individually for each animals according to the weight and solubilized with 0.2 ml saline (154 m M NaCl) just prior to injection. Two days after alloxan injection, rats with plasma glucose levels of > 140 mg/dl were included in

the study. Treatment with extracts was started 48 hours after alloxan injection. Blood samples were drawn at weekly intervals till end of study (i.e. 3 weeks). Fasting blood glucose estimation and body weight measurement were done on 1,7,14 and 21 days respectively. 36 rats were used for this study. All treatments were done for 21 days via oral route.

2.6 Experimental Design

Male albino rats [weighing 150-200 (g)] were divided randomly in to six groups. Each Groups has six rates.

Group- A: Served as normal control.

Group-B: The Second group of rats with diabetes was induced by intraperitoneal injection of alloxan.

Group-C: Alloxan treated rats were administered the Glibenclamide (10 mg/kg) and served as standard.

Group-D: Alloxan treated rats were administered the Ethyl Linoleate (20 mg/kg).

Group-E: Alloxan treated rats were administered the Ethyl Linoleate (40 mg/kg).

Group-F: Alloxan treated rats were administered the Ethanolic extract (20 mg/kg).

Table 1. Effect of ethyl linoleate and ethanolic extract on body weight of alloxan-induced diabetic rats

S. no.	Treatment	Body weight (g)			
		1 st day	7 th day	14 th day	21 st day
1	Normal control	200.01±1.7	202.52±1.34	204.00±1.45	205±1.63
2	Diabetic control (Alloxan)	210±2.3	167±5.9	153±2.53	136±1.89
3	Standard (Alloxan+ glibenclamide 10 mg/kg)	203±1.8*	204±1.44***	205±1.56***	206±1.69***
4	Alloxan + ELA (20 mg/kg)	205.6±1.78	203.2±1.02***	201.1±1.17***	200±1.32***
5	Alloxan + ELA (40mg/kg)	204.5±1.65	203.1±2.2***	201.73±1.02***	199.21±1.73***
6	Alloxan + EtOH Ext. (20 g/kg)	205.2±1.89	197.02±2.2***	190.72±3.1***	185.47±5.2***

Values are expressed in Mean±S.E.M values. $p < .05$, $p < .01$ and $p < .001$ (Dunnett's - test); diabetic control was compared with the extracts and standard treated groups .

All values are recorded based on the six replications of tests and analysed statistically, where * , ** and ***represent the confident level at 95% ($p < .05$) ,99% ($p < .01$) and 99.9% ($p < .001$) respectively

Table 2. Effect of ethyl linoleate and ethanolic extract on blood glucose level against alloxan induced diabetic rats

S. no.	Treatment	Blood glucose(mg)			
		1 st day	7 th day	14 th day	21 st day
1	Normal control	90.73±2.85	90.27±3.45	90.67±6.15	90.55±5.14
2	Diabetic control (Alloxan)	265.5±15.65	264.01±14.5	265.93±15.43	269.05±16.12
3	Standard (Alloxan + glibenclamide 10 mg/kg)	263.02±11.2*	160.8±7.97***	103.26±7.18***	95.02±5.14***
4	Alloxan + ELA (20 mg/kg)	254.03±11.36	174.56±11.97***	102.45±7.87***	96.01±4.5***
5	Alloxan + ELA (40 mg/kg)	256.54±11.93	176.52±10.43***	115.16±5.87***	96.22±3.2***
6	Alloxan + EtOH Ext.20 mg/kg)	264.03±10.07	170.01±18.11***	143.02±15.36***	91.13±2.9***

Values are expressed in Mean±S.E.M values. $p < .05$, $p < .01$ and $p < .001$ (Dunnett's - test); diabetic control was compared with the extracts and standard treated groups .

All values are recorded based on the six replications of tests and analysed statistically, where * , ** and ***represent the confident level at 95% ($p < .05$) ,99% ($p < .01$) and 99.9% ($p < .001$) respectively

Table 3. Biochemical parameters of rat's blood on 21st day compared with normal control

S. no.	Biochemical parameter	21 st day treatment (M±S.E.M)					
		Normal control	Diabetic control (Alloxan)	Standard (Alloxan + glibenclamide 10 mg/kg)	Alloxan + ELA (20 mg/kg)	Alloxan + ELA (40 mg/kg)	Alloxan + EtOH Ext.20 mg/kg)
1	Haemoglobin (g/dl)	12.4±0.53	09.03±0.31	09.03±0.31	11.73±0.81	12.53±0.34	12.11±0.56
2	Albumin (g/dl)	3.8±0.3	3.8±0.3	3.8±0.3	3.8±0.3	3.8±0.3	3.8±0.3
3	Globulin (g/dl)	3.78±0.28	3.78±0.28	3.78±0.28	3.78±0.28	3.78±0.28	3.78±0.28
4	Serum Urea (mg/dl)	24.16±1.83	61.65±4.96	31.16±3.31***	26.01±0.01***	25.08±0.81***	25.98±0.98***
5	Serum Creatinine (mg/dl)	0.31±0.01	1.91±0.10	0.58±0.13	0.35±0.02	0.33±0.02	0.32±0.91
6	Serum chloesterol (mg/dl)	91.03±5.40	158.10±3.27	110.01±7.9***	93.07.±4.23***	90.83±2.85***	90.12±6.16***
7	Serum triglycerides (mg/dl)	060.9±3.54	100.13±6.54	64.98±3.74	61.98±3.74	60.46±3.53	61.23±2.73
8	Serum protein (g/dl)	8.35±0.09	4.15±0.12	6.24±0.17	9.07±0.08	8.89±0.87	8.76.±0.96
9	HDL (mg/dl)	63.52±3.54	16.76±1.55	69.42±1.54***	62.42±1.20***	63.23±1.31***	62.30±2.23***
10	LDL (mg/dl)	12.00±0.65	93.07±4.32	57.46±4.769***	21.64±0.42***	28.26±0.50***	15.73±0.35***

Values are expressed in Mean±S.E.M values. $p < .05$, $p < .01$ and $< p < .001$ (Dunnett's - test); diabetic control was compared with the extracts and standard treated groups. All values are recorded based on the six replications of tests and analysed statistically, where *, ** and *** represent the confident level at 95% ($p < .05$), 99% ($p < .01$) and 99.9% ($p < .001$) respectively

2.7 Biochemical Analysis

The body weight of each group was estimated at the 1st, 7th, 14th and 21st day the results were calculated in the above Table -1. Serum was separated by centrifuging the blood samples at 6000 rpm for 20 minutes and stored in the refrigerator until analysed. Serum glucose level test was done on the normal, diabetic, and treated diabetic rats on days 7, 14, and 21 of the experimental period to determine blood glucose levels in animals were determined using the Tietz method [10]. Rats with diabetes having hyperglycemias (i.e. with blood glucose of 90 to 270 mg/dl) were taken for the experiment. Anti-diabetic study was designed to find out the correlation of alloxan induced diabetes mellitus and also the effect of Ethyl Linoleate from extract of *Decalepis hamiltonii* seed in experimental animals (above Table -2). On the twenty first day of experiment the animals were sacrificed and blood was collected from various groups by puncturing the retro-orbital plexus, kept aside for half an hour for clotting. The serum was analyzed for various biochemical parameters such as Glycosylated hemoglobin (HbA1C) [11], Total cholesterol [12], HDL [13], LDL, Serum creatinine [14], Blood urea [15] and Total protein [16] were determined using reagent kits purchased from Piramel Health care, Mumbai, India. The results were mentioned in above Table -3.

2.8 Histomorphologic Changes of Pancreas

The rat was etherized and dissected under anesthesia. The organs like liver, pancreas, kidney and heart were removed and immediately fixed in freshly prepared 10% neutral buffered formalin fixative for 12 hours and then processed using tetrahydrofuran as clearing agent. The cleared tissues were paraffin-embedded with an orientation for longitudinal and transverse section and cut into 3-5 μm sections for histological staining and light microscopic observations.

For the microscopic examination, the rats were sacrificed by an overdose of diethyl ether. The sections were immediately excised from each lobe of the pancreatic islet. All samples were embedded in paraffin, cut in sections of 3 μm thickness and stained with hematoxylin and eosin [17]. The sections were deparaffinized in xylene(DPX), hydrated through downgraded alcohol series and stained in aqueous hematoxylin for 2-5 min. The stained sections were water-washed, dehydrated and counter stained in 0.1% eosin in 95% alcohol for 15-20

seconds. After further dehydration and clearing in xylene, they were mounted in DPX.

2.9 Statistical Analysis

The experimental results were expressed as statistical comparisons of Mean \pm S.E.M were carried out by one way analysis of variance (ANOVA) followed by Dunnett's Multiple Comparisons Test. p-values less than .05, .01 and .001 were considered as statistically significant. The statistical significance of difference between two independent groups was calculated for the determination of blood glucose levels.

3. RESULTS AND DISCUSSION

3.1 Structure of Ethyl Linoleate

The ¹H- NMR spectrum of Ethyl Linoleate showed the multiplet at δ 5.04-5.18 ppm represents the olefinic protons (-CH=CH-). A doublet signal at δ 3.12-3.14 ppm is representing ethoxy protons of the ester functionality of the Ethyl Linoleate. The bis-allylic proton signal of polyunsaturated fatty acid (like linoleic acid) generally appears around at δ 2.02-2.30 ppm. So, the triplet at δ 2.29-2.30 ppm indicates the bis-allylic protons (-C=C-CH₂-C=C-) of the unsaturated fatty acid chain. The triplet at δ 2.29 ppm represents the α -methylene protons to ester (-CH₂-COOEt). The α -methylene protons to double bond (-CH₂-C=C-) appear as a multiplet at δ 1.99-2.05 ppm. The β -methylene protons to ester (CH₂-C-COOEt) also appear as a multiplet at δ 1.77- 1.83 ppm. The terminal methyl protons (-CH₃) at δ 0.85-0.88 ppm appear as a multiplet. The adjacent quaternary carbon 1-C revealed correlations to 2-H, 3-H, and 1'-H, which is consistent with the omega-6 fatty acid skeleton. The signal at δ 59.55 ppm in the ¹³C- NMR spectrum of Ethyl Linoleate is due to the ethoxy carbons of esters. The signal at δ 172.77 ppm represents the carbonyl carbon of the ester molecules of Ethyl Linoleate and the olefinic carbons appear at δ 127.45, 127.70, 128.07 and 129.64 ppm. The methylene and methyl carbons of fatty acid moiety appear in the range from δ 13.83 to 33.45 ppm. From these data, the number of double bonds were determined to be 2. As expected from an elemental composition of C₂₀H₃₆O₂, 13 unsaturations in the aliphatic Ethyl Linoleate chain system and a double bond were recorded. IR spectrum of Ethyl Linoleate showed a C=O stretching band of Ethyl ester at 1736 cm⁻¹ and C-O stretching bands at 1114, 1179 and 1243 cm⁻¹.

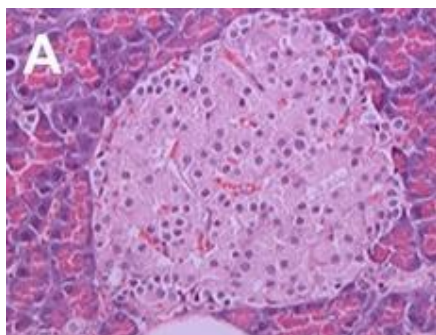


Fig. 2. [Normal Pancreas] Section shows normal pancreas with insulin in pancreas

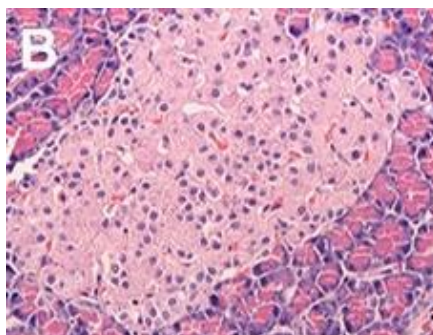


Fig. 3. [Diabetic pancreas] Section shows degeneration of β -cells with granules

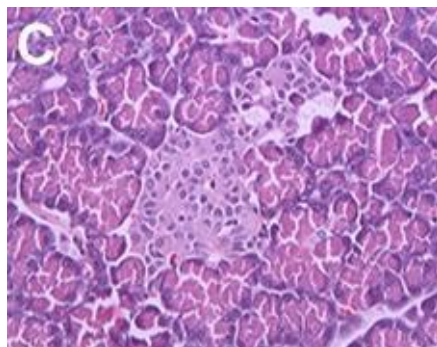


Fig. 4. [Pancreas treated with test drug (ELA of 20 mg/kg)]Section shows increased size of islets

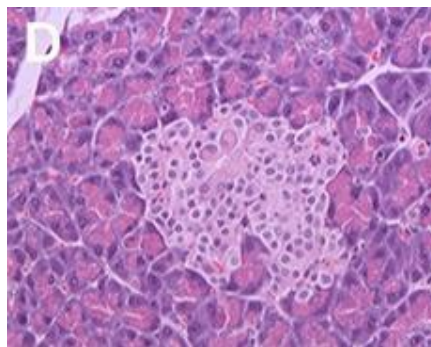


Fig. 5. [Pancreas treated with test drug (ELA 40 mg/kg)] Section shows increase in granulated and normal β - cells

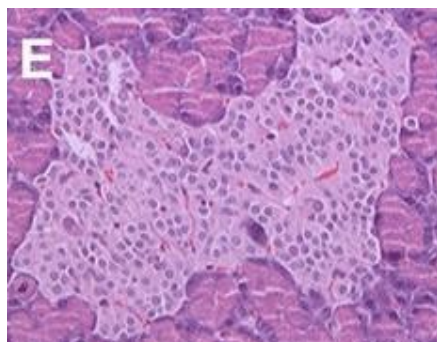


Fig. 6. [Pancreas treated with test drug (EtOH Ext. 20 mg/kg)] Section shows increase in granulated and normal β - cells

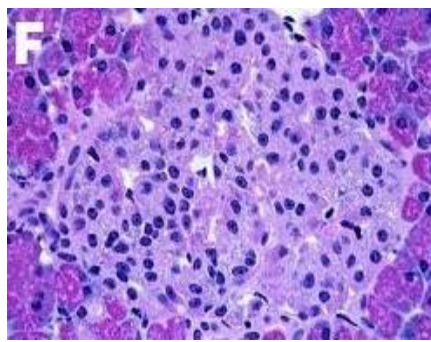


Fig. 7. [Pancreas treated with standard (Glibenclamide10 mg/kg)] Section shows pancreas with mild image

The weak signal at 1779 cm^{-1} may due to C=C stretching frequency. Strong and sharp signals at 2855 and 2955 cm^{-1} are due to C-H stretching frequencies. The absorbance at 3008 cm^{-1} indicates the =C-H stretching frequency. The observation of an absorption peak at 724 cm^{-1}

suggested the $-\text{CH}_2-$ rocking [18]. From the molecular ion signal of Ethyl linoleate at m/z 308. This shows $[\text{CH}_2=\text{CH}-\text{CH}=\text{CHCH}_2]^+$ fragment which appears at $m/z = 67$ as the base peak, an elemental composition of $\text{C}_{20}\text{H}_{36}\text{O}_2$ as ascertained.

3.2 Effects on Blood Glucose

In our present study, biochemical parameters were unchanged in non-diabetic rats. Our results also showed diabetic control rat significant increase in creatinine (1.91 ± 0.10) and urea (61.65 ± 4.96) levels as compared with normal control animals (0.31 ± 0.01 , 24.16 ± 1.83). The diabetic hyperglycemia induced by alloxan produces elevation of urea and creatinine levels in plasma, which are considered as significant markers of renal dysfunction. There was no significant difference in the activity of 20 (96.01 ± 4.5) and 40 (96.22 ± 3.2) mg/kg. The activity of 40 (96.22 ± 3.2) mg/kg was more active and the activity was comparable with that of the standard drug (95.02 ± 5.14), glibenclamide. The serum lipid profile reached a peak in diabetic control rats (100.13 ± 6.54), whereas the level of total protein decreased (4.15 ± 0.12). Total protein levels are significantly decreased in rats with alloxan induced diabetes due to increased protein catabolism. Alloxan induced diabetic rats showed higher cholesterol (158.10 ± 3.27) as compared with control (91.03 ± 5.40). After continuous treatment with the Ethyl Linoleate 20 mg/kg (93.07 ± 4.23) and standard drug (110.01 ± 7.9) for 21 days, rats with alloxan induced diabetes (158.10 ± 3.27) showed a marked decrease in cholesterol levels with a significant increase in lipoprotein. The present study found that daily administration of an Ethyl Linoleate sample from *Decalepis hamiltonii* seed to diabetic rats gradually increased (4.15 ± 0.12 , 9.07 ± 0.08) their protein levels, and that the Ethyl Linoleate had a pronounced effect on protein content, which results for total protein being in accordance with those of previous report [19]. Ethyl Linoleate 20 (96.01 ± 4.5) and 40 mg/kg (96.22 ± 3.2) exhibited significant anti hyperglycemic activities in alloxan induced diabetic rats (269.05 ± 16.12). This sample (20, 40 mg/kg) showed improvement in parameters like body weight (200 ± 1.32 , 199.21 ± 1.73) and lipid profile (LDL 21.64 ± 0.42 , 28.26 ± 0.50) as well as regeneration of β -cells (Figs. 5 & 6) of pancreas and so might be of value in diabetes treatment.

3.3 Histomorphological Observation

The pancreas was removed for identifying histopathological changes. Pancreatic sections stained with hematoxylin and eosin. The sections revealed that alloxan caused severe necrotic changes of pancreatic islets, especially in the centre of islets. Nuclear changes, karyolysis, disappearance of nucleus and in some places residue of destroyed cells were visible [20]. The

cellular integrity and architecture were intact in the non-diabetic control group-A (Fig. 2). Relative reduction of size and number of islets especially around the central vessel and severe reduction of beta cells were clearly seen in diabetic control group-B (Fig. 3). Pancreas of the diabetic group -C (Fig. 4), which consumed 10mg/kg body wt. glibenclamide (Fig. 7), showed similarity to group- A (Fig. 2). Study of pancreas of treated diabetic groups- D (Fig. 5) and E (Fig. 6) showed increased size of islets and hyperchromic nucleus. There was also a relative increase of granulated and normal beta cells in the group -E (Fig. 6), which consumed 20 mg/kg body wt. Ethyl Linoleate, when compared with the diabetic group -D (Fig. 5) which consumed 40 mg/kg Ethyl Linoleate [21,22]. The administration of alloxan to the normal rats results in the destruction of beta cells of Islets of Langerhans and malfunctioning of the pancreas. This results in the diabetic condition leading to the increase in the blood glucose levels and decreased body weight in the untreated diabetic rats. The elevation of blood glucose in alloxan induced diabetic rats may be due to lower levels of plasma insulin [23].

4. CONCLUSION

For the first time was studied the effect of oral administration of Ethyl Linoleate in alloxan induced diabetic rats, results showing anti-diabetic activity and lowering serum total cholesterol, as it significantly lowered the serum glucose levels and increased the body weight of diabetic rats. The insulin deficiency, results in improved glucose, causing hyperglycemia. A significant reduction in the body weight was observed in the alloxan induced diabetic rats. The decrease in the weight in diabetics is due to continuous excretion of glucose and decrease in peripheral uptake of glucose and glycogen. Further biochemical investigations will clearly elucidate the mechanism of action and will be helpful this compound as a therapeutic target in diabetes research. A dose of 20 mg/kg significantly brought the blood sugar level of the alloxan induced diabetic rats to normal condition. Thus, the folk use of the plant for the control of diabetes may be supported by this study.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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