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Research Article

Antihyperlipidemic and Hepatoprotective Effects of Ethanolic Extract of *Cissus quadrangularis* in High-Fat Diet-Induced Hyperlipidemic Rats

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ABSTRACT

The present study investigates the antihyperlipidemic and hepatoprotective potential of the ethanolic extract of *Cissus quadrangularis* (EECQ) in Wistar albino rats. Dried and powdered plant material was subjected to Soxhlet extraction with ethanol, yielding a semi-solid green extract. Hyperlipidemia was induced in male Wistar rats (200–250 g) using a high-fat emulsion. The animals were divided into groups and treated with either a standard drug (Rosuvastatin, 10 mg/kg) or EECQ at low and high doses. Biochemical parameters, including lipid profile, liver function tests, and oxidative stress markers, were assessed. The study demonstrated that high-fat diet-induced hyperlipidemia caused significant disturbances in lipid metabolism, liver function, and oxidative stress. Treatment with EECQ produced dose-dependent improvements, with the high dose showing significant reductions in total cholesterol, triglycerides, LDL levels, and oxidative stress markers, along with an increase in HDL levels. Histopathological analysis further supported the protective effects of the extract. These findings suggest that EECQ holds therapeutic potential as a natural alternative for the management of hyperlipidemia and associated hepatic dysfunction.

INTRODUCTION

Obesity is a complex disease characterized by having an excessive amount of body fat, which poses serious health risks. It is not merely a cosmetic issue but a medical problem associated with various diseases like heart disease, diabetes, high blood pressure, high cholesterol, liver disease, sleep apnea, and certain cancers.

Obesity has become the number one public health threat in the twenty-first century, replacing malnutrition in the twentieth century. Its prevalence has dramatically risen over the past few decades in most developed countries. It has become a significant burden for the health economy. Whilst the changing lifestyle, the obesogenic environment has a significant influence on the increasingly higher incidence of

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obesity; there are several genetic risk factors such as gene variants, genetic syndromes, and single gene mutations, which make it very difficult to control obesity.

Obesity can lead to numerous health complications including:

- Heart disease
- Strokes
- Type 2 diabetes
- Certain cancers
- Musculoskeletal disorders like osteoarthritis, and fatty liver disease.



Fig: 1 Causes of Obesity

PLANT PROFILE:

Cissus quadrangularis is a perennial plant of the grape family. It is commonly known as veldt grape, winged treebine or adamant creeper. *Cissus quadrangularis* supplements are used in alternative medicine to treat joint pain, enhance bone health, and support weight loss. This succulent creeping vine contains bioactive substances such as flavonoids, phenols, tannins, plant sterols, resveratrol, vitamins, and other nutrients.



Fig: 2 *Cissus quadrangularis*

Taxonomical Classification:

Table: 1 Taxonomical Classification

Rank	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta (vascular plants)
Division	Magnoliophyta (flowering plants)
Class	Magnoliopsida (dicotyledons)
Order	Vitales
Family	Vitaceae (Grape family)
Genus	<i>Cissus</i>
Species	<i>Cissus quadrangularis</i> L.

Vernacular / Common Names:

Table: 2 Vernacular Names

Language/Region	Name
English	Veldt grape, Devil's backbone, Bone setter
Hindi	Hadjod / Hadjora / Harjor
Sanskrit	Asthisamhari, Vajravalli
Tamil	Pirandai
Telugu	Nalleru
Malayalam	Changalamparanda
Kannada	Asthisamharaka
Marathi	Harjora
Bengali	Harjora

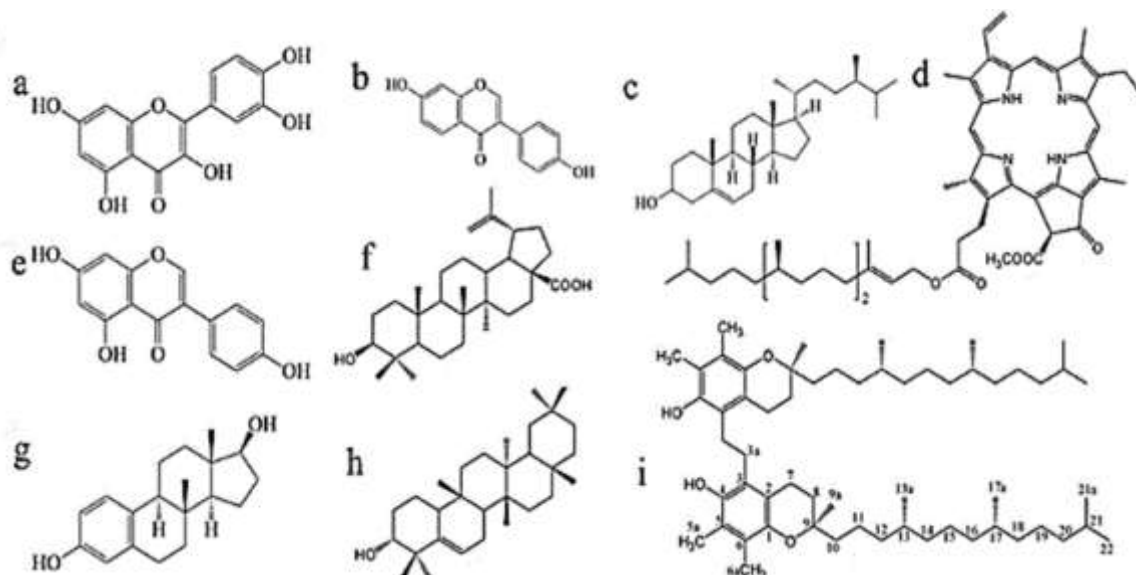
Major Chemical Constituents:

Cissus quadrangularis contains a wide range of bioactive compounds:

- Ascorbic acid (Vitamin C)



- Carotenoids
- Calcium
- Flavonoids (e.g., quercetin, kaempferol)
- Triterpenoids
- Stilbene derivatives (e.g., resveratrol)
- Iridoids
- β -sitosterol
- Phytosterols
- Anabolic steroidal substances (possibly ketosteroids)
- Phenolic compounds
- Quercetin & kaempferol glycosides



Chemical structures compounds in the *Cissus quadrangularis* Linn extract a) quercetin, b) diadzein, c) β -sitosterol, d) Pheophytin-a, e) genistein, f) betulinic acid, g) estradiol, h) β amyrin, i) 1,2-bis-(5- γ -tocopheryl)ethane

Fig: 3 Bioactive Compounds

Pharmacological / Medicinal Uses:

Cissus quadrangularis is extensively used in traditional medicine and has been validated by several pharmacological studies.

Table: 3 Pharmacological Uses

Pharmacological Action	Description / Uses
Bone healing	Accelerates fracture healing; stimulates osteoblast activity; used in Ayurveda for bone injuries
Anti-inflammatory	Reduces inflammation; useful in arthritis and inflammatory conditions
Antioxidant	Neutralizes free radicals; protects tissues from oxidative stress
Anti-ulcer	Protects gastric mucosa; used for ulcers and acid reflux
Analgesic	Pain relieving properties
Anti-obesity	Shown to reduce body weight and lipid levels in some studies
Anti-diabetic	Helps regulate blood glucose levels
Anti-microbial	Active against certain bacteria and fungi
Anti-cancer	Some extracts show cytotoxic effects on cancer cell lines
Cardio-protective	Beneficial for heart health; reduces cholesterol and lipid levels
Hepato-protective	Protects liver from toxin-induced damage

MATERIALS AND METHODS:

Collection of Selected Plant:

Cissus quadrangularis L collected from in around Thiruvannamalai district, Tamilnadu. Collected herbs were authenticated by NATIONAL INSTITUTE OF SIDDHA MINISTRY OF AYUSH, Chennai.

Certificate No: NISMB7472025

Date: 17-03-2025

Cissus quadrangularis L (Vitaceae) (Part – Stem & Leaves)

Materials:

Soxhlet apparatus, class slide slip cover , test tube holder , test tube stands, stand with clamp , measuring cylinder, pipette , beaker, conical flask , glass rod, hot air oven ,electronic balance , grinding machine , aluminium foil ,spatula, filter

paper , funnel , tripod stand , silica crucible , cotton desiccator, microscope.

Extraction:

The plant of *Cissus quadrangularis L* were dried under shade and then powdered with a mechanical grinder. The powder was passed through sieve No: 40 and stored in an airtight container for further use.

Preparation Of Ethanolic Extract: Collect dried plant of *Cissus quadrangularis L* were cleaned with water & shade dried until a constant weight was obtained & subsequently powdered & sieved mash no 40. Powdered material 5kg was extracted with of water at 50 degree in soxhlet apparatus 1L for 72hr. dark green semi – solid residues. 525g was obtained by evaporating the extract under reduced pressure.

Materials And Methods:

Extraction of *Cissus Quadrangularis L*:

Table: 4 Nature and Colour of Ethanol Extract of *Cissus quadrangularis L*

SR. NO.	NAME OF EXTRACT	COLOUR	CONSISTENCY	YIELD %W/W
1	Ethanolic extract	Light greenish	Sticky mass liquid	23.7



Fig: 4 Ethanolic Extract of *Cissus quadrangularis L*

Preliminary Phytochemical Studies:

The leaves of *Cissus quadrangularis L* were subjected for hot continuous extraction using Ethanolic as solvent. The yield was found to be 23.7 % w/w. the extracts obtained were subjected to various phytochemical tests, to identify the active constituents, which showed the presence of, alkaloids, glycosides, flavonoids, and steroids, compounds. The results were given in table: 5

Table: 5 Results of Phytochemical Analysis of *Cissus quadrangularis* L

PHYTOCONSTITUENTS	ETHANOLIC EXTRACT
Alkaloids	+
Saponins	-
Glycosides	-
Carbohydrates	-
Tannins	-
Flavonoids	+
Terpenoids	+
Steroids	+
Phenolic compounds	-
Proteins and amino acids	-
Fixed oils and fatty acids	-
Gums and mucilage	-

+ = PRESENT

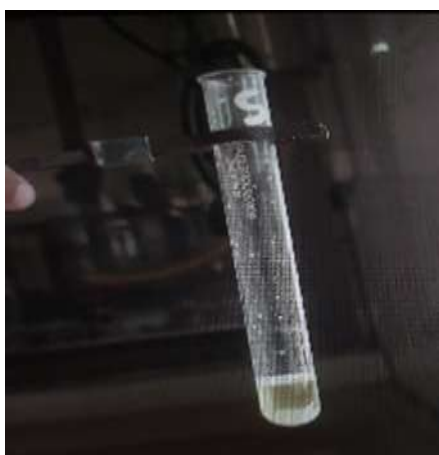
- = ABSENT



Flavonoids



Alkaloids



Terpenoids



Steroids

Fig: 5 Chemical Test

Preliminary Phytochemical Analysis:

Table: 6 Phytochemical analysis

SR. NO	PHYSIO-CHEMICAL CONSTANT	<i>CISSUS QUADRANGULARIS L</i>	LIMITS (%W/W)
1	Total Ash	6.3±1.5	Not more than 7.5
2	Acid Insoluble Ash	1.1±1.5	Not more than 2.5
3	Water Soluble Extractive	22.8±1.5	Not less than 25
4	Loss On Drying	9.5	Not more than 12

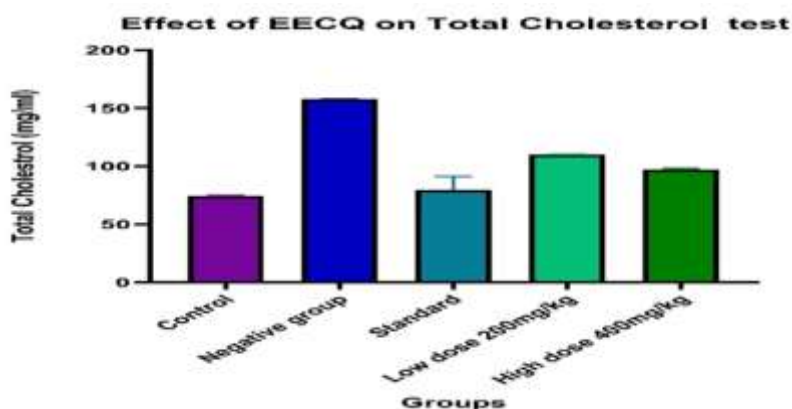
PHARMACOLOGICAL ACTIVITY:**Effect Of EECQ on Total Cholesterol:****Table: 7 Effect Of EECQ On Total Cholesterol**

SR.NO	GROUPS	Total Cholesterol (mg/ml)
1	Control	74.50 ± 0.227
2	Negative group	157.7 ± 0.165 a ****
3	Standard group	79.28 ± 5.270 a ^{ns} b ****
4	Low Dose-200mg/kg	110.1 ± 0.146 a **** b **** c ****
5	High Dose-400mg/kg	97.11 ± 0.406 a **** b **** c ***

Values are represented in Mean ± SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
- b - Group II vs Group III, Group IV, Group V
- c - Group III vs Group IV, Group V (one way ANOVA followed by Turkey test).

**Fig: 6 Effect of EECQ On Total Cholesterol****Effect Of EECQ on Total Glycerides Test:****Table: 8 Effect Of EECQ On Total Glycerides Test**

Sr. No	Groups	Total Glycerides (mg/ml)
1	Control	65.87 ± 0.317
2	Negative group	140.6 ± 0.417 a ****
3	Standard group	90.11 ± 0.166 a **** b ****
4	Low Dose-200mg/kg	118.9 ± 0.375 a **** b **** c ****
5	High Dose-400mg/kg	89.89 ± 0.194 a **** b **** c ^{ns}

Values are represented in Mean ± SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
- b - Group II vs Group III, Group IV, Group V



- c - Group III vs Group IV, Group V (one way ANOVA followed by Turkey test).

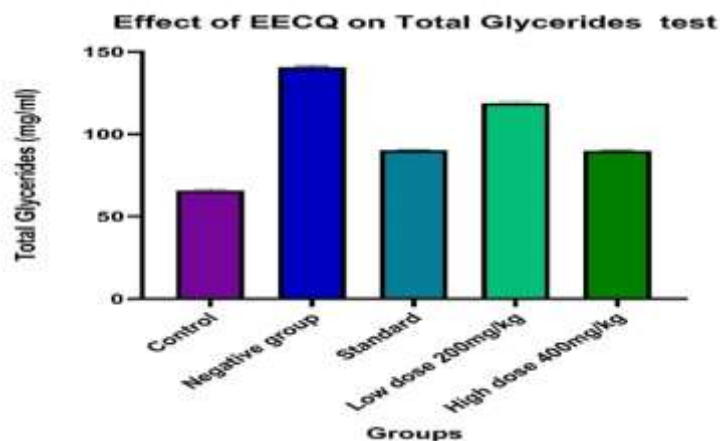


Fig: 7 Effect of EECQ On Total Glycerides Test

Effect Of EECQ on High Density Lipoprotein:

Table: 9 Effect of EECQ On High Density Lipoprotein

SR.NO	GROUPS	HDL (mg/ml)
1	Control	23.03 ± 0.126
2	Negative group	18.82 ± 0.277 a ***
3	Standard group	25.79 ± 0.229 a *** b ****
4	Low Dose-200mg/kg	22.72 ± 0.145 a ^{ns} b **** c ****
5	High Dose-400mg/kg	25.10 ± 0.291 a *** b **** c ^{ns}

Values are represented in Mean ± SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
- b - Group II vs Group III, Group IV, Group V
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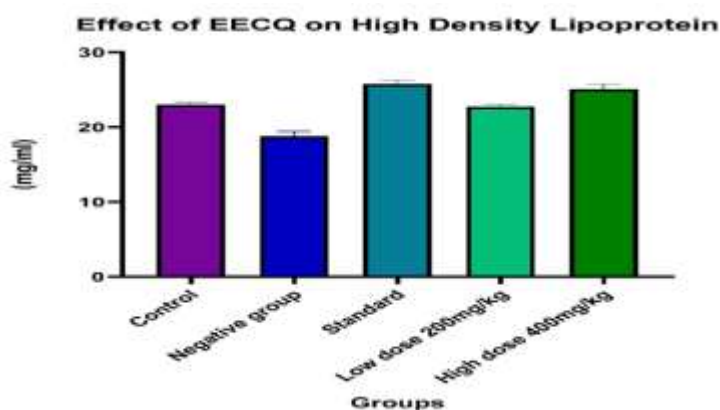


Fig: 8 Effect of EECQ on High Density Lipoprotein

Effect Of EECQ on Low Density Lipoprotein:

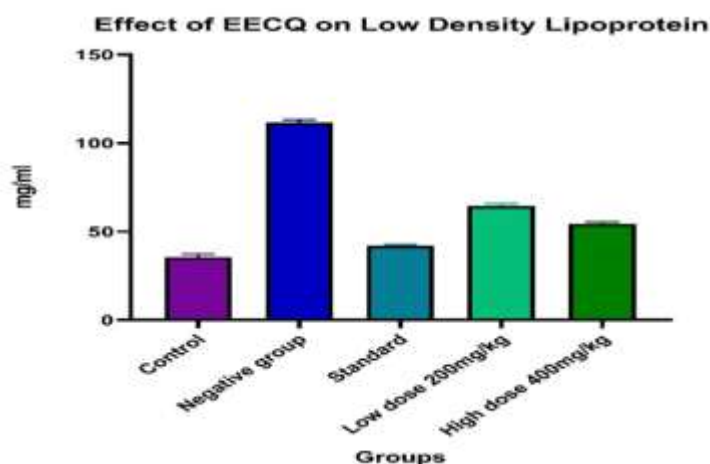
Table: 10 Effect of EECQ On Low Density Lipoprotein

SR.NO	GROUPS	LDL(mg/ml)
1	Control	35.58 ± 0.793
2	Negative group	111.7 ± 0.696 a ****
3	Standard group	41.97 ± 0.331 a **** b ****
4	Low Dose-200mg/kg	64.53 ± 0.544 a **** b **** c ****
5	High Dose-400mg/kg	54.39 ± 0.439 a **** b **** c ****

Values are represented in Mean ± SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
- b - Group II vs Group III, Group IV, Group V
- c - Group III vs Group IV, Group V (one way ANOVA followed by Turkey test).

**Fig: 9 Effect of EECQ On Low Density Lipoprotein**

Effect of EECQ on Very Low-Density Lipoprotein:

Table: 11 Effect of EECQ on Very Low Density Lipoprotein

SR.NO	GROUPS	VLDL (mg/ml)
1	Control	10.71 ± 0.120
2	Negative group	19.06 ± 0.176 a ****
3	Standard group	12.77 ± 0.207 a **** b ****
4	Low Dose-200mg/kg	14.89 ± 0.202 a **** b **** c ****
5	High Dose-400mg/kg	12.03 ± 0.277 a ** b **** c ^{ns}

Values are represented in Mean ± SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
- b - Group II vs Group III, Group IV, Group V
- c - Group III vs Group IV, Group V (one way ANOVA followed by Turkey test).

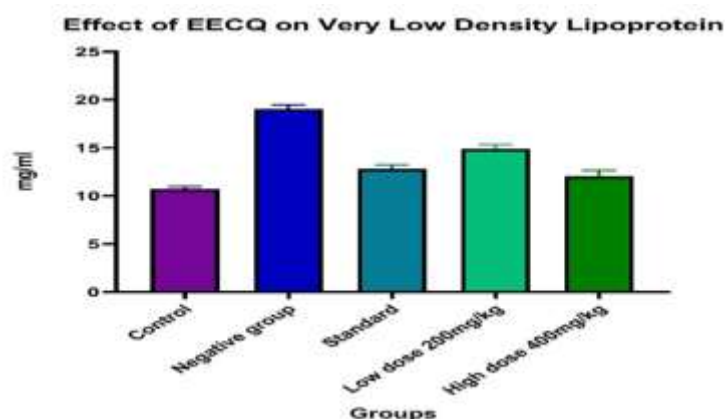


Fig. 10 Effect of EECQ On Very Low-Density Lipoprotein

EFFECT OF EECQ ON ATHEROGENIC INDEX:

Table: 12 Effect of EECQ on Atherogenic Index

SR.NO	GROUPS	Atherogenic Index
1	Control	1.420 ± 0.072
2	Negative group	3.430 ± 0.069 a****
3	Standard group	1.472 ± 0.006 a ^{ns} b****
4	Low Dose-200mg/kg	1.632 ± 0.081 a ^{ns} b**** c ^{ns}
5	High Dose-400mg/kg	0.832 ± 0.101 a*** b**** c****

Values are represented in Mean ± SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

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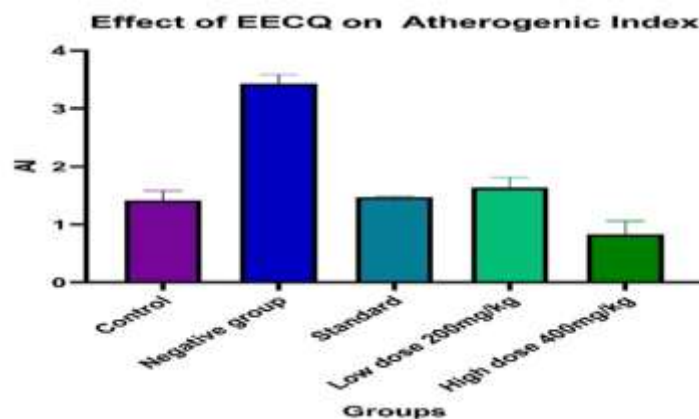


Fig. 11 Effect of EECQ on Atherogenic Index

4.4.7 EFFECT OF EECQ ON CORONARY RISK INDEX:

Table: 13 Effect of EECQ On Coronary Risk Index

S.NO	GROUPS	Coronary Risk Index
1	Control	3.412 ± 0.047
2	Negative group	18.63 ± 0.157 a****

3	Standard group	2.460 ± 0.164 a*** b****
4	Low Dose-200mg/kg	6.634 ± 0.123 a**** b**** c****
5	High Dose-400mg/kg	8.410 ± 0.121 a**** b**** c****

Values are represented in Mean ± SEM, n=5 ns-Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
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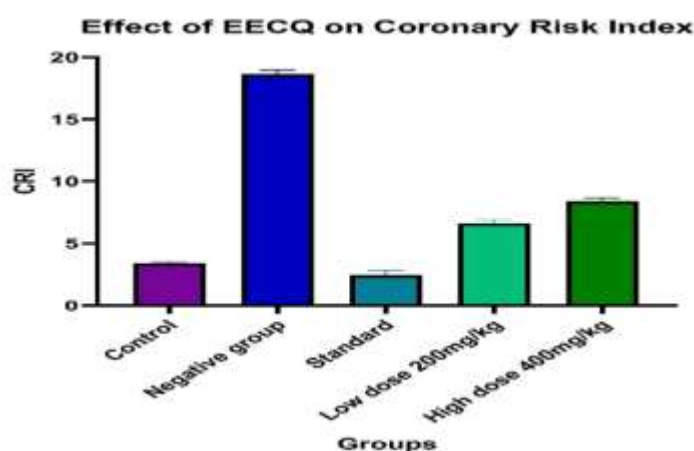


Fig: 12 Effect of EECQ On Coronary Risk Index

Effect Of EECQ On SGOT:

Table: 14 Effect of EECQ On SGOT

SR.NO	GROUPS	SGOT Unit / lit
1	Control	132.0 ± 0.359
2	Negative group	246.0 ± 0.357 a****
3	Standard group	136.3 ± 0.384 a**** b****
4	Low Dose-200mg/kg	162.4 ± 0.251 a**** b**** c****
5	High Dose-400mg/kg	153.3 ± 0.912 a**** b**** c****

Values are represented in Mean ± SEM, n=5 ns-Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
- b - Group II vs Group III, Group IV, Group V
- c - Group III vs Group IV, Group V (one way ANOVA followed by Turkey test).

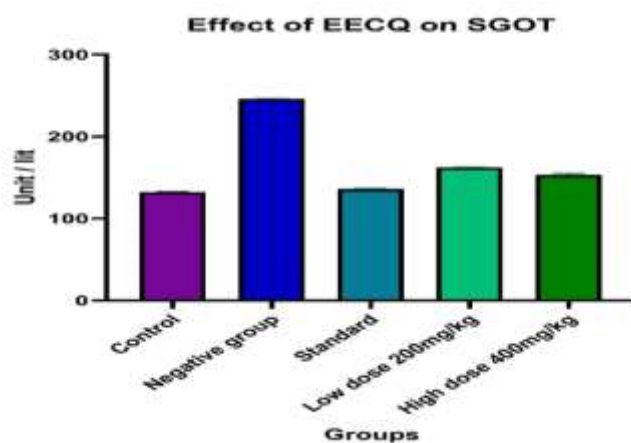


Fig: 13 Effect of EECQ On SGOT

Effect of EECQ on SGPT:

Table: 15 Effect of EECQ On SGPT

SR.NO	GROUPS	SGPT Unit / lit
1	Control	61.35 ± 0.295
2	Negative group	141.5 ± 0.421 a****
3	Standard group	64.24 ± 0.439 a*** b****
4	Low Dose-200mg/kg	101.6 ± 0.297 a**** b**** c****
5	High Dose-400mg/kg	94.84 ± 0.290 a**** b**** c****

Values are represented in Mean ± SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

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- b - Group II vs Group III, Group IV, Group V
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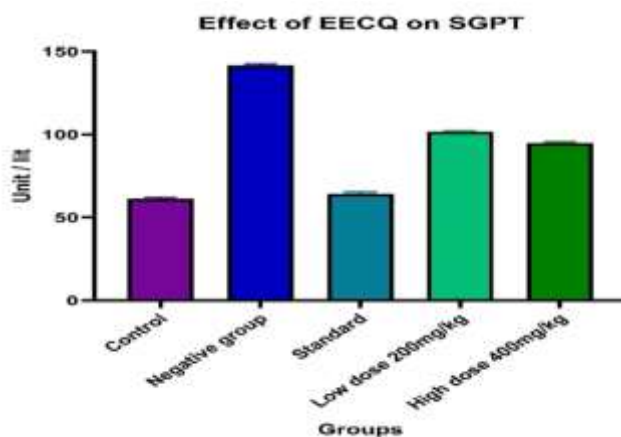


Fig: 14 Effect of EECQ On SGPT

Effect Of EECQ On MDA:

Table: 16 Effect of EECQ On MDA

SR.NO	GROUPS	MDA nmol/g
1	Control	3.402 ± 0.017
2	Negative group	8.166 ± 0.012 a****

3	Standard group	3.798 ± 0.015 a**** b****
4	Low Dose-200mg/kg	6.396 ± 0.020 a**** b**** c****
5	High Dose-400mg/kg	4.004 ± 0.016 a**** b**** c****



Values are represented in Mean $\pm$ SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
- b - Group II vs Group III, Group IV, Group V
- c - Group III vs Group IV, Group V (one way ANOVA followed by Turkey test).

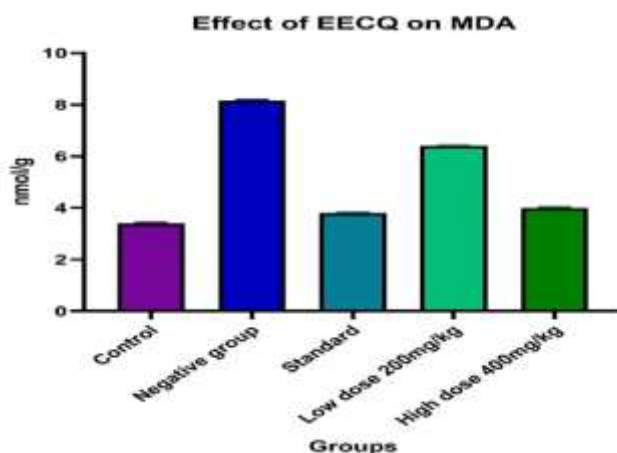


Fig: 15 Effect of EECQ On MDA

Effect Of EECQ on Catalase (CAT):

Table: 17 Effect Of EECQ On CAT

SR.NO	GROUPS	CAT Unit / mg
1	Control	58.95 $\pm$ 0.039
2	Negative group	25.40 $\pm$ 0.030 a ****
3	Standard group	52.89 $\pm$ 0.102 a **** b ****
4	Low Dose-200mg/kg	38.79 $\pm$ 0.033 a **** b **** c ****
5	High Dose-400mg/kg	49.01 $\pm$ 0.060 a **** b **** c ****

Values are represented in Mean $\pm$ SEM, n=5 ns- Non significant, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001, *****p<0.00001

Comparison:

- a - Group I vs Group II, Group III, Group IV, Group V
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- c - Group III vs Group IV, Group V (one way ANOVA followed by Turkey test).

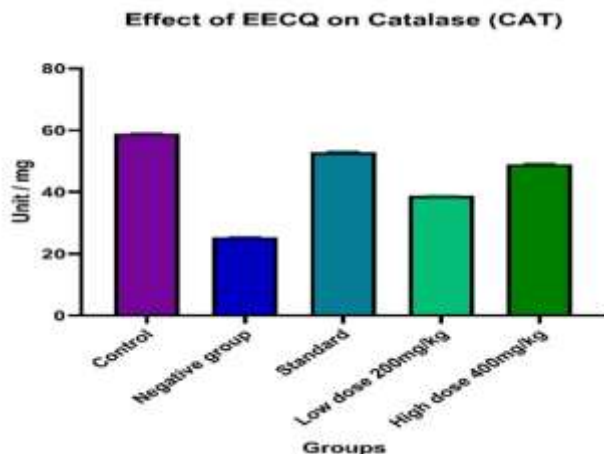


Fig: 16 Effect of EECQ On CAT



CONCLUSION:

The present study demonstrates that induction of hyperlipidemia leads to significant alterations in lipid metabolism, liver function, and oxidative stress parameters, confirming its detrimental effect on hepatic and cardiovascular health. Treatment with the standard drug successfully normalized these biochemical and histopathological changes, validating its efficacy. Importantly, the ethanolic extract of *Clerodendrum quadriloculare* (EECQ) exhibited dose-dependent antihyperlipidemic and hepatoprotective effects. While the lower dose produced moderate improvements, the higher dose showed significant reductions in cholesterol, triglycerides, LDL, and oxidative stress markers, along with an increase in HDL levels. These findings suggest that EECQ possesses promising therapeutic potential as a natural alternative for the management of hyperlipidemia and its associated complications.

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