WORLD JOURNAL OF PHARMACEUTICAL RESEARCH
SJIF Impact Factor 8.453
Volume 13, Issue 7, 298-320. Review Article ISSN 2277– 7105

HYPOLIPIDEMIC ACTIVITY OF CISSUS QUADRANGULARIS AGAINST ATHEROGENIC DIET-IINDUCED HYPERLIPIDEMIA IN EXPERIMENTAL RATS

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Article Received on
09 February 2024,
Revised on 29 Feb. 2024,
Accepted on 19 March 2024
DOI: 10. 20959/wjpr20247-31819

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INTRODUCTION

Cissus quadrangularis is a vine that grows in Africa and parts of Asia. It is one of the most commonly used medicinal plants in Thailand, and is also used in traditional African and Ayurvedic medicine. All parts of the plant are used for medicine. *Cissus quadrangularis* is used for diabetes, obesity, high cholesterol, bone fractures, allergies, cancer, stomach upset, painful menstrual periods, asthma, malaria, wound healing, peptic ulcer disease, weak bones. encultivated primarily as a garden ornamental and medicinal plant. This species escaped from cultivation and can now be found naturalized in dry forests, coastal places, forest edges, scrublands across dry, arid and semiarid habitats in tropical and warm temperate regions of the world. *Cissus quadrangularis* reaches a height of 1.5 m (4.9 ft). Each has a tendril emerging from the opposite side of the node racemes small white, yellowish, orgreenish flowers; globular berries are red when ripe. *Cissus quadrangularis* can grow in nutritionally poor soil. It cannot grow in the shade. It prefers dry or moist soil and can tolerate drought.

Most supplements come in powder, capsule, or syrup form are available at natural health shops and pharmacies. Ideally you should start with lower dose andslowly work your way up to asses your tolerance.

CHEMICAL CONSTITUENTS

Flavanoids	:	Quercetin, Daidzen, Genistein
Triterpenoids	:	Friedelin, Vitamin C

Stilbene derivatives	: Quadrangularin-A, Resveratrol, Piceatannol
Iridoids	: 6-0-meta-methoxy-benzozyl, Picroside, Catapol, Pallidol
Phytosterols	: Beta-sitosterol
Calcium	: Major constituents

Active constituents: Alpha-amyrine, Beta-amyrine, Beta-sitosterol, Stigmasterol, Resveratrol, Quadrangularin-A, 31-methyl triacontanoic acid, Iso-penta decanoic acid, Friedelan-3-one, Pallidol, Picatannol.

INTRODUCTION OF HERBAL MEDICINE IN MODERNPHARMACY

Traditional recipes for treatment of physical and mental ailments exist in all major ancient civilizations of the world. Needless to mention that the root and stem extracts of the plant *Cissus quadrangularis* have therapeutic efficacy and are known to possess antioxidant, antimicrobial activity, and are routinely used to accelerate the process of bone fracture healing. The plant is considered as a versatile medicinal plantin both Ayurvedic and modern drug development areas for its valuable medicinal uses. It is a very rich source of some minerals, which are necessary for proper functioning of human body.

PHARMACOLOGICAL ACTIVITIES

Bone healing activity

The anabolic steroid from the *Cissus quadrangularis* plant showed a markedinfluence in the rate of fracture healing by early generation of all connective tissue. *Cissus quadrangularis* contains vitamins and steroids, which are found to have specific effect on bone fracture healing.

Anti obesity activity

Cissus quadrangularis formulation called cylaris that decreased waist circumference body mass index reduced serum lipid levels.

Anti-ulcerative activity

The anti-ulcerative effect of *Cissus quadrangularis* extract on enzyme H+K+-ATPase that is deemed responsible for producing acidity in stomach is observed.

Anti-diabetic activity

Anti diabetic property of *Cissus quadrangularis* was noted where dry powder of *Cissus quadrangularis* is obtained through ethyl acetate extraction. This is tested for diabetes

induced in wister albino rats by administering alloxan.

Antioxidant and free radical scavenging activity

Methanol extract of *Cissus quadrangularis* exhibits strong antioxidant and free radical scavenging activity in in vitro and in vivo systems mainly due to the presence of β-carotene.

Gastro protective Activity

Because of its significant source of carotenoids, triterpenoids and ascorbic acid, *Cissus quadrangularis* is used for the gastrointestinal diseases in traditional medicine, and has gained significant recognition on human nutrition. Numerous studies demonstrated the impact of *Cissus quadrangularis* extract (CQE) on gastrointestinal toxicity and gastro-protective effect. This is together with its function underpinning the clinical intervention toward aspirin induced gastric mucosal damage.

Central nervous system activity

The root extract possesses stimulant CNS function suggested by decreasing exploratory actions. Methanol root extract comprises saponins that exhibit powerful sedative action and also suppress spontaneous motor action in mice.

Analgesic, anti-inflammatory and stimulatory activity

Methanol extract has analgesic, non-inflammatory and venotonic impacts with hemorrhoids, non-inflammatory activity attributable to flavonoids and β- sitosterol. β-sitosterol in methanol extract does have the potential to reduce MPO enzymes. This indicate a significant decrease in the influx of neutrophils into the inflamed tissue. Ethanol extract has beneficial effect on neutrophils triggered by aspirin-induced tissue damage in rats.

LITERATURE REVIEW

- GARIMA MISHRA et al.., the current study evaluates about CISSUS QUARANGULARIS is a succulent plant family vitaceae usually found in tropical & subtropical xeric wood. It finds application in Medicine. Some of the pharmacological use of the plant are linked to cell reinforcement, free radical search, bone regeneration, ulceration & Diuretics.

- JUSTIN RAJ et al., the present study explains about *CISSUS QUARANGULARIS* is a succulent plant of family vitaceae commonly found in tropical & sub tropical xeric wood. It is

a fleshy, cacus- like liana widely used as acommon food item in India. The plant is prescribed in ancient ayurvedic literature as tonic & analgesic. The plant is believed to be useful in helminthiasis, skin disease, leprosy, epilepsy, tumors, chronic ulcer, swelling.

- CAMEL REX M et al.., the current study evaluates about *CISSUS QUADRANGULARIS* is a fleshy plant found in major parts of the world, especially in Asia, Africa, and few other tropical regions. It is one of the common food item in India. It is used for various treatments like fracture healing,anti- ulcer, anti- fungal, analgesic, antibacterial properties.

- AYESHA SIDDIQUA el at..., the present study evaluates about succulent herbal plant belong to family vitaceae. also known as *VITAS QUARANGULARIS*, heliotropium indicum. It is used as panchana (digestive aid), sara (relieves constipation), athiyuk (strengthening bones), also used to treat gastritis etc.

- W P CASTELLI, CAN J CARADIOL el at.., the current study of *CISSUS QUADRANGULARIS* in the USA about to launch a massive campaign to identify those members of population risk for coronary artery disease (CAD).the high blood pressure campaign started in 1970s aims at identifying people with Elevated with cholesterol, nonfatal hearst attacks.

- IGWEG JC el at.., the present study evaluates about *CISSUS QUADRANGULARIS* of Dyslipidemia in menopause is a known feature in women, whether it leads to significant increase in development of coronary heart disease (CHD). This study aims to comparing the level of total serum cholesterol

PLANT INTRODUCTION

CISSUS QUADRANGULAris

TAXONOMY OF PLANT

TAXONOMY CLASSIFICATION

Kingdom	:	Plantae
Subkingdom	:	Tracheobionta
Super division	:	Spermatophyta
Division	:	Magnoliophyta
Class	:	Magnoliopsida
Sub class	:	Rosidae
Order	:	Vitales
Family	:	Vitaceae
Genus	:	Cissus
Species	:	Quadrangularis

Common names

Bengali	:	Hasjora, Harbhanga
English	:	Edible Stemmed Vine
Marathi	:	Kandavel
Tamil	:	Piranti, vajjravalli
Oriya	:	Hadavhanga
Gujarati	:	Vedhari
Hindi	:	Hadjod, Hadjora
Kanada	:	Mangarahalli
Malayalam	:	Cannalamparanta
Telegu	:	Nalleru
Urdu	:	Harjora

HABBITAT

C. quadrangularis is a succulent shrubby climber. It is vegetatively propagated mainly in the month of May to July. It requires warm tropical climate suchas the Deccan peninsula. It is also found on the lower slopes of the Western Ghats andis widespread across drier areas of Arabia and Africa.

MORPHOLOGY

Cissus quadrangularis has thick, succulent, four-sided, stems that constrict at the nodes Phyllotaxy is alternate and distichous. Leaves are three-lobed and flanked at the base by a

pair of stipules that are attached to and as wide as the elongating shoot. The simple (unbranched) tendrils are produced after and opposite leaves at each node in a continuous pattern. Petals are yellow. *Cissus quadrangularis* produces adventitious roots at nodes and is easily propagated asexually bycutting or layering. The axillary bud complex in *C. quadrangularis* is supernumerary.

DISTRIBUTION

Cissus quadrangularis (Linn) has been used by the common man in India, and neighboring countries, Pakistan, Sri Lanka, Malaysia. It is a common perennial climber, which is distributed throughout India, particularly in warm tropical regions.

DESCRIPTION

It is a climbing herb, tendrils simple, opposite to the leaves, leafless when old. Flowers small, greenish white, bisexual, tetramerous, in umbellate cymes, opposite to the leaves. Calyx is cup shaped. Fruit globose or obovoid fleshy berries, succulent, very acrid, dark purple to black, one seeded; seeds ellipsoid or pyriform. The stem is buff colored with a greenish tinge, dichotomously branched, sub- angular, glabrous, fibrous and smooth. C. quadrangularis is a succulent shrubby climber.

Stems is 4-angled, jointed at nodes, internodes are 8 to 10 cm long and 1.2 to 1.5 cm wide. Leaves are simple, lamina ovate or reniform, ±5 cm wide.

TRADITIONAL USES

The plant is prescribed in the ancient Ayurvedic literature as a general tonic and analgesic, with specific bone fracture healing properties. The plant in believed to be useful in helminthiasis, anorexia, dyspepsia, colic, flatulence, skin diseases, leprosy, hemorrhage, epilepsy, convulsion, haemoptysis, tumors, chronic ulcers, swellings. It is also used in complaints of the back and spine, muscular pains, osteoarthritis, rheumatoid arthritis and osteoporosis .It is used to treat scurvy, menstrual disorders, gonorrhea ,asthma, burns and wounds, bites of poisonous insects and for saddle sores of horses and camels, It is used for treatment of gastritis constipation, eye diseases, piles and anemia, syphilis, gout, leucorrhoea, veneral diseases, epistaxis.

UTILITY OF PLANTS

1. The herb is used for osteoarthritis, rheumatoid arthritis and osteoporosis.

2. The roots and stems are used to treat fractures of the bones.
3. The stem paste boiled in limewater is given for asthma.
4. The herb powder is administered in treatment of hemorrhoids and certain bowl infections.
5. Stem juice is used for scurvy, debilitating menstrual disorders, epistaxis.
6. The herb is fed to cattle to stimulate milk flow.
7. The strong fleshy quadrangular stem is traditionally used to treat acid reflux of gastritis, eye disorders, piles and anemia

PARTS USED MEDICINALY:FLOWERS

- Small, greenish white, bisexual, tetramerous, in umbellate cymes, opposite tothe leaves.
- Calyx is cup shaped.

FRUITS

Fruit globose or obovoid fleshy berries succulent, very acrid, dark purple toblack, one seeded. seeds ellipsoid or pyriform.

STEM

- It have fleshy quadrangular stems.
- Stem is buff coloured with greenish ting.
- It is dichotomously branched sub-angular, glaborous fibrous & smooth.

LEAVES

- Simple or lobed, cordate broadly ovate or reniform, serrate, dentate sometimes 3-foliate and glabrous.
- The leaf portion constitutes only 5%-8% of the aerial plant parts.

ROOTS

CULTIVATION AND COLLECTION

Cissus quadrangularis is a wild plant found in India, South Africa and in hot regions. These plants are not usually cultivated but due to the demand of the plants for medicine its now cultivated in some parts of the world. *Cissus quadrangularis* are mainly propagated by cuttings and the plants are collected and dried.

HYPOLIPIDEMIC ACTIVITY EXTRACTION MACERATION

Maceration is one of the widely adopted and widely used techniques that can be applied in wine making. Maceration involve soaking plant materials [coarse or powdered form] in a stoppered container along with a suitable solvent and let it be standat room temperature for a period of minimum 3 days with frequent agitation andshaking.

This process helps to soften and break the plant's cell wall to release the soluble phytochemicals which are present inside the plant cells. After 3 days, the mixture is pressed or strained by filtration.

Maceration is one of the conventional method in which heat is transferred through convection and conduction process and the selection of solvents for maceration will determine the type of components extracted from the samples.

METHODS OF EXTRACTION

1. Hydroalcholic extraction
2. Petroleum ether extraction
3. Chloroform extraction

1. HYDROALCOHOLIC EXTRACTION

In this process the coarsely powdered crude drug is placed in a stoppered container with the hydroalcoholic solvent (70% alcohol & 30% water) and allowed to stand at room temperature for a period of 32 hours with frequent agitation and the soluble matter has dissolved. The mixture is then strained, the marc(the damp solid material) is pressed and the combined liquids are clarified by filtration or decantation after standing.

2. PETROLEUM ETHER EXTRACTION

In this process the coarsely powdered crude drug is placed in a stoppered container with the petroleum ether and allowed to stand at room temperature for a period of 32 hours with frequent agitation and the soluble matter has dissolved. The mixture is then strained, the marc(the damp solid material) is pressed and the combined liquids are clarified by filtration or decantation after standing

3. CHLOROFORM EXTRACTION

In this process the coarsely powdered crude drug is placed in a stoppered container with the chloroform and allowed to stand at room temperature for a period of 32 hours with frequent agitation and the soluble matter has dissolved. The mixture is then strained, the marc(the damp solid material) is pressed and the combined liquids are clarified by filtration or decantation after standing.

FILTRATION PROCESS

EXPERIMENTAL PROCEDURE

EXPERIMENTAL PROCEDURE

ANIMAL

Wister albino adult male rats weighing 150-200g from animal housing facility of Vels university were housed in Chennai. Polypropylene cages maintained with temperature 27°C ±1°C and 12 hours light and dark cycle. The animals were allowed to adapt to the environment for 7 days and supplied with a standard pellet diet (sai durga foods, banglore) and water *ad libitum.* The experimental protocol has got the approval IAEC bearing no.

CHEMICALS

Atorvastatin obtained from local pharmacy (periyandavar medical). Diagnostic kits for estimation were purchased from Merck diagnostic india ltd. anesthetic ether, Ethyl acetate and Ethanol (SD chemical Mumbai).

ATHEROGENIC DIET

Experimental hyperlipidemic diet

Experimental diet consist of well pulverized mixture of cholesterol-400mg/kg, cholic acid-50mg/kg and coconut oil. This mixture is made into paste like molds and isfeeds to the rats.

TREATEMENT WITH ATHEROGENIC DIET

The prepared atherogenic diet was used in place of normal pellet diet to all the groups except control. Rats were exposed to atherogenic diet and water *ad libitum* for 20 days and were used to study the effect of drug against experimental hyperlipidemia.

PHARMACOLOGICAL EVALUATION

All animals starved for 18 hours and provided water *ad libitum* before the experiment.

The animals were divided into five groups of six rats each.

- Group 1 served as normal control administered with 2%CMC only
- Group 2 served as hyperlipidemic control rats received atherogenic diet.
- Group 3 and 4 served as test groups received 200mg/kg and 400mg/kg respectively
- Group 5 served as Atorvastatin (10mg/kg /day) considered as standard. All the groups except the normal control group administered received atherogenic diet after inducing the hyperlipidemia, the respective treatment was continued for 7 days. Animals were given standard pellet diet and water *ad libitum.*

Collection of blood

The next day after the completion of experimental study, the blood was taken from the rats under mild anesthetic state by retro orbital sinus puncture. The collected blood samples were centrifuged (2500 rpm) for 10 minutes. Then serumsamples were separated and it was used for various biochemical analyses. Then animals were sacrificed and the liver, heart and kidney were taken for histopathological study.

Liver lipid extraction

The liver was homogenized in cold 0.15M KCl and extracted with CHCl3:CH3OH (2% v/v). This lipid extract was used for the estimation of lipid parameters.

Biochemical analysis

The serum and liver were analyzed for serum total cholesterol, triglycerides, high-density

lipoprotein (HDL), low-density lipoprotein (LDL), very low- density lipoprotein (VLDL) by standard enzymatic calorimetric methods.

Histopathology

All rats were sacrificed after the collection of blood sample. Liver was excised from the rats to visually detect gross lesions, and weighed to determine weight variation and preserved in 10% neutral formalin for histopathological assessment.

The tissue was embedded in paraffin, and then sectioned, stained with haematoxylin and eosin and were examined microscopically Statistical evaluation All the values were expressed as mean ± standard error of mean. The data were statistically analyzed by one-way ANOVA followed by Dennett's t-test, and value P < 0.05 was considered to be significant.

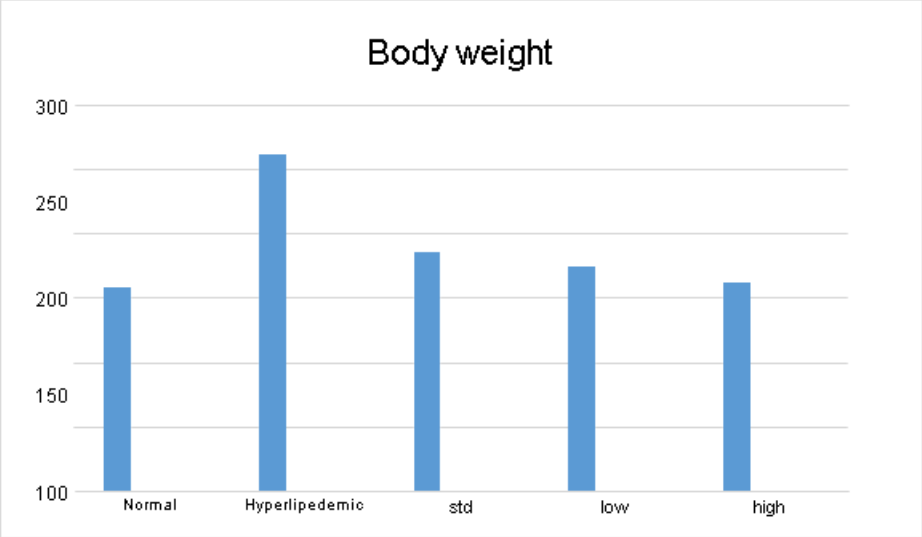
Statistical evaluation

All the values were expressed as mean ± standard error of mean. The data were statistically analyzed by one-way ANOVA followed by Dennett's t-test, and value P <0.05 was considered to be significant.

Table 1: Effect of *CQ* on body weight of atherogenic induced hyperlipidemic rats.

S. No	Groups	Body weight
1	Normal control	159.64±3.31
2	HyperlipidicControl	262.80±1.23
3	CQ 200mg/kg	186.93±2.44*
4	CQ 400mg/kg	174.93±0.98*
5	Atorvasatin (10mg/kg/day)	162.95±0.98**

All the values were represented as mean±SEM. All the data were statistically analyzedby one-way ANOVA followed by Dunnett's test and values*p<0.5* were considered to the significant.*p<0.001;**p<0.01 vs control,



All the values were represented as mean±SEM. All the data were statistically analyzedby one-way ANOVA followed by Dunnett's test and values*p<0.5* were considered to the significant.*p<0.001;**p<0.01 vs control.

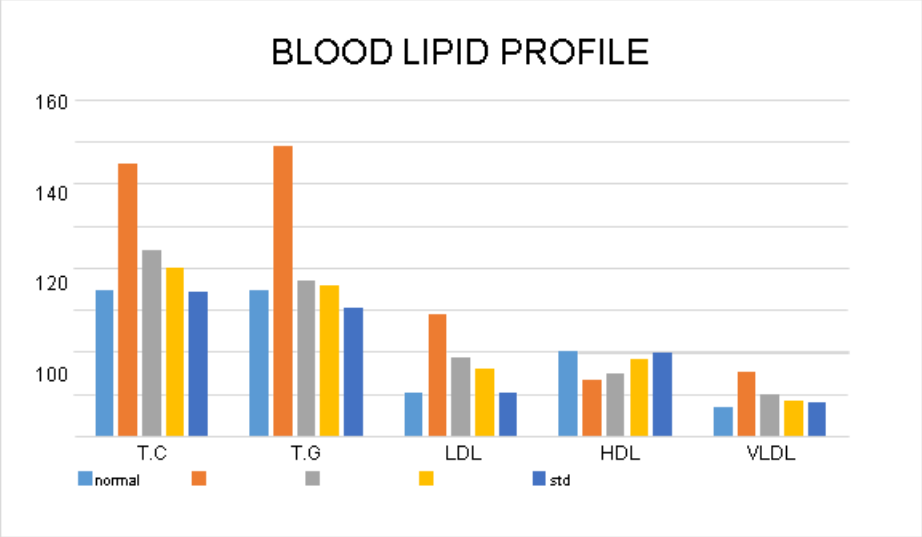
Total body weight in the hyperlipidemia-induced group have significantly increasedcompared to normal rats. The values have risen to 262.80±1.23 mg/dl compared to Group I (normal rat group), in which values lie in the range 159.64±3.31 mg/dl.

This indicates hypercholesterolemia. In the treatment group treated with CQ (200 mg/kg) and CQ (400 mg/kg), the values are reduced 186.93±2.44 ($P < 0.001$) and 174.93±0.98 mg/dl ($P < 0.01$), respectively. There is a significant reduction in total cholesterol values in CQ treatment group. On the other hand, atorvastatin also has significantly reduced serum total cholesterol levels to 162.95±0.98 mg/dl ($P < 0.001$) [Table 1].

Table 2: Effect of *CQ on* Blood lipid profile of atherogenic –induced hyperlipidemic rats.

Group	Treatment	T.C.	T.G.	LDL	HDL	VLDL
I	NormalControl	70.93±1.33	70.66±1.61	21.93±1.42	41.83±1.57	14.86±1.16
II	HyperlipiicControl	130.67±1.49	138.67±1.63	58.67±1.39	27.67±1.22	31.95±1.65
III	CQ 200mg/kg	89.86±1.37*	74.99±1.13*	38.67±1.48*	30.83±0.98*	20.83±0.94*
IV	CQ400mg/kg	80.85±1.69*	72.97±0.98*	32.83±1.16*	37.75±1.28*	17.67±1.39*
V	Atovastatin10Mg/kg	69.7±1.26**	61.96±1.44**	21.98±1.29*	40.83±1.50*	16.99±1.97**

All the values were represented as mean±SEM. All the data were statistically analyzedby one-way ANOVA followed by Dunnett's test and values*p<0.5* were considered to the significant.*p<0.001;**p<0.01 vs control.



Total cholesterol levels in the hyperlipidemia-induced group have significantly increased compared to normal rats. The values have risen to 130.67±1.49 mg/dl compared to Group I (normal rat group), in which values lie in the range 70.93±1.33 mg/dl. This indicates hypercholesterolemia. In the treatment group treated with CQ (200 mg/kg) and CQ(400 mg/kg), the values are reduced to 89.86±1.37 ($P < 0.001$) and 80.85±1.69 mg/dl ($P < 0.01$), respectively. There is a significant reduction in total cholesterol values in CQ treatment group. On the other hand, atorvastatin also has significantly reduced serum total cholesterol levels to 69.7±1.26 mg/dl ($P < 0.001$) [Table 1].

The TG levels have reached as 138.67±1.63 mg/dl in hyperlipedemia-induced group compared to normal rats where the values are 70.66±1.61 mg/dl. This indicates triglyceridemia. In the group treated with CQ (200 mg/kg) and (400 mg/kg), the values are significantly reduced to 74.99±1.13 mg/dl ($P < 0.01$) and 72.97±0.98 mg/dl ($P < 0.01$), respectively. In the atorvastatin treated group, the values are reduced to 61.96±1.44 mg/dl ($P < 0.001$) [Table 1].

LDL-cholesterol in atherogenic-induced group has significantly increased to 21.93±1.42 mg/dl compared to normal rat group, 58.67±1.39 mg/dl. In the group treated with CQ(200 mg/kg) and (400 mg/kg), the values were reduced to 38.67±1.48 and 32.83±1.16 mg/dl ($P < 0.001$), respectively. There is a significant reduction in LDL-cholesterol values in CQ treatment group. atorvastatin has significantly reduced LDL-cholesterol level to 21.98±1.29 mg/dl ($P < 0.001$) [Table 1].

HDL-cholesterol in atherogenic -induced group has significantly decreased compared to normal rats. The values have reduced to 41.83±1.57 mg/dl compared to normal rat group, 27.67±1.22 mg/dl. In the group treated with CQ(200 mg/kg) and (400 mg/kg), the values were 30.83±0.98 ($P < 0.01$) and 37.75±1.28 mg/dl ($P < 0.01$), respectively. In atorvastatin treated group, the values were 40.83±1.50 mg/dl ($P < 0.001$) [Table 4].

VLDL-cholesterol in atherogenic-induced group has significantly increased to 31.95±1.65 mg/dl compared to normal rat group, 14.86±1.16 mg/dl. In the group treated with CQ (200 mg/kg) (400 mg/kg), the values are reduced to 20.83±0.94 ($P <0.01$) and 17.67±1.39 mg/dl ($P < 0.01$), respectively. There is a significant reduction in CQ treatment group. atorvastatin has significantly reduced VLDL-cholesterol level to 16.99±1.97 mg/dl ($P < 0.001$) [Tables 1].

Table 3: Effect of *CQ on* liver lipid profile of atherogenic -induced hyperlipidemic rats.

Group	Treatment	T.C	T.G.	LDL	HDL	VLDL
I	NormalControl	81.67±0.99	76.95±1.99	22.67±1.84	42.67±0.98	19.99±1.38
II	Hypolipidemic Control	162.67±1.22	164.97±1.60	51.75±2.56	27.65±1.17	41.6±0.99
III	CQ200mg/kg	88.65±0.99*	90.65±1.17*	39.62±1.15*	31.99±0.99*	28.72±0.79*
IV	CQ 400mg/kg	81.8±0.99*	80.62±1.11*	26.8±1.20*	40.55±1.54*	19.98±1.26*
V	Atorovastatin(10mg/kg/day)	79.55±1.11*	73.75±1.29*	23.99±1.45*	39.6±1.13*	18.6±0.99*

All the values were represented as mean±SEM. All the data were statistically analyzed by one-way ANOVA followed by Dunnett's test and values*p<0.5* were considered to the significant.*p<0.001;**p<0.01 vs control, Total cholesterol levels in the hyperlipidemia-induced group have significantly increased compared to normal rats. The values have risen to 162.67±1.22 mg/dl compared to Group I (normal rat group), in which values lie in the range 81.67±0.99 mg/dl. This indicates hypercholesterolemia. In the treatment group treated with CQ (200 mg/kg) and CQ(400 mg/kg), the values are reduced 88.65±0.99 ($P < 0.001$) and 88.65±0.99 mg/dl ($P < 0.01$), respectively. There is a significant reduction in total cholesterol values in CQ treatment group. On the otherhand, atorvastatin also has significantly reduced serum total cholesterol levels to 79.55±1.11 mg/dl ($P < 0.001$) [Table 1].

The TG levels have reached as 164.97±1.60 mg/dl in hyperlipedemia-induced group compared to normal rats where the values are 76.95±1.99 mg/dl. This indicates triglyceridemia. In the group treated with CQ (200 mg/kg) and (400 mg/kg), the values are significantly reduced to 90.65±1.17 mg/dl ($P < 0.01$) and 80.62±1.11 mg/dl ($P <0.01$), respectively. In the atorvastatin treated group, the values are reduced to73.75±1.29 mg/dl ($P <$

0.001) [Table 1].

LDL-cholesterol in atherogenic-induced group has significantly increased to 51.75±2.56 mg/dl compared to normal rat group, 22.67±1.84 mg/dl. In the group treated with CQ(200 mg/kg) and (400 mg/kg), the values were reduced to 39.62±1.15 and 26.8±1.20 mg/dl (P < 0.001), respectively. There is a significant reduction in LDL- cholesterol values in CQ treatment group. atorvastatin has significantly reduced LDL- cholesterol level to 23.99±1.45 mg/dl (P < 0.001) [Table 1].

HDL-cholesterol in atherogenic -induced group has significantly decreased compared to normal rats. The values have reduced to 27.65±1.17 mg/dl compared to normal rat group, 42.67±0.98 mg/dl. In the group treated with CQ(200 mg/kg) and (400 mg/kg),the values were 31.99±0.99 (P < 0.01) and 40.55±1.54 mg/dl (P < 0.01), respectively. In atorvastin treated group, the values were 39.6±1.13 mg/dl (P < 0.001) [Table 4].

VLDL-cholesterol in atherogenic-induced group has significantly increased to 41.6±0.99 mg/dl compared to normal rat group, 19.99±1.38 mg/dl. In the group treated with CQ (200 mg/kg) and (400 mg/kg), the values are reduced to 28.72±0.79 (P < 0.01) and 19.98±1.26 mg/dl (P < 0.01), respectively. There is a significant reduction in CQ treatment group. atorvastatin has significantly reduced VLDL-cholesterol level to 18.6±0.99 mg/dl (P < 0.001) [Tables 1]

HISTOPATHOLOSY STUDY

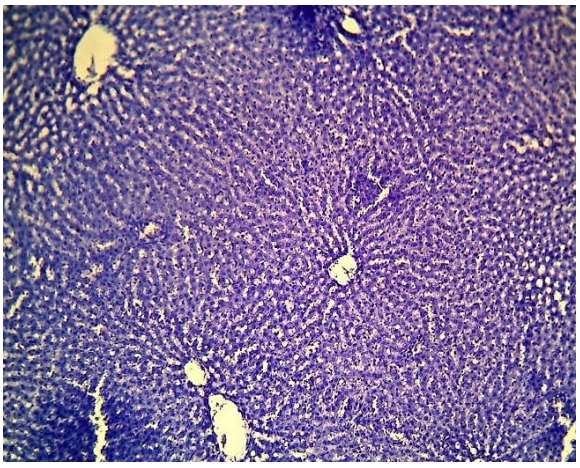


Figure 1: Normal Control Rat.

Section of liver parenchyma with hepatocyte which appear normal, and centralvein & portal tract are normal.

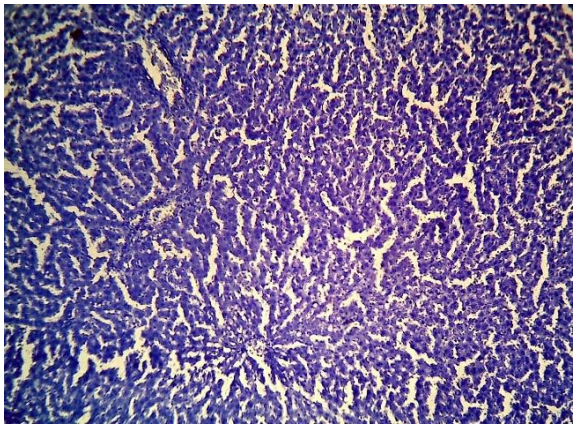


Figure 2: Hyperlipedemic Control.

Section of liver parenchyma with scattered focal area of necrosis of hepatocye.

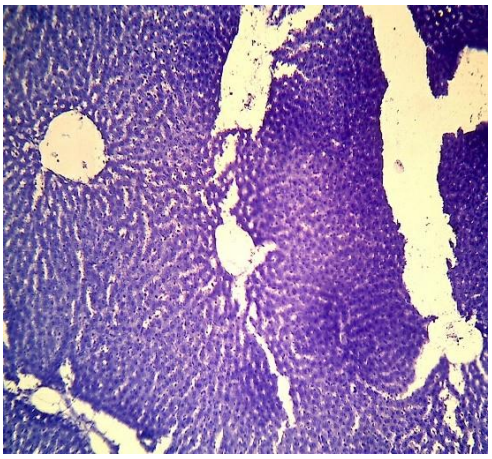


Figure 3: Positive Control.

Section of liver parenchyma shows normal

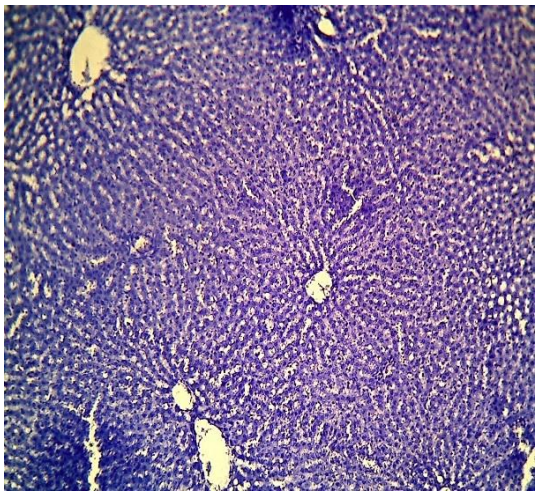


Figure 4: Treatment group (4) Rat.

Section of liver parenchyma with minimal necrosis, and minimal inflammation

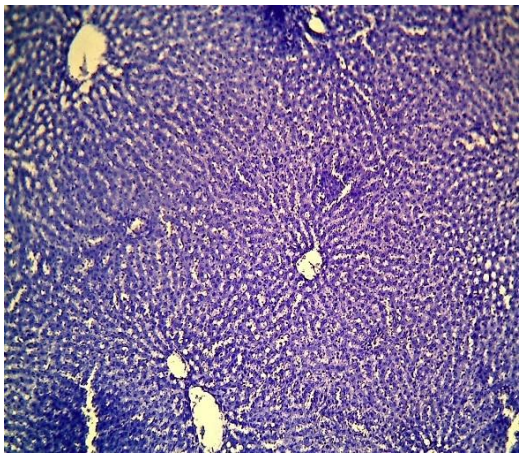


Figure 5: Treatment group (5) Rat.

Section of liver parenchyma with hepatocyte which appear normal, and central vein & portal tract are normal.

DISCUSSION

The reduction in cholesterol may indicate the increased oxidation of mobilized fatty acids by inhibition or lipolysis. The present investigation showed that all atherogenic induced rats displayed hyperlipidemia as shown by their elevated levels of serum and liver cholesterol, triglyceride, VLDL, LDL and also the reduction in the HDL level. Literature reveals that an increase in HDL cholesterol and decrease in TC, LDL cholesterol and TG is associated with a decrease in the risk of ischemic heart diseases. In general, consumption of more fat may lead to the production of increased VLDL, resulting in the formation of maximum amounts of LDL which may stick to the walls of the blood vessels causing blockages for the normal flow of blood. The strong association between the risk of coronary artery diseases (CAD), high levels of LDL-C and low levels of HDL-C has been well established. Atherogenic has been widely used to block the clearance of triglyceride-rich lipoproteins to induce acute hyperlipidemia particularly, in rats it has been used for screening natural or chemical hypolipidemic drugs. The results showed that *CQ* produced a significant reduction in cholesterol level and also it reversed atherogenic induced hypolipidemic in rats. Similarly, *CQ* at a dose of 200 and 400mg/kg significantly lowered both plasma triglycerides and cholesterol levels. The reduction of total cholesterol by the *CQ* at the dose level of 200 and 400 mg kg may be associated with a decrease of LDL, which is the ultimate aim of many hypolipidemic agents.

This study suggests that cholesterol-lowering activity of the *CQ* may increase the fecal excretion of bile acids and neutral sterols with the consequent reduction of hepatic cholesterol because of its use in the biosynthesis of these bile acids. These fractions also slow down the rate of diffusion through the intestinal mucosa thereby reducing the absorption of cholesterol and triglycerides.

EVALUATION CERTIFICATE

This is to certify that the Dissertation work entitiled "HYPOLIPIDEMIC ACTIVITY OF CISSUS QUADRANGULARIS AGAINST ATHEROGENIC DIET INDUCED HPERLIPIDEMIA IN EXPERIMENTAL RATS" submitted by *Asso. Prof. Selva K, M.Pharm, ASLIN NISHA. T [561856007], JOBIN GEORGE. B [561856013], KALAYARASI. A [561856014], RITHICK RAJ.R [561856027].To the Tamilnadu Dr.MGR MEDICAL UNIVERSITY, CHENNAI in partial fulfillment for the Degree of Bachelor of Pharmacy is a bonafide work carried out by the candidate in the Department of Pharmacology, Sri Ram Nallamani Yadava College Of Pharmacy Tenkasi and was evaluated by us, during the Academic year 2021-2022

ACKNOWLEDGEMENT

We solemnly express our heartiest thanks to our honourable respected Principal, Dr.P.THIRUPATHY KUMARESAN, M.Pharm, Ph.D., for providing us the support and to have the extensive use of the college facilities to complete our project work.

We are much thankful to vice principle, Prof.Mrs. K.SENIKANI, M.Pharm., Associate Professor, Department of Pharmacology for their help and suggestions during our project work.

Next, We take this opportunity to express, our deep sense of gratitude to our respected and beloved teacher, Who was also our enthusiastic guide, Mrs. K.SELVA, M.Pharm., Associate professor, Department of Pharmacology, for providing us with innovative and impressive ideas tocomplete our project work successfully.

We express our sincere thanks to all the Teaching and Non-Teaching Staff members of Department of Pharmacology for their help in our project.

We also extend our warm thanks to our beloved Parents and our Family Members for their unconditional love and support, and also were a backbone for us to complete our project.

We would like to thank our Friends and our entire batch, for their support.

Last but not least, We humbly submit our dissertation work into the hands of Almighty who is the source of all knowledge and wisdom.

Dedicatied To Beloved Our Parents Teachers, God & Friends Hypolipidemic Activity Of Cissus Quadrangularis Against Atherogenic Diet-Induced Hyperlipidemia In Experimental Rats.

AIM & OBJECTIVE

To study the hypolipidemic activity of *cissus quadrangularis* against atherogenic diet-induced hyperlipidemia in experimental rats.

CONCLUSION

The results obtained from the pharmacological screening have led to the conclusions that, it have significant antihyperlipidemic activity. Hence it can be exploited as antihyperlipidemic therapeutic agent or adjuvant in existing therapy for the treatment of hyperlipidemia. Further study by measurement of heparin-releasable plasma LPL activity and LCAT activity is significant can be undertaken.

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