Curry Leaf (*Murraya Koenigii*) In Hyperlipidiemia, Cholesterol Reduction

Syeda Fizza Noor

[1]*Faculty of Pharmacy and Pharmaceutical Sciences, University of Karachi Pakistan*

ABSTRACT:

Curry leaves (*Murraya koenigii*) is a commonly used herb in many foods because of it's tempting aroma and flavor, more over it has been use over a decade for its therapeutic benefits in treating various diseases and had abundance in many fruitful constituents including alkaloids which plays an important role in curing diseases and boasting health. Talking about hyperlipidiemia which been a major concern of today's world giving rise to many other health related diseases i.e; Cardiovascular, kidney related diseases, obesity etc effecting overall lifestyle. To reduce or replace the use of medication one can prevent it by natural herbs, diet and physical exercise taking note on curry leaves which can be a beneficial part in reducing cholesterol majorily the carbazole alkaloids (Mahanimbine, Mahanine), flavonoids (myricetin, quercetin and catechin), Saponins, Terpenes and polyphenols present in curry leaves, which can be extracted, isolated for the treatment of cholesterol replacing or avoiding the complexibilities in the future.

KEY WORDS: Curry leaves, hyperlipidiemia, flavonoids

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Address of Correspondence:
Email: syedafizzanoor@gmail.com

INTRODUCTION:

Curry leaf:

- English name: Curry leaf
- Urdu name: Kari patta or Meetha neem
- Scientific name: *Murraya koenigii*
- Synonym: *Bergera koenigii*
- Family: Rutaceae

It consists of almost 150 genera and 1600 species, it is a small tropical to sub-tropical tree or shrub valuable for their volatile oils and alkaloids(1).



Fig:1 Curry leaf

Categorization:

There are 14 chemotypes having 3 major categories based on leaf essential oil chemical profiles:

1. Monoterpenoids (7 chemotypes)

2. Sesquiterpinoids (3 chemotypes)
3. Mono and sesquiterpinoids predominant oils (4 chemotypes) (2)

These chemotypes helps the consumer to select the leaf according to their taste buds and requirement of essential oil making it specific for their need as well as for the research to select them according to the quality, quantity and characteristics requirements for a better experience with less expenditure(3).

Occurrence:

Murraya koenigii, commonly known as curry-leaf tree, is a native of India subcontinent and Southeast Asia including Sri Lanka, Myanmar, Indonesia, Southern China and Hainan, this aromatic plant is widely cultivated for its fragrant leaves which are a staple in South Asian cuisine(4, 5). Talking about Pakistan, Curry leaves are a prominent part of many dishes in Pakistan mostly used in desi tarkas and providing a distinct, slightly bitter and citrusy flavour(6, 7).

Plant:

A deciduous shrub or tree up to 6 m in height and 15-40 cm in diameter with short trunk, thin smooth grey or brown bark and dense shady crown. It features pinnate, glossy green leaves, white flowers and shiny black, single seeded berries. It thrives in full sun, well-drained soil and warm climates(7).

Leaves are 15-30 cm long each bearing 11-25 leaflets alternate on rachis, 2.5-3.5 cm long ovate lanceolate with an oblique base. Margins irregularly serrate, petioles 2-3 mm long, they have a slightly pungent, bitter and feebly acidic taste, and they retain their flavor and other qualities even after drying(7, 8).

Constituents and their role:

The main purpose of this review is to provide the literature about the phytochemical and active compounds responsible for its antihyperlipidiemia effect which is still unclear and required more research to brigde the gap between herbal and medicinal use in treating cholesterol(9, 10).

A deeper exploration of these compounds will help clarify their role in treating various health conditions not only hyperlipidiemia but also promoting the safe, standardized use of this plant in clinical practice(11). These includes:

Alkaloids:

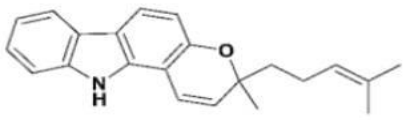
Alkaloids are organic compounds that include one or more nitrogen atoms in a heterocyclic ring. The alkaloid present in Curry leaf are carbazole alkaloids including mahanine, mahanimbine and koenimbine(12).

Uses:

They offers potent antidiabetic, antioxidant and anti- inflammatory properties. They are used to manage digestive issues (diarrhoea, dysentery), reduce blood sugar, support cardiovascular health and inhibit cancer cell growth(13).

In cholesterol:

Carbazole alkaloids like mahanimbine reduce cholesterol by inhibiting accumulation of LDL and fat in blood vessels, have antioxidant properties reduce oxidative stress, support CDV Health and lowering triglycerides(14).



Mahanimbine

Flavonoids:

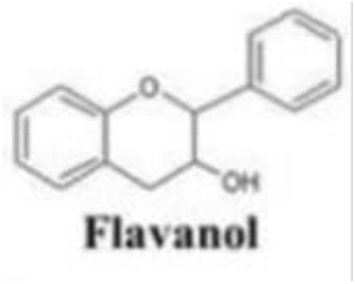
Curry leaves are rich in flavonoids particularly myricetin, flavanol and quercetin. Flavonoids are secondary metabolites that are phenolic and are produced by plants as a defensive mechanism. They are responsible for the production of aromatic compounds and the pigmentation of fruits and plants(15).

Uses:

Myricetin and Quercetin help neutralize free radicals, reduces inflammation and lower chronic disease risk. Similar to alkaloids they supports cardiovascular health, improve digestion, promote hair growth and help regulate blood sugar levels due to their potent antioxidant and anti-inflammatory properties(16).

In cholesterol:

Quercetin, catechin and rutin have antioxidant and cholesterol lowering effects, reduces LDL, and triglycerides while increasing HDL.



Polyphenols:

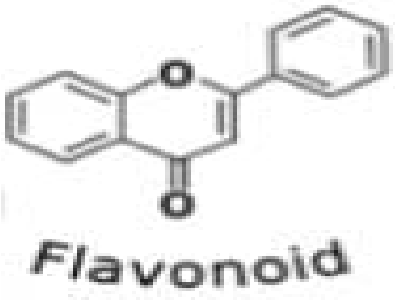
It consists of phenolic acids, flavonoids, tannins, lignans, and coumarins. These bioactive compounds provides significant health benefits(17).

Uses:

They help fighting oxidative stress, managing diabetes, reducing cholesterol, combating inflammation and acting as natural food preservatives.

In cholesterol:

Same as flavonoids, polyphenols also reduces LDL and triglycerides and have significant antioxidant behaviour(18).



Terpene compounds:

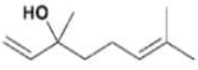
Curry leaves are a rich source of volatile essential oils dominated by monoterpenes and monoterpene hydrocarbons. These terpenoid compounds are responsible for the distinct aroma, flavour and various therapeutic properties of the plant. They exist in a wide range of forms and varieties (Myrcene, Linalool, Elemol, Geranyl acetate)(19).

Uses:

These compounds have antibacterial, antifungal, antioxidant activities. Act as a hair growth tonic, insect repellent and digestive aid, also utilize in skin care, oral hygiene and as a culinary flavouring agent with somewhat harmful side effects(20, 21).

In cholesterol:

Similarly terpenes with other phytochemicals help reduce cholesterol by lowering total cholesterol, LDL and triglycerides.



Linalool

Applications:

Benefits of curry leaf:

- Curry leaves are abundant in **fiber.** It promotes our digestive health and regular bowel movements. It is useful in treating diarrhoea and nausea and also controls the blood glucose levels in the body(22).

  Curry leaves are a source of **high concentration of proteins** is essential for the proper growth and development of the body and strengthens our immune system.

Curry leaf is a powerhouse of **Calcium** helps in improving bone health, strengthening the teeth and preventing diseases like osteoporosis and osteomalacia(23).

Curry leaves are also an excellent source of Phosphorous one of the most important nutrients in curry leaves, it helps in cleansing the kidneys, preserves normal heart beat and lessen painful muscle spasm after exercise. It is also used for the growth and repair of cells and tissues.

Not only minerals and vitamins, curry leaves are also a source of number of volatile essential oils like α-pinene, sabinene, β-pinene, α terpinene etc having anti-inflammatory, anti-bacterial, anti-diabetic, anti-dysenteric, carminative and digestive properties beneficial for the hair, skin and oral health. It is also effective against hyperglycemia, high cholesterol and aids in digestion.

Medicinal uses:

1. Curry leaves have antibacterial properties against Proteus vulgaris, Bacillus subtilis, and Corynebacterium pyogene.
2. It also have Anti-inflammatory and Anti- oxidant properties.
3. It cues the skin
4. Relives oxidative stress.
5. Helps to treat diabetes by reducing blood glucose and promoting insulin sensitivity.
6. It also act as hepatoprotective agent.
7. Have antihyperlipidiemic effect.
8. Prevent anemia.
9. Promote eye health and is good for vision.
10. Helps in reducing weight treating obesity.
11. It aids in digestion treating many GI disorders.
12. Also promote dental and bone health, and many more(24).

Industrial uses:

1. Essential oils from curry leaves plant can be added to erythema and sun protection lotions.
2. Volatile oil, crystalline glycoside, and murragin derived from the blossoms are used in different industrial products.
3. Used for aromatherapy by soap and other cosmetic products.
4. Different components in curry leaf (carotene, folic acid, riboflavin, calcium and zinc) are used to make supplements beneficial to dental health and can also be used to make mouth washes.
5. The extract from the seed of curry leaf plant can be used in skin care product as a lightening and softening agent due to the presence of flavonoids, phenol and vitamin C reducing hyperpigmentation as well as due to its antioxidant properties and presence of mahanimbine regulating melanin synthesis, All these are formulated in the form of creams, lotions, serums and herbal masks making it a valuable component in cosmetic industry.

Effect on Cholesterol:

Cholesterol is a 27 carbon essential sterol and a type of fat that is present virtually in all cell membrane of body cells predominantly in liver (80%) and intestines. Its main function in body is not only to provide cell integrity and fluidity but also facilitates in transportation of phospholipids, producing steroid hormones (aldosterone, cortisol etc), vitamin D and bile acids. Its synthesis and excretion are tightly regulated as small deviation from the range result in serious consequences.

Cholesetrol formation:

It synthesis occur in the cytosol and the smooth endoplasmic recticulum. It is complex energy consuming process involving about 30 steps. The biosynthesis pathway is known as Mevalonate pathway(25).

Cholesterol HOMEOSTATSIS:

The body keeps cholesterol at a strict balance by regulating its synthesis, uptake and excretion, these pathways includes:

1. SREBP Pathway (Transcriptional control)
2. HMG-CoA Reductase regulation (Post-Translational control)
3. LDL Receptor Regulation (Uptake control)

In body, there are two carrier proteins for transportation of cholesterol:

a) Low density proteins (LDL)
b) High density protein (HDL)

LDL “referred as bad cholesterol” is primary carrier of cholesterol in blood. Oxidation of LDL by free radicals leads towards a hard plaque formation in the arteries due to which risk of heart attack and stroke increases(10).

On the other hand, HDL that is called as “good quality cholesterol” helps to remove excess cholesterol from the body and prevents plaque formation thus minimizing chances for cardiovascular disorders.

Two key enzymes are of prime importance:

a) **HMG-CoA** (3-hydroxy-3-methylglutaryl coenzyme A) reductase; the rate limiting enzyme engaged in cholesterol biosynthesis
b) **ACAT** (acyl CoA: cholesterol O-acyltransferase) which participates in esterification of cholesterol in body tissues(10).

Drugs used for cholestrol reduction:

Drugs to reduce cholesterol particularly LDL includes:

a) **Statins** (HMG-CoA Reductase Inhibitors) a first line treatment. It lowers cholesterol production in the liver. E.g Atrovastatin, Rosuvastatin etc.
b) **Selective cholesterol absorption inhibitors**. E.g Ezetimibe.
c) **PCSK9 Inhibitors** E.g Alirocumab, Evolocumab etc.
d) **Fibrates** used to lower triglycerides and can slightly raise HDL E.g Fenofibrate, Gemfibrozil etc.
e) **Resins** forced the liver to use body cholesterol to form bile E.g cholestyramine, colesevelam etc.
f) **Nicotinic acid** (Vitamin B) improves overall lipid profile.

All these advances in medical research helps mankind to cop up with hyperlipidimiea that have now been become a major problem due to unhealthy life style. No doubt that these discoveries are beneficial in treating hyperlipidemia but also have certain life threatening side effects (e.g Rhadomylosis, liver dysfunctioning) which diverting the minds to natural sources having lesser side-effects, cheap and is readily available with

in the house hold. It had been reported that alkaloids from certain plant help reducing cholesterol, treat diabetes and many more therapeutic advantages over medicines(25). Talking about curry leaves as one of the important herb in treating hyperlipidimeia due to its diversity in variety of such constituents.

Role of curry leaves in hypolipidimeia:

As discuss earlier side effects of statin such as hyperglycemia and peripheral neuropathy cause many people do not want to take the drugs, so as a researcher we can't left them with the same problem we have to look for better alternatives that are not only less hazardous but at the same time have the same efficacy as that attain with medicines to increase the compliance with cheaper cost effective traditional medicines to treat dyslipidemia such as the curry leaf, but that does not mean the use of traditional medicines is safe without side effects. Improper use of traditional medicines can cause unwanted side effects(26). Epidemiological studies revealed that curry leaves contains high level of antioxidants and help to reduce risks of cardiovascular problems by showing hypolipidmic and anti-atherogenic potential.

Evidence-based molecular mechanism:

It was observed that the antihyperlipidemic property of Murraya koenigii is because of three bioactive carbazole alkaloids mahanine, mahanimbine, and marrayanol been successfully extracted from fresh curry leaves using acetone, highlighting their potential in reducing cholesterol.

Similarly ethanolic extracts of Murraya Koenijii shows very high antioxidant potential which contribute in the treatment of hypercholestrolemia. Phenolic compounds, flavonoids with linolenic acid, oleic acid and palmitic acid also playing beneficial role against artherosclerosis. Another evidence was found in a research work where ethanolic extract of curry leaf was investigated to check the effect on plasma lipid metabolism and liver(26). This resulted in significance decrease in plasma lipid level. After 24 hours of treatment total plasma cholesterol, LDL cholesterol, triglycerides and Apo-lipo-protien B was decreased by 35, 50, 50 and 60% respectively. This study revealed that ethanolic extract of curry leaf mitigate triglycerides deposition in fatty liver and facilitate flow of blood in coronary arteries by reducing serum and liver lipids(27).

Another Study in 2012 proved that administration of curry leaf extract at a dose of 300 mg / KgBW in obese rats and receiving intraperitoneal injection of 1g / KgBW glucose can reduce body weight, total cholesterol, triglycerides, and blood glucose levels(27).

The results of phytochemical tests from samples of curry leaves shows some of its compounds such as:

a) Flavonoids have the potential to as act as inhibitors of the HMG-CoA reductase enzyme as well as Flavonoids can increase the activity of the lipoprotein lipase enzyme to hydrolyse triglycerides into free fatty acids so that triglyceride levels in the body can decrease resulting in decrease cholesterol synthesis.
b) Alkaloids can inhibit the activity of the pancreatic lipase enzyme so that the absorption of monoglycerides and fatty acids decreases and does not cause fat accumulation.
c) Saponins can lower cholesterol by binding and preventing absorption of cholesterol by forming complex bonds that do not dissolve with cholesterol so that cholesterol cannot be absorbed by the intestine(27).

d) Tannins are able to inhibit the absorption of fat in the intestine by reacting with mucosal proteins and intestinal epithelial cells. Tannins can deposit mucosal proteins on the surface of the small intestine, thereby reducing the effectiveness of cholesterol absorption.

CONCLUSION:

Different researches had been done regarding the role of curry leaf in cholesterol reduction, this review emphasizes on the connection between curry leaves and their role in hyperlipidimeia leading towards a much healthier, selective and beneficial use of curry leaf.

It has been reported that curry leaf have hypolipidimic effect causing reduction in total cholesterol, triglycerides and LDL. Showing slower breakdown of fat and cholesterol. However, further studies are required to fully understand the behaviour of different components contributing to the result that is its mechanism, dose/amount, side-effects associated to chronic, interaction and other related consequences these future studies help to avoid serious side effects associated with current medicines switching toward herbal products.

One should not rely on a single study and must consult the physician before use as once a wise man said everything within the universe had a negative side if not use properly and within limit same apply on herbal products.

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