Acta Scientific Pharmaceutical Sciences (ISSN: 2581-5423)

Volume 5 Issue 3 March 2021

Review Article

A Pharmacognostic and Pharmacological Review on *Chrysophyllum cainito L.*

Rokeya Sultana[1]*, Deeksha Rai[1], Sandhya Vasanth[2] and Mohammed Gulzar Ahmed[2]

[1]Department of Pharmacognosy, Yenepoya Pharmacy College and Research Centre, Yenepoya University, Mangalore, Dakshina Kannada, Karnataka, India

[2]Department of Pharmaceutics, Yenepoya Pharmacy College and Research Centre, Yenepoya University, Mangalore, Dakshina Kannada, Karnataka, India

***Corresponding Author:** Rokeya Sultana, Professor, Department of Pharmacognosy, Yenepoya Pharmacy College and Research Centre, Yenepoya University, Mangalore, Dakshina Kannada, Karnataka, India.

Received: January 14, 2021

Published: February 25, 2021

Abstract

Chrysophyllum cainito L. which belongs to the family Sapotaceae is a tree which grows in tropical region. It is an ornamental tree, which bears fruits. Star apple, cainito and caimito are the different names given to *Chrysophyllum cainito* which depends on where it is present. Traditionally it is used as an herbal medicine for the treatment of diabetics. The fruits and leaves of *Chrysophyllum cainito* are a good source of polyphenolic compounds. The fruits are used in the preparation of dessert which is served chilled. Leaf infusions are been used in treatment of diabetes and articular rheumatism. The fruit exhibits antioxidant properties due to the presence of polyphenols. Various other phytoconstituents present are alkaloids, glycosides, triterpenoids and sterols. Pectin is present in the extracts and fractions of the pulp, as a result it is widely used in many food and pharmaceutical industries as a gelling agent and polyphenolic compounds such as catechin, epicatechin, gallocatechin and gallic acid are found in the leaves of plant. Studies have discovered different pharmacological activities such as antioxidant, anti-diabetic, anti-microbial and anti-viral.

Keywords: *Chrysophyllum cainito*; Star apple; Polyphenols; Antioxidant Activity; Antidiabetic Activity

Introduction

Chrysophyllum cainito L. which belongs to family Sapotaceae is grown as an ornamental as well as orchard tree, which bears edible fruits. Star apple, cainito, caimito are the different names have been given to *C. cainito*. Mexico, Argentina, Peru, Vietnam, India, China, Malaysia and other low to medium altitude countries are the places of common habitat of *Chrysophyllum cainito* [1]. Paul Standley and Louis Williams were the botanist who discovered the first species of Chrysophyllum cainito from West Indies [2].

Chrysophyllum cainito is an evergreen tree which is 25m in height and 4 - 8m in width which is mostly found in the tropical region. The tree has an erect stem, hanging branches and small leaves (Figure 1) which are dark green in color, simple, oval and entire which are 5 - 15 cm long and the leaf underneath shines golden color when viewed from far. The tiny flowers are purplish white and have a sweet fragrant smell and hang in clusters. Fruits are round, oblate or ellipsoidal and the fruit color varies from red-purple to dark-purple or pale green (Figure 2 and 3). The pulp of the fruit is

soft, milky and sweet and consists of 10 flat hard seeds. The seeds of *C. cainito* have an asterisk mark in the center because of which gives the fruit is given a common name "star apple". It is a hermaphroditic tree [3].

- Kingdom: Plantae
- Clade: Tracheophytes
- Clade: Angiosperms
- Clade: Eudicots
- Clade: Asterides
- Order: Ericales.

Figure 1: *Chrysophyllum cainito* leaves.

Figure 2: *Chrysophyllum cainito* fruits.

Figure 3: *Chrysophyllum cainito* fruits.

Trees are generally grown from seeds and they remain viable for several months which germinate easily. Seedlings are obtained in 5 to 10 years. Vegetative propagation is the most commonly used method of propagation. Budding or grafting technique produces trees which bear fruits one year after planted on soil. When the tree attains maturity the production of star apple will be around 150 lbs in the fruiting season from February to March. A mature tree of star apple in India will possibly yield 150 lbs of fruit in the short fruiting season of February and March. Temperature of 37.4^{0}F to 42.8^{0}F and 90% relative humidity is essential to keep the fruit in good condition for about 3 weeks [4].

Chemical constituents

Alkaloids, flavonoids, phenols, sterols, triterpenes, saponins, tannins and cardiac glycosides were detected during the screening of extracts. Vitamin A and sodium are present in the pulp extracts. Star apple also consists of protein, moisture, fat, fiber and carbohydrates.

Polyphenolic compounds such as catechin, epicatechin, gallocatechin, epigallocatechin, quercetin, quercitrin, isoquercitrin, myricitrin and gallic acid were found to be present in the fruit. GC-MS analysis revealed that volatile constituents such as (E)-2-hexenal, 1-hexanol, limonene, linalool, alpha-copaene and hexadecanoic acid were present [5].

Triterpenoids such as ursolic acid, beta-sitosterol, β-amyrin acetate, gentistic acid and lupeol were found in the leaves. When the

leaves were analyzed by GC/MS analysis presence of compounds such as Methyl myristate C14(0), Methyl myristoleate C15(1), Pentadecanoate C16 (saturated), Methyl palmitate C17 (saturated), Methyl palmitoleate C17(1), Methyl heptadecanoate C18 (0), Methyl oleate C19(1), Methyl linoleate C19(2), Methyl linolenate C19(3), Methyl arachidate C20(0), Methyl eicosenoate C21(1), Methyl eicosadienoate C21(2), Methyl eicosatrienoate C21(3) were revealed [6].

Pharmacological properties

Antioxidant activity: Leaf extracts of *Chrysophyllum cainito* were subjected to antioxidant activity by DPPH method. The DPPH radical scavenging activity was affected by hydroxyl groups present in the phenolic and flavonoid compounds. The reaction of DPPH with radical scavenger lead to the color change from purple to pale purple or yellow. Reduction in the absorption of stable radical DPPH at 515 nm lead to the evaluation of free radical scavenging activity. The standard to evaluate antioxidant activity was Gallic acid which was quantified by HPTLC. The maximum antioxidant activity found was in 70% ethanolic extract of leaf ($P < 0.05$) [7].

Polyphenolic antioxidants such as (+)-catechin, (-)-epicatechin, (+)-gallocatechin, (-)-epigallocatechin, quercetin, quercitrin, isoquercitrin, myricitrin and gallic acid were been identified from the fruits of *Chrysophyllum cainito* L. Highest concentration of (-)-epicatechin was present in star apple fruits (7.3 mg/kg fresh weight) and it showed highest antioxidant activity (IC_{50} = 40 µM) in the DPPH assay [7].

Antidiabetic activity: Leaf infusions of *Chrysophyllum cainito* was used as an antidiabetic agent. Diabetes induced by Alloxan in rabbits was taken to evaluate the antidiabetic activity. The blood glucose levels decreased after consuming *Chrysophyllum cainito* 20 g/l in 6 weeks from 5 g/l to 1.4 g/l. This infers that that *C. cainito* leaves have a glucose-lowering effect at doses > 10 g/l.

Antidiabetic effects of *C. cainito* were studied by Hegde., *et al*. using Alloxan and streptozotocin induced diabetic rat models. The hydro alcoholic extract at the concentration of 200 mg/kg body weight and 400mg/kg body weight of rats decreased blood glucose when compared with untreated diabetic control [8].

Antimicrobial activity: Antimicrobial activity of Pulp and seed of *Chrysophyllum cainito* was screened using agar well diffusion method. Diameter of zone of inhibition was measured around the extract and antimicrobial activity was evaluated. Different level of antibacterial and antifungal activity against *Staphylococcus aureus, Escherichia coli, Salmonella typhi, Pseudomonas aeruginosa, Candida albicans, Aspergillus and Penicillium ascomycetous fungi* was exhibited by the seed as well as the pulp. More sensitivity was shown by Staphylococcus, *Pseudomonas and salmonella* at concentrations 250 mg/ml, 250 mg/ml and 31.225 mg/ml and zone of inhibition ranged from 1 mm to 10 mm [9].

Antihypertensive activity: Mao., *et al*. first discovered the blood pressure lowering ability of *C. cainito* pulp**.** The inhibitory action of angiotensin - I converting enzyme (ACE) potential was shown by the extracts and pulps which is recognized as the major part of renin-angiotensin system which regulates the blood pressure. Ethyl acetate fraction showed highest ACE inhibition activity in comparison with other fractions.

Isolated tissue of aorta was used for *ex vivo* study. When the extract containing phenolics of 50 μg/ml and 10 μg/ml gallic acid were compared with standard captopril 0.5 and 0.25 µg/ml a prominent relaxation effect was seen. Finally, it was found that ethyl acetate fraction reduced the high arterial pressure of hypersensitive rat induced by salt in comparison to non-hypersensitive rat [10,11].

Anti-inflammatory activity: Crude methanol extract and two isolated terpenes (Lup-20(29)-en-3β-O-hexanoate and 3β-Lup-20(29)-en-3-yl acetate) which are isolated from leaves of *Chrysophyllum cainito* were checked for Antihypersensitivity and anti-inflammatory activity in case of carrageenan induced hypersensitivity in paw oedema mice was determined.

It was found that in case of hexane fraction slight significant inhibition of hypersensitivity was seen in carrageenan induced hypersensitivity, but ethyl acetate fraction did not show any effect. Crude methanolic extract showed slight inhibition of paw oedema in comparison to control group ($p < 0.0001$). Both crude methanol extract and hexane fraction reduced the myeloperoxidase activity. It was found that the chloroform fraction reduced the level of IL-1β in the paw tissue while the TNF-α releasing was still intact. It was also found that the two triterpenes isolated showed inhibitory activity on carrageenan induced hypersensitivity in mice [11].

Wound healing activity: When the ethanolic extract of the leaves of *Chrysophyllum cainito* were applied on excision as well as wounds it lead to shortening of the recovery time of wounds when compared to control drugs. Ethanolic extract of *C. cainito* leaves at three doses 2.5%, 5% and 20%. was used to prepare ointment. Test ointment of about 0.5g was used and applied on the site of wound. Extract of high dose (20%) showed high rate of wound healing and it was seen that wound was recovered completely on 10^{th} day whereas the recovery was seen 12^{th} day in the control group [12].

Antilipase activity: Increased risk of developing chronic diseases is due to obesity which leads to conditions such as cardiovascular disease, diabetes and many other diseases. Inhibiting the absorption of fat is can keep the body weight controlled and *Chrysophyllum cainito* can be considered here as its extracts can interfere in the lipase activity.

C. cainito leaves showed inhibitory activity of 74.91% for methanol extract, but the hexane partition showed higher inhibitory activity of 92.11%. Pancreatic lipase inhibitory agents dissolved in greater amounts in hexane solution [13].

Activity in bone disorders: Osteosarcoma (OS) is a rare tumor of bone where the worldwide incidence rate is found to be 3.4 cases per million people each year. It is a major cause of death among adults, adolescents and elderly people. The fraction of polyphenols of *Chrysophyllum cainito* fruit pulp at a concentration of 50 µg/ml showed an increase in the concentration of reactive oxygen species in the U-2 osteosarcoma cells when compared to nontreated control group. The fraction produced ROS which showed statistical equivalence to ROS produced which was stimulated by 100 μM H_2O_2 [14].

Conclusion

Chrysophyllum cainito has been planted throughout the world for its fruits which are known to contain many nutrients like proteins, carbohydrates, vitamins, as well as amino acids. Extracts of different parts of the plant are used traditionally and many biological activities of the extracts are being studied. Extracts are screened for different pharmacological activities such as antioxidant, antidiabetic, anti-inflammatory, anticancer, antihypertensive and wound healing. Most important activities are found to be antidiabetic, antioxidant and antimicrobial. However, the mechanism behind all these activities has to be studied further.

This review article is based on the extensive survey to collect the details regarding *Chrysophyllum cainito* which will pave a way to explore new research. Consuming rich diet of antioxidant fruits like star apple may help in reducing the risk of chronic diseases.

Conflict of Interest

The authors declare no conflict of interest.

Bibliography

1. Shailajan Sunita and Deepti Gurjar. "Pharmacognostic and phytochemical evaluation of *Chrysophyllum cainito* Linn. leaves". *International Journal of Pharmaceutical Sciences Review and Research* 26.1 (2014): 106-111.

2. Das Arindam., *et al*. "A brief review on *Chrysophyllum cainito*". *Journal of Pharmacognosy and Herbal Formulations* 1.1 (2010): 1-7.

3. Blancke Rolf. "Tropical fruits and other edible plants of the world: An illustrated guide". Cornell University Press (2016).

4. Doan Hau V and Thao PLe. "*Chrysophyllum cainito*: A Tropical Fruit with Multiple Health Benefits". *Evidence-Based Complementary and Alternative Medicine* (2020).

5. Oranusi SU., *et al*. "Antimicrobial activities and chemical compositions of *Chrysophyllum cainito* (star apple) fruit". *Net Journals* 3.3 (2015): 41-50.

6. Sayed DF., *et al*. "Modulatory effects of *Chrysophyllum cainito* L. extract on gamma radiation induced oxidative stress in rats". *Biomedicine and Pharmacotherapy* 111 (2019): 613-623.

7. Ningsih Indah Yulia., *et al*. "Antioxidant activity of various Kenitu (*Chrysophyllum cainito* L.) leaves extracts from Jember, Indonesia". *Agriculture and Agricultural Science Procedia* 9 (2016): 378-385.

8. Ernest Amoikon Kouakou., *et al*. "Effect of aqueous extract of *Chrysophyllum cainito* leaves on the glycaemia of diabetic rabbits". *African Journal of Pharmacy and Pharmacology* 3.10 (2009): 501-506.

9. Oranusi SU., *et al*. "Antimicrobial activities and chemical compositions of *Chrysophyllum cainito* (star apple) fruit". *Net Journals* 3.3 (2015): 41-50.

10. Mao Li-Mei., *et al*. "*In vitro, ex vivo* and *in vivo* anti-hypertensive activity of *Chrysophyllum cainito* L. extract". *International Journal of Clinical and Experimental Medicine* 8.10 (2015): 17912.

11. Meira Nicole Anzanelo., *et al*. "Anti-inflammatory and anti-hypersensitive effects of the crude extract, fractions and triterpenes obtained from *Chrysophyllum cainito* leaves in mice". *Journal of Ethnopharmacology* 151.2 (2014): 975-983.

12. Shailajan Sunita and Deepti Gurjar. "Wound healing activity of *Chrysophyllum cainito* L. leaves: Evaluation in rats using excision wound model". *Journal of Young Pharmacists* 8.2 (2016).

13. Briones AT and CL Chichioco-Hernandez. "Lipase inhibitory activity of Carica papaya, *Chrysophyllum cainito*, Corcorus olitorius, Cympogon citrates and Syzygium cumini extracts". *Food Research* 2.1 (2017): 51-55.

14. Li Liu-Bing., *et al*. "Poly-phenolic fraction of *Chrysophyllum cainito* extract induces cell death in osteosarcoma cells". *Bangladesh Journal of Pharmacology* 10.4 (2015): 972-979.