Pharmacognosy Reviews, 2025; 19(38):191-196.
www.phcogrev.com

Review Article

A Review on the Phytochemical and Pharmacological Activities of *Cynometra* Species from the Southern Western Ghats

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ABSTRACT

The genus *Cynometra* L., belonging to the tropical legume family Fabaceae (subfamily Detarioideae), includes a diverse group of species found in various tropical regions. Several *Cynometra* species are well known for their role in traditional medicine, especially in areas where they are part of the native plant life. This review highlights and summarizes scientific research on the chemical composition and pharmacological properties of three species native to the southern Western Ghats-*Cynometra travancorica, Cynometra beddomei*, and *Cynometra bourdillonii*. Among them, *Cynometra travancorica* has been the most extensively studied, while *Cynometra bourdillonii* remains largely unexplored, with little to no research available. This review highlights the various pharmacological activities of these species, including anti-oxidant, anti-inflammatory, anti-microbial, anti-obesity, anti-estrogenic, anti-tumor, and cytotoxic properties. These insights serve as a valuable resource for further research. Comparative studies can play a key role in identifying *Cynometra* species with unique chemical compositions and in understanding how differences in their secondary metabolites affect their medicinal properties. However, the therapeutic potential of these species remains largely untapped due to the limited number of studies available. In particular, the lack of *in vivo* research and clinical trials continues to be a major barrier to fully exploring and validating their pharmacological benefits. This review may assist researchers in exploring the pharmacological properties of *Cynometra*, potentially leading to new discoveries in drug development.

Keywords: *Cynometra*, Southern Western Ghats, Phytochemistry, Pharmacognosy.

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Received: 07-05-2025;
Revised: 24-07-2025;
Accepted: 15-09-2025.

INTRODUCTION

Plants naturally produce a wide range of chemical compounds to carry out their biological functions. Interestingly, many of these compounds act on the human body in much the same way as pharmaceutical drugs. This indicates that, like conventional medicines, herbal remedies can offer health benefits but may also cause side effects. Medicinal plants form the foundation of traditional medicine systems around the world, with over 3.3 billion people in developing countries relying on them regularly for healthcare needs.[1] Many of these plants are rich in biologically active compounds that have shown promising antioxidant, antimicrobial, anti-diabetic, and anti-inflammatory properties. Because of these therapeutic effects, plant extracts and phytochemicals hold great potential in the development of effective and natural treatments for various health conditions.

The Fabaceae (or Leguminosae) family, one of the largest groups of flowering plants (angiosperms), is well known for its significant role in traditional diets and herbal medicine across cultures. This highly diverse plant family is divided into three subfamilies and includes around 665 genera and 17,500 species worldwide. In India, it is represented by around 100 genera and 1,100 species.[2] The genus *Cynometra* was first described by Linnaeus in 1741 and later included in the first edition of Species Plantarum published in 1753.[3] *Cynometra* and *Maniltoa* exhibit notable morphological similarities, particularly in their foliage, young strobiliform racemes, and legumes. However, key differences exist in their floral structures. The flowers of *Maniltoa* differ significantly from those of *Cynometra* with variations in the receptacle-cup, which is generally more elongated, an often eccentrically positioned stipe, and a higher number of stamens. Given these distinctions, a comprehensive and critical study is necessary to clarify the phylogenetic and taxonomic relationships between *Cynometra* and Maniltoa.[4,5]

DOI: 10.5530/phrev.20252329

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Traditional healers prepare remedies using various plant parts of *Cynometra* to address a range of ailments. However, detailed information on their specific uses for treating pathological conditions, as well as their chemical, pharmacological, and toxicological properties, remains limited. Therefore, to better understand and highlight the medicinal value of this genus, it is essential to systematically gather, organize, and review all relevant information.

According to the International Union for the Conservation of Nature (IUCN) Red List, the conservation status of *Cynometra* species varies widely. A significant portion about 36% has not yet been evaluated (NE). Around 29% are considered to be of Least Concern (LC), while 19% are classified as Endangered (EN). Additionally, 6% fall under the Vulnerable Category (VU), and 5% are listed as Near Threatened (NT). A smaller percentage 3% are marked as Data Deficient (DD), meaning there isn't enough information to assess their risk, and 2% are classified as Critically Endangered (CR), indicating they face an extremely high risk of extinction in the wild.

The *Cynometra* genus includes a total of 113 known species, out of which three have been reported from the Southern Western Ghats. 11 species (9.7%) are used in traditional medicine to treat various ailments. Across eight species (7.1%), 185 secondary metabolites belonging to different categories, primarily flavonoids and terpenoids, have been identified. Additionally, 10 species (8.8%) have undergone various biological activity assays, with the primary evaluations focusing on *in vitro* anti-oxidant, anti-microbial, and cytotoxic activities, as well as anti-inflammatory properties. However, no human clinical trials or safety data are currently available for this genus.[6] At times, the stem bark of *Cynometra travancorica* is used as a substitute for *Saraca asoca* because of their similar appearance. *Saraca asoca* is a primary ingredient in Asokarishta, a traditional fermented polyherbal remedy widely used as a uterine tonic. It is especially valued for treating abnormal uterine bleeding and various other gynaecological disorders.[7] These morphological similarities between *Cynometra travancorica* and *Saraca asoca* demand various comparative studies, focusing on aspects such as anti-inflammatory, anti-oxidant, anti-estrogenic, anti-obesity and toxicological studies

Morpho-taxonomic characters of *Cynometra* sp. native to Southern Western Ghats

Cynometra travancorica Bedd

This is an evergreen tree with a short, buttressed trunk. The bark is smooth and reddish-brown, about 3-4 mm thick, with tiny pores (lenticels) on the surface and a similar reddish-brown color inside. The leaves are arranged alternately and are typically made up of two leaflets. Each leaflet measures about 8-12 cm long and 2-3 cm wide, often curved (falcate), ovate-oblong or lance-shaped, and asymmetrical at the base. The leaf veins are pinnate with 6-8 slender, prominent pairs. The flowers are small, around 6-8 mm across, rosy white in color, and found in short, densely clustered axillary racemes. Each flower has ovate bracts (1-3 mm long) that are puberous and ciliate. Bracteoles are also ovate and about 2 mm long. There are four sepals, about 3 mm long, oblong, reflexed, and hairless. The 5 petals are nearly equal in size, around 4 mm long, and each has a narrow base (clawed). There are 10 stamens in each flower, alternating in length, with the connective tissue at the base slightly split and very faintly pointed at the tip. The ovary is half-inferior, smooth, and crescent-shaped. The fruit is a flat, indehiscent pod measuring 2.5-3 cm in length. It is smooth but wrinkled along the edges, semicircular in shape. The inner suture is nearly straight, while the outer margin is broadly curved. Each pod typically contains a single seed.[8]

Cynometra beddomei Prain

This is an evergreen tree with bark that appears blackish-green on the outside and dull red on the inside. The leaves are paripinnate and alternately arranged, each composed of 4 to 6 opposite leaflets. The leaflets measure about 2.5 cm long and 1-1.8 cm wide, and are obliquely shaped- somewhat obovate to oblong. The base of each leaflet is slanted (oblique) and ends either sharply (acute) or wedge-like (cuneate), with a tip that is broadly pointed (obtusely acuminate) and sometimes notched (emarginate). There are 6-8 pairs of lateral veins. The flowers are creamy white and grow in small clusters from the leaf axils. The flower stalk (peduncle) is 12-20 mm long. Bracts are ovate, pressed close to the stem, hairy and striate. They overlap one another (imbricate) and fall off with age. The pedicels are about 5 mm long and covered in soft hairs. The sepals are 3 mm long, hairy, and ciliate. There are five free petals, each about 3.5 mm long and 1 mm wide, narrow and tapering at the base, nearly equal in size, and smooth. The flower has ten stamens, alternating in length-five are about 5 mm long, the other five about 7 mm. The ovary is half-inferior and densely covered with long, brown hairs. The fruit is a single-seeded pod, reniform-globose, with grooves near the sutures and indehiscent.[9]

Cynometra bourdillonii Gamble

Evergreen trees, leaf rachis 5 cm long; leaflets pairs, nearly similar, obliquely obovate, slightly retuse, cuneate, glabrous, 2.5×1-1.8 cm. Peduncle 1.2 cm long. stamens alternately long and short. Pod smooth, globular with a vertical groove, 1.3 cm across.[10]

METHODOLOGY

This review compiles detailed information on plants from a wide range of peer-reviewed research articles, sourced through various electronic databases and platforms such as ScienceDirect, Scopus, Google Scholar, Google, PubMed, and ResearchGate. The keywords used for the online search included *Cynometra travancorica, Cynometra beddomei, Cynometra bourdilloni*, plant description, ethnomedicinal significance, phytochemistry, and

pharmacological activities. These plants were selected based on their presence in the southern Western Ghats. Various parts of the plant contain multiple phytoconstituents, which have been utilized in the treatment of different physiological disorders. This paper presents a comprehensive compilation of all the available data on phytochemical and pharmacological properties of *C. travancorica, C. beddomei* and *C. bourdilloni.*

Phytochemical profiling

Sasidharan and Padikkala[7] and John *et al.*,[11] carried out phytochemical analyses of ethanol extracts from *Cynometra travancorica* to explore its bioactive components. Their screening revealed the presence of several important compounds, including sterols, fats/lipids, glycosides, phenols, carbohydrates, tannins, resins, reducing sugars, saponins, flavonoids, and acidic compounds. However, certain compounds such as phlobatannins, terpenoids, anthraquinones, and alkaloids were not detected in the ethanol extract. In a separate analysis using methanolic extracts of *C. travancorica*, flavonoids, alkaloids, tannins, and phenols, the compounds with wide range of pharmacological potential were identified. These findings highlight the plant's potential as a source of bioactive compounds with therapeutic value.[7]

Meera *et al.*,[12] studied the phytochemical composition of the methanolic extract of *Cynometra travancorica* bark and identified the presence of several bioactive compounds, including flavonoids, alkaloids, tannins, and phenols. These phytoconstituents are recognized for their potential to exhibit various pharmacological activities, suggesting the therapeutic relevance of *C. travancorica* bark extract.

Pharmacological Activity

Cynometra species are known for their wide range of medicinal properties, including antioxidant, anti-inflammatory, antibacterial, anti-estrogenic, and anti-obesity effects. They have also shown potential in toxicological safety, as well as anti-tumor and cytotoxic activities. The pharmacological potential of its plant extracts is discussed in detail in the following sections.

Antioxidant activities

Sabiha *et al.*,[6] investigated the antioxidant potential of acetone and methanolic bark extracts from *Cynometra travancorica* and *Cynometra beddomei* using three *in vitro* assays: superoxide scavenging, hydroxyl radical scavenging, and lipid peroxidation inhibition. The bark extracts of *C. travancorica* showed effective superoxide scavenging activity, with IC_{50} values of 80 µg/mL for the acetone extract and 68 µg/mL for the methanolic extract. *C. beddomei* bark extracts demonstrated IC_{50} values of 79 µg/mL (acetone) and 58 µg/mL (methanol) in the same assay. When evaluating hydroxyl radical scavenging, the methanolic bark extract of *C. travancorica* showed promising activity, with IC_{50} values of 75 µg/mL for the acetone extract and 55 µg/mL for the methanolic extract. For *C. beddomei*, the IC_{50} value for hydroxyl radical scavenging was 95 µg/mL with the acetone extract and 82 µg/mL with the methanolic extract. Both *C. travancorica* and *C. beddomei* extracts also showed the ability to inhibit lipid peroxidation. In this assay, the acetone bark extract of *C. travancorica* had an IC_{50} value of 53 µg/mL, while *C. beddomei* showed 58 µg/mL. The methanolic bark extracts were more potent, with *C. travancorica* showing the strongest activity at an IC_{50} of 23 µg/mL, followed by *C. beddomei* at 44 µg/mL. Since a lower IC_{50} value reflects stronger antioxidant activity, the methanolic extract of *C. travancorica* demonstrated the most effective inhibition of lipid peroxidation.[7]

Meera *et al.*,[12] investigated the antioxidant properties of the methanolic stem bark extract of *Cynometra travancorica* using various *in vitro* assays, including DPPH, superoxide radical scavenging, and total antioxidant activity tests. The extract demonstrated strong free radical scavenging ability under lab conditions. In mice exposed to Sodium Fluoride (NaF) to induce oxidative stress, treatment with the extract significantly boosted the activity of key antioxidant enzymes-catalase by 46.6% and superoxide dismutase by 53.8% and restored Glutathione (GSH) levels by 48.1% in liver tissue. It also reduced lipid peroxidation by 44.9%, indicating lower levels of cellular damage. Histopathological analysis of liver tissues showed a marked improvement, with clear signs of recovery from fluoride-induced damage. The study confirmed that the methanolic bark extract of *C. travancorica* helped reverse oxidative damage caused by fluoride toxicity. Additionally, FTIR analysis revealed the presence of active functional groups in the extract, supporting its antioxidant and protective effects. Overall, the findings highlight the extract's potential in reducing oxidative stress and promoting tissue healing.[12]

Suhail[13] conducted a comparative study to evaluate the antioxidant activity of methanolic extracts from *Saraca asoca* and its commonly used substitutes, *Kingiodendron pinnatum* and *Cynometra travancorica*. The antioxidant effects were tested in Swiss albino mice by measuring the levels of antioxidant enzymes and glutathione in their blood, serum, and tissues. The results showed a significant improvement in antioxidant enzyme activity at both 200 mg/kg and 400 mg/kg extract doses. Catalase activity increased by 19.97% and 33.17% with *S. asoca*, 10.09% and 36.87% with *K. pinnatum*, and 15.92% and 49.19% with *C. travancorica*. Similarly, superoxide dismutase activity increased by 16.89% and 31.33% (*S. asoca*), 24.43% and 39.05% (*K. pinnatum*), and 27.91% and 48.58% (*C. travancorica*). Glutathione levels also increased notably by 25.98% and 51.69% for *S. asoca*, 19.21% and 43.76% for *K. pinnatum*, and 9.75% and 56.36% for *C. travancorica*. These findings suggest that the methanolic extracts of *C. travancorica* and *K. pinnatum* exhibit strong antioxidant activity and could be effective natural alternatives to *S. asoca* in traditional and therapeutic applications.

Anti-inflammatory activity

Sasidharan and Padikkala[7] studied the anti-inflammatory effects of *Cynometra travancorica* and *Cynometra beddomei* using both acute and chronic inflammation models in rats. When *C. travancorica* bark extract was administered at doses of 50 mg/kg and 100 mg/kg body weight, it reduced carrageenan-induced acute inflammation by 50% and 61.11%, respectively. The same doses also reduced formalin-induced chronic inflammation by 54.5% and 63.3%. However, the leaf extract of *C. travancorica* did not show significant anti-inflammatory effects at either dose. In the case of *C. beddomei*, the bark extract showed 44.4% and 66.7% inhibition of acute inflammation at 50 mg/kg and 100 mg/kg, respectively. Interestingly, the methanolic leaf extract also proved effective, reducing inflammation by 55.5% and 77.8% at the same doses. In the chronic inflammation model, the bark extract reduced swelling by 54.5% and 63.6%, while the leaf extract showed even higher inhibition rates of 45.5% and 81.8% at 50 mg/kg and 100 mg/kg, respectively.[7]

Suhail *et al.*,[14] investigated and compared the anti-inflammatory effects of methanolic bark extracts from *Saraca asoca* and its commonly used substitutes, *Kingiodendron pinnatum* and *Cynometra travancorica*, using Swiss Albino mice. The bark from each plant was chopped, powdered, and extracted with methanol for testing. In the carrageenan-induced paw edema model, inflammation peaked at the 3rd hr. At higher doses, *S. asoca* extract reduced swelling by 65.88%, while *K. pinnatum* and *C. travancorica* showed 60% and 67.06% inhibition, respectively-indicating strong anti-inflammatory activity across all three plants. In a separate test using formalin to induce inflammation, lower doses of the extracts reduced swelling by 32.87% (*S. asoca*), 48.56% (*K. pinnatum*), and 46.71% (*C. travancorica*). At higher doses, the reduction improved to 52.13%, 52.59%, and 53.52%, respectively. For comparison, the standard anti-inflammatory drug diclofenac (10 mg/kg) showed 58.02% inhibition. These findings suggest that *K. pinnatum* and *C. travancorica* are nearly as effective as *S. asoca*, supporting their traditional use as potential alternatives in managing inflammation.[14]

Nafar *et al.*,[15] also highlighted the anti-inflammatory potential of *C. travancorica* using *in vivo* models of both acute and chronic inflammation in mice. When administered orally, the methanolic extract showed significant anti-inflammatory effects, with the response increasing in a dose-dependent manner.

Anti-bacterial activity

John *et al.*,[11] investigated the antibacterial properties of *Cynometra travancorica* leaf extracts prepared using ethanol and cold water. The study tested the extracts against a variety of both gram-positive and gram-negative bacteria using the filter paper disc diffusion method. The most notable antibacterial effect was observed against Staphylococcus aureus, a gram-positive bacterium, with an inhibition zone of 10.2 mm and an activity index of 0.637. Among the tested bacteria, the effectiveness of the extract followed this order: *Staphylococcus aureus* > *Escherichia coli* > *Streptococcus mutans* > *Bacillus subtilis* > *Pseudomonas fluorescens* > *Klebsiella pneumoniae.* No antibacterial activity was detected against *Enterobacter aerogenes*. Antibacterial activity of the cold-water extract was in the order: *Staphylococcus aureus* >*Streptococcus mutans* >*Escherichia coli*. No activity was observed against *E. aerogenes*, while moderate activity was noted against *P. fluorescens, K. pneumoniae*, and *B. subtilis*. These results highlight the extract's significant antibacterial potential, particularly against gram-positive bacteria. Both the cold water and ethanolic extracts identified *Staphylococcus aureus* as the most sensitive strain, while *Enterobacter aerogenes* remained resistant.[11]

Anti-estrogenic activity

Suhail *et al.*,[16] investigated the anti-estrogenic effects of methanolic extracts from *Saraca asoca* and its substitute plant, *Cynometra travancorica*, using female Wistar rats as the test model. The rats were divided into four groups, with six animals in each. The first group served as the control and received only the vehicle (DMSO). The second group was given estrogen via intraperitoneal injection to induce elevated hormone levels. The third and fourth groups were treated orally with 400 mg/kg of the respective plant extracts, also dissolved in DMSO. After 10 days of treatment, blood samples were collected from all the animals, and the serum was separated for further analysis.

The extract made from *S. asoca* and its substitute *C. travancorica* was found to be effective in reducing elevated estrogen levels in female Wistar rats. On the 10th day of treatment, blood samples were collected from each rat, and the serum was analyzed for estrogen levels. In untreated (normal) rats, the average estrogen level was 55.88±8.23 pg/mL. However, when the rats were given estradiol, the levels rose sharply to 256.5±17.66 pg/mL. Treatment with both plant extracts significantly lowered estrogen levels and among the two goups, the one treated with *C. travancorica* extract showed the most notable reduction, with estrogen levels dropping to 85.63±11.38 pg/mL.[16]

Toxicological studies

Toxicological studies were carried out on Swiss albino mice to evaluate the safety of plant extracts from *Saraca asoca* and *Cynometra travancorica*.[16] The mice were divided into three groups, each with six animals, and treated with extract doses of 600 mg/kg and 800 mg/kg for 21 days. After the treatment period, the animals were sacrificed, and their organs were examined through both hematological and histopathological analyses to detect any possible toxic effects. The results were reassuring. Even at high doses of 800 mg/kg administered over 14 days, no signs of toxicity or mortality were observed. The treated mice showed no significant changes in body weight or food and water intake. Major organs including the liver, kidneys, spleen, heart, and lungs retained normal weights. Liver function markers (SGOT,

SGPT, bilirubin, albumin, and globulin) remained within healthy ranges, and kidney function and blood parameters also showed no adverse effects. These findings confirm the safety of both *S. asoca* and *C. travancorica* extracts for future pharmacological research.[16]

Anti-obesity activity

Suhail *et al.*,[17] carried out a comparative study to explore the anti-obesity effects of *Cynometra travancorica* and *Saraca asoca* extracts. The plant materials were prepared using the maceration method to obtain the extracts, which were then tested for their potential in managing obesity. The study was conducted on Sprague Dawley rats, each weighing between 150-180 grams, and obesity was induced by feeding them a high-fat diet. Over an eight-week period, the rats' body weight was monitored weekly. At the end of the study, blood samples were collected to analyze serum lipid profiles, helping to evaluate how effectively the plant extracts reduced obesity-related parameters. The study compared the effects of standard anti-obesity drugs such as orlistat (60 mg/kg) with the plant extracts (400 mg/kg). The findings proved that both plant extracts exhibited promising anti-obesity potential, suggesting their therapeutic role in managing diet-induced obesity.

In vitro studies have been carried out to evaluate how standard drugs and plant extracts influence the activity of pancreatic lipase, an enzyme crucial for fat digestion. Findings suggested that while body weight gain in control groups corresponded to normal physiological growth, significant increases were observed in high-fat diet-fed groups. Conversely, treatment with orlistat or plant extracts has been shown to resist excessive weight gain. Terminal blood sample analyses revealed improvements in serum lipid profiles, indicating potential lipid-lowering effects of plant extracts in obesity management. Elevated lipid levels induced by High Fat Diet (HFD) reversed upon treatment with standard anti-obesity drugs or plant extracts. Additionally, High-Density Lipoprotein (HDL) levels were found to increase in standard and extract-treated groups, indicating a potential lipid-modulating effect. These findings indicate that the methanolic extracts of *S. asoca* and *C. travancorica* have notable anti-obesity potential. This is supported by their ability to reduce weight gain in rats fed a high-fat diet, as well as their effectiveness in inhibiting pancreatic lipase activity in laboratory tests.[17]

Anti- tumour activity

Meera *et al.*,[18] investigated the anti-tumor activity of *C. travancorica* using both solid tumor and ascites tumor models. Solid tumors were induced by injecting Dalton's Lymphoma Ascites (DLA) cells at a concentration of 1×10^6 cells per mouse into the right hind limb of 5- to 6-week-old female Swiss albino mice. The mice were divided into three groups: Group I served as the control and received no treatment, while Groups II and III were given *C. travancorica* extract orally at doses of 250 mg/kg and 500 mg/kg of body weight, respectively.

Group IV was treated with cyclophosphamide at a dose of 10 mg/kg body weight, which served as the standard reference drug. Both the *C. travancorica* extract and cyclophosphamide were given orally for 10 consecutive days, beginning on the same day the tumor was induced. The results showed that administering the extract at a dose of 500 mg/kg body weight led to a 51.1% decrease in solid tumor size. Ascites tumor was induced by injecting DLA cells (1×10^6 cells/mouse) into the peritoneal cavity. The extract at 500 mg/kg body weight increased the life span of ascites tumor-bearing mice by 50.3%.

Cytotoxic activity

The cytotoxic potential of the methanolic bark extract of *Cynometra travancorica* was tested against cancerous and normal cell lines. The extract was evaluated for its effects on Dalton's Lymphoma Ascites (DLA) cells, colorectal cancer cells (HCT-15), and normal Epithelial Cells (IEC-6). The viability of DLA cells was measured using the trypan blue dye exclusion method, while the MTT assay was used to assess cytotoxicity in HCT-15 and IEC-6 cells. The results showed that the extract effectively reduced the viability of both DLA and HCT-15 cancer cells, with IC_{50} values of 65±5.6 µg/mL and 11.2±6.3 µg/mL, respectively. Importantly, the extract had no harmful effect on normal IEC-6 cells, suggesting it may selectively target cancer cells without affecting healthy tissue.[18]

CONCLUSION

The genus *Cynometra* has been identified as a valuable botanical source of bioactive compounds, contributing to various medicinal applications. This review compiled the existing literature on the phytochemicals, secondary metabolites, and pharmacological properties of three *Cynometra* species with distribution in southern Western Ghats. Of the three species selected for this review, reports on the bioactivity studies were available mostly for *Cynometra travancorica*. Not much literature on phytochemical and pharmacological activities was available for *Cynometra beddomei* and *Cynometra bourdilloni* suggesting the necessity for a detailed research in these species. Future studies should also focus on the safety, mechanisms of action, and comprehensive metabolomic, botanical, and genetic profiling of the plant extracts. Such investigations will be crucial in establishing standardized quality control measures, ensuring their effective and safe use in medicine.

ABBREVIATIONS

IUCN: International Union for the Conservation of Nature; **NE:** Not Evaluated; **LC:** Least Concern; **EN:** Endangered; **VU:** Vulnerable; **NT:** Near Threatened; **DD:** Data Deficient; **CR:** Critically Endangered; **IC_{50}:** Half-maximal Inhibitory

Concentration; **DPPH:** 2,2-diphenyl-1-picryl hydrazyl; **GSH:** Glutathione; **NaF:** Sodium fluoride; **FTIR:** Fourier Transform Infrared Spectroscopy; **IZ:** Inhibition Zone; **AI:** Activity Index; **DMSO:** Dimethyl sulfoxide; **SGOT:** Serum Glutamic Oxaloacetic Transaminase Test; **HFD:** High Fat Diet; **HDL:** High Density Lipoprotein; **DLA:** Daltons Lymphoma Ascites; **HCT:** Colorectal cancer cells; **IEC:** Intestinal Epithelial Cells; **MTT:** **3**-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide assay.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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Cite this article: Jacob JC, Nair RK. A Review on the Phytochemical and Pharmacological Activities of *Cynometra* Species from the Southern Western Ghats. Pharmacog Rev. 2025;19(38):191-6.