

# A Narrative Review on Anti-inflammatory Activity of *Rubia cordifolia* Linn

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## ABSTRACT

Herbal medicine, deeply rooted in traditional practices, has gained global attention for its efficacy and minimal side-effects. Among such medicinal plants, *Rubia cordifolia* Linn. (*Manjistha*), commonly known as Indian Madder, is a prominent Ayurvedic herb valued for its anti-inflammatory, antioxidant, and antimicrobial properties. Traditionally, its roots have been employed as blood purifiers, analgesics, and tonics, contributing to treatments for skin ailments, urinary tract disorders, and inflammation. This review explores the pharmacological potential of *Rubia cordifolia*, emphasising its anti-inflammatory activities. The review highlights the plant's efficacy in managing inflammation-related conditions, supported by preclinical studies and traditional applications. Key phytochemicals identified in *Rubia cordifolia* include anthraquinones, triterpenoids, and naphthoic acid esters, which contribute to its bioactivity. Anti-inflammatory activity was evaluated using in-vitro and in-vivo assays, with additional antioxidant assessments conducted through radical scavenging tests. The roots demonstrated significant anti-inflammatory effects, largely attributed to anthraquinones, which also exhibit antioxidant and antitumour properties. This supports the traditional use of *Manjistha* in treating inflammatory disorders. The review suggests the synergy of its phytochemical profile may contribute to its therapeutic applications and potential as a natural remedy. The findings underscore *Rubia cordifolia*'s therapeutic potential as an alternative remedy for inflammatory diseases, reflecting its significance in medicine and Ayurveda. However, further clinical trials are necessary to validate its safety and effectiveness for broader medical use.

**Keywords:** Anthraquinones, Inflammation, *Manjistha*, *Rubia cordifolia*, *Rubiaceae*

## INTRODUCTION

Herbal-based remedies have been used in India to treat and cure a wide range of illnesses [1]. In addition, Indian traditional medicine has a wide range of prescriptions for treating conditions like ulcers, skin infections, leprosy, diarrhoea, scabies, venereal illness, wounds, inflammation, and snake bites [2]. Indian madder, or *Manjistha*, is another name for *Rubia cordifolia* (*Rubiaceae*), which grows all over India. It can be found throughout all of India's hilly regions, stretching from the northwest Himalayas eastward to the foot of 8000 feet and then south to Ceylon. This plant's roots are acknowledged as official and have a significant therapeutic value [3]. Growing up to 10 meters in length, this perennial herbaceous prickly creeper or climber can be found all throughout the country and reaches heights of 3750 meters. It thrives in light (sandy), medium (loamy), and heavy (clay) soils [4]. Trees, shrubs, and even rare plants are included in the roughly 450 genera and 6500 species that make up the family *Rubiaceae*. The perennial herbaceous climbing plant *Rubia cordifolia* L. (*Rubiaceae*), commonly referred to as "*Manjistha*," has very long roots that are cylindrical and flexuous and have a thin red bark. The base of stems is often lengthy, rough, grooved, and woody. It is well-known that these family of plants, particularly the roots, contain significant concentrations of anthraquinones [5]. Generally speaking, the stem, leaves, roots, and fruits of the plant *Rubia cordifolia* are used for their medicinal qualities. *Manjistha* has been used as a dye, for skin care and therapy, and internally for urinary tract diseases. Traditionally, roots have been employed as blood purifiers, anthelmintics, analgesics, hepatoprotectives, anti-inflammatory, astringent, tonic, antiseptic, diuretic, de-obstruent, and antidiarrheic [6,7]. According to the ancient Ayurvedic literature *Bhava Prakash*, *Manjistha* is able to bond with *amavisha* (free radicals) and *garavisha* (xenobiotics), which are poisons that cause inflammation, skin diseases, ulcers, and other issues. *Manjistha*, also known as *Jingi* (vibrational energy) in Sanskrit, aids in the restoration of the tissues' intelligence. *Manjistha* contains a healthy dose of both *agni* (hot) and *soma* (cooling). *Agni* facilitates

the herb's penetration into tissues at the cellular level, while *Soma* aids in absorbing and neutralising the poisons [8]. This plant has been utilised as a natural food colouring and hair dye in addition to its medical uses. Because natural dyes and colouring materials are used in food, medicine, and other consumables for human use, there is a growing interest in their isolation [9].

Additionally, the Chinese Pharmacopeia officially lists this plant as a herbal remedy for the treatment of free radical-related illnesses such as haemostasis, arthritis, dysmenorrhoea, and haemorrhage. It can be used as a blood purifier, among other things. It aids in the treatment of skin conditions, blood purification, boosting appetite, and uterine stimulation and contraction [4]. The primary objective of this narrative review was to critically evaluate the antioxidant effects of *Rubia cordifolia* based on available scientific literature. This review aims to:

1. A detailed analysis of the pharmacological properties of *Rubia cordifolia* Linn. and its active compounds.
2. An exploration of the historical and contemporary uses of the herb in Ayurvedic medicine.
3. A review of clinical studies and trials assessing the efficacy and safety of *Rubia cordifolia* in treating anti-inflammatory diseases.

**Pharmacological activities:** The *Rubia cordifolia* Linn. plant. is well known for having a broad spectrum of pharmacological actions, which makes it useful for treating a number of illnesses. The plant has long been used medicinally to treat skin conditions and to treat cancer. Numerous conditions, such as Alzheimer's, diabetes, cancer, acne, inflammation, allergies, enterocolitis, and bacterial and viral infections, can be effectively treated with *Rubia cordifolia*, according to published research. Additional reported activities include the following: anti-tumour [10], anti-inflammatory, urinary disorders [11], anti-stress, anti-microbial hepatoprotective [12], radioprotective [13], and anti-cancer [14]; anti-microbial, anti-fungal, hypotensive, analgesic, anti-malarial, anti-oxidant, anti-

leukaemic and mutagenic functions, immunomodulatory [15], anti-inflammatory, and anti-oxidant [16].

**Radiation protection:** Using the survival, haemopoietic cell protection, and micronucleus assays, the radioprotective properties of an alcoholic extract of *R. cordifolia* root was investigated. Intraperitoneal administration of *R. cordifolia* extract 90 minutes before to the radiation exposure resulted in a significant radiation protection (67%) as measured by enhanced animal survival. Furthermore, as indicated by the inhibition of Thiobarbituric Acid Reactive Substance (TBARS), the extract also prevented radiation-induced lipid peroxidation. Therefore, it seems that *R. cordifolia*'s alcoholic root extract offers a strong defense against genotoxicity, haemopoietic damage, and lipid peroxidation brought on by radiation. The anti-oxidant, metal-chelation, and anti-inflammatory properties of *R. cordifolia* extract seem to be its mode of action [17].

**Hepatoprotective activity:** One of the main components of *Rubia cordifolia* Linn., rubiadin, has hepatoprotective properties against the liver damage caused by carbon tetrachloride (CCl<sub>4</sub>) in rats. Rubiadin was given orally once daily for 14 days at doses of 50, 100, and 200 mg/kg. After being treated with carbon tetrachloride, the significantly increased serum enzymatic activities of Gamma-Glutamyl Transferase (gamma-GT), Serum Glutamic Oxaloacetic Transaminase (SGOT), Serum Glutamate Pyruvate Transaminase (SGPT), and Serum Alkaline Phosphatase (SALP) were dose-dependently returned to normal. In the meantime, glutathione reductase and glutathione S-transferase's decreased activities were also brought back to normal [18].

**Antibacterial activity:** *Rubia cordifolia* methanol extract and chloroform are known to have antibacterial properties, particularly against gram-positive strains. However, the methanol extracts of plants also showed dose-dependent inhibition of gram-negative *P. aeruginosa*. When compared to the standards of streptomycin and penicillin G, the aqueous extract of *Rubia cordifolia* demonstrated a substantial level of activity against *B. subtilis* and *S. aureus* [19].

**Antiacne property:** *Rubia cordifolia* methanol extract prevents *Propionibacterium acne* from growing [20]. It exhibits poor activity against IL-8 and moderate effectiveness against TNF alpha. It is thought to be astringent and beneficial for external inflammations such as skin conditions and ulcers [21]. In a gel formulation, the *R. cordifolia* fraction high in anthraquinones was visible. Compared to regular Clindamycin gel, it demonstrated anti-acne effectiveness against *Propionibacterium acne*, *Staphylococcus epidermidis*, and *Malassezia furfur* [22].

## Literature Research

The research papers and journal articles used in the mini-review were found using search terms like "*Manjistha*", "*Rubia Cordifolia*", "In-vitro", "In-vivo", "Extract" on websites like PubMed, Google scholar and others. The evaluation of research articles and journals by rapid reviewing approach is based on these databases.

**Study selection and data gather:** This review was carried out using Pubmed, Science Direct, Scopus, Proquest, Google, Google Scholar, databases published research articles from 1983 to 2018. The engine found 120 articles. These comprised on different activities such as anti-microbial, anti-oxidant, anti-tumour, anti-bacterial, and so on. Total 16 articles on anti-inflammatory study, 10 available and 6 for buying.

**Exclusion criteria:** Literature that contains technical errors, literature that was not written in English, and literature that had no impact on our search were excluded from the review.

## RESULTS

The papers that satisfied the eligibility requirements were considered. Articles that were repetitive or did not meet the inclusion criteria were eliminated. Each abstract was evaluated separately, and attempts

were made to get full text publications for research purposes [Table/ Fig-1] [13,23-31].

## Chemical Composition of *Rubia cordifolia* [32]

**Quinones:** It is known that plants of the *Rubiaceae* family contain significant levels of anthraquinones, particularly in the roots. The colouring material found in *R. cordifolia* roots is a combination of manjistin (xanthopurpurin-2-carboxylic acid) and purpurin (trihydroxy anthraquinone). Numerous anthraquinones, including 4-dihydroxy 2-methylantraquinone, 1, 5-dihydroxy 2-methylantraquinone, and 3-prenyl methoxy 1, 4-naphthoquinone, have been recovered from the roots of *Rubia cordifolia* L. The anthraquinones ruberythric acid, lucidin primeveroside, alizarin (1,3-dihydroxy-2-ethoxymethyl-9,10-antraquinone), mollugin (1-hydroxy-2-methyl-9,10-antraquinone), and 2-methyl-1,3,6-trihydroxy-9,10-antraquinone 2-methyl-1,3,6-trihydroxy-9,10-antraquinone and 3-O-(6'-O-acetyl)- $\alpha$ -rhamnosyl-(1 $\rightarrow$ 2)- $\beta$ -glucoside 3-O- $\alpha$ -glucoside (1 $\rightarrow$ 2)- $\beta$ -rhamnosyl. Testing had been done on the cytotoxic potential of naphthohydroquinones and their dimers. *Rubia cordifolia* roots and stems have yielded anthracene compounds known as rubiasins. The bioactive component mollugin was successfully isolated and purified using preparative High-Speed Countercurrent Chromatography (HSCCC) straight from the ethanol extract of *R. cordifolia*.

**Iridoids:** Alizarin, garancin, and manjistin are present in 6-methyl geniposidic acid.

**Triterpenoids:** It has been possible to isolate oleananes such rupiprasin A, B, and C as well as arborane triterpenoids like rubiarbonol A, B, C, D, E, and F.

**Pentacyclic triterpenes:** Based on <sup>1</sup>H NMR, <sup>13</sup>C NMR, mass spectral and chemical evidence, it has been demonstrated that the isolated rubicoumaric acid and rubifolic acid from *Rubia cordifolia* are 30-hydroxy-3 $\beta$ -p-hydroxycoumaroyloxy-urs-12-ene-28-oic acid and 3 $\beta$ ,30-dihydroxy-urs-12-ene-28-oic acid (30-hydroxyursolic acid), respectively.

**Naphthoic acid esters:** These are separated from *Rubia cordifolia* roots.

**Bicyclic hexapeptides:** After more research, hexapeptides that were extracted from *Rubia cordifolia* roots were discovered to be cytotoxic.

The chemical structure of some compounds of *Rubia Cordifolia* is given below [Table/Fig-2-5] [25,33,34].

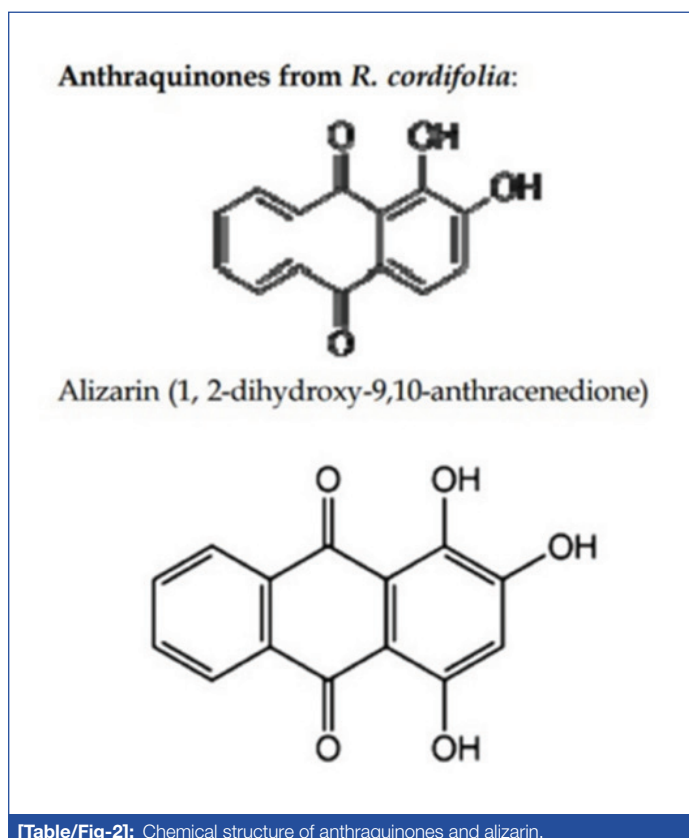
## DISCUSSION

Many publications demonstrated the anti-inflammatory properties of *Manjistha*, with most of the activities being detected by use of plant. The indigenous medical system frequently uses *Rubia cordifolia* Linn (*Rubiaceae*) as a crude medication to treat fever, inflammation, and rheumatoid arthritis. In addition to being referenced in Ayurveda, this herb is a common ingredient in many goods that are sold [35]. It has been well documented in earlier research that *Rubia cordifolia* (*Manjistha*) has anti-inflammatory property.

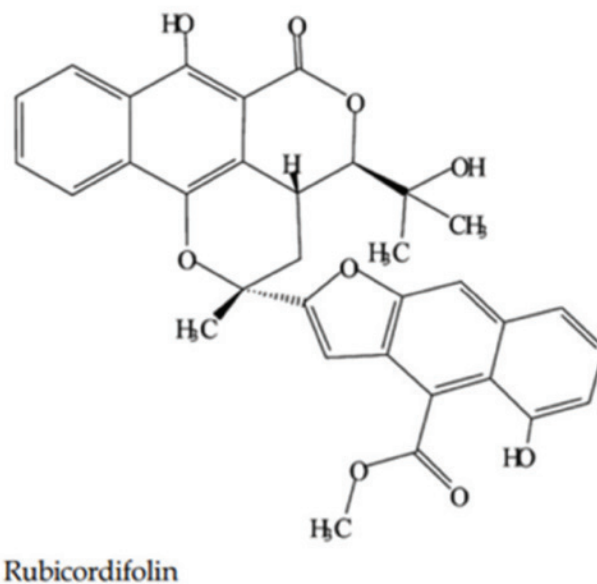
In rats with carageenan and pedal oedema, the study documents the plant's beneficial effects in comparison to phenylbutazone, a common non steroid anti-inflammatory medication. When compared to the control values, phenylbutazone had a highly significant (p-value <0.001) anti-inflammatory impact at 2-, 4-, and 6-hours following carrageenan injection. Even so, the effect was remained substantial (p-value <0.05) but had diminished after 24 hours. The Indian *Manjistha*, *Rubia cordifolia* Linn., had anti-inflammatory effect at four and six hours with a dose of 20 mL/kg that was comparable to phenylbutazone. But after 24 hours, the effects of the 10 mL and 20 mL doses were greater than those of phenylbutazone. A While the 30 mL/kg dose of *Rubia cordifolia* showed no anti-inflammatory effects at two, four, or six hours, a delayed and noteworthy response was observed after 24 hours [23].

S. No.	Author and References	Study type	Therapeutic regimen	Sample size	Outcome
1.	Antarkar DS et al., 1983 [23]	In-vivo (Experimental study)	10-20 mL/kg of the water extracts	Male albino rats (100-200 gm)	<i>Rubia cordifolia</i> exhibits and inflammatory properties at doses of 10 and 20 mL/kg.
2.	Kasture SB et al., 2001[24]	In-vivo (Experimental study)	Petroleum ether extract of <i>Rubia cordifolia</i> roots and benzene, ethyl acetate and methanol (Yield, 1.8, 1.0 and 0.2 g respectively)	Male Wistar rats, weighing 160-180 gm	The overall findings indicate the petroleum ether roots and its ingredient RCB1 have potent anti-inflammatory properties. This molecule has been shown to be effective against both the main phase of adjuvant arthritis and carrageenan-induced oedema, indicating that it can act as an anti-inflammatory in both the acute and chronic phases of inflammatory processes.
3.	Tripathi YB and Singh AV 2007 [13]	In-vivo (Experimental study)	Alcoholic extract of <i>Rubia cordifolia</i> root extract	8-10-week-old swiss albino mice of strain A (25-40 gm)	Because <i>Rubia cordifolia</i> root extract includes many phytochemicals, its alcoholic extract has a considerable radioprotective potential and may operate through multiple pathways. The potential mechanisms responsible for its radioprotective properties could be attributed to its anti-inflammatory, antioxidant, and metal chelation properties.
4.	Patil R et al., 2009 [25]	In-vivo (Experimental study)	10-20 mL/kg of the water extracts	Male albino rats (100-200 gm)	At doses of 10 and 20 mL/kg, <i>Rubia cordifolia</i> exhibits anti-inflammatory properties.
5.	Patel A et al., 2010 [26]	In-vivo (Experimental study)	Methanolic extract of root of <i>Rubia cordifolia</i>	30 Male, Wistar, weighing 200-250 gm	Rat paw oedema was caused by the inhibition on carrageenan after six hours, respectively. According to the current findings, this extract shown effective therapeutic effectiveness in cases of acute inflammation.
6.	Ghosh S et al., 2010 [27]	In-vivo (Experimental study)	Methanol extract of <i>R. cordifolia</i>	Wistar rats (15) with 10, 20 and 40 mg/kg i.p.	The rationale behind ethnomedical reporting on these traditional medicinal plants stems from the discovery that <i>Ventilago madraspatana</i> Gaertn., <i>Rubia cordifolia</i> Linn., and <i>Lantana camara</i> Linn. exhibit anti-inflammatory and anticancer properties.
7.	Tailor CS et al., 2010 [28]	In-vivo (Experimental study)	Ethanol extract of stem of <i>Rubia cordifolia</i> stem (20 & 40 mg/kg/mL)	Male albino rats (100-200 gm)	These findings supported our conclusion that high doses of ethanolic extract have anti-inflammatory properties.
8.	Pawar AT et al., 2011 [29]	In-vivo (Experimental study)	Hydroalcoholic root extract of <i>Rubia cordifolia</i>	Male Wistar albino rats 150-200 gm	<i>Rubia cordifolia</i> may help people with inflammatory bowel disorders and can prevent enterocolitis in rats that is brought on by indomethacin.
9.	Nyeem MA and Mannan MA 2018 [30]	In-vivo (Experimental study)	Methanolic extract of root of <i>Rubia cordifolia</i>	Male albino rats (100-200 gm)	Rats with carrageenan paw edema were used in the study to examine the anti-inflammatory properties of <i>R. cordifolia</i> . When the plant was given 10 and 20 milliliters per kilogram of the water extracts, it exhibited notable anti-inflammatory properties.
10.	Shen CH et al., 2018 [31]	In-vivo (Experimental study)	Hydroalcoholic root extract of <i>R. cordifolia</i>	Male albino rats (100-200 gm)	In order to evaluate the spectrum-effect correlations of RCE, the current data offer a solid foundation for combining chemical fingerprints with analgesic and anti-inflammatory activity.

[Table/Fig-1]: The overview of articles selected in narrative review [13,23-31].



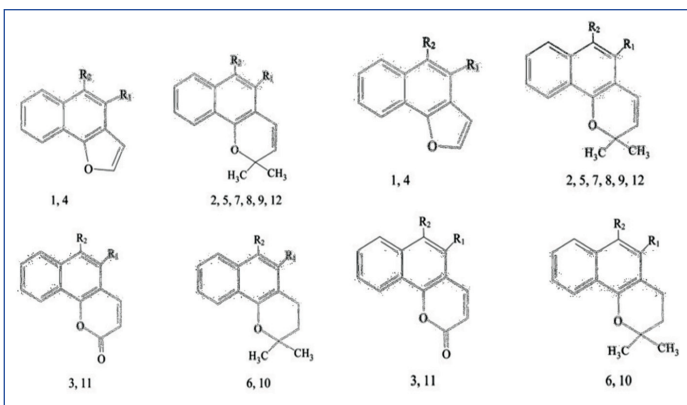
[Table/Fig-2]: Chemical structure of anthraquinones and alizarin.



[Table/Fig-3]: Chemical structure of Rubicordifolin.

According to Khalid HJ, *R. cordifolia* has historically been used externally as an astringent and analgesic for skin conditions, ulcers, and inflammations [36].

Additionally, the herb is said to alleviate burning, itching, and skin exudation symptoms (Nadkarni KM and Nadkarni AK) [37]. In eczema research, topical treatment of the plant resulted in a 50% decrease in severity score in four days, along with a considerable improvement in oedema, exudation, and itching (Bapalal NA) [38]. Rats with carrageenan paw oedema were used in the study to examine the anti-inflammatory properties of *R. cordifolia*. When the plant was given 10 and 20 milliliters per kilogram of the



[Table/Fig-4]: Some other structures of *Rubia Cordifolia*.

No	R <sub>1</sub>	R <sub>2</sub>	
1	COOMe	OH	Mollugin
2	COOMe	OH	Furomollugin
3	COOMe	OH	Rubilactone
4	COOMe	OMe	Methylfuromollugin
5	COOMe	OMe	Mollugin methyl ether
6	COOMe	OH	Dihydromollugin
7	COOMe	OAc	Acetylmollugin
8	COOCH <sub>2</sub> CH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>	OMe	# I
9	COOMe	OCH <sub>2</sub> Ph	# II
10	COOMe	OMe	Dihydromollugin methyl ether
11	COOMe	OMe	Methylrubilactone
12	COOH	OMe	2,2-Dimethyl-6-methoxy-2H-naphtho-[1,2-b]pyran-5-carboxylic acid

#I - Isopentyl 2, 2-dimethyl-6-methoxy-2H-naphtho-[1,2-b] pyran-5-carboxylate  
 #II - Methyl 2, 2-dimethyl-6-benzyloxy-2H-naphtho-[1,2-b] pyran-5-carboxylate (Morita *et al.*, 1992).

Qiao *et al.* (1990) isolated 12 compounds from roots of *R. cordifolia* of which 9 compounds have been characterized by chemical and spectroscopic methods as -

1. Alizarin
2. 1-hydroxy-2-methyl-9,10-anthraquinone
3. 1,3,6-trihydroxy-2-methyl-9,10-anthraquinone-3-O-(6'-o-acetyl)-alpha-L-rhamnosyl (1 to 2) - beta-D-glucoside
4. 1,3,6-trihydroxy-2-methyl-9,10-anthraquinone-3-O-alpha-L-rhamnosyl (1 to 2)-beta-D-glucoside
5. 1,3,6-trihydroxy-2-methyl-9,10-anthraquinone-3-O-(6'-o-acetyl)-beta-D-glucoside
6. 2-carbomethoxy-3-prenyl-1,4-naphthohydroquinone di-beta-D-glucoside
7. Rubimallin
8. beta-sitosterol
9. Damosterol

[Table/Fig-5]: Labelling of chemical structure of phytoconstituents shown in [Table/Fig-3] [33,34].

water extracts, it exhibited notable anti-inflammatory properties. According to Antarkar DS *et al.*, the action was similar to that of phenylbutazone (100 mg/kg) [23]. According to Khalid HJ, *R. cordifolia* has historically been used externally as an astringent and analgesic for skin conditions, ulcers, and inflammations [36].

Also, the plant is Cumene hydroperoxide synthesis and the lipoxygenase enzyme pathway were both suppressed by *R. cordifolia*. Leukotrienes, one type of inflammatory mediator implicated in asthma, arthritis, and other inflammatory illnesses, are produced through the lipoxygenase pathway (Tripathi YB and Sharma M) [16].

Adverse paw oedema caused by carrageenan is the typical experimental paradigm used to study acute inflammation. Since carrageenan has no apparent systemic effects and is not known to be antigenic, it is the preferred phlogistic agent for testing anti-inflammatory medications. Furthermore, there is a high degree of reproducibility in the experimental model. Carrageenan-induced oedema is a biphasic reaction. The initial phase releases histamine, serotonin, and kinins; the second phase, which peaks at three hours, releases prostaglandin and slow-acting chemicals. Rat paw oedema produced by carrageenan was used to assess the

methanolic extract of *Rubia cordifolia* root. They significantly reduced the amount of carrageenan-induced edema in rat paws. However, the inhibition was lower than that of a standard drug, Diclofenac sodium [26].

Five groups of 15 wistar rats each were used for the in-vivo anti-inflammatory investigation. Two groups received injections of either DMSO (vehicle control) or indomethacin (10 mg/kg; standard medicine) while the other three groups received 10, 20, and 40 mg/kg i.p. of the test chemical. Each experimental rat's right hind paw's subplantar region was given a subcutaneous injection of carrageenan suspension (1% in normal saline; 0.1 mL) after 30 minutes to cause acute inflammation. Before this phlogistic drug was administered, the paw volume was measured plethysmographically (with water), and this method was continued at hourly intervals for up to six hours. The findings were the average of three separate trials, and the following formula was used to determine the percentage of inhibition:  $\{(Ec-Et)/Ec\} \times 100$ , where Ec denotes the control group's oedema volume and Et denotes the treated group's oedema volume [39].

The study's overall findings indicate that *R. cordifolia* root's petroleum ether roots and its ingredient RCB1 have potent anti-inflammatory properties. This molecule has been shown to be effective against both the main phase of adjuvant arthritis and carrageenan-induced oedema, indicating that it can act as an anti-inflammatory in both the acute and chronic phases of inflammatory processes. Its effect on polyarthritis that has already developed suggests a potential inhibition of the cell-mediated mechanism of adjuvant arthritis. Although the analgesic impact was stronger in the earlier test, the chemical also demonstrated analgesic efficacy in the writhing and tail flick tests. Therefore, the findings along with gastrolesive action that is greater than ibuprofens imply that the anti-inflammatory activity of RCB1 may be associated with inhibition of the enzymes cyclo-oxygenase I and cyclo-oxygenase II [24].

The anti-inflammatory properties of *Rubia cordifolia*, Linn. (Indian *Manjistha*) were investigated in an in-vivo investigation on rats suffering from carrageenan paw oedema. When the plant was given 10 and 20 milliliters per kilogram of the water extracts, it exhibited notable anti-inflammatory properties. The activity was similar to 100 mg/kg of phenylbutazone [40].

Nyeem MA and Mannan MA conducted a study on the analgesic and anti-inflammatory properties of the *Rubia cordifolia* root methanolic extract in rats. Rat paw oedema caused by carrageenan was used to test the anti-inflammatory properties of *Rubia cordifolia* (100–300 mg/kg, p. o.). In the tail flick test, *Rubia cordifolia* (100–300 mg/kg, p.o.) significantly (p-value <0.05) enhanced reaction time and significantly (p-value <0.005) reduced paw edema caused by carrageenan [30].

The 2, 2 diphenyl 1 picrylhydrazyl method was used to test the free radical scavenging activity of *Rubia Cordifolia* Linn. in 80% methanol extract, hexane fraction, chloroform fraction, ethyl acetate fraction, butanol fraction, and their precipitates that were extracted from the roots of *Rubia cordifolia* L. At a concentration of 1 mg/mL, the hexane and ethyl acetate extracts exhibited the highest levels of free radical scavenging activity. *Rubia cordifolia* extract contains anthraquinones and their glycosides, according to phytochemical analyses [41]. The main antioxidant phenolic components found in *R. cordifolia* roots were hydroxyanthraquinones. Glycosylation of the hydroxyanthraquinones decreased their activity, the ortho-dihydroxy structure in the hydroxyanthraquinone molecules could significantly increase their radical scavenging effect, and hydroxy groups on one benzene ring of the anthraquinone structure were necessary for hydroxyanthraquinones to exhibit activity.

The main components of this plant are terpenes, alizarin glycosides, hexapeptides, and Anthraquinones [42]. Other known active phytochemicals of this plant include furomollugin and its dimers, rubilactone {3'-carbomethoxy-4'-hydroxy-naphtho (1',2'-2,3)pyran-

-6-one), cordifolioside and O-methyl deoxybouvardin (hexapeptide), rmlougin, naphthohydroquinones, and rubiadin (1, 3-dihydroxy-2-methyl anthraquinone) [43].

Cumene hydroperoxide-induced lipid peroxidation was considerably inhibited by *R. cordifolia* alcoholic extract [44]. The protective effect was shown to be superior to that of PBQ (parabenzquinone) and vitamin E. Rubiadin was linked to its antioxidant properties, and it also demonstrated notable iron chelation properties [45]. *Rubia cordifolia* extract prevented rabbit platelets from aggregating when Platelet Activating Factor (PAF) was present. Additionally, it demonstrated anticancer properties and inhibited the activity of potato lipoxygenase.

Cosmetic medications were categorised by Charak Samhita as *Varnya*, *Kushtaghna*, *Kandughna*, *Vayasthapaka*, *Udardaprashmana*, and so on. It has been said that certain medicinal herbs, such as *Haridra*, *Manjistha*, *Sariva*, *Chandana*, *Amalaki*, *Ghrithumari*, and others, can improve the appearance of skin, hair, teeth, and nails. To stay healthy, these herbs balance the *Agni*, *Dosha*, and *Dhatu*. A healthy proportion of *Dhatu* and *Updhatu*, which is a prerequisite for having fit and attractive skin and body, requires the perfect balance of these three. Among these plants, *Manjistha* (*Rubia cordifolia*) is regarded as a very beneficial skin care herb because of its *Varnya*, *Rakta-prasadaka*, *Rakta-shodhaka* (blood purifier), *Vishaghna*, and *Rasayana* characteristics, which are used to lighten black spots and make the complexion more even. In terms of chemistry, it contains resins, lime salts, colouring compounds, and glucosides called manjisthin and purpurin [46]. This herb's methylonic extract has been shown to exhibit a mean suppression of tyrosinase activity of 14.80%, which makes it a skin-whitening agent [47].

*Manjistha* has long been employed in numerous polyherbal treatments for a range of illnesses and cosmetic products. In the *Brihat trayi* (*Charak Samhita*, *Sushruta Samhita*, *Ashtanga Hridaya*), the Ayurvedic herb *Manjistha* is listed. It is referred to as *varnya*, *jwaraghana*, and *vishaghana mahakashaya* by Charaka [48]. *Sushruta* has divided it into three categories: *pitta sanshaman*, which calms *pitta dosha*, *ambasthadi gana*, and *priyangvadi gana* [49,50]. Along with the *priyangvadi* group of plants, *Vagbhata* also mentions it and is commonly referred to as *raktshodhak* [51]. Therapeutically, it is recommended for *Yoni roga* (menstrual disorder), *Kustha* (skin illness), *Sarpavisa* (snake bite), *Visarpa* (herpes virus), *Aksi roga* (eye disease), *Arsa* (haemorrhoids), and *Bhagna* (fracture) according to the Indian Ayurvedic Pharmacopoeia [52].

## CONCLUSION(S)

Classical manuscripts mention the *R. cordifolia*, a traditional herb with amazing medical properties. According to Ayurveda, each part of the plant, commonly referred to as panchaang, has medicinal properties. It's like sunshine dispersing its rays of hope and eliminating the darkness of various diseases. Every article reviewed above demonstrated the plants anti-inflammatory properties. Thus, plants such as *R. cordifolia* can be used as an alternative remedy for a variety of health-related issues and can also cure problems in such conditions. By offering advantages, this plant also benefits in the fields of medicine, agriculture, economics and society. However, several human experiments are still required before this plant quality may be used globally. The plants anti-inflammatory properties have been proven by the present narrative review.

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