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## Review on Pharmacognostic and Anti-inflammatory activity of few Indian medicinal plants

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### ABSTRACT

The aim of the present work was to study the potential therapeutic effects of the herbal medicinal drugs which is more beneficial than the synthetic drugs where majority of the adverse effects could be seen in them especially gastric irritation is the most common with the use of non-steroidal anti-inflammatory drugs. Medicinal plants are considered as rich resources of ingredients which can be used in drug development of either pharmacopeial, non-pharmacopoeia or synthetic drugs. Various plants are used to treat inflammation. Inflammation is a biological response of the immune system that can be triggered by a variety of factors such as pathogens, damaged cells, toxic compounds, or irradiation. It can cause redness, heat, swelling, and pain. Here we have some plants which have anti-inflammatory activity are *Azadirachta indica*, *Acacia catechu*, Clove, *Aloevera*, *Ricinus communis*, Myrrh, *Zingiber officinale*, Fenugreek.

**Keywords:** anti-inflammatory, inflammation, *Azadirachta indica*, *Ricinus communis*, *Commiphora molmol*, Ginger.

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#### 1. Introduction

The term 'medicinal plant' includes various types of plants used in herbal medicine. It is the use of plants for medicinal purposes. The major use of herbal medicines is for health promotion and therapy for chronic, as opposed to life-threatening, conditions. However, usage of traditional remedies increases when conventional medicine is ineffective in the treatment of disease, such as in advanced cancer and in the face of new infectious diseases. Treatment

with medicinal plants is considered very safe as there is no or minimal side-effects. These remedies are in sync with nature, which is the biggest advantage. The golden fact is that, use of herbal treatments is independent of any groups and the sexes. Most of the herbal drugs formulated are free of side-effects or reactions. This is the reason why herbal treatment is growing in popularity across the globe. Herbs that have medicinal quality provide rational means for the treatment of many internal diseases, which are otherwise

considered difficult to cure. Apart from the medicinal uses, herbs are also used in natural dye, pest control, food, perfume, tea and so on. Treatment of common ailments such as diarrhea, constipation, hypertension, low sperm count, dysentery and weak penile erection, piles, menstrual disorders, bronchial asthma, are given by the traditional medicine practitioners very effectively.

Inflammation is the immune system's response to harmful stimuli, such as pathogens, damaged cells, toxic compounds, or irradiation and acts by removing injurious stimuli and initiating the healing process. These factors may induce acute and/or chronic inflammatory responses in the Inflammation is therefore a defense mechanism that is vital to health. Usually, during acute inflammatory responses, cellular and molecular events and interactions efficiently minimize impending injury or infection. This mitigation process contributes to restoration of tissue homeostasis and resolution of the acute inflammation. However, uncontrolled acute inflammation may become chronic, contributing to a variety of chronic inflammatory diseases. At the tissue level, inflammation is characterized by redness, swelling, heat, pain, and loss of tissue function, which result from local immune, vascular and inflammatory cell responses to infection or injury. Important microcirculatory events that occur during the inflammatory process include vascular permeability changes, leukocyte recruitment and accumulation, and inflammatory mediator release.

Various pathogenic factors, such as infection, tissue injury, or cardiac infarction, can induce inflammation by causing tissue damage. The etiologies of inflammation can be infectious or non-infectious. In response to tissue injury, the body initiates a chemical signaling cascade that stimulates responses aimed at healing affected tissues. These signals activate leukocyte chemo taxis from the general circulation to sites of damage. These activated leukocytes produce cytokines that induce inflammatory responses.

## 2. Etiology of inflammation

### Non-infectious factors:

Physical: burn, frostbite, physical injury, foreign bodies, trauma, ionizing radiation

Chemical: glucose, fatty acids, toxins, alcohol, chemical irritants (including fluoride, nickel and other trace elements)

Biological: damaged cells

Psychological: excitement.

**Infectious factor:** Bacteria, viruses, other microorganisms

### Mediators and Biomarkers of Inflammation:

The discovery of cellular and molecular inflammatory mediators and the development of sensitive biomarkers have rapidly advanced our understanding of inflammation and its role in pathology. These biomarkers include:

1. Reactive oxygen and reactive nitrogen oxide species (ROS and RNOS)
2. Formation of DNA adducts
3. Cytokines (e.g., IL-6 and TNF-alpha) and chemokines
4. Acute-phase proteins (e.g., C-reactive protein or CRP)

5. Prostaglandins

6. Cyclooxygenase (COX)-related metabolites

7. Inflammation-related growth factors and transcription factors (e.g., NF-kappaB)

8. Major immune cell types

The specific immune cells and mediators at play are variable and dependent upon the injury, the onset/duration of the injury, and multiple genetic loci.

**Madhavalu B et al** proved the anti-inflammatory activity of aqueous leaf extract of *Azadirachta indica* which belongs to the family of *Meliaceae*. Native to Indian subcontinent and to dry areas throughout south Asia. The active constituents of the plant are flavonoids, tannins, alkaloids and tetranortriterpenes (nimbin, nimbinin, nimbidinin, nimbolide and nimbidic acid). The *Azadirachta indica* is used for treating anti-inflammatory, antimicrobial, anticancer, antimalarial, antifungal, analgesics and antipyretic activity. The study was conducted using carrageenan induced paw edema method with three groups of six albino rats of either sex (150-200g) using Celecoxib as standard the extract was used at 500mg/kg body weight and the standard was used at 1% w/v in saline. Group1: animals were treated with saline which is used as control. Group2: animals were treated with *Azadirachta indica*. Group3: animals were treated with Celecoxib. The acute inflammation was produced by sub plantar injection of 0.1ml of 1%w/v suspension of carrageenan in normal saline to all the animals and prior to carrageenan the drugs were administered orally 1hour before. The activity was carried out for 3hours where paw volumes were noted for one hour interval using plethysmometer. The aqueous extracts of *A. indica* leaf (500mg/kg p.o)has significantly ( $p < 0.001$ ) inhibited carrageenan rat induced paw edema and a maximum inhibition of rat paw edema was shown by *A. indica* and Celecoxib was  $0.99 \pm 0.06$  at 3hours &  $0.79 \pm 0.05$  at 2hours after carrageenan injection & the percentage of inhibition was 16.27% & 34.83% when compared with control group. Hence the *A. indica* leaf extract shows the significant anti-inflammatory activity in chemical induced pain model in rats.

**Gulzar Alam et al** proved the anti-inflammatory activity of petroleum ether, ethanol, ethanol: water extract of *Acacia catechu* Wild which belongs to the family Fabaceae using Carrageenan induced rat paw edema method. *Acacia catechu* wild is widely available in India. The chemical constituents of the plant are. Flavonoids like kaempferol, dihydrokaempferol, taxifolin, isorhamnetin, afzelechin and dimeric procyanidin along with quercetin and epicatechin in heartwood of *Acacia catechu* wild. *Acacia catechu* wild used for the treatment of anti-inflammatory, diarrhea, osteoarthritis, anticancer, skin diseases, hemorrhoids, colitis, dysentery and anthelmintic activity. The study was conducted using five groups of six Wister albino rats of either sex (150-200g) using Indomethacin as standard of 10mg/kg body weight, the standard was used at 0.1ml of 1% w/v suspension of carrageenan in normal saline. The control group receives vehicle orally, whereas the other groups [i.e., pet. ether extract (300mg/kg)], ethanol extract of 300mg/kg and ethanol: water extract (300mg/kg) treated

with the standard and test drug respectively by oral route and subsequently after one hour treatment, 0.1ml of 1% w/v suspension of carrageenan in normal saline was injected to sub plantar region of left hind paw to induce edema. The activity was carried out for 4 hours where paw volumes were noted for every one-hour interval using plethysmometer. Based on the test results it can be observed that the highest percentage of inhibition of ethanol extract was found to be 45% compared to standard which was 54%. Hence the ethanol extract of *Acacia catechu* Wild at 300mg/kg shows the significant decrease in paw volume in carrageenan induced paw edema in rats.

**Nining Sugihartini et al** proved the anti-inflammatory activity of essential oil of clove belonging to the family *Myrtaceae* in absorption base ointment by adding penetration enhancers which increases skin permeability such as oleic acid and propylene glycol of 2.5% concentration. Clove is native to the molucca islands beside new guinea and southern Philippines. Mainly imports from Madagascar and Indonesia. The active constituents of the plant are volatile oil with eugenol as main component, flavonoids (quercetin and kaemferol derivatives), tannins, furfural and ketone. Clove is used for the treatment of anti-inflammatory, antibacterial, antiseptic, local anesthetic, stomachic and tonic. The study was conducted using four groups of Balb/ C strain of male mice, using topical sodium diclofenac as standard of 100mg and the positive control group was induced with 0.1ml of croton oil of 4% concentration which is compared with the standard drug. The composition of oleic acid & propylene glycol was oleic acid 100% [F1], 50% oleic acid & propylene glycol [F2], and 100% propylene glycol [F3]. The ointment of formula 1, 2 and 3 were given to a group of mice after they were induced with inflammatory agent. After 24 hours, the mouse was dripped with 0.1ml of 4% croton oil at its back. Later the application of 100mg ointment was done after 30 min and the treatment was given for about 3 days. Based on the results of test it was observed that the [F3] shows the significant decrease in COX-2 expression, the number of inflammatory cells and the epidermal thickness when compared with the standard drug. Hence the inflammatory activity of eugenol in essential oil of clove increases with the addition of the composition enhancer which provides good anti-inflammatory activity.

**Bhattacharjee et al** proved the anti-inflammatory activity of aqueous extract of *Aloe vera* belonging to the family *Liliaceae* using carrageenan induced acute inflammatory rat model. *Aloe vera* is widely available in India. The leaves are thick and fleshy, green to grey-green, with some varieties showing white flecks on their upper and lower stem surface. The chemical constituents of the plant are containing 30% aloin which is a mixture of 3 isomers barbaloin, beta barbaloin, isobarbaloin, aloinoside A, aloinoside B, capaloresinotannol with p-coumaric acid, resin of curacao variety contain barbaloresinotannin. *Aloe vera* used for treatment of anti-inflammatory, antispasmodic, strong purgative, skin diseases, antioxidant, antimicrobial, diabetic and wound healing activity. The study was conducted using

six groups each contained six rats using Indomethacin as standard drug in which, the positive control group receives the vehicle orally, the negative control group was induced by 1% carrageenan orally and the other two test group receives the 1% carrageenan and aqueous extract 1:5w/v at a concentration of 125µl, 250µl orally and the protection group was treated with *A. vera* 125µl doses orally once a day for 7 days prior from the day of injection & the standard group was treated with 60µl of 10mg/ml Indomethacin dose equivalent to 10mg/kg body weight. The activity was carried out for 3.5 hours where the paw volumes were noted at 0h, 0.5h, 1.5h, 2.5h, 3.5h. The percentage of inhibition was evaluated by graphical presentation which showed 92.7% of inhibition by indomethacin after 3.5hrs of carrageenan injection, treatment groups of 125µl & 250µl showed 58.69% & 74.09% of inhibition respectively. Hence it can be concluded that the crude gel of *A. vera* can also reduce the inflammatory pain efficiently. However high doses will have some toxic effects.

**Raju Ilavarasan et al** proved the anti-inflammatory activity of root extract of *Ricinus communis* belonging to the family *Euphorbiaceae* using carrageenan induced paw edema model. *Ricinus communis* available in India, Brazil, USA, USSR, Rumania. Pale yellow in colour, nauseating odour, first it is bland afterwards slightly acrid and nauseating in taste. The chemical constituents of the plant triglycerides of 80% ricinoleic acid, isoricinoleic acid, linoleic acid, stearic acid and isostearic acid. *R. communis* used for the treatment for mild purgative, anti-inflammatory, lubricating agent, ricinoleic acid is used a contraceptive in creams and jellies. The study was conducted using four group of adult wistar albino rats of either sex using diclofenac sodium as a standard drug and carrageenan as a control group. Fresh root was collected of this plant was chopped, shade-dried and coarsely powdered. Powder is treated with petroleum ether and extracted with methanol using Soxhlet extractor.

The extract was dried under reduced pressure using a rotary flash evaporator Paw edema was induced by 0.1ml of 1% carrageenan in physiological saline into the sub-plantar tissues of the left hind paw of each rat. The methanolic extract of *Ricinus communis* (250 and 500 mg/kg) were administered orally 30min before administration of carrageenan. The paw volume was measured at 60, 120, 180 and 240min by the mercury displacement method using a plethysmograph. The Inhibitions percentage of paw volume treated drug group was compared with the control group of carrageenan. Diclofenac sodium (5mg/kg) was used as the reference standard. The cotton pellet-induced granuloma in rats was studied. weighing 1mg of cotton pellets were autoclaved and injected by subcutaneously in both sides of the groin region of each rats Group 1 served as control and received the vehicle's extract RCM at concentration of 250 and 500mg/kg was administered orally for groups 2 and 3 for 7 days. Group 4 animals received diclofenac sodium at a dose of mg/kg for the same period. Animals were sacrificed on 8<sup>th</sup> day and the pellets together with the granuloma

tissues were carefully removed, dried in an oven, weighed and compared with control. Data analyzed by the anti-inflammatory activity by using one-way analysis of variance followed by Dunnett's t-test,  $p < 0.05$  was considered as significant. Based on the result the methanolic extract of *Ricinus communis* root possess significant ( $p < 0.001$ ) anti-inflammatory activity in both carrageenan-induced paw edema and cotton pellet granuloma models.

**Mostafa Abbas Shalaby and Ashraf Abd-Elkhalik Hammouda et al** proved the analgesic, anti-inflammatory, and anti-hyperlipidemic activities of *Commiphora molmol* belonging to the family *Burseraceae* using paw edema model. *Commiphora molmol* available in North east africa, Southern Arabia. Externally reddish brown, internally brown in colour, aromatic and agreeable odour, bitter and acrid in taste. The chemical constituents of the plant volatile oil, resin, gum, and bitter principle.

The volatile oil consists of eugenol, m-cresol and cuminaldehyde. *C. molmol* used for the treatment for anti-inflammatory, perfumes and incense, antiseptic, stimulant, astringent and carminative. The study was conducted using 5 groups of male Wister mice and Dawley rats, indomethacin as a standard drug and formalin as a control drug. Two hundred grams of *C. molmol* resin fine powder were soaked in 1L of 90% ethanol and kept in a refrigerator with daily shaking for 3days. The ethanol extract was filtrated using double-layer of gauze. The extracts were concentrated using rotatory evaporator connected with an electric vacuum pump and metal water bath adjusted at 50-degree C.

The obtained semisolid ethanol extracts of *C. molmol* was kept in a refrigerator until further use. 0.1ml of 2% formalin was injected by subcutaneous route in the right hind paw. Rats were divided into five groups of five rats each. Group 1 was orally given the vehicle, and remaining four groups were injected with 0.1ml of 2% formalin solution in the right hind paw. After few min induction of edema, the rats of group 2 were intraperitoneally injected by anti-inflammatory drug indomethacin 10mg/kg body weight. Groups 3,4, and 5 were orally given *C. molmol* extracts with respective dose. The volume of paw edema was measured and 12h post administration of standard or extracts. Data were expressed as mean standard error. Difference between the control and experimental groups were carried out using students t-test. Difference between the experimental groups was considered significant at  $P < 0.05$ . Based on the result of ethanol extract of *C. molmol* fine powder possess anti-inflammatory activity in paw edema model.

**Rohini Karunakaran et al** prove the anti-inflammatory effect of aqueous extract of *Zingiber officinale* belonging to the family *Zingiberaceae* using carrageenan-induced inflammation on Sprague Dawley rats. Native to south east Asia also cultivated in India, west indies, Australia. Buff in colour, aromatic odour, pungent in taste.

The chemical constituents of the plant are terpenoids, flavonoids, saponins, tannins and phenols. *Z. officinale* used for the treatment for anti-inflammatory, carminative, stomachic, flavoring agent. The study was conducted using five group of SD rats, using diclofenac sodium as a standard drug and carrageenan as a control drug. Aqueous ginger extract was prepared from ginger S75ml cold, sterile 0.9% NaCl solution, and 25ml of ice-cold water to make the volume 100ml. The homogenization was carried out in blender for 12min. The homogenized mixture was filtered three times through cheesecloth. The filtrate was centrifuged at 2000 rpm for 10min, the clear supernatant fraction was separated, and volume made up to 100ml with normal saline.

The concentration of this ginger preparation was calculated to have 200mg/ml based on the weight of the starting material. The aqueous extract was stored in sample tubes at 20 degree C until fed to rats. The rats were divided into five groups. Group 1 served as normal saline and all other groups were comprised carrageenan-induced inflammation rats. Group 2 served as carrageenan control. Groups 3 and 4 received *Z. officinale* orally. Group 5 received the reference drug diclofenac sodium. Based on the result of aqueous ginger extract of *Zingiber officinale* possess anti-inflammatory activity in carrageenan-induced inflammation. Results indicate that aqueous extracts of *Z. officinale* have significantly decreased the carrageenan-induced inflammation and related paw edema in our study on SD rats.

**Kilambi Pundarikashudu et al**proved the anti-inflammatory activity of fenugreek seed powder, was extracted in petroleum ether by cold maceration [FSPEE] OF 0.5ml/kg. Fenugreek seed petroleum ether extract against carrageenan formaldehyde paw oedema on rats. Fenugreek native to indigenous to the countries on the eastern shores of the mediterranean. Cultivated in India, Africa, Egypt, Morocco, and occasionally in England. Yellowish brown in colour, spicy odour, bitter and peculiar in taste. The chemical constituents of the plant amino acids:4-hydroxyisoleucine, 4-hydroxyleucine lactone, arginine, histidine and lysine. Steroidal saponins, alkaloids, flavonoids, carbohydrates. Fenugreek used for the treatment anti-inflammatory, analgesics, antiadhesive, anticarcinogenesis, antitumor, antioxidant, antiplatelet activity.

The study was conducted using 5 groups of 5 animals in each group. Albino rats of either sex (200-250) were used in the experiment [Phenylbutazone] OF 100mg/kg was used as standard PBZ dissolved in 1% normal saline with 2 days of tween 80. Paw volume was measured at 0 and 48hours after formaldehyde administered. The results, GLC of FSPEE showed Oleic (33.61%), Linolic (12.51) acid. 0.5ml/kg of FSPEE was used in treatment, there was 37% ( $P < 0.05$ ) and 85% ( $P < 0.55$ ) reduction in inflammatory of the paw in carrageenan and formaldehyde-induced paw oedema. The conclusion, thus, petroleum ether extract of fenugreek seeds had been shown significant anti-inflammatory activity.

Table 1

SL.NO	Authors name	Name of the plant	Part of the plant	Model	Activity proved
1	Madhavalu B et al.	<i>Azadirachta indica</i> (Neem)	Aqueous extract of leaf	Carrageenan (chemical) induced pain model	Anti-inflammatory
2	Gulzar Alam et al.	<i>Acacia Catechu wild</i>	Fresh leaves of Acacia catechu & Pet.ether, Ethanol, Ethanol: water extract	Wister albino rats	Anti-inflammatory
3	Nining Sugihartini et al.	<i>Syzygium aromaticum</i> (Clove)	Essential oil of clove	Balb/C strain of male mice	Anti-inflammatory
4	Bhattacharjee et al	<i>Aloevera</i>	Crude gel of Aloe vera	Carrageenan induced rat model	Anti-inflammatory
5	Raju Ilavarasan et al	<i>Ricinus communis</i>	Fresh root	Wister albino rats, Carrageenan & Cotton pellet granuloma	Anti-inflammatory
6	Mostafa Abbas Shalaby, Ashraf Abd-Elhalik Hammouda et al	<i>Commiphora molmol</i> (Myrrh)	Fine powder	Wister mice & Sprague dawley rat model	Anti-inflammatory
7	Rohini Karunakaran et al	<i>Zingiber officinale</i>	Roots	Carrageenan induced & Sprague Dawley rat model	Anti-inflammatory
8	Kilambi Pundarikakshudu et al	<i>Trigonella foenum-graceum Linn</i> (Fenugreek)	Pet.ether Extract of Fenugreek-k seed powder	Carrageenan induced, Formaldehyde induced paw oedema, Complete Freund's Adjuvant induced arthritis & Cotton pellet induced granuloma	Anti-inflammatory

### 3. Conclusion

The above-mentioned plants significantly reduces the inflammation because of the presence of some active/chemical constituents like flavonoids, tannins, alkaloids, tetranortriterpenes, carbohydrates, steroids, glycosides, diterpenes, sesquiterpenes, linoleic and linolenic acids etc. As our lifestyle is now getting techno-savvy, we are moving away from nature. While we cannot escape from nature we are part of nature. As herbs are natural products, they are free from side effects, they are comparatively safe, eco-friendly and locally available. Herbal products are today the symbol of safety in contrast to the synthetic drugs, which are regarded as unsafe to human being and environment. Although herbs had been priced for their medicinal, flavouring and aromatic qualities for centuries, the synthetic products of the modern age surpassed their importance, for a while. However, the blind dependence on synthetic is over and people are returning to the naturals with hope of safety and security.

### 4. Acknowledgments

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