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Review Article

AN OVERVIEW ON PLANTS WITH ANTI-INFLAMMATORY POTENTIAL

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ABSTRACT

Inflammation is a protective mechanism of the body which involves vascular tissues, plasma proteins or cells and chemical mediators for the removal of hazardous stimuli like pathogens, allergens, irritants or cell damage and initiates the healing process. Anti-inflammatory drugs like steroidal and non-steroidal anti-inflammatory drugs are used to treat inflammation. Recently, the synthetic drugs shows a number of side effects such as kidney failure, ulceration and bleeding, liver damage etc. Therefore a search for the other substitute with no or less side effects is necessary. Plants are used from ancient times to treat various serious disorders. Plant constitutes a large number of chemicals which are responsible for the treatment of disease in an archaistic manner. The present review was pile up various plants with anti-inflammatory potential.

Keywords: Inflammation, Medicinal plants, Anti-inflammatory potential

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INTRODUCTION

Inflammation is a protective reaction to tissue damage and involves a complex process of enzyme activation, release of chemical mediators, fluid recruitments, cell migration, tissue damage and healing [1]. Increasing vascular permeability, protein denaturation and membrane alterations are the complex processes, which is associated with pain, fever, swelling and redness [2]. Various harmful stimuli such as pathogens, irritants and chemicals initiate the vascular response. As inflammation is the protective mechanism which removes hazardous stimuli but if inflammation is not treated it leads to diseases like rheumatoid arthritis, atherosclerosis and vasomotor rhinorhoea [3]. In the inflammatory process important role played by chemical mediators that tends to direct the inflammatory response. The mediators produced by plasma proteins or cells including mast cell, neutrophils, platelets, monocytes and macrophages and they bind to specific receptors and produces vascular permeability, neutrophil chemotaxis, smooth muscles contraction and various enzymatic activities [4]. Histamine, leukotrienes, tumor necrosis factor, prostaglandins, serotonin and cytokines are the chemical mediators mostly responsible for inflammatory response.

The most of the inflammation treated by using the synthetic drugs like non steroidal anti-inflammatory drugs and opioids but in current days these are not useful to treat all cases of inflammation due to their potent side effects [5]. As a result, a search for the other alternatives with less side effects and potency seems crucial and advantageous. The medicinal plants have a number of chemical constituents from which novel anti-inflammatory agents can be discovered. Research on biological activities of plants yields a number of compounds for the development of modern drugs during the past two centuries [6]. The study of plants that have been traditionally for curing inflammation is still fruitful and logical research strategy in the source of new anti-inflammatory drugs [7]. The aim of present study was to compile data on plants or herbal medicines with anti-inflammatory potential.

Plants with anti-inflammatory potential

Screening by *in vitro* models

Zizyphus spina

The alcoholic extract of the dry powdered seeds and fruits of *Z. spina* was investigated by protein denaturation method. The result designated anti-inflammatory activity of both parts of the plant extract was significant and comparable with the standard anti-inflammatory drug, diclofenac [8].

Solanum xanthocarpum

The anti-inflammatory activity of stem and leaf extracts of *Solanum xanthocarpum* was performed by using HRBC membrane lysis method. The prevention of hypotonicity induced HRBC membrane lysis was taken as a measure of the anti inflammatory activity. The anti-inflammatory activity of the ethanol extracts of stem and leaves were compared to that of the standard drug hydrocortisone. Leaf extract at a concentration of 12.0 mg/ml illustrated maximum protection of HRBC (73.66±1.45%) in hypotonic solution [9].

Aervalanata

The *in-vitro* anti-inflammatory activity of *Avera lanata* was studied by HRBC lysis and protein denaturation method against diclofenac sodium as standard drug. There was a concentration dependent inhibition of lysis of HRBC and protein denaturation by the *A. lanata* extract and the effect of diclofenac sodium was found to be less when compared with the ethanol extract [10].

Zingiber Officinale

The Ethanolic extract of ginger was evaluated for *in vitro* anti-inflammatory potential using proteinase inhibitory assay against aspirin as standard drug. The ethanolic extract of ginger showed *in vitro* anti-inflammatory potential by inhibiting (78.49%) proteinase activity [11].

Thymus vulgaris

The methanolic extract of *Thymus vulgaris* was evaluated by LOX assay for it's *in vitro* anti-inflammatory potential. *Thymus vulgaris* extract showed the highest total phenolic content which is responsible for anti-inflammatory activity [12].

Plumeriarubra

The ethanolic extract of fresh flowers was evaluated for anti-inflammatory activity by using HRBC membrane stabilization method and inhibition of albumin denaturation method. The results revealed a concentration dependent increase in anti-inflammatory potential [13].

Bauhinia purpurea

Petroleum ether and methanolic extracts of stem bark of *B. purpurea* were subjected for *in vitro* anti-inflammatory potential by using protein denaturation and membrane stabilization methods. The highest concentration of extract showed effective anti-inflammatory potential [14].

Mangifera indica

Methanol and ethanol leaf extracts of *M. indica* were investigated for their *in vitro* anti-inflammatory proprieties by HRBC membrane stabilization method compared to diclofenac as standard. The prevention of hypotonocity induced HRBC membrane lysis was taken as a measure of anti inflammatory activity. The methanolic extract of *Mangifera indica*at 100µg/ml is 15.2% and at a concentration, 200µg/ml is 19.2% shows the highest anti inflammatory activity [15].

Gliricidiasepium

The anti-inflammatory activity of aqueous extract of *Gliricidiasepium* flowers by *in vitro* model by HRBC membrane stabilization assay. Aqueous extract showed dose dependant anti-inflammatory activity in human red blood cell membarane stabilization method at different concentrations (100-500 µg/kg) with a percentage protection of 7.15, 11.25, 22.71, 24.83 and 26.95 compared to standard diclofenac 32.09% at 10 µg/kg [16].

Bulbophyllum Kaitense

Petrolieum ether chloroform, ethanol and aqueous extracts of *Bulbophyllum Kaitesnse* were tested human red blood cell membrance stabilization method. The plant extract showed significant activities in both of the anti-inflammatories says as compared to diclofenac drug dependent manner. This investigation suggests that ethanolic extract has anti-inflammatory potential activity [17].

Justiciabetonica

The ethanolic extract of the whole plant of *Justiciabetonica* was evaluated by HRBC membrane stabilisaton assay. Diclofenac sodium was used as standard drug. The extract exhibited membrane stabilization effect by inhibiting hypo tonicity induced lysis of erythrocyte membrane. Ethanolic extract of *Justiciabetonica* prevents hypo tonicity induced membrane lysis to an extent of 83.11% at the concentration of 500µg/ml [18].

Mimusopselengi

The methanolic extract of leaves of *M. elengi* was studied by using HRBC membrane stabilization method. It has been reported that certain saponins and flavonoids exerted profound stabilizing effecton lysosomal membrane. The methanolic extract of leaves which showed positive tests for phenolics and flavonoids exhibited the highest membrane stabilizing the activity of 69.13±0.78 compared to that of standard diclofenac potassium which exhibited87.89±0.69% protection at 100 µg/ml concentrations [19].

Screening by *in vivo* models

Rauvolfiatetraphylla

Hydro-alcoholic, methanolic, ethyl acetate and hexane extract of *Rauvolfiatetraphylla* root bark were studied in carrageen an induced acute inflammation in rats. In carrageen, an induced inflammation model, hydro-alcoholic and methanolic extract of *R. tetraphylla* root bark at three different doses produced significant (P<0.001) reduction when compared to vehicle treated control group and hexane, ethyl acetate extracts [20].

Cassia auriculata

The anti-inflammatory activity of aqueous, methanolic, ethyl acetate and hydro alcoholic extracts of *Cassia auriculata* leaves using carrageen an induced paw model. Indomethacin (10 mg/kg) was used as reference compound in the present study. Among all extracts methanolic extract showed maximum anti-inflammatory potential due to the presence of alkaloids, flavonoids, tannin and steroids [21].

Cyathoclinelyrata

The chloroform extracts of whole part of *Cyathoclinelyrata* was evaluated by carrageen an induced hind paw edema and formalin induced paw edema method for its anti-inflammatory potential. The results suggest that the chloroform extracts of the whole part of *Cyathoclinelyrata*c as posses anti-inflammatory potential [22].

Basellaalba

The methanolic extract of *B. alba* leaf was studied by using cotton pellet induced inflammation and In the carrageen an induced inflammation models. The plant extract has been shown a significant activity at 500 mg/kg dose (p<0.001) which was comparable with the standard drug. It can be concluded that *Basellaalba* possesses a good anti-inflammatory activity [23].

Brideliamicrantha

The anti-inflammatory potential of methanol extracts of leaf of *Brideliamicrantha* evaluated by using acute, sub-acute and chronic models of inflammation in Wistar rats. In the carrageenan-induced acute inflammation model, 400 mg/kg of extract produced 71.79 % edema inhibition. In the histamine induced rat paw edema model, the extract exhibited 72.97 % protection at 400 mg/kg. In the sub-acute model using formaldehyde-induced paw edema, 400 mg/kg of extract showed 59.77 % (0.35±0.03) inhibition after 24 h [24].

Vitexagnus

The petroleum ether, ethyl acetate, methanol and aqueous extracts of leaves were subjected to standard acute, sub acute and chronic models of inflammation at 200 and 400 mg/kg. All extracts produced significant inhibition while methanol extract at 400 mg/kg caused a maximum inhibition of 43% in paw edema, 75%inhibition in sub acute and 59.28% inhibition in the chronic inflammation model. It was concluded that the anti-inflammatory activity might be due to flavonoids in the extracts and plant regulates the inflammation by a significant decrease of TNF-α and IL-6 by macrophages [25].

Dendrophthoe falcate

The ethanolic, aqueous, chloroform and petroleum ether extracts of *D. falcata* leaves were illustrated by using carrageen an-induced paw edema model. The highest anti-inflammatory potential of 90.24% inhibition of paw edema volume was showed by petroleum ether extract at 200 mg/kg dose. Ibuprofen was treated as a standard drug at 10 mg/kg body weight [26].

Smilax wightii

The *S. wightii* fruit extract was evaluated for the anti-inflammatory potential by using carrageen an induced paw edema. *S. wightii* exhibited the significant anti-inflammatory activity at the dose of 100 mg/kg and 200 mg/kg, body weight. The per cent inhibition of paw oedema of *S. wightii* was 59.77 and 77.58 at various doses [27].

Table 1: List of plants with anti-inflammatory potential screened by *in vivo* models

Plant name	Plant parts	Extracts	Screening model	References
Dracaena cinnabari	Resin	Methanol	CIPE	[28]
Partheniumcamphora	Whole plant	Aqueous, ethanol	CIPE	[29]
Ficusvirens	Bark	Ethanol	CIPE	[30]
Tragiacannabina	Whole plant	Methanol, chloroform	CIPE	[31]
Prenanthessarmentosus	Leaves	Chloroform,	CIPE	[32]
Ixoracoccinea	Flower	Methanol	CIPE	[33]
Melia azedarach	Seed	Hexane	CIPE, FIPE	[34]
Rotula aquatic	Whole plant	Pet ether, ethyl acetate, ethanol	CIPE, CPG	[35]
Cuscutareflexa	Stem	Alcoholic, aqueous	HIPE	[36]

Murdannialoriformis	Whole plant	Ethanol	CIPE, CPG	[37]
Kalanchoepinnata	Stem	Aqueous, ethanol	CIPE	[38]
Ziziphusxylopyrus	Stem bark	Chloroform, methanol	CIPE	[39]
Coriandrumsativum	Leaves	Ethanol	CIPE	[40]
Syzygiumsamarangense	Leaves	Methanol	CIPE	[41]
Ixorapavetta	Leaves	Ethanol	CIPE	[42]
Ocimum sanctum	Leaves	Aqueous	CIPE	[43]
Murrayakoenigii	Root	Pet ether, ethyl acetate, chloroform	CIPE	[44]
Vitexnegundo	Leaves	Hydroalcoholic	CIPE	[45]
Antidesmamenasu	Leaves	Aqueous	CIPE, CPG	[46]
Sapinduslaurifolius	Leaves	Methanol	FIPE	[47]
Corallocarpusepigaeus	Rhizome	Methanol, ethyl acetate	CIPE	[48]
Solanum melongena	Leaves	Aqueous	CIPE	[49]

CIPE: Carrageen an Induced Paw Edema; CPG: Cotton Pellet Granuloma; FIPE: Formalin Induced Paw Edema; HIPE: Histamine Induced Paw Edema.

DISCUSSION

The therapeutic use of herbal medicine increased from past decades due to the side effects of synthetic drugs. Herbal medicines as the major remedy in the traditional system of medicine have been used in medical practice from ancient timings [50]. Ayurveda the "Science of Life" is the holistic alternative science from India. Herbs are staging a comeback over the globe. Ayurveda said to be a world medicine is the most holistic or comprehensive medical system available. The herbal products are safe in contrast to synthetic drugs that are regarded as unsafe to the human body and environment [51]. Inflammation is the protective mechanism of the body that helps to protect itself from injury, allergens, toxins, irritants and chemicals. Now a day whole world moves towards herbal medicines with minimum side effects and cost effective for the treatment of such ailments. There are a number of studies evaluate the anti-inflammatory potential of plants but very few leads towards clinical studies.

CONCLUSION

The present review outline the varies new anti-inflammatory plants for the discovery and development of novel medicines with less side effects, cost effective and more effective for the treatment of inflammatory disease. This study will helpful to researchers in the future to improve the status and to determine which constituents are effective which will providing clues and developing new anti-inflammatory drugs. All the plants involve in the review are studied by pre-clinical methods and it will helpful to the clinical organization to improve the research and innovation of anti-inflammatory drug.

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CONFLICT OF INTERESTS

Declare none

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