Promising herbs for the management of inflammation associated with various pathological conditions - A Review

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ABSTRACT

Ailments with ignescent etiopathology have expanded in rate lately. Medications utilized for restorative administration of such provocative ailments are alleviating the disease and yet additionally countering genuine perilous outcome. Allopathic medications really pejorare the disease condition in patients, particularly with rheumatoid joint pain and osteoarthritis. Add to this the huge number of individuals detriment by these medications, as well as their huge expenses and the need of using reciprocal means become obvious. On the other hand, natural medicines offer one engaging approach to decrease the use of allopathic non-narcotic anti-phlogistic agents. The reason for administering herbs incorporate long accounts of utilization, a broad examination on various natural constituents, the relative simplicity of administration profile, economical and magnificent security records. So far, Many Phyto-constituents are investigated for numerous therapeutic applications, albeit a large fraction of these reports are of scholarly interest, only some of them get a pass for clinical preliminaries. Future exploration should look into the molecular mechanisms of various therapeutic applications of the natural plants in different ailments associated with inflammation. This review is a compilation of anti-inflammatory natural agents along with reported action path. We have summarized all necessary information regarding the title with the aid of best possible sources.

INTRODUCTION

Inflammation is considered as an in-vivo intrinsic reaction, which becomes evident to shield the body from toxic and unwanted boosts, bringing about the edema of tissues, torment, or even damage at a cellular level. The primary purpose behind this system is to fix and return the harmed tissue to the normal condition. The expansion in the size of the vessels is seen around the inflamed loci (i.e., neutrophils, macrophages, and lymphocytes) during the starting phases of inflammation. However, in consecutive time, numerous sorts of cells arrive at neutrophils, trailed by macrophages within 48 hours and lymphocytes following a few days. It is notable that the bio-chemical disturbances of cells happen during inflammation, prompting the arrival of arachidonic acid, and further goes through two metabolic precursor pathways known as the lipoxygenase and cyclooxygenase pathways.
The results of the COX pathway are prostaglandins (cause of intense inflammation) and thromboxane, whereas the LOX pathway gives rise to leukotrienes and hydroperoxy fatty acids as depicted in Figure 1, (Palumbo, 2017).

Aggravation can be ordered into two classifications: intense and interminable inflammation. Intense inflammation is considered as the principal line of guard against injury. It happens in a brief timeframe and is showed by the discharge of liquid and plasma proteins alongside the migration of leukocytes, for example, neutrophils. Then, chronic aggravation takes delayed span and is showed by the activity of lymphocytes and macrophages, bringing about fibrosis and tissue rot. Inflammation is considered as one of the most well-known factors of diseases, going from the mild to a severe condition like malignancy (Fuster and Sanz, 2007).

As of now, non-steroidal anti-inflammatory drugs such as diclofenac, aspirin, celecoxib and ibuprofen are widely employed for the treatment of inflammation.

These medications display their pharmacological action by hindering the COX-1 movement, and in this way, restrict the synthesis of prostaglandins, as shown in Figure 2, (Piazuelo and Lanas, 2016).

Adverse events associated with NSAIDs

NSAID consumers with rheumatoid joint pain had ten times expanded danger of hepatotoxicity when contrasted with NSAID-clients with osteoarthritis. Another danger factor is accompanying introduction to other hepatotoxic medications. The poisonous effect of NSAIDs becomes worst with simultaneous utilization of other hepatotoxic medications. Metabolic distortion may happen as hereditary polymorphism (Sriuttha et al., 2018).

Nephrotoxicity of NSAIDs is viewed as a bizarre condition when compared to the occurrence of GI and cardiac adverse effects. Clinical indications of non-narcotic initiated nephrotoxicity incorporates electrolyte lopsidedness, for example, hyperkalemia, decrease glomerular filtration rate, a nephritic condition identified with drug instigated negligible change ailment, incessant kidney malady, intense interstitial nephritis, edema, sodium reserve and renal papillary rot. Age progression itself can build the danger of GI seeping. The action underlying NSAIDs incited GI unfavourable impacts lies in the way that these drugs restrain prostaglandin formation, causing debilitating of the defensive GI mucosal hindrance and inclining one to bleeding. Susceptibility of all non-steroidal anti-inflammatory agents for cardiac unintended impacts such as example, thrombotic complications, myocardial necrosis, stroke edema and hypertension has already been established (Harirforoosh et al., 2014).

Drug - Drug interaction

Non-narcotic anti-phlogistic agents are one of the most widely recognized agents for unfavourable medication responses (Table 1). As patient age and the quantity of drugs increment, non-steroidal agents in the older ought to be advised with alert. (Vostinaru, 2017)

Contra-indications

There are many reported cautious and contraindicated pathological events with NSAIDs (Table 2) (Crighton et al., 2020).

Plant-based or natural medication has been utilized since ancient time to treat pain, aggravation, and inflammatory intervened torment. One-fourth of our tree greenery is not found somewhere else on the planet, and a considerable lot of our herbaceous verdure and various groups of species are exceptional. In view of nutritional investigations, these restorative plants contain assorted nutritive qualities and have possible bioactive compounds with the well-established activity against many inflammatory ailments, including gout or aging maladies (Wirth et al., 2005).

WHO characterizes restorative plants as plants which have compounds that may be utilized for the medicinal purposes and by designing valuable medications from the metabolites. As per the WHO, therapeutic plants are as yet being utilized by the individuals in developing nations to treat different illnesses. Strikingly, about 20% of current medicines have been evolved from natural assets; for example, therapeutic plants (Wangchuk, 2018).

Molecular action mechanism of anti-inflammatory herbs

A significant number of herbs exert therapeutic effect by hindering the inflammatory pathways in a similar manner as NSAIDs. According to the reported data, mechanism path includes inhibition potential of prostaglandins, NO production, pro-inflammatory cytokines (IL-6, TNF-α and IL-1β), as well as prevention of arachidonic acid metabolism and eicosanoid biosynthesis, leading to COX-2 inhibition and reducing inflammation (Maroon et al., 2010).

In addition to the LOX and COX pathways; many natural compounds act by blocking MAPKs, STAT-3 and nuclear factor-kB pathways (Ghasemian et al., 2016).
Table 1: Drug interaction of NSAIDs and commonly used medications.

| Medication                                      | Interaction                                                   |
|------------------------------------------------|---------------------------------------------------------------|
| Anti-platelets (clopidegrel, aspirin)          | Augmented peril of GI bleeding                                |
| Angiotensin-converting enzyme inhibitors (ACE inhibitors) | Rise in blood pressure by exerting antihypertensive effects |
| Angiotensin receptor blockers (ARB); Beta-blockers (atenolol, metoprolol) | High blood pressure followed by antihypertensive effects |
| Calcium antagonists                            | Propagation in blood pressure associated with antihypertensive effects |
| Corticosteroids                                | Increase menace of GI bleeding                                |
| Digitalis glycosides                           | Shoot up serum digoxin level                                  |
| Diuretics                                      | Elevate arterial pressure of blood flow by mimicking the action of antihypertensive agents. |
| Methotrexate                                   | Non-opioids hamper renal clearance of methotrexate            |
| Selective serotonin reuptake inhibitors        | Increase menace of GI bleeding                                |
| Warfarin and other anticoagulants              | Increase the peril of GI bleeding                             |
NSAIDs should usually be avoided.

1. NSAID sensitive individuals, like aspirin, actuated asthma
2. In case of peptic ulcer and stomach bleeding tendency.
3. In chronic liver diseases.
4. Reye’s syndrome
5. Salicylates are not recommended in children with influenza or smallpox.

Types of inflammation

Joint Inflammation

Inflammation is a natural reaction to injury because of different anxious trigger factors, for example, microbes, wrecked cells or certain chemicals. A few, pathological indicators of arthritis, are caused by misled provocative inflammation response in the joint. Expanded cell count as well as fiery matters within joints are responsible for soreness, ligament decay and abnormal joint lining growth (Maione et al., 2016).

In certain ailments, the body’s safeguard system known as immune framework mediates an inflammatory response without the presence of any foreign trigger factor. Under such condition, the body’s immune system starts harming its own tissues. Rheumatoid joint pain is the common example for this. Most, by and large, variety of joint pain related with an immune system provocative condition incorporate fiery joint pain, rheumatoid joint inflammation, psoriatic joint pain and fundamental lupus erythematosus (Buttgereit et al., 2015). A list...
of natural compounds for the management of joint inflammation is summarized in Table 3.

Inflammatory Skin Disorders

Incendiary skin ailments are the most widely recognized integumentary disorders. Such problems spread an expansive scope of classes that incorporate numerous conditions going in seriousness, from gentle tingling to grave clinical health entanglements. They are usually manifested by the shaded eruption, tingling, swelling and rankle, by raised incendiary plaques secured by white scales, by micro-organisms tainted injuries or by rash indications (Voiculescu et al., 2014). A list of natural compounds for the management of skin inflammation is presented in Table 4.

Cardiovascular Inflammation

Cardiovascular maladies stand as the primary death factor around the whole world. The etiology of these

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Table 3: Natural compounds for joint inflammation

| Botanical name                              | Chemical constituent       |
|--------------------------------------------|----------------------------|
| Clerodendrum phlomidis L. (Lamiaceae)       | β-sitosterol                |
| Erycibe obtusifolia Benth. (Convolvulacea)  | scopoletin, (Actor and Smith, 2019) |
| Garcinia mangostana L. (Clusiaceae)         | γ-mangostin                |
| Gaultheria yunnanensis (Franch.) Rehder (Ericaceae) | Catechin              |
| Gymnaster koraensis (Nakai) Kit. (Apiaceae) | Gymnasterkoreayne B (Xin et al., 2017) |
| Magnolia Officinalis Rehder                 | Magnolol                   |
| Malus domestica Borkh. (Rosaceae)           | Maslinic acid              |
| Saussurea lappa Clarke                      | Costunolide                |
| Stephanotis mucronata Merr. (Apocynaceae)   | Stephanoside E (Ansari, 2019) |
| Withania somnifera (L.) Dunal (Solanaceae)  | Withanolides               |

Table 4: Natural compounds for skin inflammation

| Botanical name                              | Chemical constituent       |
|--------------------------------------------|----------------------------|
| Arachis hypogaea L. (Fabaceae)             | Quinic acid                |
| Chromolaena odorata L. (Asteraceae)        | Coriolic acid (Adetunji et al., 2021) |
| Citrus unshiu (Rutaceae)                   | Nobiletin                  |
| Curcuma longa L. (Zingiberaceae)           | Tetrahydro curcuminoid     |
| Mangifera indica (Anacardiaceae)           | Polyphenols (Chomnawang et al., 2005) |
| Panax ginseng (Araliaceae)                 | Ginsenoside                |
| Punica ginseng L. (Punicaceae)             | Punicalagins               |
| Juniperus communis L. (Cupressaceae)       | Polyphenols (Athar and Nasir, 2005) |
| Vitis vinifera L. (Vitaceae)               | Quercetin 3-O-glucoside    |
| Zanthoxylum piperitum (Rutaceae)           | α-sanshool                 |
| Botanical name                       | Chemical constituent                                      |
|-------------------------------------|-----------------------------------------------------------|
| Andrographis paniculata Nees (Acanthaceae) | Andrographolide                                            |
| Belamcanda chinensis (L.) DC. (Iridaceae) | Tectorigenin                                               |
| Cimicifuga racemosa L. (Ranunculaceae) | Cimiracemate A                                            |
| Forsythia viridissima (Oleaceae)     | Phyllyrin                                                  |
| Salvia miltiorrhiza Bunge (Lamiaceae) | Tanshinone IIA                                            |
| Schisandra chinensis (Turcz.) Baill. (Schisandraceae) | α-cubebenoate                                               |
| Schisandra sphenanthera (Schisandraceae) | Schisantherins A–D                                        |

| Botanical name                        | Chemical constituent                                      |
|---------------------------------------|-----------------------------------------------------------|
| Eriobotrya japonica (Thunb.) Lindl. (Rosaceae) | Epicatechin                                                |
| Usnea ghattensis. (Parmeliaceae)      | Usnic acid                                                |
| Lonicera japonica Thunb. (Caprifoliaceae) | 3’, 4’, 5,7-tetrahydroxy flavone                          |
| Psoralea corylifolia L. (Fabaceae)    | Corylifol A                                               |
| Sarcandra glabra (Thunb.) Nakai (Chloranthaceae) | Isofraxidin                                               |
| Radix Scutellariae (Lamiaceae)        | Baicalin                                                   |
| Vitex rotundifolia (Lamiaceae)        | Casticin                                                   |
| Artemisia argyi (Asteraceae)          | DSF-52                                                    |
| Ceasalpinia sappan L. (Fabaceae)      | Brazilein                                                  |
| Chloranthus henryi Hems1. (Chloranthaceae) | shizukaol B                                               |
| Ligusticum chuanxiong Hort (Umbelliferae) | 3-butyldene-4,5-dihydroisodenzo Furanone                   |
| Olea europaea L. (Oleaceae)           | Kaempferol.                                                |
| Amorphophallus paeoniifolius (Araceae) | Betulinic acid                                            |
| Dumortierahirsuta Nees (Marchantiaceae) | Ricardin D                                                |

(An et al., 2020)
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constant illnesses is portrayed by surplus evolution of nascent free radicals, a fizzling of endothelium-dependent vasodilation, hypertension as well as a change of platelet administrative function. Then again, various appearances of CVM are frequently connected with progressing provocative conditions that importantly enact transcriptional movements and enzymes (for example cell nuclear factor – κB, erythroid 2-related factor) emphatically associated with the endothelial brokenness and advancement of atherosclerosis (Mason and Libby, 2015). A tabular sheet of herbal compounds for the treatment of cardiovascular inflammation is designed in Table 5.

Other Inflammatory Diseases

Developing information propose that unreasonable release of inflammatory trigger factors from occupant lung eosinophils and neutrophils intervene intense lung scathe, aviation route hyper-responsiveness and the hyper-discharge of bodily fluid. Then again, leukocytes attachment to endothelium assumes another crucial role in lung inflammation (Lopalco et al., 2015).

Furthermore, the hyper-penetration of leukocytes and the improper production of TNF-α are the usual reasons for incendiary bowel disease. Crohn’s illness and ulcerative colitis are the two most ubiquitous types of bowel disease (Radulovic and Niess, 2015).

As far as Focal nervous system is concerned, uncontrolled and unreasonable enactment of microglia usually adds to inflammation interceded neuro degeneration (Barrientos et al., 2015).

Natural compounds for lung, neuro and gastrointestinal inflammation treatment are given in Table 6.

CONCLUSION

The enthusiasm for the quest of restoratively dynamic compounds in therapeutic plants has expanded worldwide lately. Additionally, most plants for the assumed therapeutic potential are not yet researched. There are various examinations which have been asserted the aspect of a couple of plants in exacerbation reduction. We present a couple of herbs with anti-inflammatory impacts, which have been evaluated in clinical and preliminary evaluation parameters. In this manner, continuous investigations and clinical preliminaries ought to be kept on controlling and give experimentally based plants to lessen aggravation and advance well-being.

Conflict of Interest

The authors declare that they have no conflict of interest for this study.

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REFERENCES

Actor, J. K., Smith, K. C. 2019. Translational inflammation. Translational Inflammation, pages 1–22.

Adetunji, C. O., Palai, S., Ekwuabu, C. P., Egbuna, C., Adetunji, J. B., Ehis-Eriakha, C. B., Kesh, S. S., Mtewa, A. G. 2021. A general principle of primary and secondary plant metabolites: Biogenesis, metabolism, and extraction. Preparation of Phytopharmaceuticals for the Management of Disorders, pages 3–23.

An, J., Chen, B., Kang, X., Zhang, R., Guo, Y., Zhao, J., Yang, H. 2020. Neuroprotective effects of natural compounds on LPS-induced inflammatory responses in microglia. American Journal of Translational Research, 12(6):2353–2378.

Ansari, S. 2019. Ethnobotany and pharmacognosy of qust/kut (Saussurea lappa, CB Clarke) with special reference of Unani medicine. Pharmacognosy Reviews, 13(26):71–76.

Athar, M., Nasir, S. M. 2005. The taxonomic perspective of plant species yielding vegetable oils used in cosmetics and skin care products. African journal of biotechnology, 4(1):36–44.

Barrientos, R. M., Kitt, M. M., Watkins, L. R., Maier, S. F. 2015. Neuroinflammation in the normal aging hippocampus. Neuroscience, 309:84–99.

Bhalla, N. P., Suman, B. 2010. Anti-inflammatory activity of herbal plants. Journal of Economic and Taxonomic Botany, 34(3):544–547.

Buttgereit, F., Smolen, J. S., Coogan, A. N., Caijchen, C. 2015. Clocking in: chronobiology in rheumatoid arthritis. Nature Reviews Rheumatology, 11(6):349–356.

Chomnawang, M. T., Surassmo, S., Nukoolkarn, V. S., Gritsanapan, W. 2005. Antimicrobial effects of Thai medicinal plants against acne-inducing bacteria. Journal of Ethnopharmacology, 101(1-3):330–333.

Crighton, A., McCann, C., Todd, E., Brown, A. 2020. Caution with NSAIDs. British Dental Journal, 228(8):568–568.

Ernst, E. 2002. Treatments used in complementary and alternative medicine. Side effects of drugs Annual, 25:567–578.

Fuster, V., Sanz, J. 2007. Vascular inflammation. Journal of the American Society of Hypertension, 1(1):68–81.
Ghasemian, M., Owlia, S., Owlia, M. B. 2016. Review of Anti-Inflammatory Herbal Medicines. *Advances in Pharmacological Sciences*, 2016:1–11.

Harirforoosh, S., Asghar, W., Jamali, F. 2014. Adverse Effects of Nonsteroidal Anti-Inflammatory Drugs: An Update of Gastrointestinal, Cardiovascular and Renal Complications. *Journal of Pharmacy & Pharmaceutical Sciences*, 16(5):821–821.

Howes, M. J. R. 2018. Phytochemicals as anti-inflammatory nutraceuticals and phytopharmaceuticals. *Immunity and Inflammation in Health and Disease*, pages 363–388.

Li, Z., He, X., Liu, F., Wang, J., Feng, J. 2018. A review of polysaccharides from Schisandra chinensis and Schisandra sphenanthera: Properties, functions and applications. *Carbohydrate Polymers*, 184:178–190.

Liu, H., Li, G., Zhang, B., Sun, D., Wu, J., Chen, F., Kong, F., Luan, Y., Jiang, W., Wang, R., Xue, X. 2018. Suppression of the NF-kB signalling pathway in colon cancer cells by the natural compound Riccardin D from Dumortierahirsute. *Molecular Medicine Reports*, 17(4):5837–5843.

Lopalco, G., Cantarini, L., Vitale, A., Iannone, F., Anelli, M. G., Andreozzi, L., Lapadula, G., Galeazzi, M., Rigante, D. 2015. Interleukin-1 as a Common Denominator from Autoinflammatory to Autoimmune Disorders: Premises, Perils, and Perspectives. *Mediators of Inflammation*, 2015:1–21.

Maione, F., Russo, R., Khan, H., Mascolo, N. 2016. Medicinal plants with anti-inflammatory activities. *Natural Product Research*, 30(12):1343–1352.

Maroon, J. C., Bost, J. W., Maroon, A. 2010. Natural anti-inflammatory agents for pain relief. *Surgical Neurology International*, 1(1):80–80.

Mason, J. C., Libby, P. 2015. Cardiovascular disease in patients with chronic inflammation: mechanisms underlying premature cardiovascular events in rheumatologic conditions. *European Heart Journal*, 36(8):482–489.

Palumbo, S. 2017. Pathogenesis and Progression of Multiple Sclerosis: The Role of Arachidonic Acid-Mediated Neuroinflammation. *Multiple Sclerosis: Perspectives in Treatment and Pathogenesis*, pages 111–124.

Piazuelo, E., Lanas, A. 2016. Clinical effects of NSAIDs and COXIBs in colon cancer prevention. In *NSAIDs and Aspirin*, pages 203–218. Springer.

Radulovic, K., Niess, J. H. 2015. CD69 Is the Crucial Regulator of Intestinal Inflammation: A New Target Molecule for IBD Treatment? *Journal of Immunology Research*, 2015:1–12.

Sriutthha, P., Sirichanchuen, B., Permsuwan, U. 2018. Hepatotoxicity of Nonsteroidal Anti-Inflammatory Drugs: A Systematic Review of Randomized Controlled Trials. *International Journal of Hepatology*, 2018:1–13.

Voiculescu, V. M., Lupu, M., Papagheorghe, L., Giurcaneau, C., Micu, E. 2014. Psoriasis and Metabolic Syndrome–scientific evidence and therapeutic implications. *Journal of Medicine and Life*, 7(4):468–471.

Vostinaru, O. 2017. Adverse effects and drug interactions of the non-steroidal anti-inflammatory drugs. *InTech Open*, pages 17–31.

Wangchuk, P. 2018. Therapeutic Applications of Natural Products in Herbal Medicines, Biodiscovery Programs, and Biomedicine. *Journal of Biologically Active Products from Nature*, 8(1):1–20.

Wirth, J. H., Hudgins, J. C., Paice, J. A. 2005. Use of Herbal Therapies to Relieve Pain: A Review of Efficacy and Adverse Effects. *Pain Management Nursing*, 6(4):145–167.

Xin, L. T., Yue, S. J., Fan, Y. C., Wu, J. S., Yan, D., Guan, H. S., Wang, C. Y. 2017. Cudrania tricuspidata: an updated review on ethnomedicine, phytochemistry and pharmacology. *RSC Advances*, 7:31807–31832.