

Anti - Inflammatory Drugs Developed From Plant Extracts

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Abstract: This article analyzes the pharmacological properties of anti -inflammatory drugs prepared on the basis of plant extracts, their bioactive components, and mechanisms of action on the human body. Flavonoids, alkaloids, saponins, tannins, and essential oils derived from plant sources reduce inflammation by blocking inflammatory mediators. Natural - origin preparations have fewer side effects compared to chemical drugs and can be used for long-term therapy. The article highlights the anti - inflammatory, antioxidant, and immunomodulatory effects of extract from plants such as turmeric (*curcuma longa*), ginger (*zingiber officinale*), aloe (*aloe vera*), and chamomile (*matricaria chamomilla*). The research result indicate that plant - based preparations can serve as effective adjunctive agents in the complex treatment of inflammatory diseases.

Keywords: Phytotherapy, plant extracts, inflammation, bioactive compounds, flavonoids, antioxidants.

Introduction: Inflammation is a complex defensive reaction of the body that develops in response to external or internal factors, with its main purpose being the elimination of the damaging agent and the restoration of injured tissues. However, when the inflammatory process becomes prolonged or uncontrolled, it can lead to the development of various chronic diseases such as arthritis, dermatitis, bronchitis, gastritis, and others. In modern medicine, numerous synthetic anti-inflammatory drugs (such as steroidal and non-steroidal agents) are used to reduce this process. However, many of these drugs may have adverse effects on the liver, kidneys, and digestive system when used for a long period. Therefore, in recent years, interest in natural sources - particularly in drugs developed from plant extract - has been increasing. Bioactive compounds derived from plants, including flavonoids, phenols, alkaloids, essential oils, and saponins, exert effective therapeutic effects by inhibiting inflammatory mediators, neutralizing free radicals, and accelerating tissue regeneration. The natural origin, safety, and multifaceted effects of phytotherapeutic agents make them an important alternative and complementary approach in modern

medicine.

Phytotherapy is a method of preventing and treating diseases through the use of natural medicinal substances derived from plants. In recent years, phytotherapy has become one of the important directions in modern medicine, as it provides a complex, gentle, and safe effect on the body. Preparations based on plant extracts contain biologically active compounds such as flavonoids, saponins, alkaloids, tannins, essential oils, and vitamins, which possess anti - inflammatory, analgesic, antioxidant, and immunomodulatory properties. The advantage of phytotherapy lies in the fact that it not only has a symptomatic effect but also acts on the mechanisms underlying the development of the disease. For example, during the inflammatory process, plant extracts reduce the synthesis of prostaglandins and cytokines, neutralize free radicals, improve capillary blood circulation, and accelerate tissue regeneration. Moreover, due to their low toxicity, such remedies can be used for long-term treatment. Commonly used phytotherapeutic agents include extracts derived from plants such as turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), chamomile

(*Matricaria chamomilla*), aloe vera, rosehip (*Rosa canina*), and juniper (*Juniperus communis*). Medicinal forms developed from these plants - such as infusions, tinctures, ointments, and capsules - have demonstrated high effectiveness in treating inflammatory conditions such as arthritis, bronchitis, dermatitis, gastritis, and stomatitis. When used in combination with synthetic drugs, phytotherapy enhances their therapeutic efficacy, reduces adverse effects, and activates the body's natural defense mechanisms. Therefore, plant - based medicines are considered an integral part of comprehensive anti-inflammatory therapy.

Plant Extracts are concentrated mixtures obtained by extracting biologically active substances from medicinal plant raw materials using various solvents. They are derived from different parts of the plant - such as leaves, roots, bark, fruits, or flowers - and contain numerous bioactive components including flavonoids, alkaloids, saponins, tannins, essential oils, and organic acids. In the preparation of plant extracts, solvents such as water, ethanol, methanol, glycerin, ether, or other organic solvents are used. The extraction process depends on factors such as temperature, duration, type of solvent, and the chemical composition of the plant material. Properly selected technological conditions ensure the preservation of bioactive compounds and maintain their pharmacological activity. Many plant extracts possess anti-inflammatory, antibacterial, antiviral, and antioxidant properties. For instance, the curcumin found in turmeric (*Curcuma longa*) extract has been proven to reduce inflammatory mediators by inhibiting the synthesis of prostaglandins. The ginger (*Zingiber officinale*) extract contains gingerols and shogaols, which help relieve pain and slow down the inflammatory process. Similarly, chamomile (*Matricaria chamomilla*) and aloe vera extracts accelerate tissue regeneration and reduce swelling. The advantage of plant extracts lies in their natural origin - they are easily absorbed by the body and usually cause fewer side effects compared to synthetic drugs. Therefore, phytotherapy - based preparations are widely used in modern medicine as part of comprehensive treatment for inflammatory diseases.

Inflammation is a protective and adaptive response of the body that occurs as a result of tissue injury, microorganisms, toxins, or immune reactions. The main purpose of this process is to repair damaged tissues, eliminate the source of infection, and protect the organism. Mediators such as prostaglandins, cytokines, histamine, serotonin, and bradykinin play a key role in the development of inflammation. Their excessive production leads to clinical signs such as pain, swelling, heat, and redness. Bioactive compounds derived from

natural plants are recognized as effective agents in inhibiting the inflammatory process. They reduce the synthesis of mediators, neutralize free radicals, and decrease oxidative stress in tissues.

For example. Flavonoids block inflammatory mediators, strengthen capillary walls, and exhibit antioxidant properties. Alkaloids slow down nerve impulse transmission, reduce pain sensation, and help normalize immune responses. Saponins decrease fluid accumulation in the inflammatory focus and stabilize cell membranes. Tannins possess antibacterial and tissue-regenerating effects. Essential oils show antiseptic and antimicrobial properties while stimulating tissue repair. Studies have shown that bioactive substances regulate inflammation through complex natural mechanisms and are less toxic compared to synthetic drugs. Therefore, preparations developed on their basis are considered effective not only for symptomatic relief but also for pathogenetic treatment of inflammatory diseases.

Flavonoids are polyphenolic compounds widely distributed in plants, playing important roles in pigment formation, protective functions, and various bioactive effects. They are abundantly found in the leaves, fruits, bark, roots, and flowers of plants. Flavonoids possess antioxidant, anti-inflammatory, antiallergic, antimicrobial, and general protective properties. In the inflammatory process, the main significance of flavonoids lies in their antioxidant and enzyme-inhibiting activities. They reduce inflammation by neutralizing free radicals, stopping lipid peroxidation, and protecting cell membranes from oxidative damage. Moreover, flavonoids inhibit the enzymes cyclooxygenase (COX) and lipoxygenase (LOX), thereby decreasing the synthesis of prostaglandins and leukotrienes - key inflammatory mediators. The most active flavonoids include quercetin, rutin, apigenin, luteolin, and catechin. For example, quercetin reduces intracellular oxidative stress and suppresses the production of inflammatory cytokines, while apigenin normalizes immune cell activity, reducing swelling and pain at the site of inflammation. Flavonoids are present in many plants, particularly in turmeric (*Curcuma longa*), ginger (*Zingiber officinale*), chamomile (*Matricaria chamomilla*), black tea (*Camellia sinensis*), and citrus fruits. Phytopreparations developed from these compounds are of natural origin, well - absorbed by the body, and serve as effective anti-inflammatory agents with minimal side effects.

Antioxidants are a group of bioactive substances that neutralize free radicals formed in the body and protect cells and tissues from oxidative stress. Free radicals are reactive oxygen species that can damage cell

membranes, proteins, lipids, and DNA. An increase in oxidative stress enhances the inflammatory process, causes tissue damage, and contributes to the development of many chronic diseases such as atherosclerosis, diabetes, arthritis, and cancer. Natural plants contain various antioxidant compounds - flavonoids, ascorbic acid (vitamin C), tocopherol (vitamin E), carotenoids, phenolic compounds, and tannins - which capture free radicals and limit their damaging effects on cells. These substances help maintain the integrity of cell membranes, reduce the production of inflammatory mediators, and accelerate tissue regeneration.

For example. Curcumin (derived from *Curcuma longa*, turmeric) is a potent antioxidant that reduces oxidative stress and suppresses inflammatory proteins. Catechins (found in black and green tea) inhibit lipid peroxidation and protect cells from free radical damage. Ascorbic acid (vitamin C) enhances collagen synthesis and promotes the repair of damaged tissues. Tocopherol (vitamin E) is a fat-soluble antioxidant that prevents the oxidation of membrane lipids. An important property of antioxidants is that they not only reduce the consequences of inflammation but also strengthen the immune system and slow down the aging process at the cellular level. Therefore, antioxidant preparations based on plant extracts are widely used in the comprehensive treatment and prevention of inflammation-related diseases.

CONCLUSION

In conclusion, anti-inflammatory drugs developed from plant extracts have great practical importance in modern medicine. The bioactive compounds they contain - flavonoids, alkaloids, saponins, tannins, and antioxidants - exert natural therapeutic effects by inhibiting inflammatory mediators, neutralizing free radicals, and stimulating tissue regeneration. Phytotherapeutic agents are safer, more environmentally friendly, and have a multifaceted impact on the body compared to synthetic drugs. Their long - term use is generally associated with minimal side effects. Research has shown that plant extracts are effective in treating inflammatory diseases not only symptomatically but also pathogenetically. Therefore, preparations derived from natural plants play a significant role in maintaining human health, reducing chronic inflammatory conditions, and accelerating rehabilitation processes.

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