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Natural Management of Myositis: Anti-Inflammatory Plants and Their Benefits

Ashok Kumar B.S.
Department Pharmacognosy, R.L. Jalappa College of Pharmacy, Sri Devaraj Urs Academy of Higher Education and Research, Tamaka, Kolar, Karnataka, India.

Abstract: Myositis is an inflammatory muscle disease characterized by muscle weakness, pain, and swelling, which can significantly impact a patient's quality of life. While conventional treatments such as corticosteroids and immunosuppressants are commonly used, they often come with adverse side effects and limitations. There is growing interest in natural remedies, particularly medicinal plants with anti-inflammatory, antioxidant, and immune-modulating properties, as complementary therapies for managing myositis. This manuscript explores the potential benefits of several medicinal plants, including turmeric (Curcuma longa), ginger (Zingiberofficinale), Boswellia (Boswelliaserrata), willow bark (Salix alba), devil's claw (Harpagophytumprocumbens), ashwagandha (Withaniasomnifera), and green tea (Camellia sinensis). The anti-inflammatory compounds in these plants, such as curcumin, gingerol, boswellic acids, salicin, harpagosides, withanolides, and epigallocatechin gallate (EGCG), may help reduce muscle inflammation, pain, and oxidative stress in patients with myositis. This review highlights the current evidence supporting the use of these plants, their mechanisms of action, and their potential role as part of an integrative approach to managing myositis.

Keywords: Myositis,Corticosteroids, Anti-inflammatory,Medicinal plants.

Introduction:

Myositis is a group chronic inflammatory muscle diseases, including dermatomyositis,polymyositis. Myositis characterized by muscle inflammation, weakness, and pain (Dalakas, 2015). The causes of myositis are not known, but believed to involve environmental factors,autoimmune mechanisms,and genetic predispositions (Mammen, 2010). Myositis is managed by using of immunosuppressants,corticosteroids, and other pharmacological agents which will reduce inflammation and modulate the immune response (Rider & Miller, 2010). However, these treatments often cause significant side effects, such as infections, osteoporosis, and gastrointestinal issues (Marie &Moerschel, 2014), necessitating the exploration of alternative and complementary therapies.

In recent years, there has been a growing interest in alternative therapies for managing myositis,particularly medicinal plants (Panahi et al., 2016). Medicinal plants contain Bioactive compounds with antioxidant,anti-inflammatory, and immunomodulatory properties that may help to improve overall muscle

functionby reduce alleviate pain, and muscle inflammation (Gupta et al., 2013). Several medicinal plants, such as turmeric, ginger, Boswellia, willow bark, devil's claw, ashwagandha, and green tea, have been usedtraditionally for their therapeutic effects in treating inflammatory and autoimmune conditions (Aggarwal et al., 2007; Black et al., 2010; Siddiqui, 2011; Vlachojannis et al., 2009; Chrubasik et al., 2003; Sandhu et al., 2010; Cabrera et al., 2006). Emerging scientific evidence suggests that these medicinal plants may also offer significant benefits in managing myositis.

This manuscript aims to review the current understanding of the role of these medicinal plants in the natural management of myositis, highlighting their bioactive compounds, mechanisms of action, and potential therapeutic benefits. By integrating these natural remedies into the management plan, patients may experience reduced symptoms, fewer side effects, and an overall improvement in quality of life.

Medicinal Plant used for the management of Myositis:

1. Turmeric:

Curcuma longa L., commonly known as turmeric, belongs to the family Zingiberaceae, renowned for its aromatic plants and includes other economically and medicinally significant species. The rhizomes of Curcuma longa are extensively utilized due to their rich content of bioactive compounds. These include non-volatile curcuminoids such as curcumin, demethoxycurcumin, and bisdemethoxycurcumin, along with volatile mono- and sesquiterpenoids (Itokawa et al., 2008; Lobo et al., 2009).

Turmeric's pharmacological properties are diverse, encompassing antiproliferative, anti-inflammatory, anticancer, antidiabetic, hypocholesterolemic, anti-thrombotic, antihepatotoxic, antidiarrheal, carminative, diuretic, antirheumatic, hypotensive, antimicrobial, antiviral, antioxidant, larvicidal, insecticidal, antivenomous, and antityrosinase effects (Wilson et al., 2005;Reanmongkol et al., 2006; Lin et al., 2010; Angel et al., 2014). Among these, the antioxidant and anti-inflammatory properties of curcumin, the principal bioactive compound in turmeric, have been extensively researched.

Curcumin exhibits potent antioxidant effects due to its unique chemical structure, which includes carbon-carbon double bonds, a β-diketo group, and phenyl rings with hydroxyl and o-methoxy groups (Wright, 2002; Priyadarsini et al., 2003). These structural features enable curcumin to neutralize free radicals through hydrogen and electron donation mechanisms, as demonstrated in studies utilizing laser flash photolysis and pulse radiolysis (Jovanovic et al., 1999; Nardo et al., 2008). Curcumin scavenges various reactive oxygen species (ROS), such as superoxide radicals, hydrogen peroxide, and nitric oxide radicals, and inhibits lipid peroxidation (Ak&Gulcin 2008). Additionally, it enhances the activity of antioxidant enzymes like superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx), and upregulates glutathione levels by increasing

the activity of glutathione transferase (Menon &Sudheer, 2007). Curcumin also inhibits ROS-generating enzymes, including lipoxygenase (LOX), cyclooxygenase (COX), and xanthine oxidase, functioning as a chain-breaking antioxidant due to its lipophilic nature (Priyadarsini et al., 2003).

Curcumin's anti-inflammatory potential is also well-documented. It inhibits pro-inflammatory transcription factors such as nuclear factor kappa B (NF-κB) and activator protein-1 (AP-1), which are pivotal in initiating and sustaining inflammatory responses (He et al., 2015). Curcumin reduces the production of pro-inflammatory cytokines, including tumor necrosis factor-alpha (TNF-α), interleukin-1 beta (IL-1β), interleukin-2 (IL-2), interleukin-6 (IL-6), interleukin-8 (IL-8), macrophage inflammatory protein-1 alpha (MIP-1α), monocyte chemoattractant protein-1 (MCP-1), C-reactive protein (CRP), and prostaglandin E2 (PGE2) (Panahi et al., 2014a). Additionally, it down-regulates inflammatory enzymes such as 5-lipoxygenase (5-LOX) and cyclooxygenase-2 (COX-2), and inhibits the mitogen-activated protein kinase (MAPK) pathways and nitric oxide synthase (NOS) (Panahi et al., 2014b; He et al., 2015). These actions underline curcumin's potential as a therapeutic agent for managing chronic inflammatory diseases.

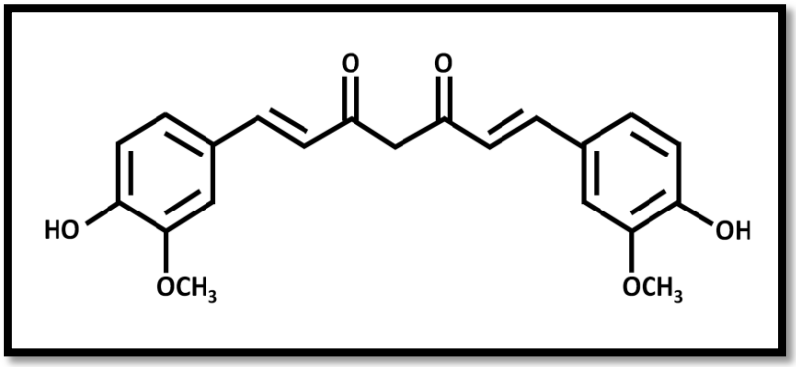

Figure 1: Curcumin

2. Ginger:

Zingiberofficinale Roscoe is a widely used spice with a long history of medicinal use, dating back thousands of years. It is well-regarded in both complementary and alternative medicine, and various regulatory authorities have classified ginger as a safe herbal supplement (Vemuriet al., 2017). Traditionally, ginger has been used to treat numerous ailments, including fevers, colds, headaches, nausea, and digestive issues. It is also valued for its antibacterial, antiviral, and anti-emetic properties (Dugasani et al., 2010; Konmun et al., 2017; Lashgari et al., 2022).

Ginger contains over 200 bioactive compounds, with its primary constituents being tannins, anthocyanins, terpenes (such as α-zingiberene and β-bisabolene), and phenolic compounds, including gingerols, paradols, shogaols, and zingerone (Semwal et al., 2015; Mao et al., 2019). Among these, gingerols, particularly 6-gingerol, are the main pungent compounds responsible for many of ginger's

pharmacological properties. Research has shown that gingerols exhibit various beneficial effects, such as anti-inflammatory, antioxidant, antimicrobial, anti-cancer, and anti-diabetic properties (Liang et al., 2018;Embuscado, 2015; Hitomi et al., 2017; Wang et al., 2018a; Lashgari et al., 2022).

Ginger's anti-inflammatory properties are one of its most widely studied benefits. Gingerols have been found to inhibit important inflammatory pathways, such as the nuclear factor kappa B (NF-κB) and phosphatidylinositol-3-kinase (PI3K)/Aktsignaling pathways, which play key roles in the inflammatory process (Guleria et al., 2022; Zahoor et al., 2020; Zhang et al., 2021). By suppressing NF-κB activation, ginger increases anti-inflammatory cytokines and decreases pro-inflammatory cytokines, producing effects similar to non-steroidal anti-inflammatory drugs (NSAIDs) (Kumar et al., 2013; Aziz et al., 2015; Deng M. et al., 2022).

Ginger has been a significant component in Ayurvedic and traditional Chinese medicine for its anti-inflammatory effects. Studies dating back to the 1970s revealed that ginger can suppress prostaglandin biosynthesis, confirming its potential in treating inflammation-related conditions. These findings solidify ginger's role as a valuable natural remedy for managing inflammatory diseases (Mao et al., 2019; Zhou et al., 2022).

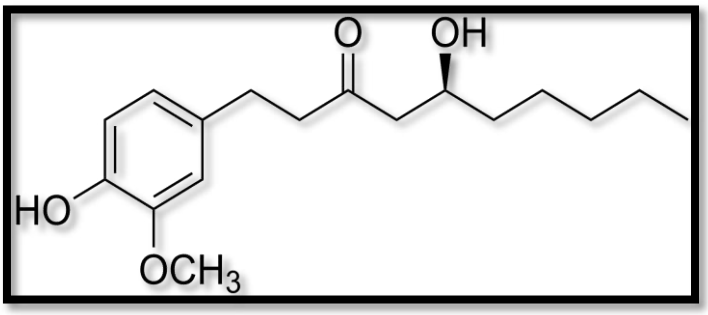

Figure 2: Gingerol

3. Boswelliaserrata:

BoswelliaserrataRoxb., a member of the Burseraceae family, is native to India and parts of Southeast Asia. This tree has been utilized for centuries in traditional medicine, religious rituals, and incense production. It produces an oleo-gum resin known as frankincense, renowned for its potent anti-inflammatory properties. The resin is harvested by making incisions in the tree's bark, allowing the sap to ooze out and harden into a gum. This resin contains a rich array of bioactive compounds, predominantly boswellic acids (BAs), which are responsible for its significant therapeutic effects, particularly in reducing inflammation (Basch et al., 2004; Majeed et al.,2021).

The most prominent boswellic acids include 11-keto-β-boswellic acid (KBA) and 3-O-acetyl-11-keto-β-boswellic acid (AKBA), which are known for their strong anti-inflammatory effects. These compounds primarily inhibit the enzyme 5-lipoxygenase (5-LO), a key player in the production of leukotrienes. Leukotrienes

are inflammatory mediators that play a central role in conditions such as asthma, rheumatoid arthritis, and inflammatory bowel disease (Weber et al., 2006; Wang et al., 2018). By blocking the 5-LO pathway, boswellic acids help reduce the formation of these pro-inflammatory molecules, thereby alleviating inflammation.
In addition to 5-LO inhibition, AKBA also modulates several important signaling pathways, including the nuclear factor kappa B (NF-κB) and Nrf2/HO-1 pathways. These pathways regulate the production of inflammatory cytokines such as tumor necrosis factor-alpha (TNF-α) and interleukin-1 beta (IL-1β). By down-regulating these pathways, AKBA reduces the levels of pro-inflammatory cytokines, effectively limiting inflammation and oxidative stress (Park & Kim 2011; Xiong et al., 2019; Mini et al., 2021).
Moreover, other boswellic acids, such as β-boswellic acid (βBA), exhibit anti-inflammatory effects by inhibiting enzymes like serine protease cathepsin G and microsomal prostaglandin E synthase (mPGES). Cathepsin G plays a role in tissue degradation and inflammation, while mPGES is involved in producing prostaglandin E2 (PGE2), another key mediator of inflammation (Majeed et al.,2021; Rall et al., 1996; Gilbert et al., 2020). Variations in Boswellia extract compositions can affect their anti-inflammatory potency. Interestingly, some extracts, despite having lower AKBA content, demonstrate higher biological activity, suggesting that other boswellic acids such as KBA and βBA may also significantly contribute to reducing inflammation (Mini et al., 2021).

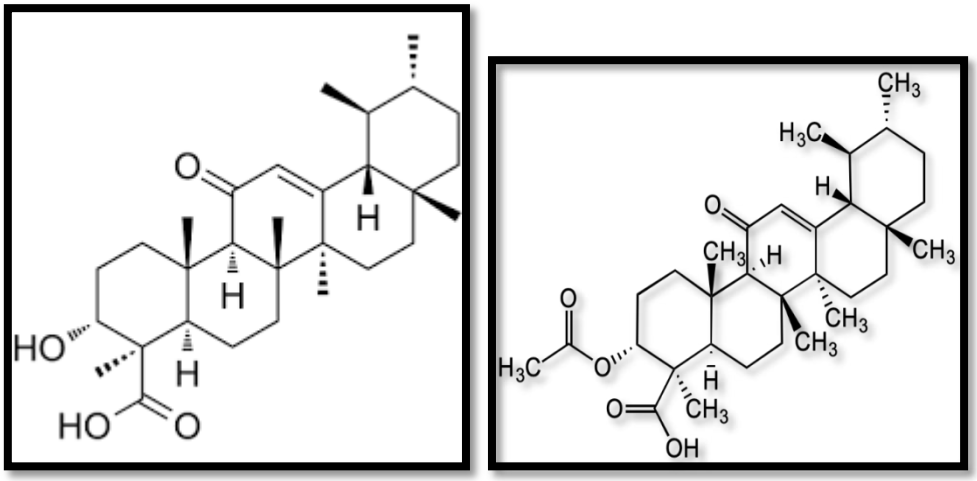

Figure 3:11-keto-β-boswellic acid (KBA) and 3-O-acetyl-11-keto-β-boswellic acid (AKBA)

4. Willow bark

Willow bark, scientifically known as Salix, has been widely used for its anti-inflammatory properties for over 3500 years (Moninari et al., 2019). Ancient civilizations such as those in Egypt, South America, Greece, and China used it to treat pain and fever (Moninari et al., 2019; Levesque &Lofont 2000). Its most famous active compound, salicin, was a precursor to modern aspirin and plays a

central role in its anti-inflammatory effects (Buchner &Ueber Das 1828). However, the therapeutic action of willow bark cannot be attributed solely to salicin.

The anti-inflammatory effects of willow bark are largely due to its ability to inhibit cyclooxygenase (COX) enzymes, particularly COX-2, which are involved in prostaglandin synthesis. This inhibition reduces the production of prostaglandins, which are key mediators of inflammation and pain (Gerhardt et al., 1853). Aspirin, derived from salicin, works similarly by blocking the COX enzyme, leading to pain relief and reduced inflammation (Tanasecu et al., 2000). However, unlike aspirin, the entire willow bark extract contains other compounds such as polyphenols and flavonoids that further enhance its anti-inflammatory action (OketchRabah et al., 2019).

Research has shown that willow bark extract can reduce levels of pro-inflammatory cytokines, such as tumor necrosis factor-alpha (TNF-α), and prevent the nuclear translocation of NF-κB, a transcription factor that regulates inflammation (Bonaterro et al., 2010). These mechanisms contribute to its overall anti-inflammatory effect (Ishikado et al., 2013). In addition, willow bark has been demonstrated to inhibit the enzyme lipoxygenase, which is another key player in the inflammatory pathway (Schmid et al., 2001). By targeting multiple pathways, willow bark can reduce inflammation in conditions like osteoarthritis and rheumatoid arthritis (Vlachoiannis et al., 2011; Shara&Stohs 2015).

Flavonoids and polyphenols found in willow bark also contribute to its anti-inflammatory potential. These compounds are known to scavenge free radicals and reduce oxidative stress, which plays a role in chronic inflammation (Schmid et al., 2001). By neutralizing oxidative damage, these components help to maintain cellular integrity and prevent further inflammatory responses (Nieman et al., 2013).

The effectiveness of willow bark in treating inflammatory conditions has been the subject of several studies, with results showing its ability to relieve pain and inflammation in osteoarthritis, rheumatoid arthritis, and other inflammatory conditions (Biegert et al., 2004)

While salicin derivatives in willow bark are metabolized into salicylic acid, the concentration of salicylates in the blood after willow bark administration is often too low to produce the same effects as aspirin (Nieman et al., 2013).Nevertheless, the broader range of active compounds in willow bark, including its polyphenols and flavonoids, supports its therapeutic efficacy in reducing inflammation through mechanisms beyond COX inhibition.

Overall, willow bark's anti-inflammatory properties stem from its multi-faceted approach to inhibiting pro-inflammatory pathways, reducing oxidative stress, and providing relief from inflammation and pain. This makes it a valuable natural remedy in managing chronic inflammatory conditions, although further research is needed to fully understand its clinical efficacy (Schmid et al., 2001;Nieman et al., 2013).

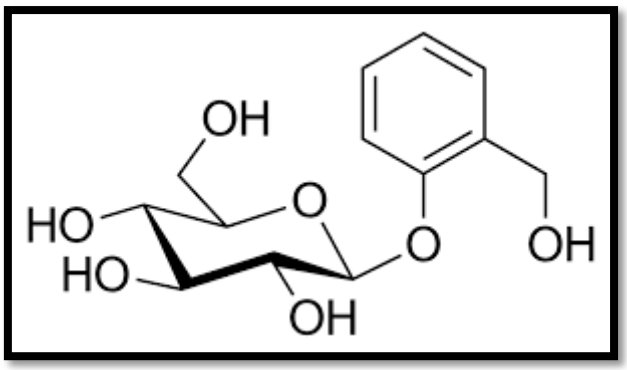

Figure 4: Salicin

5.Harpagophytumprocumbens

Harpagophytumprocumbens is commonly called as Devil's claw and native to the arid regions of southern Africa, particularly the Kalahari Desert, Namibia, and Madagascar. It thrives in dry, sandy environments, and is recognized for its distinctive "claw-like" fruits, which give the plant its name. The plant belongs to the Pedaliaceae family and is valued primarily for its tuberous roots, which have been used for centuries in traditional African medicine due to their medicinal properties(Milen et al., 2013).

Traditionally, Devil's claw has been employed to address various health concerns, including digestive issues, loss of appetite, fever, menstrual irregularities, and inflammation. It was also historically used to assist childbirth and treat more severe conditions like syphilis (Joshi et al., 2020; Steenkamp & Steenkamp, 2019). Topically, the plant's ointments were applied to heal sores, sprains, and boils, while internally, it was consumed as a bitter tonic for its reputed anti-inflammatory and digestive benefits (Mncwangi et al., 2012).

The plant contains a wide range of bioactive compounds, such as amino acids, carbohydrates, iridoids, flavonoids, and phytosterols (Muzila et al., 2018; Mncwangi et al., 2012; Pretorius et al., 2022). Notably, its tubers are rich in iridoid glycosides like harpagoside, as well as terpenoids, glycosides, and acetylated phenolics. These compounds have been explored in drug development due to their medicinal value (Sahib et al., 2019).

Devil's claw has shown significant anti-inflammatory, analgesic, antibacterial, antifungal, antiviral, and anticancer properties, making it a promising alternative to non-steroidal anti-inflammatory drugs (NSAIDs) for managing inflammatory conditions and degenerative rheumatic diseases (Akhtar &Haqqi, 2012; Mundy &Ncube, 2014). It has also been used for treating blood disorders, fevers, sprains, and various rheumatic conditions (Shedayi et al., 2014), and is marketed as a dietary supplement for arthritis relief (Mariano et al., 2020).

The primary active compound, harpagoside, is an iridoid glycoside with potent anti-inflammatory and analgesic effects. Both harpagoside itself and extracts from Harpagophytumprocumbens have been demonstrated to have anti-rheumatic properties. The European Pharmacopoeia stipulates that commercial Devil's claw

products must contain at least 1.2% harpagoside to ensure therapeutic effectiveness (Milen et al., 2013).

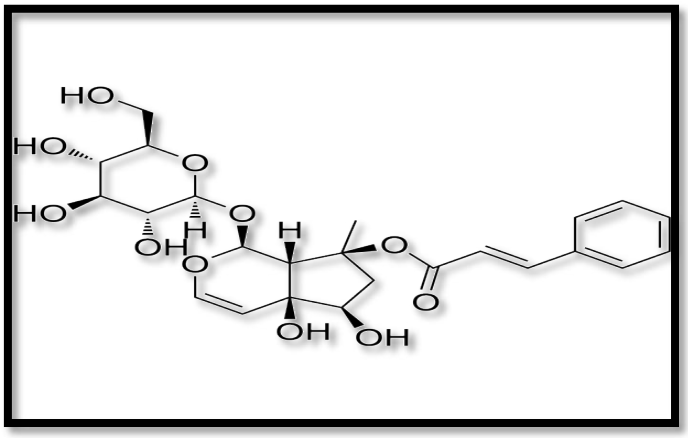

Figure 5: Harpagoside

5. Camellia sinensis

Green tea, a popular beverage made from the leaves of Camellia sinensis, contains high levels of bioactive polyphenols, including catechins, flavones, and flavonols. These phenolic compounds make up approximately 30% of green tea's dry weight, with catechins accounting for about 15% and flavonols 0.4% (Graham 1992; Peterson et al., 2005). The flavonols and flavones in green tea include myricetin, quercetin, apigenin, and kaempferol, which primarily exist as glycosides (Peterson et al., 2005; Monobe et al., 2015). The content and composition of these compounds can vary depending on the tea cultivar (Wu et al., 2012; Jian et al., 2015).

Flavonols have been shown to exhibit several health benefits, including anticancer properties, by inhibiting the growth of cancer cells, reducing angiogenesis, and promoting apoptosis (Lea et al., 2015). In addition to their anticancer effects, flavonols have antioxidative and antihyperlipidemic properties, which have been demonstrated in various studies (Semwal et al., 2016; Nomura et al., 2016). Regular consumption of green tea has been linked to an increase in plasma antioxidant capacity (Rietveld & Wiseman 2003), and flavonol supplementation has shown positive effects on cardiometabolic risk factors, such as reducing levels of triacylglycerol, total cholesterol, low-density lipoprotein (LDL), fasting plasma glucose, and blood pressure, while increasing high-density lipoprotein (HDL) levels (Menezes et al., 2017).

Flavonol glycosides, which are present in green tea, generally have weaker antioxidative effects compared to their aglycone counterparts (Plumb et al., 1999). Green tea has also been studied for other health-promoting functions, including weight regulation, protection against ultraviolet radiation, maintenance

of bone mineral density, and its antibacterial, antihypertensive, antifibrotic, and neuroprotective activities (Cabrera et al., 2006; Khan & Mukhtar 2007).

Inflammation is a critical factor in many health conditions, and the anti-inflammatory effects of green tea and its catechins, particularly (−)-epigallocatechin-3-gallate (EGCG), have been widely researched. EGCG is the most active catechin in green tea and has shown powerful anti-inflammatory effects. For example, EGCG can reduce the production of interleukin-8 (IL-8) in airway epithelial cells, which helps reduce respiratory inflammation (FerroeroMiliani et al., 2007). This is achieved by inhibiting neutrophil recruitment and preventing the formation of reactive oxygen species (ROS). EGCG also blocks IL-1β-induced activation of NF-κB, a key transcription factor in inflammatory processes (Bogdanski et al., 2012).

Additionally, EGCG has been found to down-regulate the JAK1/2 tyrosine kinase pathway, which reduces the expression of pro-inflammatory genes induced by interferon-gamma (IFN-γ) in vascular endothelial cells (Park 2012). These findings highlight the potent anti-inflammatory properties of green tea, making it a promising natural agent for managing inflammation and related diseases. discuss only anti-inflammatory.

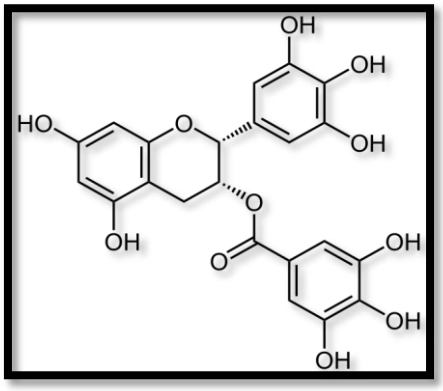

Figure 5: Epigallocatechin-3-gallate

Conclusion:

The exploration of medicinal plants such as turmeric, ginger, Boswellia, willow bark, devil's claw, ashwagandha, and green tea offers promising potential as complementary therapies for managing myositis. These plants contain bioactive compounds like curcumin, gingerol, boswellic acids, salicin, harpagosides, withanolides, and EGCG, which exhibit anti-inflammatory, antioxidant, and immune-modulating properties. Current evidence suggests that these compounds can reduce muscle inflammation, pain, and oxidative stress, thereby improving symptoms and possibly enhancing the quality of life for patients with myositis. While more rigorous clinical trials are needed to confirm these benefits, integrating such natural remedies with conventional treatments may offer a

holistic approach to managing this debilitating condition, minimizing the adverse effects of standard therapies and providing a more sustainable long-term management strategy.

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