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Review Article

## Herbs as Skeletal Muscle Relaxant: An Updated Review

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### Abstract

When compared to modern drugs, herbal medicines are usually accepted by doctors and patients for having greater therapeutic efficacy and fewer adverse effects. A diverse class of drugs known as skeletal muscle relaxants is frequently used to treat two distinct underlying disorders: spasticity resulting from upper motor neuron syndromes and muscular pain or spasms resulting from peripheral musculoskeletal problems. Skeletal muscle (SM) controls insulin sensitivity, glucose uptake, and blood glucose homeostasis, all of which are essential for energy and glucose metabolism. A progressive and widespread loss of skeletal muscle mass and strength that results in physical handicap, a low quality of life, and perhaps death is known as sarcopenia. Herbs are a valuable tool for illness prevention. These all have dysregulated skeletal muscle and sarcopenia. These medicinal herbs are being used over recent years. In this Review article we will keep an eye on an updated review on herbs as skeletal muscle relaxant. We will discuss about musculoskeletal disorders, phytochemicals role in disorders. Herbs like aloe barbedensis, curcuma longa, zingiber officinale, citrus aurantium, chamaemelum nobile, hibiscus rosa sinensis etc. will be studied for their role in skeletal muscle relaxation.

**Keywords:** Skeletal muscle relaxant, sarcopenia, herbal medicines, herbs, skeletal muscles, myopathy

## INTRODUCTION

Skeletal muscles are the principal sites for glucose absorption, use, lipid metabolism, and energy balance, and they play a significant role in overall metabolic activity. Physical activity, nutrition, age, and genetics have all been shown to alter skeletal muscle function and metabolism.<sup>1</sup> A muscle relaxant is a medication that alters skeletal muscle function, reduces muscular tone, and is used to treat symptoms such muscle spasms, discomfort, and hyperreflexia.<sup>2</sup> Herbal medicines are generally acknowledged by physicians and patients for their superior therapeutic efficacy and fewer side effects when compared to current medications. The phytochemical profiles of herbal medicines can give guidance for designing, screening, and creating innovative multi-target therapies.

The synergistic effects of several active ingredients have been linked to the therapeutic effectiveness of herbal medicines; nevertheless, the majority of these active ingredients are soluble, which results in decreased bioavailability and higher systemic clearance. These reasons need an excessively high systemic dose of herbal medications.<sup>3</sup> About 40% of the body's mass is made up of skeletal muscles, which are necessary for carrying out daily physiological functions. For overall bodily health, this means that skeletal muscle development, metabolism, and contractile function must be maintained throughout life. However, growing older and other pathological disorders are often linked to a reduction in muscular performance.<sup>4</sup>

Older persons are susceptible to a progressive decrease of skeletal muscle mass, muscular strength, and/or muscle

function; obese older adults are especially at risk. Another condition called sarcopenia is defined by a progressive and widespread loss of skeletal muscle mass and strength, which puts elderly people at risk for negative outcomes including impairment, a worse quality of life, and even death.<sup>5</sup> Plant-based medicines have always been the first line of defense against illnesses and for preserving health. The production of novel medications from medicinal plants has been made possible by the significant simplification of chemical principles from natural sources. Herbs and spices are known to be rich sources of natural antioxidants, which makes them crucial for delaying illness and aging.<sup>6</sup> However, because of their illnesses and physical restrictions, the elderly and patients with muscular morbidities are constrained. This has made non-exercise and pharmacotherapeutic therapies a focal point for MSD research, further facilitating their development. Insulin resistance in the skeletal muscles is a prominent factor in poor whole-body glucose clearance in morbid circumstances including obesity and Type-2 Diabetes Mellitus. Plants have long been a valuable source of pharmacologically active phytochemicals that have been used to treat a wide range of illnesses. For instance, research has shown that the ethanolic extract of Russian tarragon (*Artemisia dracunculu* L.) is a powerful blood sugar-lowering medication that also increases insulin sensitivity in both naturally occurring and artificially induced diabetic mouse models.<sup>7,8</sup> Furthermore, among other MSDs, sarcopenia may benefit from the use of the tannase-converted green tea extract in therapy.<sup>9</sup> Natural goods are being researched as possible SM metabolism modulators and treatment agents for metabolic diseases. Examples of these items include plant extracts and phytochemicals. By altering

signaling pathways related to glucose metabolism, natural compounds such quercetin, resveratrol, and curcumin have been demonstrated to enhance SM function and insulin sensitivity in metabolic diseases.<sup>1</sup>

### About Musculoskeletal Disorders

Blood glucose (BG) homeostasis, movement, postural stability, and thermogenesis are mostly attributed to skeletal muscle.<sup>1</sup> An increasing number of older persons have a progressive decrease of skeletal muscle mass, muscular strength, and/or muscle function; obese older adults are especially at risk for this condition.<sup>5</sup> They support vital biological processes such as energy metabolism, core temperature regulation, nutrition sensing, and organ and bone protection. The word "sarcopenia" refers to the gradual loss of muscle mass and function in the aged and chronically sick. It is a major cause of disability, loss of independence, long-term care requirements, and overall mortality. Diseases known as MSDs, such as psoriatic and rheumatoid arthritis, mostly affect the muscles, connective tissues, bones, and joints.<sup>10,11</sup> Myofascial pain syndrome, fibromyalgia, tension headaches, mechanical low back or neck pain, and myofascial pain syndrome are common musculoskeletal disorders that cause soreness and muscle spasms.<sup>12</sup>

### Phytomedicine and their role in the Treatment of MSDs

About 40% of a person's weight is made up of skeletal muscles, which are vital for overall health. Maintaining your posture and carrying out daily activities are the responsibilities of your skeletal muscles.<sup>[5]</sup> Numerous botanicals and medicinal plants have been discovered over time to have a good impact on the management of skeletal muscle issues, such as atrophy and muscle weakening, therefore enhancing the course of therapy.<sup>13</sup> Plant-based medicines have always been the first line of defense against illnesses and for preserving health. Herbs reduce skeletal muscle inflammation and MSDs by both promoting blood circulation and repairing damaged skeletal tissue.<sup>4</sup>

#### *Zingiber officinale*

Ginger (*Zingiber officinale*) is a subsection of the Zingiberaceae family and is mostly found in traditional medical systems.<sup>[14]</sup> Because of its rich phytochemistry, ginger is useful as a nutritional supplement and a herbal medication. It can help prevent aging, reduce inflammation, and treat degenerative conditions including rheumatism and arthritis.<sup>4,15</sup> One research found that it was statistically significant in reducing the symptoms related to osteoarthritis (OA)<sup>16</sup>, but another suggested that its usefulness should only be used in the first half of the treatment plan.<sup>4</sup>

#### *Euphorbia milii*:

It has been discovered that the undiluted latex of *E. milii* irritates the eyes and skin of mammals. discovered to irritate the skin and eyes of mammals. *E. milii* was found to contain triterpenes, flavonoids,  $\beta$ -sitosterol, cycloartenol,  $\beta$ -amyrin acetate, lupeol, and euphol, according to phytochemical investigations.<sup>3</sup>

#### *Curcuma longa*:

Turmeric (*Curcuma longa*) is rhizomatous herbaceous perennial plant and a subset of the Zingiberaceae family.<sup>[4]</sup> The chemical compound predominantly found in *C. longa* is curcumin (4) or diferuloylmethane.<sup>17,18,4</sup> Its property has been demonstrated in the alleviation of pain, metabolic syndrome, inflammation and degenerative conditions.<sup>4,1</sup> The administration of curcumin has not only been attributed to the reduction of muscle loss following sepsis and endotoxemia but

also to inducing the regeneration of the wasted muscle after the traumatic injury. Furthermore, curcumin reduces the inflammation associated with exertive exercise-induced muscle damage.<sup>4</sup>

#### *Chamaemelum nobile*:

A naturally occurring glycoside called Apigenin, which is a member of the cyclone class, is present in chamomile (*Chamaemelum nobile*). The most effective flavonoid inhibitor of the skeletal muscle sarcoplasmic reticulum is apigenin. The calming effect of chamomile on muscles results in a gradual dilation of isolated blood vessels through its influence on calcium influx. The herb *Martica chamomilla*, which is native to Europe and West Asia but has been modified in Australia, the United States, and Britain, contains apigenin, which is present in a variety of fruits and vegetables as a single active ingredient. Apigenin inhibits vasoconstriction, exhibiting non-specific and non-competitive actions. conventional medical care Both the essential oil and the extract from *Chamaemelum nobile* exhibit long-lasting, direct effects on smooth muscle relaxation.<sup>19</sup>

#### *Aloe barbadensis*:

Aloe vera, also known as *Aloe barbadensis*, is a tropical succulent plant that withstands dryness and is a member of the Liliaceae family.<sup>20</sup> Anthraquinones, fatty acids, flavonoids, lectins, terpenoids, mono- and polysaccharides (glucomannan, hemicelluloses, and pectins), tannins, sterols (campesterol and  $\beta$ -sitosterol), enzymes, salicylic acid, minerals (Fe, Cr, Cu, Ca, Mg, Na, K, P, Zn, and Mn), and vitamins are just a few of the abundant bioactive compounds found in aloes.<sup>4,21</sup> The strong anti-inflammatory and anti-arthritic properties of *A. barbadensis* can be attributed to the quantity of these substances.<sup>22</sup> These characteristics could be extended to the management of inflammation linked to MSDs.

#### *Justicia zeylanica (L.)*

Nees, often referred to as Adulasa, is a tiny, subherbaceous perennial shrub that grows around the world and in many parts of India. Family (Acanthaceae). Vasicoline, adhatodine, vasicolinone, and anisotine are among the alkaloids that have been isolated from leaves; other compounds include alkanes, triterpenes (a-amyrin), flavonoids (astragaline, quercetin), and certain steroids (daucosterol). Due to the presence of several pyrroquinazoline (bitter) alkaloids, such as vasicine (about 0.0541 to 1.2 percent), vasicol, and vasicinone, as well as minor ingredients such adhatonine, vasicinol, and vasicinolone, Adulasa (*JZ*) offers a wide range of medicinal qualities. Adulasa leaves are used as an antispasmodic, expectorant, and sedative. The herb possesses insecticidal, parasiticidal, antihelminthic, and antispasmodic qualities. In an investigation, the hydroalcoholic leaf extracts of AM and JZ were tested on albino rats for their ability to relax muscles. The results showed that the extracts did not have any grip strength or muscle relaxant properties.<sup>2</sup>

#### *Citrus limon*

Lemons, or *Citrus limon*, are members of the Rutaceae family. This tree produces delicious yellow fruits that, when processed, generate juice and essential oil.<sup>4,23</sup> The leaves of the tree are evergreen. The flavones (apigenin, diosmin, orientin, and vitexin); flavanones (eriodictiol, hesperidin, hesperitin, naringin, and neohesperidin); and their derivatives are among the phytoconstituents of *C. limon* juice extract and essential oils that exhibit pharmacological activity. Eriocitrin, limonin, and nomilin are further trace amounts found in *C. limon*.<sup>[24]</sup> Therefore, due to its possible anti-inflammatory properties, a number of this plant's formulations can reduce arthritis and joint inflammation.<sup>4,25</sup>

### ***Valeriana officinalis L.***

Because of its sedative and anxiolytic qualities, *Valeriana officinalis L.* is a perennial plant with thick roots that is frequently taken as a herbal supplement. Myorelaxant qualities of *V. officinalis* have also been demonstrated. The primary family of chemicals known to be present in *V. officinalis* was detected in our extract by phytochemical analysis. It was discovered that the three primary sesquiterpenes, hydroxyvalerenic acid, acetoxvalerenic acid, and valerenic acid, corresponded to the reference compounds. Regarding the skeletal muscle system, the efficacy of *V. officinalis* extracts to influence locomotor activity was shown to be variable among *in vivo* experiments. Skeletal muscle is relaxed by the SE of *V. officinalis* tested. *V. officinalis* has sedative and anxiolytic qualities, but it can also be utilized for its skeletal muscle relaxant effects. Less side effects might be caused by the extract than by conventional myorelaxants since it would reduce skeletal muscle strength without affecting tone or endurance.<sup>26</sup>

### ***Glycyrrhiza glabra***

Simple sugars, triterpenes, saponins, flavonoids, polysaccharides, pectins, amino acids, mineral salts, asparagines, bitters, essential oil, fat, estrogen, gums, mucilage (rhizome), proteins, resins, starches, sterols, volatile oils, tannins, and glycosides are just a few of the substances that have been isolated from the roots of *G. glabra*.<sup>4,27,28</sup> The plant known as liquorice (*Glycyrrhiza glabra*) is a member of the Leguminosae family. It has been demonstrated that estradiol helps skeletal muscles by promoting satellite cell growth. Skeletal muscles are susceptible to varying effects of estrogenic hormones because they have receptors unique to estradiol on their muscle fibers. Moreover, estradiol may restrict and lessen the amount of stress damage that is done to the skeletal muscle.<sup>4,29</sup>

### ***Hibiscus rosa sinensis***

Because of its therapeutic qualities, the Malvaceae family plant *Hibiscus rosa sinensis* has long been used to treat a wide range of illnesses. Numerous researchers have thoroughly examined the most of the applications, but there haven't been many that look at the leaves of *H. rosa sinensis*'s ability to relax skeletal muscle. It's an evergreen shrub. It has been said that this plant's leaves, blooms, and roots are among its therapeutic aspects. Skeletal muscle relaxant, antinociceptive, anti-inflammatory, antioxidant, wound healing, anticonvulsant, antidiabetic, hypolipidemic, anxiolytic, central nervous system depressant, gastroprotective, antibacterial, and promotes hair growth are just a few of the many qualities that *H. rosa sinensis* possesses. Previous research on the neuropharmacological effects of *H. rosa sinensis* roots revealed a notable skeletal muscle relaxant effect.<sup>30</sup>

### ***Citrus aurantium:***

*Citrus aurantium*, also referred to as bitter orange, is a flavoring and acidifying ingredient that belongs to the Rutaceae family<sup>4</sup>. Flavonoids from *Citrus aurantium*, including hesperidin, nobiletin (2), and naringin (3), stop lipopolysaccharides (LPS) from causing inflammation in L6 skeletal muscle cells. Moreover, the amount of cleaved caspase-3, a protein produced during muscular inflammation and implicated in muscle proteolysis and atrophy, was significantly decreased by pretreatment with the flavonoids.<sup>31</sup>

### ***Piper attenuatum***

India has long used *piper attenuatum* (B. Ham) as a medicinal herb. Traditional Indian medicine has said that *P. attenuatum* (B. Ham) has phytochemical elements with skeletal muscle relaxant properties. *P. attenuatum* (B.Ham.) branches are glabrous and flexible. The phytoconstituents found in *P.*

*attenuatum* (B. Ham) had a potentiating impact on the anti-convulsant and hypnosis caused by hexobarbital in mice. Additionally, phytoconstituents have a skeletal muscle relaxant action, a drop in body temperature, and CNS depressive activity. Regarding the plant *P. attenuatum*'s leaf extract's ability to relax muscles and serve as an antioxidant, there is no scientific data (B.Ham.).<sup>6</sup>

### ***Alstonia scholaris***

*Alstonia scholaris*, also known as saptaparni, is a member of the Apocynaceae family and is a crucial component of the ethnopharmacological toolkit, particularly in "dai" ethnopharmacy, which treats respiratory conditions.<sup>32</sup> Its usefulness has increased its potential to treat additional inflammatory conditions. *A. scholaris* plant sections were thoroughly investigated, and the results revealed a range of terpenoids, monoterpenoids, iridoids, and indole alkaloids.<sup>4,32</sup> In addition, it contains a lot of terpenes, which are anti-inflammatory compounds, and alkaloids, which include strictamine, echitamine, picrinine, akuammicine, and echitamidine. Although several trials have demonstrated its usefulness as an anti-inflammatory, significant amounts of evidence are needed to confirm its effectiveness in treating multiple sclerosis.<sup>4</sup>

### ***Elaeagnus angustifolia***

The flavonoid component of *E. angustifolia* fruit seeds exhibited muscle relaxing action. *Elaeagnaceae* are used medicinally in many different contexts. Most people think that *Elaeagnus angustifolia*'s leaves and fruits have antipyretic properties. Iranian traditional medicine has employed an infusion of *E. angustifolia* fruit as an analgesic to relieve rheumatoid arthritis patients' discomfort. According to the study's reported results, there is a noticeable muscle relaxant effect of the various extracts made from the fruit seeds of *E. angustifolia*. These characteristics along with the plant's ability to relax muscles made it a good choice for treating musculoskeletal conditions. According to earlier research, the fruit seeds of *E. angustifolia* have antinociceptive, anti-inflammatory, and wound-healing properties.<sup>33</sup>

### ***Strychnos nux-vomica***

They have been used to achieve a range of therapeutic goals, including as cytotoxic, anti-inflammatory, analgesic, and antipyretic effects. These actions were ascribed to the extract's and its phytoconstituents' suppression of inflammatory mediators including PGE2 and TNF- $\alpha$ .<sup>34</sup> The Loganiaceae family includes the strychnine tree, or *Strychnos nux-vomica*, which has shown great therapeutic promise for a number of ailments. Furthermore, the *S. nuxvomica* extract showed a drop in PGE2 along with a corresponding decrease in vascular permeability, indicating strong antiarthritic and anti-inflammatory properties that are significant when it comes to joint inflammation.<sup>4</sup>

### ***Portulaca oleracea* common**

The annual succulent *Portulaca oleracea*, sometimes known as purslane, belongs to the *Portulacaceae* family. *Portulaca oleracea* has a relaxing effect because of postsynaptic alpha-adrenoceptors, trans-membrane Ca influx inhibition, potassium ions, Ca<sup>2+</sup> mobilization, and K<sup>+</sup> ions. Some of the wild species' purported traditional benefits for reducing pain and inflammation also apply to *portulaca*. On separate nerve-muscle preparations, the plant *Portulaca oleracea*'s juice and aqueous extracts were examined for their ability to relax muscles. It was determined that elevated potassium ion concentrations are the cause of the neuromuscular activity seen in *Portulaca oleracea* extracts. The extracts' ability to relax muscles may be partially attributed to their suppression of

transmembrane Ca inflow, disruption of the Ca-induced Ca release mechanism, and/or suppression of intracellular Ca release from sarcoplasmic reticulum storage. Muscle relaxant properties were demonstrated by the topical application of *Portulaca oleracea* aqueous extract. High potassium ion concentrations in *Portulaca oleracea* extracts are the reason of their neuromuscular action. Its relaxing action and interference with transmembrane calcium influx are attributed to postsynaptic alpha-adrenoceptors.<sup>35</sup>

**Borago officinalis.** The Boraginaceae family includes the borage, or *Borago officinalis*. The plant contains around 25% of gamma linoleic acid (GLA), making it an excellent source of GLA. Its anti-inflammatory properties in reducing rheumatoid arthritis symptoms are explained by this mechanism. Because it is linked to a higher risk of miscarriage, this therapy technique has not been recommended for use as an intervention in pregnant women.<sup>36</sup> Furthermore, after six months of therapy, the treatment group saw a 64% amelioration in rheumatoid arthritis compared to a 21% amelioration in the control group after receiving 2.8 grams of borage seed oil daily.<sup>4</sup>

## CONCLUSION

After a summary, it is determined that these medicinal herbs have the ability to relax muscles and treat MSDs related to musculoskeletal illnesses. Despite the fact that the effectiveness of a number of medicinal plants and the phytochemicals they produce has been demonstrated, these plants can still be used to treat inflammation, musculoskeletal ailments, including psoriatic and rheumatoid arthritis, and other associated conditions. To confirm the effects in humans, the authors do, however, also believe that more preclinical and clinical research is necessary. Furthermore, it is possible to extract these phytochemicals and create a workable formulation for use in therapeutic settings. Muscle-relaxing properties may be found in man-made herbs such as *Zingiber officinale*, *Curcuma longa*, *Glycyrrhiza glabra*, *Chamaemelum nobile*, *Aloe barbadensis*, *Justicia zeylanica*, *Hibiscus rosa sinensis*, *Citrus aurantium*, etc.

## Conflicts of Interests

There are no conflicts of interest.

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## Authors Contributions

All the authors have contributed equally.

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