

“Lemongrass” and its applications for the treatment of hypertension

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Abstract

Hypertension (high blood pressure) is the pre-symptom of cardiovascular disease. The number of people living with hypertension has doubled to 1.28 billion and proportionally increased until today. This is a long-term disease and requires continuous monitoring. A traditional Chinese herbal, “Lemongrass”, might be a good choice for the mainstay of hypertension. Some library search engines are used, such as SCI/SCIE, PubMed, and Scopus, within ten to twenty years, from 1999-2020. The searched keywords and phrases are “lemongrass”, “formulation”, “traditional Chinese medicine”, “hydrogel”, “hypertension”, “lemongrass + tea formulation”, “lemongrass + hydrogel”, “Lemongrass + Hypertension”, “Lemongrass + traditional Chinese medicine” etc. This mini-review discusses the background of hypertension, lemongrass, research progress, mechanism, lemongrass tea formulations, lemongrass with Traditional Chinese Medicine (TCM) formulations, and the lemongrass hydrogel application in the treatment of hypertension.

Introduction

Hypertension is a global problem with an estimated 26% of the world’s population which has 972 million people, and will be increased to 29% in 2025.¹ Some diseases, include stroke, chronic

heart and coronary heart diseases silent killers. It must take effective prevention or treatment measures for hypertension.² In western countries, several antihypertensive drugs such as diuretics, β -blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors are common to lower blood pressure. However, this is not a long-term treatment as it has adverse reactions, such as dizziness, headaches, and body weakness.³ Lemongrass is a natural herbal and doesn’t have any side effects, except for people prone to skin and respiratory tract allergic reactions, it may be a more suitable candidate for the treatment of hypertension.

Lemongrass

It is also known as *Cymbopogon citratus*. This thrives in warm growing conditions and is a tropical herb packed with a strong citrus flavour. Its leaves have a wide range of medical values, especially for the treatment of hypertension. According to the Traditional Chinese Medicine (TCM) theory, lemongrass belongs to the “Herbs that warm the Interior and expel Cold” category. Its functions are to remove an internal cold and restore “Qi” within the body through liver and lung meridians to improve blood circulation as well as the “Qi” and “body fluids” to nourish the body.⁴

Research progress

Accumulated evidence has shown that lemongrass (*Cymbopogon citratus*) elicited relaxation on vascular smooth muscle. The ease of vascular smooth muscle through prostacyclin (PGL₂) since inhibition of its synthesis by indomethacin resulted in a contraction of hypertensive rat models become low blood pressure.^{4,5} Dzeufiet *et al.* reported that the aqueous extract of *Cymbopogon citratus* possessed antihypertensive activity in rats by changing biochemical and oxidative status. It was also protected the liver, kidney, and vascular endothelium against damages to the blood vessels induced by chronic consumption of ethanol and sucrose.⁶ Nambiar *et al.* indicated the properties of *Cymbopogon citratus*, including antioxidant and anti-inflammatory for preventing the damage of blood vessels as it increased the level of nitric oxide to help its vasodilation.⁷ Later on in 2018, Sompam *et al.* discovered the lemongrass water extract consisted of several polyphenolic compounds such as gallic acid, iso-quercetin, quercetin, rutin, catechin, and tannic acid, which decreased serum lipid peroxidation to have the antioxidant and cardiotoxic functions.⁸

Mechanism

Lemongrass consists of phytoactive constituents, including saponins, tannins, flavonoids, alkaloids, and anthraquinones.

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These bioactive components interact with the enzyme or transport systems, especially for the $\text{Na}^+\text{-K}^+$ ATPase and alpha epithelial Na^+ channel [αENaC] mRNA that helps the renal tubules reabsorption of H^+ . It is effective in acid-base and electrolyte homeostasis to reduce or control the level of blood pressure.⁹ Rhiouani *et al.* reported that saponin regulated the blood pressure and renal function in hypertensive rats through the $\text{Na}^+\text{-K}^+$ ATPase channel.¹⁰ Jouad *et al.* also identified that flavonoids in lemongrass increased the concentrations Na^+ , K^+ , and 2Cl^- of a urinary system to influence the salt and water transport in renal tubules.¹¹ Chen *et al.* discovered the inhibitory effect of saponins on the Renin-Angiotensin-Aldosterone System (RAAS) to maintain the level of blood pressure, balance the acid-base condition, and control the fluid volume in the body.¹² The bioactive components in lemongrass are contributed to the $\text{Na}^+\text{-K}^+$ ATPase and alpha epithelial Na^+ channel [αENaC] associated with the body metabolism for the prevention of hypertension.

Lemongrass tea formulation

Nowadays, lemongrass is formulated as a herbal tea drink to prevent and treat hypertension. The lemongrass tea recipe is simple. Cut the lemongrass in 1 or 2 inches and add 5 cups of water, a few mints with jiggery for boiling in 5 to 10 minutes. In 2012, Ullah *et al.* reported lemongrass tea effectively reduced high blood pressure and decreased heart rate.¹³ Koner *et al.* identified lemongrass tea as antioxidants to detoxify and clean the toxic substance within our body. It regulated blood circulation and lowered blood pressure by the potassium ion from lemongrass tea. This also limited cholesterol absorption and purified it in the liver to prevent hypertension and heart diseases.¹⁴

However, excess consumption of lemongrass tea might influence the homeostatic mechanisms such as balancing the acid-base and electrolytes of body fluid.⁹ Some exhibit potential side effects, including frequent urination and allergic reactions.¹⁵ Ekpenyong *et al.* identified that if the lemongrass tea is at a high dose or as a prolonged treatment, the estimated Glomerular Filtration Rate (eGFR) could be decreased and followed by a decline in the other renal function indices.¹⁶

Lemongrass TCM formulation and clinical study

In the TCM formulation, lemongrass efficacy relieves wind from the surface, removes blood stasis, and dredge collaterals. It is used in the cure of cold, headache, stomach pain, diarrhea, rheumatic arthralgia, bruises, and to regulate blood pressure. The dosage of lemongrass for oral administration is about 3-9g in Chinese medicine decoction.

Lee *et al.* reported lemongrass suppressed the sympathetic nervous system activity and blood pressure in a clinical study of 24 young male adults. Participants drank 180 mL of lemongrass tea for two weeks every morning, and their average blood pressure dropped from 153/90 mmHg to 141/82 mmHg.¹⁷

Lemongrass hydrogel

Could lemongrass be suitable for synthesizing hydrogel? De Matos *et al.* indicated hydrogel integrating lemongrass-loaded nanosponges with an enhanced antifungal effect *in vitro* or *in vivo*.¹⁸ This nanosponges delivery system study may also act as a

carrier of an anti-hypertensive drug in the future. Earlier in 2013, Campos *et al.* reported lemongrass antioxidant properties to prevent endothelial dysfunction associated with an oxidative imbalance promoted by different oxidative stimuli. It decreased the Reactive Oxygen Species (ROS) production and inhibited the vasoconstrictions induced by thromboxane A.¹⁹

Lemongrass hydrogel synthesis possibly relates to natural polymers such as alginate, cellulose derivatives, and chitosan. It depends on the biocompatible and biodegradable properties. The nanoscale of lemongrass as carriers for a delivery system includes Polycaprolactone (PCL), Polylactic Acid (PLA), polyurethane, and Polyvinyl Pyrrolidone (PVP) because of the good tissue compatibility, solute permeability, and excellent electro-spinnability.²⁰

Conclusion

The above information demonstrates that lemongrass and its TCM formulations are possible candidates for the treatment of hypertension. Herbal tea is not well-regulated and formulated in TCM and its application for the hydrogel. However, this must pay attention to the dosage of lemongrass in daily life and further develop it into hydrogel. Much more works need to be done as the previous investigations are inconclusive, such as qualitative and quantitative assessments of lemongrass in the human body.

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