

## REVIEW ARTICLE

# Astonishing *Cymbopogon citratus* (Lemongrass) for Healthcare

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### ABSTRACT

*Cymbopogon citratus*, Stapf (Lemon grass) is a widely used herb in tropical countries, especially in Southeast Asia. The essential oil of the plant is used in aromatherapy. The compounds identified in *Cymbopogon citratus* are mainly terpenes, alcohols, ketones, aldehyde and esters. Some of the reported phytoconstituents are essential oils that contain Citral  $\alpha$ , Citral  $\beta$ , Nerol Geraniol, Citronellal, Terpinolene, Geranyl acetate, Myrcene and Terpinol Methylheptenone. The plant also contains reported phytoconstituents such as flavonoids and phenolic compounds, which consist of luteolin, isoorientin 2'-O-rhamnoside, quercetin, kaempferol and apiginin. Studies indicate that *Cymbopogon citratus* possesses various pharmacological activities such as anti-amoebic, antibacterial, antidiarrheal, anti-filarial, antifungal and anti-inflammatory properties. Various other effects like antimalarial, antimutagenicity, antimycobacterial, antioxidants, hypoglycemic and neurobehavioral have also been studied. These results are very encouraging and indicate that research should be pursued more extensively to confirm these results and reveal other potential therapeutic effects. With regard to the development of quality herbal medicine standardization of the extracts, phytopharmacology of different extracts, isolation and characterization of active phytopharmaceuticals, elucidation of the mechanism of action of the isolated compounds and clinical trials of the compounds are much needed. In the changing global scenario, the interest in plants with medicinal value is increasing substantially in the primary healthcare system both in the developed and in the developing countries. Therefore, the information will help scientists and researchers to screen the compounds responsible for different bioactivities and to elucidate the molecular mechanism of action. Although a lot of pharmacological investigations have been carried out based on the ingredients present, a lot more can still be explored, exploited and utilized.

Keywords: Active phytopharmaceuticals, Flavonoids, Phenolic compounds, Vitamins and Mineral.

Received 20.07.2017 Accepted 30.09.2017

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### INTRODUCTION

*Cymbopogon citratus* is native to Sri Lanka and South India, and is now widely cultivated in the tropical areas of America and Asia. Lemongrass is a tall, perennial grass is a coarse plant with linear leaves that grows in thick bunches, emerging from a strong base and standing for about 3 meters in height with a meter-wide stretch (Fig 1) . *Cymbopogon* is a genus of about 55 species, These are tufted perennial C<sub>4</sub> grasses with numerous stiff stems arising from a short, rhizomatous rootstock [1-2].

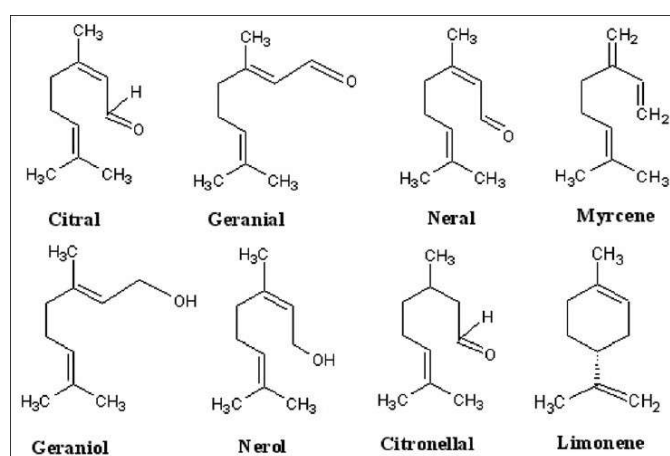


Fig 1. Lemon grass in natural habitat

The plant is used as a fragrance and flavoring agent and in folk medicine as an antispasmodic, hypotensive, anticonvulsant, analgesic, antiemetic, antitussive, antirheumatic, antiseptic and treatment for nervous and gastrointestinal disorders and fevers. The plant is also used as an antibacterial, antidiarrheal and antioxidant, but the mode of action for the different bioactivities has not been studied in detail [1].

*Cymbopogon citratus* contains various phytoconstituents such as flavonoids and phenolic compounds, terpenoids and essential oils, which may be responsible for the different biological activities. Hence, we can isolate some pure phytopharmaceuticals, which in turn can be used as lead molecules for synthesizing the novel agents having good therapeutic activity.

The name Cymbopogon is derived from the Greek words “kymbe” (boat) and “pogon” (beard), referring to the flower spike arrangement [3]. Lemongrass is widely used as a culinary herb in Asian cuisine and also as a medicinal herb in India. It has a subtle citrus flavor and can be dried and powdered, or used fresh. It is commonly used in teas, soups, and curries. It is also suitable for use with poultry, fish, beef, and seafood. Lemongrass herb has numerous health benefiting essential oils, chemicals, minerals and vitamins that are known to have anti-oxidant and disease preventing properties. The herb carries 99 calories per 100 g but contains no cholesterol [2].



**Fig 2. Chemical constituents of lemongrass**

### Chemical constituents and health benefits of lemongrass

The chief chemical component in lemongrass herb is **citral** or *lemonal*, an aldehyde responsible for its unique lemon odor. Citral also has strong anti-microbial and anti-fungal properties. Additionally, its herb parts also carry other essential oils such as *myrcene*, *citronellol*, *methyl heptenone*, *dipentene*, *geraniol*, *limonene*, *geranyl acetate*, *nerol*, etc (Fig 2). These compounds are known to have counter-irritant, rubefacient, insecticidal, anti-fungal and antiseptic properties. Its leaves and stems are very good in folate (100 g leaves and stem provide about 75 µg or 19% of RDA). Folates play a vital role in cell division and DNA synthesis.

When given during the peri-conception period, they can help prevent neural tube defects in the baby. Its herb parts are also rich in many invaluable essential vitamins such as pantothenic acid (vitamin B5), pyridoxine (vitamin B-6) and thiamin (vitamin B-1). These vitamins are essential in the sense that body requires them from external sources to replenish. Furthermore, fresh herb contains small amounts of anti-oxidant vitamins such as vitamin-C, and vitamin-A.

Lemon grass herb parts, whether fresh or dried, are rich sources of minerals like potassium, zinc, calcium, iron, manganese, copper, and magnesium. Potassium is an important component of cell and body fluids, which helps control heart rate and blood pressure. Manganese is used by the body as a co-factor for the antioxidant enzyme, *superoxide dismutase*. Fresh lemongrass stalks and leaf buds can be available all year-round in the local markets. Many home-makers in East Asia, however, pick them fresh for use in cooking from the backyard garden. If you have to purchase from the herb stores, choose fresh lemongrass leaves and stems featuring fresh and lemon-like flavor with a hint of rose fragrance.

Lemongrass contains antioxidants, flavonoids and phenolic compounds such as luteolin, glycosides, quercetin, kaempferol, elimicin, catechol, chlorogenic acid, and caffeic acid, all of which help in providing an impressive range of medicinal aids. The main component of lemongrass is lemonal or citral, which has anti-fungal and antimicrobial qualities, while also providing a distinct lemony smell.

Some of the most well-known health benefits of lemongrass include:

Lemongrass possesses anti-hyperlipidemic and anti-hypercholesterolemic properties that support healthy cholesterol levels. Studies have shown that the regular consumption of lemongrass has shown

significant results in sustaining healthy levels of triglycerides and reducing the LDL cholesterol in the body. This helps in preventing the accumulation of lipids in the blood vessels and promotes the unobstructed flow of blood in the arteries and prevents various cardiac disorders such as atherosclerosis. Lemongrass helps in cleansing and flushing harmful toxic wastes out of the body, as a result of its diuretic properties. Detoxification helps in better regulation of various organs of the body, including the liver and kidney, while also helping to lower the levels of uric acid. The diuretic effect of lemongrass helps in increasing the quantity and frequency of urination, which helps in maintaining digestive health, eliminating accrued fats, and assisting in maintaining a clean system. Lemongrass is effective in treating various types of cancers without affecting the healthy normal cells of the body. Research conducted to prove the anti-cancerous activity of lemongrass has shown promising outcomes in the prevention of skin cancer. Studies have shown that a certain component, citral, which is present in lemongrass, helps in inhibiting the growth of hepatic cancer cells during the initial phases and prevents any further production of cancerous cells. Another study has provided supporting evidence regarding the anti-proliferative effect of citral in impeding the growth of human breast cancer cells and the induction of apoptosis [3].

Lemongrass works as an antiseptic and is effective in treating infections such as ringworm, sores, Athlete's Foot, scabies, and urinary tract infections because of its antimicrobial and anti-fungal properties. Studies have shown that lemongrass exerts healing effects on dermatological infections, such as yeast infections, by inhibiting the growth of pathogens. Another study provided supporting evidence that demonstrated the efficacy of lemongrass over thyme, patchouli and cedar wood oil in the treatment of various diseases such as oral or vaginal candidiasis. Lemongrass helps in alleviating the pain and discomfort caused by headaches and migraines due to its analgesic properties. The phytonutrients present in lemongrass improve the blood circulation and help in relieving spasms, muscle cramps, sprains, and back aches. Lemongrass is valuable in treating sports wounds, including dislocations, internal injuries and bruises. Lemongrass is nervine and has been proven to be an excellent tonic for the nervous system. It stimulates the mind and helps in combating convulsions, nervousness, vertigo and various neuronal disorders such as Alzheimer's and Parkinson's disease. Lemongrass is used in therapeutic baths, which assist in calming the nerves and help in alleviating the symptoms of anxiety and fatigue caused by stress. Lemongrass has been proven beneficial in treating Type-2 diabetes. Studies have shown that the citral present in lemongrass helps to maintain optimum levels of insulin and improves the tolerance of glucose in the body.

Lemongrass is effective in relieving the pain and discomfort caused by rheumatism. It can be applied topically on both lumbago and sprains and helps in relieving neuralgia and other painful sufferings. Lemongrass helps in restoring the vital systems which are operational in the body, including digestion, respiration, excretion and nervous system. This assists in the better absorption of nutrients and strengthen the immune defense mechanism of the body. Lemongrass extracts have a beneficial effect on the inflammatory actions of cytokines, which are the signalling molecules through which the cells communicate and respond in the body. Studies have shown that lemongrass exerts anti-inflammatory action and its constituents such as citral may be the cause behind its inhibitory effects on cytokine production. Lemongrass has been treasured as a skin tonic and makes an effective cleanser for oily or acne-prone skin, due to its astringent and antiseptic qualities. It helps in strengthening the skin tissues and toning up the pores while also sterilizing them. Care should be taken while using lemongrass products, as the undiluted application might lead to dermal irritation in some cases<sup>4</sup>.

Lemongrass possesses antioxidant qualities and helps in protecting the body cells from the oxygen-derived free radicals. It also helps in the cleansing of blood and strengthens the spleen to discard the tarnished red blood cells. It supports the function of the thymus glands which helps to produce white blood cells. Lemongrass helps in stimulating regeneration of cells. The folate and potassium content in the stem and leaves of lemongrass aids in DNA synthesis and promotes cell division. Lemongrass is effective in curing the condition of water retention or edema. It has a cleansing effect on lymphatic congestion and helps to soothe the swelling. Lemongrass consists of the beneficial ingredients of essential oils such as nerol, citronellol, myrcene, dipentene, geraniol and methyl heptenone which possess anti-fungal, insecticidal and antiseptic properties. Lemongrass oil is extensively used in aromatherapy, due to its therapeutic effects, which help in revitalizing and refreshing the body. The cooling effect of lemongrass oil is beneficial for the body during hot weather and promotes the revival of both the mind and soul. Lemongrass oil possesses natural astringent and toning qualities which help in stimulating blood circulation and tones up the dermal tissues. It also helps in tightening, uplifting and firming lethargic or sagging skin.

Lemon grass contains citral, which has been proven to be effective in combating obesity. It prevents the accumulation of abdominal fat and promotes the use of stored energy, which helps in preventing diet-

induced weight gain. It aids in healthy metabolism and enhances the oxidation of fatty acids in the body. Lemongrass is used in the manufacturing of deodorants due to its cleansing and antibacterial properties which help to combat unpleasant body odor and prevent fungal and bacterial infections. It can also be added to footbaths to for sanitizing sore and odorous feet. Lemongrass is used for preserving ancient palm leaf manuscripts and protects them from the damage caused by microorganisms. It strengthens the leaves by providing the required moisture to the fragile palm leaves without letting the humidity cause any loss to the stored text. This protective effect can be attributed to the hydrophobic properties of lemongrass oil. Lemongrass is used in the manufacturing of shampoos and grooming products for pets due to its repellent effects on lice and ticks. Studies have shown that lemongrass essential oil has an anti-biofilm capacity and is beneficial against the infection caused by *Staphylococcus aureus* [5]. Lemongrass contains phenols which possess the capability to spread quickly through the body tissues and cure biofilms located anywhere in the body. Lemongrass disrupts the growth and communication of germs which helps in inhibiting the formation of biofilms. The essential oil of lemongrass is useful for application both topically as well as internally in the diseases diagnosed with biofilms, such as Lyme disease. Studies have shown that lemongrass essential oil has anti-microbial and anti-bacterial properties which help in fighting the infections caused by various pathogens such as *Helicobacter pylori* and *Escherichia coli*. Lemongrass is beneficial in the prevention of gastrointestinal disorders such as gastric ulcers, helps in stimulating the bowel function, and improves digestion. The anti-inflammatory properties of lemongrass are beneficial for treating constipation, ulcerative colitis, diarrhoea, nausea and stomach aches. Lemongrass is widely used in Ayurvedic medicine for its healing effects in treating coughs and colds [6-7].



**Fig 3 Lemongrass oil**

Along with other beneficial components, the vitamin C content present in lemongrass helps in providing relief from nasal blockages, flu and other respiratory disorders such as bronchial asthma. Lemongrass aids in calming the muscles and nerves which helps in inducing deep sleep. Research has showed that lemongrass tea has sedative and hypnotic properties which help in increasing the duration and quality of sleep. Lemongrass is a febrifuge and is also known as the 'fever grass', owing to its beneficial effects in lowering fevers. The anti-pyretic and diaphoretic effect of lemongrass is extensively used in Ayurvedic medicine for curing fevers by inducing sweating.

#### **PHYTOCHEMISTRY & PHARMACOLOGY OF LEMONGRASS OIL**

Emotionally, mentally, and spiritually, lemongrass is said to be the oil of energetic cleansing. In this way it might be helpful in clearing energy from a home, or letting go of negative energy you might be holding onto, which may help those feeling stuck, heavy, or low. Below is a longer list of possible or suggested lemongrass essential oil uses and benefits for more ideas on how to use this unique oil (Fig 3).

Lemongrass essential oil (*Cymbopogon flexuosus*) is created by steam distilling the leaves/blades from this grass. Lemongrass is commonly used in cooking, but the oil actually has many more benefits due to its high concentration. Its aroma is lemony and grassy but also a little bitter and pungent.

The health benefits of Lemongrass Essential Oil can be attributed to its many beneficial properties as an analgesic, antidepressant, antimicrobial, antipyretic, antiseptic, astringent, bactericidal, carminative, deodorant, diuretic, febrifuge, fungicidal, galactagogue, insecticidal, nervine, sedative and tonic substance. Lemongrass essential oil is extracted through the process of steam distillation of dried lemongrass. Lemongrass is known by the scientific names *Cymbopogon Citratus* or *Andropogon Citratus*. The main constituents of its essential oil are Myrcene, Citronellal, Geranyl Acetate, Nerol, Geraniol, Neral,

Limonene and Citral. What's more, lemongrass has many medicinal properties as well. The full explanation of the health benefits is explained below [8].

#### **Analgesic**

Things that are considered an analgesic reduce pain and inflammation. Lemongrass Essential Oil helps relieve pain in muscles and joints, as well as toothaches and headaches resulting from viral infections like a cough, cold, influenza, fever, and various poxes. It also helps cure general body pain resulting from strenuous activities and athletics.

#### **Antidepressant**

Lemongrass Oil boosts self-esteem, confidence, hope and mental strength, and it uplifts spirits and fights depression. This can be very helpful to drive away depression due to failures in their career, personal life, insecurity, loneliness, stagnation, death in the family and many other reasons. This also relieves anxiety. As an antidepressant, lemongrass can be systematically administered to patients with acute depression who are undergoing rehabilitation after acute shock. Basically, take it with your tea and relax.

#### **Antimicrobial and Antibacterial**

Lemongrass has antimicrobial properties which makes it an inhibitor of microbial and bacterial growth in the body, both internally and externally. It is also known to be effective in inhibiting bacterial infections in the colon, stomach, urinary tracts, wounds, respiratory system, and other organ systems. While also helping to cure diseases resulting from bacterial or microbial infections such as typhoid, food poisoning, skin diseases, body odor, and malaria (caused due to protozoon).

#### **Anti-pyretic**

An anti-pyretic is an agent that brings down very high fevers. This is quite similar to a febrifuge but it is effective on very high fevers as well. This oil can bring down a fever when it is beginning to reach dangerous levels. This property of Lemongrass, which comes from its essential oils, is widely known and utilized. It is often served in tea for this very purpose [4].

#### **Antiseptic**

The antiseptic properties of Lemongrass Oil make it a good application for external and internal wounds as well as an ingredient in antiseptic lotions and creams. The antiseptic properties of this oil do not let the external and internal cuts and wounds become septic.

#### **Astringent**

An astringent helps the stoppage of blood flow by contraction of the blood vessels. If someone is bleeding profusely, you need to utilize an astringent to speed up clotting of the blood and stop the flow to save his or her life.

The fact that lemongrass is an astringent helps in a different way too. It promotes contraction of gums, hair follicles, muscles, skin and blood vessels, thereby preventing loosening and falling out of teeth, hair loss and it reduces the flow of blood through the vessels. Some of these properties can be life-saving, so lemongrass is an essential source of astringent.

#### **Carminative**

Lemongrass Essential Oil can efficiently handle trouble people might have with excess flatulence. It not only helps to remove gas from the intestine, but also stops further gas from forming. Furthermore, it provides the excess gas with a safe downward passage by relaxing the muscles in the abdominal region.

#### **Deodorant**

Lemongrass Oil is far better than many of the synthetic deodorants that are a big expense, a heavy impact on the environment, and have limited lasting power. Also, those types of deodorant can sometimes produce irritation on the skin and can exacerbate certain allergies. Lemongrass oil can be a far better choice as a deodorant because it does not do any of these things. In a diluted form, it serves as an efficient deodorant without any side effects. The best thing about this is that it is herbal, so there is no damage to your body or the environment.

#### **Diuretic**

Lemongrass Oil increases urination, both in frequency and in quantity. This may sound not that important but it can be very beneficial for health. When a person urinates, fats are lost from the body, because 4% of the volume of urine is composed of fats. Obviously, the more you urinate, the more you lose fat. Urination also promotes digestion and inhibits the formation of excess gas. It removes excess water from the body and reduces swelling. Its most important contribution is that it removes toxins from the body, not to mention its ability to reduce blood pressure<sup>5</sup>. That is the reason that most pharmaceutical medications for lowering blood pressure induce frequent urination. Urination also helps clean out the kidneys. Febrifuge: Lemongrass Oil helps bring down fevers by battling the infections from which the fever is caused, as well as by increasing perspiration, which induces sweating out of toxins. Fungicidal: Lemongrass Oil has good fungicidal properties and may be used to cure fungal infections, both external and internal.

**Galactagogue**

Galactagogue is a substance or an agent that increases the formation of milk in the breasts. It also enhances the quality of that same milk. This property is very helpful for lactating mothers and the babies who need that vital source of food<sup>6</sup>. Lemongrass oil is a Galactagogue. Apart from increasing milk production, it also helps babies in another way. Babies are prone to infections, so the antimicrobial and antibacterial properties of Lemongrass oil are also absorbed in the milk and thus indirectly help the baby avoid such infections.

**Insecticidal**

Lemongrass is quite popular as an insect repellent due to its insecticidal properties. It kills insects and also keeps them away, but there isn't enough research to know exactly which insects it affects, so there is no promise on cockroaches!

**Nervine**

Lemongrass Essential Oil acts as a tonic for the nerves and the nervous system in general. It helps cure many nervous disorders such as shaking hands or limbs, nervousness, vertigo, Alzheimer's disease, Parkinson's disease and convulsions, sluggishness, and lack of reflexes. It strengthens the nerves throughout the body and stimulates them.

**Sedative**

Being a sedative is perhaps one of the most important and most appreciated medicinal properties of Lemongrass Oil. It has a great soothing, sedating and calming effects on the mind, cures inflammations, itching of skin and it relieves tension and anxiety. This feature can help patients with insomnia as well.

**Tonic**

An agent which tones up and boosts health is a tonic. Lemongrass Oil is a tonic in a very clear sense. It tones all the systems functioning in the body, such as respiratory system, digestive system, nervous system and excretory system and facilitates absorption of nutrients into the body, thus providing strength and boosting the immune system.

**Culinary uses and Lemongrass nutrition facts**

East-Indian lemongrass (*C. citratus*) is an important culinary herb and spice used extensively in cooking in many East Asian countries. Indian lemon grass (*C. flexuosus*) is employed predominantly in the perfume industry since it contains fewer myrcene and, therefore, has a longer shelf-life. With its strong lemony scent and earthy, grassy undertones, it is also effective in aromatherapy and especially when used in a diffuser [7]. Lemongrass tea like make perfect sense since the aroma of even the tea is quite lingering. Refreshing, citrus-scented lemongrass imparts a unique flavor to the recipes. Its coarse, tufted stems and leaf buds are among the most sought-after herbal parts employed in an array of cuisines all over South and East Asian regions. The herb is one of the popular ingredients used in Thailand, Vietnam, Malaysia, Cambodia, and Indonesia and as far as African and American continents for its culinary and medicinal use. Lemongrass features in many East Asian cuisines [8].

Freshly chopped stems, leaf buds as well as dried or ground herb parts used in cooking. The herb imparts distinctive lemon flavor when cut or crushed due to the release of essential oil citral. Before eating discard tough stems and fibres as they are un-chewable. Here are some serving tips: Lemongrass is one of the popular ingredient in many cuisines since its delicate flavor combines well with fish, sea-foods, meat, and poultry. It is widely used in soups, stir-fries, marinades, curries, etc., in Thailand, Vietnam, Malaysia, Philippines, and Indonesia. Tom yum is a favourite soup name in Thailand [9]. The soup is made of fresh lemongrass, kaffir lime leaves, galangal, lime juice, fish sauce, and crushed chilli peppers [9-11].

Lemongrass tea is a very refreshing beverage. Its fine buds and stems used as a garnish in salads. Ground dried lemon grass powder (sereh powder) used in place of stems in marinades in Indonesian islands. This herb is also as flavoring base in pickles. As the name implies, lemongrass smells just like lemons, but it is milder, sweeter, and far less sour. This grass is used in countless beverages (including tea), desserts and other forms of culinary creations as a flavoring agent, where fresh lemon is not available or is not to be used because of its more potent flavor.

**CONCLUSION**

Apart from folk medicines, lemongrass is commonly used in Asian cuisines, especially those of Vietnam, Thailand, and Malaysia. It is used for adding flavor to beverages such as teas, curries and soups, and also finds extensive use in the preparation of pudding, meat products, candies and baked goods<sup>10</sup>. As a vaporizer, the oil works as an effective panacea against bacteria, flu and colds. It has a stimulating agent, tonics, aromas, diuretic and antispasmodic, and so on. People suffering from urine problems can apply lemon grass oils. In hot weather, this is the best oil to cool down the body temperature and to revive the mind and soul. In other health benefits, this is used to improve digestion, nausea and menstruation problems and ailments like headaches, muscle cramps, spasms and rheumatisms.

Pharmacologically, *citral* compound found in lemon grass has been used in the synthesis of vitamin A. Lemongrass is one of the favored herbs used in herbal teas. It is also helpful in relieving colitis, indigestion, and gastro-enteritis ailments. Lemongrass oil when used in aromatherapies revitalizes the body and helps relieve symptoms of a headache, body-ache, nervous exhaustion, and stress-related conditions. Its infusions often employed to help relieve infections such as sore throats, laryngitis, bronchitis, etc. Lemongrass oil is used in massage therapy as a muscle and skin-toner.

#### REFERENCES

1. Lorenzetti BB, Souza GE, Sarti SJ, Santos Filho D, Ferreira SH.(1991). J Ethnopharmacol. ;34(1):43-8.
2. Doran AL, Morden WE, Dunn K, Edwards-Jones V. (1999). Lett Appl Microbiol.;48(4):387-92. doi: 10.1111/j.1472-765X.2009.02552
3. Silva Cde B, Guterres SS, Weisheimer V, Schapoval EE. (2008). Braz J Infect Dis. 12(1):63-6.
4. Adukwu EC, Allen SC, Phillips CA. (2011). J Adv Pharm Technol Res. 2(1): 3-8.doi: 10.4103/2231-4040.79796
5. Filipoy A. (1994). J Ethnopharmacol. 44:181-93.
6. Leite JR, Seabra ML, Maluf E, Assolant K, Suchecki D, Tufik S, et al.(1986). J Ethnopharmacol.;17:75-83.
7. Souza-Formigoni ML, Lodder HM, Gianotti FO, Ferreira TM, Carlini EA. P (1986). J Ethnopharmacol. 17:65-74.
8. Carbajal D, Casaco A, Arruzazabala L, Gonzalez R, Tolon Z. (1989). J Ethnopharmacol. 25:103-7.
9. Locksley HD, Fayez MB, Radwan AS, Chari VM, Cordell GA, Wagner H. (1982). Planta Medica. ;45:20-2.
10. Rao RR, Jamir NS. Ethnobotanical studies in Nagaland. (1982). Indian Medicinal plants. Society for Economic Botany. 36:176-81.
11. John D. (1984). Int J Crude Drug Res.22:17-39..
12. Praditvarn L, Sambhandharaksa C.(1950). A study of the volatile oil from Siam lemongrass. J Pharm Assoc Siam. 3:87-92.

#### CITE THIS ARTICLE

P Narayan and Raaz K Maheshwari: Astonishing *Cymbopogon citratus* (*Lemongrass*) for Healthcare. Res. J. Chem. Env. Sci. Vol 5 [5] October 2017. 84-90