

RESEARCH ARTICLE

***Myristica fragrans*, *Coriandrum sativum*, *Coscinium fenestratum*, and bee honey important in Ayurvedic medicine: a review**

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ABSTRACT

*Covid-19 is a worldwide pandemic disaster that has been steadily rising mortality rates and reported cases. Until today, scientists have struggled to find a therapy that is successful to control Covid-19. It has been a tough undertaking due to the mutagenic character of the viral agent. In this situation, it is necessary to concentrate on alternative methods to boost the immunity. One of the world's oldest medical systems, Ayurvedic medicine, dates back thousands of years. *Myristica fragrans*, *Coriandrum sativum*, *Coscinium fenestratum* and bee honey are four main ingredients that frequently utilized in Ayurvedic healing system, especially for immunity boosting purposes. This review emphasises the medicinal properties of the mentioned ingredients in the Ayurvedic medicinal system. The goal of this review is to encourage conservation by enhancing utilization.*

Keywords: Covid-19, Essential oil, Medicinal plant, Traditional medicine system, Bioactive compound

INTRODUCTION

The Sri Lankan *Ayurvedic* medicine system reaches back 3,000 years or more with proof evidences. As a tropical country with diverse biodiversity, Sri Lanka is a home to many plants and herbs enriched with medicinal values. During the past few decades, Sri Lankan *Ayurvedic* medicine, gain an impressive level of acceptance over the world with the concept of green synthesized medicines.

Ayurveda 'Helavedakama' is a broad phrase that refers to a variety of herbs, formulations, and treatments used to boost the body resistance against infections. It has the ability to improve the strength, energy, memory, intellect, youthfulness and the maintenance of optimum strength of the body and senses. Bioactive compounds of herbal and aromatic plants have potential to deliver a variety of health benefits, such as empower the immunity, neurodegenerative disorders, antioxidant activities, rejuvenators and thus, act as nutritional supplements. The boost of immunity occurs in two main methods firstly, by improving the body resisting capacity to limit the strength or progression of a disease, and secondly

by using the body's resistance capacity to avoid illness appearances. Traditional medicine systems provide comprehensive ways to approaches and maintain the healthy lifestyle. The ancient medicinal recipes pass from generation to generation either orally or through printed documents which were written in the native languages. Past Sri Lankan society was based on natural remedies from aromatic and medicinal plants and plant appendages, such as flowers, leaves, fruits, seeds, stems, roots, rhizomes or bulbs etc. Currently, 60-70% of the rural population in Sri Lanka uses *Ayurvedic* medicines in treatment and prevention of many illnesses (Zoysa *et al.*, 2017). In addition to their health impact, many of these herbal plants are utilized in culinary and aesthetic purposes such as cosmetic productions. Medicines with natural origin are generally preferred as they are less harmful on non-target organisms, ecologically safe, easy to modify, relatively affordable, and have less side effects on both human and the environment. In addition, the plant extracts possess much interest due to their natural bioactive agents that demonstrate wide range of inflammations.

There is evidence in the literature that *Ayurvedic* medicine give relief for several pandemic illnesses like Covid-19. Many of their properties have potential to create a suitable background for disease prevention and boost the human immunity strength. These herbal plants were also identified as providing protection to the body against harmful microorganisms based on available scientific data. Various laboratory-based clinical investigations have been conducted to investigate the scientific basis of the aforementioned herbs.

With the onset of Covid-19 global crises, improvement in scientific studies on aromatic and herbal plant with immune enhancing properties was observed (Srivastava *et al.*, 2020). In Sri Lankan context, *Ayurvedic* medicines has paid attention to a variety of herbs with bioactive compounds that possess immune stimulatory, antiviral, anti-inflammatory, analgesic, antidiabetic, mutagenic, antimutagenic, anticancer properties. Considering different bioactive compounds and their properties there is a scientific logic behind selection of different herbal plants in preparation of immunity enhancing beverage. With the outbreak of Covid-19 the entire society tends to search for natural immunity enhancing methods, due to lack of potential antivirus treatments. With the scientific estimation on 6th July 2020, there will be around 15.78 million confirmed cases and 0.64 million deaths worldwide due to Covid-19 pandemic (Srivastava *et al.*, 2020). Mortality rate of the people enhanced with the poor immunity, especially for the children and people with pre-existing health problems like diabetes, cancer, respiratory disorders etc, or elderly patients (Srivastava *et al.*, 2020).

According to the concept of 'Prevention is better than cure', people found potential natural sources to fight against these invasive agents. With this context, *Myristica fragrans* Houtt (Mace), *Coriandrum sativum* (Koththamalli), *Coscinium fenestratum* (Venivelgeta) and Bee honey have become popular herbal plants used to preparation of *Ayurvedic* beverages in Sri Lanka. There is a strong social

belief that combination of these herbal plant compounds has a possibility of enhancing the immunity strength of human. However, even though the traditional medicine existed in Sri Lanka has been replaced by western medicines recently, still there is a good demand for traditional *Ayurvedic* medicine. Thus, the ancient medicinal systems cannot be ignored. During the Covid-19 pandemic, Sri Lankans utilized *Myristica fragrans*, *Coriandrum sativum*, *Coscinium fenestratum*, and bee honey to boost immunity. The overall goal of article is to inform readers about the morphology, chemistry, and uses of the above-mentioned materials. Morphological and pharmacological identification will be useful to increase their utilization, conservation, and the industrial applications. Thus, this review will help both researchers and industry personal to identify the potential medicinal plants and their medicinal importance to use them in different applications to meet their interest.

Bee Honey

Bee honey is a kind of natural diet produced by bees using different plant-based sugar sources. Bee honey is being considered as one of the main ingredients in the *Ayurvedic* treatments throughout the world. Many of the researchers reported that varieties of honey with darker appearance are having higher antioxidant property (Kesić *et al.*, 2009). Based on different floral sources, such as sun flower, roses etc., constitution of the honey will differ from each other in its flavour, colour and odour. It is a nutritious food containing various bioactive compounds that differ according to the sources of floral organ (Kesić *et al.*, 2009). Because of these compounds, other than wound healing properties (burning wound, surgical wound), bee honey possesses immunity enhancing and hormone regulation ability. Moreover, bee honey contains number of vitamin supplements such as vitamin A, E, K, B1 B2, B6, and C, that can reduce the damages of the free radicals (Kesić *et al.*, 2009). Honey shows broad spectrum of antibacterial properties that affects wound healing by enhancing the tissue growth and reducing the scars formation through enhancing the epithelialization and osmotic effect. When consider about its nutrition composition, it contains different types of sugar such as sucrose, fructose, glucose, and in addition vitamins, minerals and amino acids (Al-Waili *et al.*, 2011). It is considered as an alternative sweetening agent for people who are suffering from diabetes. In addition, it has the ability to reduce the atherosclerosis by reducing the low-density lipids and enhancing the high-density lipids. It also contributes on the hair and skin health, through avavoiding dehydration of skin, formation of acne (Hadi *et al.*, 2016).

Beehives

Bee honey is an amazing product of bees in beehive (Figure 1). Beehives consist of 500-1,000 of drones and 3,000-60,000 of workers with one queen where the used to collect honey from the different plant sources around the hive. Bees ingest

and regurgitate honey for many times and store in honeycombs. It contains a high amount of water. Workers use their flies to evaporate the water from the hive, and then they seal and wax the hives to preserve. The composition of the honey may change with the plant sources. Acacia (*Acacia baileyana*) and Manuka (*Leptospermum scoparium*) honey are the most popular types of honey. Manuka honey is frequently used in dermatological aspects (Hadi *et al.*, 2016).



Figure 1: (a) Honey comb and (b) small scale extracted bee honey

Composition of bee honey

Bee honey composite with number of ingredients such as glucose, fructose, vitamins, phenolic compounds, enzymes (Hadi *et al.*, 2016), and minerals (Al-Waili *et al.*, 2011). Al-Waili *et al.* (2011) recorded that the composition of bee honey may change according to its sources and the form of monosaccharides and disaccharides which represents 82% of total carbohydrates. It contains several enzymes namely invertase, and catalase, monosaccharide fructose and eighteen different free amino acids where proline is the most abounded one.

Moisture (17.2%), glucose (31.28%), sucrose (1.31%), disaccharides (7.31%), fructose (38.19%), free acid as gluconic (0.43%), lactone as gluconolactone (0.14%), ash (0.17%), and nitrogen (0.04%) are the major components present in bee honey (Hadi *et al.*, 2016). In addition to these main constitutions, there are two kinds of enzymes that are originated by plants and hypopharyngeal gland of the workers bees. It contains several other minerals such as Ca, Cu, Fe, K, Mn, P, Zn, Na, and Mg. Honey contains benzaldehyde, benzene acetaldehyde, toluene, and higher concentration of phenolic compounds comparatively to other natural extract. Due to the presence of these ingredients and its ability to regenerate the damaged skin layer, many researchers reported honey as one of the best treatments that can be applied on infected skin. (Ali *et al.*, 2014).

Medicinal property of honey

Bee honey has an ability to promote positive impact on the human health and considered as one of the energy diets. It contains approximately more than 80-90 % of sugar in the form of fructose and glucose. Because of ascorbic acid, flavonoids, glucose oxidase, α -tocopherol, catalase, and peroxidase it is considered as one of the natural preservative agents (Crittenden, 2011).

Bee honey demonstrate the wide spectrum of antifungal, antiviral, antimicrobial, anti-inflammatory, hepatoprotective, anticancer, and immune stimulating properties (Al-Waili *et al.*, 2011). Since ancient time, honey has a huge demand as a food preservative agent and has been used in the *Ayurvedic* medicine. Honey has antioxidant properties which derive due to the presence of phenolic compounds. It protects and neutralise the skin from the free radical produced by the hydrogen peroxide. In addition to that, honey is a higher viscous fluid, and reduces the surfaces contact with water. It is effective during the wound healing therapy and during the food preservation (Hadi *et al.*, 2016).

Honey contains a number of different sugar types namely isomaltose, nigerose, turanose, maltulose, and fructose. Thus, according to the Hadi *et al.* (2016) it has become beneficial for a person with diabetes since such sugar in bee honey absorbs slowly by the gastrointestinal track.

Skin care

Bee honey is rich with vitamins and minerals important to protect the skin by healing and dehydration (Hadi *et al.*, 2016) and enhance the epithelisation and minimize the scares formation (Al-Waili *et al.*, 2011). Honey is used in preparation of cream and cosmetic products such as barrier cream, emollients, lotions and ointment throughout the world, as it contains glucose and fructose with natural humectant property (Hadi *et al.*, 2016). Moreover, due to its antioxidant and antibacterial features, it can be used in treating acne, removal of dead or damaged tissues and replace the new layer of skin. According to the Al-Waili *et al.* (2011) under the laboratory conditions, honey is being used to treat the wounded rats, where bee honey will enhance the tissue formation of wounded skin of the rats, formation of granulation tissues, blood vessels and collagen. In addition to the healthy skin, honey is also impotent in maintaining a healthy hair. It makes smooth and shiny hair that easy to comb (Hadi *et al.*, 2016).

Nutmeg and Mace (*Myristica fragrans* Houtt)

Nutmeg (*Myristica fragrans* Houtt) is a commodity with higher economic value which is native to tropical Asia and Australia (Bamidele *et al.*, 2011). Indonesia is the world's number one nutmeg producer, and the rest of the production is made by Sri Lanka, Maluku, North Sulawesi, Papua, Nanggroe, West Java, and West Sumatra (Rahardiyana *et al.*, 2020). According to the Jose *et al.* (2016), world annual nutmeg production is around 10,000 to 12,000 tons. *Myristica* plant gives two valuable spices as maces and nutmeg (its sister spice, lacy) where the fruit seed is represented by the nutmeg and the mature mace by the reddish covering on the seed. Both spices have compositions that are beneficial to the spleen and liver (Bamidele *et al.*, 2011). The colour of mace is an important factor that affects its commercial value (Jose *et al.*, 2016). There are few nutmeg accessions namely *Myristica argenia* WARB (Papua Nutmeg), *Myristica succedena* BLUME (Halmahera Nutmeg), *Myristica malabarica* (Malabar Nutmeg), and *Myristica speciosa* WARB (Bacan Nutmeg) which were named according to their origin (Rahardiyana *et al.*, 2020). The Indian Institute of Spices Research (IISR) has released a new variety named 'IISR vishwasree' that yields about 1000 fruits at the 8th year of planting. IISR has also released few elite lines such as A9- 20, 22, 25,69,150, A4-12,22,52, A11-23,70 as high yielders and possibility to distributed as grafts (Jose *et al.*, 2016). As it is a mild shade loving plant, it can be used to intercrop with the coconut (Jose *et al.*, 2016) and can be introduced to the other export plantations. Weevil of the coffee bean *Ataecerus fasciculatus* is a major pest in the production of stored nutmeg and mace (Jose *et al.*, 2016).

Morphology of the nutmeg plant

Nutmeg is a perennial, dioecious plant belongs to the Myristicaceae family, where the male and female blooms are rarely found on the same tree (Jose *et al.*, 2016). Nutmeg plant grows to a height of 5 to 13 metres, and occasionally, 20 metres plants also can be found. Flowers are pale yellow in colour with waxy, fleshy and bell-shaped petals. *M. fragrans* is a dioecious plant bears small, supplementary racemes of flowers (Naeem *et al.*, 2016). The fruits are fleshy, drooping, smooth, and 6 to 9 cm long with a longitudinal ridge (Jose *et al.*, 2016). Male flowers consist of six to ten stamens while female flowers are pale yellow in colour and found in axils of leaves. According to Naeem *et al.* (2016), *M. fragrans* has a long petiole (1cm) with pointed, dark green leaves that are arranged alternatively along the branches. Further, it has comparatively large simple and entire leaves with shiny upper leaf surfaces (Jose *et al.*, 2016). The fruits are yellow in colour, with a glossy outer layer (exocarp) and a squishy mesocarp underneath. The pericarp of the fruit is composed of exocarp, mesocarp, and endocarp. Fruit is round drupe, pendulous with succulent pericarp (Naeem *et al.*, 2016). When ripe, the succulent yellow fruit (mesocarp) splits into 2 valves revealing a purplish-brown, shiny seed (nutmeg) surrounded by a red aril (mace) (Figure 2). Ovary is single

and large seed finally mature into mace and nutmeg, and it can be harvested after 6-9 months of flowering (Jose *et al.*, 2016).

Nutmeg consists of 77.8% flesh, 13.1% seed, 4.0% mace, and 5.1% shell. The matured nutmeg fruit is yellowish green in color and has a tough texture and creamy flesh. It is 3-9 cm in diameter, and the skin of the seeds is tough while the colour is often dark chocolate. A coating of scarlet aril appears between the flesh and the seed, surrounding the seed with a characteristic nutmeg scent and flavor, but more delicate (Rahardiyan *et al.*, 2020). Compared to mace, nutmeg gives a strong aroma and sweet taste.

There should be specific climatic condition for the better growth of nutmeg plants (Naeem *et al.*, 2016). According to Jose *et al.*, (2016) rich and well-drained soil with sound rain fall around 2,000-3,500 mm with a temperature of around 25-30°C is suitable for the growth of nutmeg plants. Further, it grows well in altitudes 700-4,500 m. Moreover, nutmeg shows a better growth under the soil around pH 6.5-7.5, with sufficient water and high organic matter contents.



Figure 2: (a) Young plant, (b) leaves, (c) mature tree (d) fruits, (e) nutmeg and mace (f) mature fruit on the tree

Nutmeg is a kind of cross-pollinated plant where male and female plants are grown separately (Naeem *et al.*, 2016). Thus, when propagate using seed there is a huge problems of unproductivity male plants in the population. Normally male plants accounts around 50% of the nutmeg plant population. According to the literature, the most effective propagation method for this plant is either grafting

or budding. Female plants start fruiting by six year after planting. When fruits are ready to harvest, the pericarp splits and the fruit become exposed to out. After sun drying, the mace becomes dark brown in color and then it is easily separated from the seed (Jose *et al.*, 2016).

Composition of the nutmeg

Nutmeg plants have higher economic value as spices where it is popular in both *Ayurvedic* and western medicines. Because nutmeg and mace have endemic smell, pungent, medicinal properties, it is commonly used in bakery products, puddings, vegetables and cakes, biscuits, custards, buns and as also in tea or soft drinks, alcohol as a flavour enhancer. However, according to the Rahardiyan *et al.* (2020) intake of more than 0.08% of nutmeg will create toxic effects for human body.

Myristicin is the principal component addition to malbaricone, macelignan, pyrethrum (Figure 3), trimyristin (Rahardiyan *et al.*, 2020) pine, sabincene, camphene, myristin, elemicin, isoelemicin, eugenol, isoeugenol, methoxyeugenol, safrole, diametric phenylpropanoids, lignas and neolignas contains antioxidant, antibacterial, cytotoxicity, insecticidal activities (Jose *et al.*, 2016).

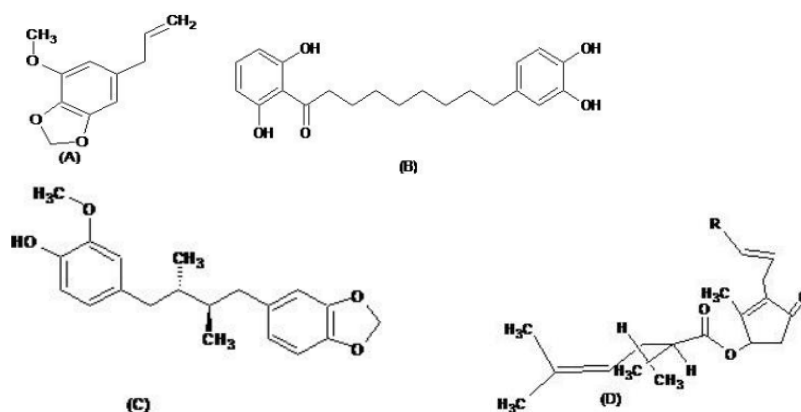
Seed and flower contain myristicin, elimicin, and safrole which has the ability to induce hallucination (Rahardiyan *et al.*, 2020). Terpeins that contain in the essential oil is responsible for the specific smell. Terpene, phenylpropanes, myristicin are the some of terpens and terpens derivatives that are toxic when used frequently. Moreover, effect of myristicin and elemicin lead the intoxicification of nutmeg (Jose *et al.*, 2016).

Nutmeg has two kinds of oil, as essential oil (volatile oil) and fixed oil (nutmeg butter). Nutmeg seed contains 5-15% of six essential oils and 24- 40% of fixed oils where myristic, stearic, palmitic, oleic, linoleic and lauric acids are the fixed oils (Jose *et al.*, 2016). Essential oil has antibacterial effects against the *Bacillus anthracis*, *Bacillus mycoides*, *Bacillus pumilus*, *Bacillus subtilis*, *Escherichia coli*, and *Saccharomyces cerevisiae* (Rahardiyan *et al.*, 2020).

Nutmeg oil is a transparent and light yellowish or pale green oil with a unique mild delicate scent (Figure 4). Nutmeg oil is extremely light and temperature sensitive non-polar solvent. It is extremely soluble in ethanol, but not in water. Seeds are primarily employed for oil extraction since the content of younger seeds is higher than that of older seeds, resulting in oil that is pale yellow in color, more volatile, and has a very distinct fragrance smell. The nutmeg oil is extracted via simple steam distillation method or hydro-distillation. Nutmeg oil contains 61-88% monoterpene hydrocarbons, 5-15% oxygenated hydrocarbons, and 2-18% aromatic ether, as well as various minor chemicals in minute concentrations (Rahardiyan *et al.*, 2020). In addition to number of isolations calcium,

phosphorous, iron, thiamine, riboflavin, and niacin also found in the nutmeg in trace amounts (Jose *et al.*, 2016).

According to the report of Rahardiyana *et al.* (2020), due to the presence of more terpenoids, nutmeg oil extraction gets darker colour. Yellowish colour oil indicates that it is uninfluenced by air or sunlight. Darker colour oil may be an indication of oxidation of the oil due to exposure to oxygen which will directly impact to aroma.



Figures 3: Chemical structure of the (A) Myristicin, (B) Malabaricone, (C) Macelignan, and (D) Pyrethrum (Jose *et al.*, 2016)



Figure 4: Colour variation of nutmeg oil extracts (Jose *et al.*, 2016).

Uses of nutmeg

In the pharmaceutical sector, nutmeg oil has been used to treat abdominal pain, diarrhoea, and bronchitis. Moreover, nutmeg may be useful in treating flatulence,

increasing metabolism, dysentery, stomach inflammation, vomiting, constipation, bloating and rheumatism and useful in treating paralysis and to improve blood circulation. It is beneficial for the healthy metabolism of liver and spleen. People in Israel are using nutmeg and mace extraction in treating different skin disease (Bamidele *et al.*, 2011).

Eugenol is another available chemical compound in nutmeg that frequently use in dental treatments and toothpaste productions. According to the literature, lignin contain in mace is used for skin whitening purposes since it has the ability to control melanin production in skin (Naeem *et al.*, 2016). Jose *et al.* (2016) reports that use of nutmeg is efficient in getting rid of the pimples. Further, seed oil is used in candle production (Terpineol), soap and hair lotions preparations. Furthermore, camphene is utilized as a component in the perfumes.

Essential oils are applied in a variety of medicinal, cosmetic, and culinary applications. It is used as a spice in various dishes, soft drinks or mixed in milk and alcohol. Oleoresin is a mixture of resins and essential oils which have characteristic flavour and aroma. It is used in culinary aspects, where mainly it is added as a flour during the production of meat and fish, pickles, sauces, soups, biscuits and bread or cake (Agbogidi and Azagbaekwe, 2013).

At high doses, ethanolic seed extract of *M. fragrans* appears to suppress the haemopoietic system. Moreover, red blood cell (RBC) count, packed cell volume (PCV), haemoglobin concentration (HbC), and platelet count all decreased significantly (Bamidele *et al.*, 2011).

Kottamalli (*Coriandrum sativum* L.)

Coriandrum sativum L., a member of the Umbelliferae family, is one of the most important essential oil yielding spices and medicinal plants. *C. sativum* essential oil and extracts have antifungal, antibacterial, anti-oxidative activities and insecticidal properties in the various chemical components in different plant parts. Furthermore, it is used to preserve the food, as a pharmaceuticals, medicine, and home remedies. It's a kind of herbaceous annual plant, which has a long history dated back to around 1550 BC as a culinary herb. It's a source of aroma compounds and essential oils with biologically active components (Shyamapada and Manisha, 2015). Ukraine is a large producer of coriander oil and, has a sway on global prices (Aftab *et al.*, 2021). The oil contains trans-tridecen, which causes a nasty odour in immature fruits and leaves known as "stink bug smell" (Shyamapada and Manisha, 2015). There are two varieties of *C. sativum* as *vulgare* and *Coriandrum microcarpum*. Although all parts of the plant are edible, the fresh leaves and dried seeds are the most commonly used in cooking (Pathak *et al.*, 2011). India, China, Thailand, Malaysia, Indonesia, and Sri Lanka are large scale consumers of this green herb since it contains specific native flavour (Schempp *et al.*, 2012). Coriander fruits contain about 0.2–1.5% of

volatile oil and 13–20% of fat (Shyamapada and Manisha, 2015). However, its fresh leaves and dried seeds are most frequently used in day-to-day life. Its green foliage, containing proteins, vitamins and rich reservoir of micronutrients and nutritional elements such as calcium, phosphorus, and iron (Bhat *et al.*, 2013). Leaves and seeds contain essential oils, which offer characteristic flavour when added to foods. It plays a significant part in preserving the shelf life of the food by avoiding rotting (Casetti *et al.*, 2011).

Morphology of the plant

C. sativum is growing throughout India, Netherlands, Italy, Eastern Europe, Central China, and Bangladesh (Pathak *et al.*, 2011). There are few wild relatives have been recorded around worldwide. This plant can be easily grown under the any environmental condition like disturbing areas like roadside (Schempp *et al.*, 2012). It has the ability to grow in wide range of climatic conditions (Pathak *et al.*, 2011).

It is an annual (short lived), melliferous, diversifies and flowering small herb that reach to 0.20 to 1.40 m in height. According to Pathak *et al.* (2011), these plants have a tap root system with three main branches and subbranches that originate from the stem which terminates with an inflorescence. When it is matured, the green colour stem turns to dark red or violet. Leaves appears in the lower part of the plant are basal in shape with three undivided lobes (Figure 5), while the upper leaves lanceolate and have filiform shape blade undivided but have three lobes. Young leaves are oval while the aerial leaves are elongated in shape (Pathak *et al.*, 2011). Leaves are green or shiny green with lower side consisted with waxy appearances. During flowering period, the leaves may be turn in to red or violet while fruits start to bear from lower part of the plant. Inflorescence is a compound umbel type with two to eight primary rays in different lengths. Central flowers are sterile, so called as stamiferous and flowers are white in colour with inferior ovary. The flowering time of coriander plants are shorter (Bhat *et al.*, 2013). Two to three days after opening the flowers, the pollen colour changed in to pink or violet (Schempp *et al.*, 2012). Fruits are round or ovate (Figure 5) and have teeth like calyx with a diameter of about 6 mm. They are spontaneously split in to the two pericarps. Every pericarp has six longitudinal splits, and when dry, it splits easily (Shyamapada and Manisha, 2015).



Figure 5: (a) *Coriandrum* seed, and (b) *Coriandrum* young leaves

Chemical composition

Different plant parts of coriander consist with different composition with different uses. Essential oil and the fatty oil are the main constituent of the fruit. The weight of essential oil content of ripe and dried fruits of coriander varies between 0.03 - 2.6%, and the content of fatty oil varies between 9.9-27.7%. Main constituent is the water (11 %), and fat (9.5%) while 28.43% is crude oil. Sugar and other essential oils, and minerals are also present in trace amounts in the fruit extract (Schempp *et al.*, 2012).

linalool, α - pinene, γ - terpine, Geranylacetate Camphor, Granio are the main components of the essential oil of the *C. sativum* (Matasyoh *et al.*, 2008). Essential oil can be extracted from various parts of plants including leaves, flowers, stem, seeds, roots, and bark. Composition of the essential oil can vary among different parts even within the same plant. Important property of the seeds of *C. sativum* L is its antibacterial quality against the Gram-positive and Gram-negative bacteria. Due to its antioxidant property, it enhances the shelf life of the food while delaying or preventing the food spoilage (Casetti *et al.*, 2011). Essential oil exhibited antibacterial action (Matasyoh *et al.*, 2008). Essential oil has the potential to induce superficial skin infections (Casetti *et al.*, 2011). Volatile components of essential oils from seeds and leaves have been shown to restrict the development of a variety of microorganisms (Chung *et al.*, 2012).

Major compounds present in coriander seeds extract are linalool (67.70%), alpha-pinene (10.5%), gamma-terpinene (9.0%), geranyl acetate (4.0%), and camphor (3.0%). It also contained high nutritional values including proteins, oils, carbohydrates, fibres and wide range of minerals, trace elements, and vitamins (Al-Snafi, 2016).

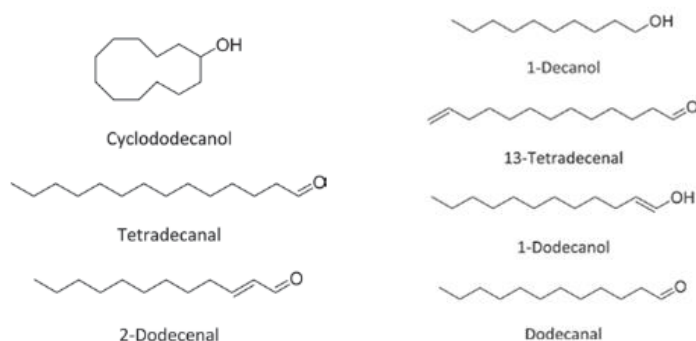


Figure 6: Structures of major constituents in the essential oil from *Coriandrum sativum* leaves and stems (Chung *et al.*, 2012).

Uses of Coriander

Fruits are used for food processing like baking of fish and meat. Mostly it is used as a curry powder. It is also used in preparation of condiments and spices, pickles, sausages, and seasonings, and for flavouring pastry, cookies, buns and cakes, and tobacco products (Schempp *et al.*, 2012), alcoholic beverages, frozen dairy desserts, candy, and puddings (Al-Snafi, 2016).

In traditional medicine, coriander seed combination with hot water is considered as a painkiller and better for the disease related to the gastrointestinal tract (Zoysa *et al.*, 2017). Fruit oil extracted by steam distillation was a common ingredient in creams, detergents, surfactants, emulsifiers, lotions, and perfumes (Al-Snafi, 2016). It is used as a stimulant, aromatic and carminative spice. It is used as a spices and herb that increase palatability (Schempp *et al.*, 2012). Seeds are applied locally to relieve swelling and discomfort. A paste of green coriander was used to cure headaches. Green coriander powder is also used in treating burning sensations and pain inflammations (Al-Snafi, 2016).

The pharmacological studies revealed it have potential to anxiolytic, antidepressant, anticonvulsant, memory enhancement, improvement of orofacial dyskinesia, neuroprotective, antibacterial, antifungal, insecticidal, antioxidant, cardiovascular, hypolipidemic, anti-inflammatory, antidiabetic, mutagenic, antimutagenic, anticancer, gastrointestinal, dermatological, reproductive, and detoxification activities (Al-Snafi, 2016).

Table 1: Previous literature for uses and of *Coriandrum sativum*

Uses	Plant Parts
Inflammation, joint pain	Seeds aqueous extract
Antiviral and neuro-energizer	Plants Aerial parts
Some liver diseases	The roasted seeds' aqueous extract
Convulsion, loss of appetite, insomnia, and anxiety and in medical purposes	Powdered seeds or dry extract
Diuretic, and stimulant activity	The whole plant parts
Grounded as an ingredient of curry powder and gingerbread,	Seeds and aqueous of leaves
Digestive stimulant	Leaves
Sedative and muscle relaxant effect	The aqueous extract
Bad breath, unpleasant odor from genitalia	Seeds
Against worm and to treat rheumatism	Fruits
Stimulates gastric secretion, treats gastric ulcers and mouth infections	Essential oils

Sources: Emamghoreishi (2007); Khare (2008); Wichtl (2009); Taherian *et al.* (2012); Nair *et al.* (2013); Grieve (2019); Bashir and Safdar (2020)

Venivelgeta (Cosciniun fenestratum)

Cosciniun fenestratum is a critically endangered shrub that is typically used in folk and *Ayurvedic* medicinal systems. Many studies have been conducted on its chemistry and medicinal properties. It belongs to the family Menispermaceae and is a kind of woody climbing shrub with numerous medicinal properties. It's a kind of deciduous plant that grows in the evergreen, semi-evergreen, and deciduous forests (Anjali *et al.*, 2011). It is distributed in India, Sri Lanka, Malaysia, Cambodia, and Vietnam. It is considered as the plant with the highest medicinal value in European countries and India. The plant is on the edge of extinction as a result of destructive collecting, overexploitation, and habitat loss. It is considered as a critical endangered plant in India. In Vietnam, it is a vulnerable and indeterminate plant in Sri Lankan conditions (Nair *et al.*, 2005).

This plant is important due to its active compound named berberine present in both the stem and root (Vijay *et al.*, 2020). Berberine is the main constitution that is contained in *C. fenestratum*. In addition to that, it contains several other important compounds for pharmacological activities. Literature reported that *C. fenestratum* have antifungal, anti-yeast, antibacterial, hypotensive, antiproliferative, anti-hepatotoxic, antipyretic, dressing wounds, antiulcer, jaundice, antidiabetic, antioxidant, and cytotoxic activities. The Root of this plant is used as stomachic, diuretic, hypotensive, and anti-dysenteric agent (Anjali *et al.*, 2011). Due to the presence of the above properties, it is used to cure a number of diseases like diabetes, wounds and ulcers, fever, jaundice, snake bites, and piles (Anjali *et al.*, 2011).

Plant morphology of Coscinium fenestratum

C. fenestratum plants are abundantly grow under the high rainfall conditions (Anjali *et al.*, 2011) with an annual rainfall of 2,000 mm and an annual temperature of 27°C in humus rich soil (Vijay *et al.*, 2020). It's a dioecious, wood climbing plant, where the male and female plants occur separately (Vijay *et al.*, 2020). *Venivelgeta* is a dioeciously cultivated plant (Khare, 2017). The flowers are yellow in colour, unisexually born in axillary inflorescences from November to September. Minimally, this plant takes around 15 years to flower (Anjali *et al.*, 2011). Leaves are simple, shiny, and smooth in appearance (Anjali *et al.*, 2011), thick and arranged alternatively (Vijay *et al.*, 2020), broadly ovate at base, while rounded, truncate or shallowly chordate at the apex (Khare, 2017).

C. fenestratum fruit type is known as drop, and the seeds are globular shape. The sap of the wood is yellow (Kare., 2017). The bark of the plant is densely haired when it is young. Cross sections absence the annual rings. The external cells of the stem are bright yellow in colour, while the outer cells are brownish yellow in colour. Most of the outer bark cells contain oil droplets (Vijay *et al.*, 2020).

In Sri Lankan context, *C. fenestratum* is a non-cultivable plantation crop that is typically found in forestry or rural settings (Vijay *et al.*, 2020). It can be a regeneration plant using the stumps and seeds of the mother plant. However, it has low regeneration capacity, while the seeds have an average dormancy period of around 6 months. When regenerating using vegetative methods, 15 cm stem cutting is preferred, but seed propagation is the most commonly used method, (Khare, 2017).

Chemical composition of Coscinium fenestratum

C. fenestratum contains 32 compounds, including two benzyloquinoline alkaloids, three aporphine alkaloids, 12 quaternary protoberberine alkaloids, oxoprotoberberine alkaloids, three tetrahydroproto berberine alkaloids, and some minor alkaloids (Anjali *et al.*, 2011). Roots consist of alkaloids like

berlambine, dihydroberlambine, 12, 13-dihydro-8-oxo berberine, tetrahydroberberine, oxyberberine, and noroxyhydrastinine (Vijay *et al.*, 2020).



Figure 7: (a) *Venivalgeta* leaf vein, (b and c) leaf appearances of vein, (d) stem, and (e) cross section of the stem.

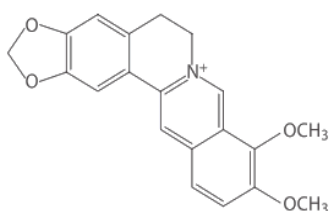


Figure 8: Structure of the Berberine

Wood is widely used for Ayurvedic purposes, while every component of this plant, from root to leaves, is used for medicinal purposes. Dry wood is used for crude drug preparation. Drugs have no specific odour but have a specific colour (Vijay *et al.*, 2020). Root pieces were used to isolate the Baberin (Anjali *et al.*, 2011). According to Nair *et al.* (2005), Berberine (Figure 8) is the active

component of *C. fenestratum* which has an antibacterial effect on certain microorganisms. Baberis is a kind of alkaloid with antiseptic properties (Zoysa *et al.*, 2017). Maceration with 80% ethanol gave the highest content of berberine in the extract (Anjali *et al.*, 2011), and it can be quantified using TLC of HPLC methods.

Uses of C. fenestratum

C. fenestratum has been reported to possess various pharmacological actions such as antioxidant, laxative, antiproliferative, antidiabetic, anti-hypotensive, anti-plasmodial and antibacterial activities. It also has antifungal and anti-yeast, activities which make it used as hair shampoo and soap production. It has also been used to enhance the skin complexion and thus, being used in production of *Ayurvedic* bath soap and bath oil. Moreover, it is used as a tea extract with other herbals as an immunity booster. In addition, Berberine has a fluorescent property (Vijay *et al.*, 2020).

C. fenestratum is being used to treat coughs, wounds, ulcers, skin diseases, abdominal disorders, jaundice, liver disorders, intrinsic haemorrhage, diabetes, and fever (Vijay *et al.*, 2020). According to the literature, it is used for healing of wounds, skin cancer, detoxifying skin bites (Anjali *et al.*, 2011) and abdominal disorders. It significantly reduces fasting blood glucose levels as well as serum triglyceride and cholesterol levels. It is also important in balancing blood pressure (Vijay *et al.*, 2020). In Malaysia, it's very famous as a traditional fabric dyeing agent, due to its natural yellow colour (Vijay *et al.*, 2020).

CONCLUSION

It is vital to raise awareness about the possible therapeutic characteristics and the influence of *Ayurvedic* and medicinal plant products in the treatment of infectious and other disorders. Since these botanical plants are cheap, have low toxicity, and are available across the country, they have the potential to boost immunity against Covid-19 and other infectious diseases. It will contribute significantly in stabilizing the healthy generation in Sri Lanka and around the world.

Bee honey is widely used in *Ayurvedic* medicine and, more recently, pharmaceutical production. Due to its natural antioxidant property, it's a very popular ingredient in skin care products. *Myristica* is the most economical spice apart from common ingredients in *Ayurvedic* medicine and the western medicinal system. Higher concentrations of some compounds cause the hallucination condition. *Kottamalli* is a famous drink that is used at the domestic level as a first aid for many diseases. Addition to the pharmaceutical applications it has being used in food production and processing. *C. fenestratum* is a famous folk medicine

in the *Ayurvedic* medicinal system and is frequently used in cosmetic production at the industrial level.

According to the available research data it can conclude that herbal medicines have good capability to regulate and protect the body from virus, bacteria etc. Even though planting materials are healthy, some reports are pointing out toxic levels, higher dosages will cause harmful effects.

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