IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

THE NOVEL APPROACH OF DEMULCENT-BASED AYURVEDIC KADHA, IMPACTS ON BUILDING HEALTH IMMUNITY AND ACTS AS AN ANTIVIRAL ACTION

Sourav Pattanayak[1], Vinutha Bhat[2], Sagar Sheel[3]

[1]M. Pharm, MBA (NMIMS), Business Development at BIBO (Hilt Brands India Pvt Ltd), Bengaluru.

[2]Assistant Professor, Faculty of Pharmaceutical Sciences, PES University, EC campus, Bengaluru.

[3]B. Pharmacy, B2B Sales, BIBO (Hilt Brands India Pvt Ltd), Bengaluru.

Abstract

The immune system is a complex network of organs, cells, and proteins that protects the body's cells and offers the body's defence against infection. Autoimmune disorders, immunodeficiencies, and allergy conditions can all be brought on by immune system abnormalities. Ayurvedic Kadha, also known as herbal tea, is a preparation of several herbs that promote immunity. Kadha is typically prepared at home with unique ingredients for healing and rejuvenation, particularly in India. It also helps build up immunity, especially in respiratory health. During the outbreak of COVID-19, the Indian Ministry of Ayush recommended the consumption of kadha in order to enhance immunity and demulcent use in kadha formulation to provide calm and shield irritated or inflamed interior tissue. Demulcent use in kadha provides a semi-permeable membrane, increasing the retention time of herbal medicament in mucous membranes. Fear regarding this pandemic has increased the widespread consumption of Kadhas. Kadhas are prepared with hot and potent Ayurvedic herbs like Ginger, Tulsi, Black pepper, Turmeric, Cinnamon, etc.

keywords- Ayurvedic Kadha, immunity boosters, antiviral, herbs, detoxification, anti-inflammatory, Demulcent property.

1. Introduction

Inflammation is a natural aspect of the immune system's reaction to viral infections, helping to lessen infection, stop viral reproduction and spread, lessen tissue damage, and eradicate contaminated cells. Acute inflammation has positive effects and is followed by regeneration and healing[1], [2].

Numerous human illnesses caused by viral infections, including those with moderate, and Significant clinical and socioeconomic problems globally are largely caused by severe or life-threatening symptoms. Human coronaviruses (CoVs), notably the Severe Acute Respiratory Syndrome(SARS) coronaviruses, were responsible for three recent large worldwide outbreaks with high morbidity and death[3]. The 2019 new coronavirus and the Middle East Respiratory Syndrome (MERS) coronavirus. SARS-CoV-2 cannot presently be treated with any approved drugs or vaccines. Due to its high incidence of contagiousness and lack of viable therapies, the World Health Organization (WHO) has deemed SARS-CoV-2 a worldwide emergency. As a result, scientists from around the globe are striving to discover a viable treatment for this condition[4].

For a very long time, ayurvedic medications and their extracts have been utilized to increase immunity and protect against viral illness[5]. Viral illnesses have traditionally been treated using Ayurvedic medications and their extracts. Making Kadha (Decoction) for oral ingestion is a significant Ayurvedic approach for enriching the active pharmacological compounds from plants. A demulcent is a mucilage-rich herb that helps calm and shield irritated or inflamed interior tissue. Emollients are what they are known as when applied to the skin and increase the drug retention time and also increase drug absorption in the systemic circulation[6], [7].There are several ways to ingest therapeutic herbs and plants, as mentioned by Panchvidh Kashyapam in the Charak Samhita (old Ayurvedic literature)[8]. Spices and herbs, as well as other dry or less juicy ingredients, are used to make kadha. The Ministry of AYUSH, Government of India(GOI) has suggested the use of Kadha for boosting immunity and reducing inflammation during the COVID-19 crisis (The Ministry of AYUSH 2020). In order to manage the COVID-19 issue, a number of

Indian Ayurvedic herbs, spices, and their active phytochemical components have been researched for their possible preventive and therapeutic uses against COVID-19[9]–[11].

Several viral proteins, host cell receptors, and Pro-inflammatory mediators and proteases were docked with the various phytochemicals and active pharmacological elements present in the various plants used to make Kadha. Additionally, these phytochemicals demonstrated a high affinity for several inflammatory mediators' functional regions. Our research shows that frequent use of this ayurvedic Kadha under the guidance of an ayurvedic doctor may assist in considerably increasing immunity, avoiding viral infection and pathogenicity, and lessening the degree of sickness in afflicted persons.

2. Demulcent property of herbs in Ayurvedic kadha

A mucilage-rich herb known as a demulcent helps calm and shield irritated or inflamed interior tissue. mucilaginous herbs that coat mucous membranes in a "gooey" and provide comfort and protection[7]. Different levels of complex mucilage components are present in these plants. These gooey, slimy substances have an obvious, immediate effect that calms and lessens inflammation in the lining of the intestines. Demulcent provide a semi-permeable layer over mucous membranes which increase drug retentionin the membrane and also helps to increase the absorption time in systemic circulation because we know that increasing the contact time increase the absorption of drug in our body also help to reduce transit time and increasing water resorption from the colon. high molecular weight substance in water solution known as a demulcent covers the skin surface to soothe itching and preserve the underlying cells[12], [13].

3. Immune building and anti-viral properties of herbs

As immune boosters, a variety of therapeutic plants and herbs are recognized, including Ginger(*Zingiber officinale*), Cinnamon (*Cinnamomum verum*), Tulsi (*Ocimum sanctum*), Babool-gum (*Acacia arabica*), Ashwagandha (*Withania somnifera*), Mulethi (*Glycyrrhiza glabra*), Piper nigrum (*Black pepper*), Bhumi Amla (*Phyllanthus niruri*), Pot marigold (*Calendula officinalis*), etc. This article mainly discussed and highlighted the antiviral and immune-building potential of common herbs used in kadha formulation.

3.1. Ginger (*Zingiber officinale*)

Ginger is a common and mostly used herb for ayurvedic treatment in several countries. Ginger has been obtained from the rhizomes of *Zingiber officinalis* belonging to the *Zingiberaceae* family[14]. Zinger rhizomes have been used as a medication for a long time for respiratory care. This is cultivated in various countries and is mostly used in India.

Gingeralso called Sunthi in Ayurveda, and it is described in ancient texts like Charaka, Sushruta, Vagbhatta, and Chakra-dutta. is a well-known herbal medication in the traditional Unani medical system.

The bioactive substances found in ginger, Alkaloids, steroids, and phenolic compounds are common and have medicinal uses. The primary fragrant compound of the rhizome is zingiberol, which also goes by the names shogoals, paradol, and zingerone. Ginger includes several sub-components besides the primary bioactive compounds. Ginger has the phenolic as well as terpene compound group. The phenolic compounds of ginger are Gingerols, Paradols, and Shogaols. The major compound was α-zingiberene at 15.20% and β-phellandrene present at 13.51%It also contains 1 to2 % volatile oil, Resorcinol present in ginger is 5 to 8%Also, the content is 34.13% crude protein, Fiber present in 4.02% and 1.063% vitamin C also present in ginger rhizomes

Ginger has the property of expectorant which helps to loosen the mucus and phlegm in the respiratory tract. It also provides relief from congestion in the common cold, respiratory infection, and flu. has antioxidant properties to boost immunity and help protect against oxidative damage from respiratory symptoms. This antioxidant activity helps to contribute to overall respiratory health and boosts the immune system. Ginger contains a phenolic compound called gingerols which acts as an anti-inflammatory agent in respiratory conditions like bronchitis[15]. It also helps to promote better respiratory functions. also used as a cough suppressant effect which can help to reduce a dry cough. has a spicy flavour and a warming effect to treat sour throat[16]. Numerous studies have demonstrated that ginger and its bioactive components effectively combat viruses such as the human respiratory syncytial virus, influenza, herpes simplex, and SARS-CoV-2[14]

3.2. Cinnamon (*Cinnamomum verum*)

Cinnamon is also known as kalmi-dalchini and cinnamon bark. Cinnamon is obtained from the dried bark of *Cinnamomum verum*. It belongs to the *Lauraceae* family. This tree has been grown in the topical area considered to be native to Sri Lanka and India. The main cinnamon is known by the name Sri Lankan cinnamon[17].

Mainly cinnamon bark is used. The volatile oil is from 0.5 to 1.0 percent in the bark. includes calcium oxide, starch, mucilage, tannins, and mucilage. The cinnamon oil content is 60 to 70% cinnamaldehyde, 7 to 10% eugenol, and benzaldehyde. Terpenes are also present in the cinnamon bark like pinene, cymene, caryophyllene, etc.

Cinnamon is used as a carminative, demulcent effect because of mucilage content and stomachic. also used for antiseptic. Eugenol shows an anti-bacterial property. Helps as a mild astringent. which serves as an antimicrobial. Cinnamon has been found to possess qualities that include antibacterial, antiviral, antifungal, antioxidant, antidiabetic, anticancer, gastroprotective, and immunomodulatory. The research found that cinnamon's low dose (10 mg/kg) merely raised serum immunoglobulin levels, whereas a greater dose (100 mg/kg)[18], [19]. markedly enhanced the phagocytic index, serum immunoglobulin levels, and antibodies. As a result, the greater dosage boosts both humoral and cell-mediated immunity. Cinnamon also helps as a flavouring agent in the Ayurvedic formulation. Commercially it helps in the preparation of kadha for boosting immunity and helps in the candy preparation process[20].

3.3. Tulsi (*Ocimum sanctum*)

Tulsi is considered the 'Mother of Herbs' and a symbol of celibacy. It is called Holy Basil or Sacred Basil because it's considered auspicious and has wide therapeutic usage. The plant Tulsi, commonly known as holy basil (*Ocimum sanctum*), has long been employed in ancient medical practices like Ayurveda. It is well-regarded for its possible health advantages, especially its use in the treatment of respiratory conditions.

Ocimum sanctum Linn was the biological source of the Tulsi. a member of the *Labiatae* family is the source of both fresh and dried Tulsi leaves[21]. This is the multi-brunches plant found everywhere in India. This plant is mainly cultivated in gardens and is also found in Nare by temples in India. It is also cultivated commercially to obtain volatile oil from Tulsi.

The volatile oil content in Tulsi (0.1 to 0.9%) depends upon the geographical area in which the plant is growing and its cultivation season. Steam distillation is used for the volatile oil collection. The main chemical constituent present is eugenol, which is present in approximately 70%, and 20% methyl eugenol is present in the Tulsi plant. Carvacrol is present at approximately 3%[22].

Additionally found is caryophyllin. Seeds contain fixed oil, which is ideally suited for dyeing. Alkaloids, glycosides, saponin, tannins, maleic, citric, and tartaric acids, as well as a considerable amount of vitamin C, are also rumoured to be present in the plant.

The anti-inflammatory ingredients in Tulsi include Eugenol, Rosmarinus acid, and Oleanolic acid. These substances may lessen respiratory system inflammation, alleviating allergies, asthma, and bronchitis symptoms. the expectorant qualities of Tulsi, it can aid in facilitating the ejection of mucus from the respiratory system. Additionally, it could function naturally as a decongestant, easing nasal and pulmonary congestion.

Tulsi has antimicrobial qualities that include protection against fungi, viruses, and bacteria. It may lessen the intensity and duration of diseases, including the common cold, the flu, and respiratory tract infections, by assisting in the battle against pathogen-caused respiratory infections.

Antioxidants including vitamin C, vitamin A, and polyphenols are abundant in Tulsi. These substances assist in preventing oxidative stress and damage brought on by free radicals, which may contribute to respiratory illnesses. Tulsi may contribute to the maintenance of general respiratory health by lowering oxidative stress. Also helps boost immunity because it has anti-oxidant properties Tulsi contains immunomodulatory properties, which means it can assist in controlling the immune system. For respiratory disorders involving an overactive immune system,

including allergic asthma, this characteristic could be helpful. Tulsi may be able to control how the immune system reacts and lessen inflammation brought on by such diseases[23].

3.4. Babool-gum (*Acacia arabica*)

Acacia arabica is also called gum arabica and Indian gum. It was obtained from the gummy exudation from the stem and branches of *Acacia arabica* from the *Leguminosae* family.

Acacia arabica plant was found in India, Sri Lanka, Africa, and Sudan. Currently, worldwide 85% of Acacia arabica is supplied by Sudan.

Acacia arabica mainly contains Arabin. Arabin was a mixture compound of potassium, magnesium, and calcium salt of Arabic acid. It also contains L-arabinose and L-rhamnose by the hydrolysis of Arabic acid[24]. Acacia arabica is used as a demulcent effect. Also, effect as suspending agent. Effect in Soothes coughs and sore throat[25].

3.5. Ashwagandha (*Withania somnifera*)

Ashwagandha also called Withania root and winter cherry. It was obtained from the dried roots. It is a member of the *Solanaceae* family and the *Withania somnifera* genus[26]. This plant was grown in subtropical and dry parts of India. This plant is also found in Egypt, Morocco, Pakistan, Afghanistan, and South Africa.

Ashwagandha contains mainly steroidal and alkaloids. Withanine was the major compound in Ashwagandha. The other alkaloidal compounds found in Ashwagandha are Somniferine, Withananine, tropine, pseudo-tropine, etc. Ashwagandha leaves contain steroidal lactone rings called withanolides[27].

Ashwagandha is used as an immunomodulatory agent to improve the immune system. Also helps to stabilize our mood. Ashwagandha has an action on the respiratory system along with help in bradycardia. Ashwagandha leaf extract shows the action on anti-viral properties in Staphylococcus aureus[28]

3.6. Glycyrrhiza (*Glycyrrhiza glabra*)

Glycyrrhiza also called Mulethi and liquorice root. Glycyrrhiza was obtained from the dried roots of *Glycyrrhiza glabra* belongs to the family of *Leguminosae*[29]. Glycyrrhiza glabra is cultivated mostly in Spain on a large scale. also cultivated in Russia and Iran.

The major chemical constituent present in Glycyrrhiza glabra is glycyrrhizin it is a triterpenoid saponin. Different species of liquorice contain different percentages of glycyrrhizin. Liquorice also contains Glycyrrhetinic acid and Carbenoxolone[30].

Liquorice is used as an expectorant and demulcent property in respiratory care treatment. Liquorice is anti-inflammatory to treatcolds and coughs. Glycyrrhiza glabra shows the boosting of immunity in the human body. It's also used as a flavouring agent. It also has a demulcent property[31]–[33].

3.7. Black pepper (*Piper nigrum*)

Black pepper is also called pepper and maricha. Black pepper is a member of the *Piperaceae* family and was first discovered in the unripe fruit of *Piper nigrum*. Black pepper was mostly cultivated in South India. Alao is cultivated in Indonesia, Brazil, Malaysia, and Sri Lanka.

Black pepper contains alkaloid piperine 5 to 9%, and 1 to 2% of volatile oil present in the black pepper. 6% resin is also present. The major chemical constituent present in black pepper was piperin and starch[34].

Black pepper is used as a stomachic and carminative property. used to boost the immune system and act as an anti-viral property. Check the effectiveness of *Piper nigrumin* chloroform and methanolic extracts as antiviral agents against the human parainfluenza virus in human cell lines and vesicular stomatitis virus (an enteric virus). They discovered that the presence of a greater amount of alkaloids in the chloroform extract increased the anti-viral action of Piper nigrum. Comparative to the commercial antiviral Ribavirin, molecular docking research demonstrated that piperine might block the methyltransferase of the Dengue virus and the VP35 interferon inhibitory domain of the Ebola virus. According to a docking-based study, black pepper's bioactive components, including piperdardine and piperanine, are significantly active against COVID-19 and can be utilized to treat the disease[35]–[37].

3.8. Bhumi Amla (*Phyllanthus niruri*)

Bhumi Amla was a medicinal herb known science the period of the Charka Samhita. Bhumi Amla is Also called Phyllanthus. Bhumi Amla was found in the aerial parts of the plant *Phyllanthus niruri* and belongs to the family of *Euphorbiaceae*[38], [39].

This plant was grown throughout India. Mainly in Maharashtra, Karnataka, Orissa, Punjab, and Uttar Pradesh.

The major chemical constituent present in Bhumi Amla was Phyllanthin, Niruriside, and Nerurin. This herb is mainly used for the treatment of viral diseases. Also, used in the relief of inflammation[40], [41].

3.9. Marshmallows (*Malva sylvestris*)

Malva sylvestris, a member of the *Malvaceae* family, is another herbal remedy plant. This plant is indigenous to Asia, Europe, and North America[42]. This plant extract has a high phenolic content and strong antibacterial qualities. However, the usage of mallow is not well supported by clinical research. This plant has been shown to have antibacterial properties against several Gram-positive and Gram-negative microorganisms.

mallow extract has been utilized for medical purposes in the past ten years. Spasmolytic, lenitive, laxative, diuretic, demulcent, anti-diarrheal, bronchodilator, expectorant, and antitussive properties of mallow have been demonstrated. It has strong antibacterial and antioxidant properties. Mallow's chemical components, including -carotene, flavonoids, vitamin E, polyphenols, and vitamin C, have antibacterial and antioxidant properties. The primary component of mallow's superior antioxidant and antibacterial properties is polyphenols. These phytochemicals' antioxidant properties enable Mallow to scavenge a variety of free radicals, protecting biological components from oxidation[43]–[45].

Marshmallow root extract was an herbal demulcent traditionally used for symptomatic treatment of oral or pharyngeal irritation and associated dry cough. According to Sultana et al., the leaves and roots of the herb have been used since ancient times to treat sore throats and coughs. “The marshmallow herb contains mucilage, which coats the throat and soothes irritation”[46].

3.10. Pot Marigold (*Calendula officinalis*)

Pot Marigold was the flowering plant of *Calendula officinalis* and belongs to the family of *Asteraceae*.[47] Pot marigold is found in India, south Europe, and north Europe, basically, it grow in warm temperature zone. Pot Marigolds contain carotenoids, flavonoids, saponin, lipids, ester, and tannin are present[48].

Marigold flower constituents have anti-inflammatory, anti-tumor, and cytotoxic properties. Pot marigolds also have the demulcent property as a soothing agent. The blooms are used as a medicinal herb and as a dye for clothing, food, and cosmetics. Also used as an antioxidant and anti-inflammatory property[49]–[51].

4. Sucralose

Sucralose is a calorie-free sweetener that can be used to reduce added sugar consumption while satisfying the need for something sweet. While some of the sweeteners in this category are calorie-free (like sucralose, monk fruit sweeteners, and stevia sweeteners) and others are low-calorie (like aspartame), they are all generally referred to as sugar substitutes, high-intensity sweeteners, nonnutritive sweeteners, or low-calorie sweeteners. Sucralose is a very contentious artificial sweetener, much like other ones. While some assert that it is completely safe[52], [53].

Sucralose has been found to be safe in more than 100 safety trials that span more than 20 years of study. The FDA authorized its use as a sweetener in 15 certain food categories in 1998. Sucralose was given "general-purpose sweetener" status by the FDA in 1999, allowing it to be used in any kind of food or beverage. Leading international health organizations have determined that sucralose is safe for use as intended, including the Joint FAO/WHO Expert Committee on Food Additives (JECFA) and the European Food Safety Authority (EFSA)[54], [55].

Sucralose is safe for consumption by both adults and children when used within the ADI, according to organizations like the FDA and JECFA that oversee food safety and health. It is not anticipated that children's metabolism of sucrose will differ from that of adults. According to the EFSA, FDA, and JECFA, consuming low-calorie sweeteners within their respective ADIs is safe for women who are expecting or nursing. Sucralose intake has no known side effects, and research has proven that it has no negative effects on fetuses or pregnant or nursing women[56], [57].

5. Benefits of Kadha

Long-term immunity booster - Vitamins and antioxidants included in Kadha aid in boosting immunity by battling free radicals, antioxidants are believed to defend against infections.

Bodily detoxification - An antioxidant property present in Kadha, detoxifying the body is a great use of it. Antioxidants like ginger, black pepper, and turmeric help the body stay clean and healthy.

Aids in respiratory issues - Kadhas are excellent for cough and cold. Tulsi and lemongrass are effective in easing the symptoms of respiratory conditions including asthma.

Facilitates Better digestion - After meals, drinking Kadha can assist with symptoms including nausea, vomiting, and indigestion. It promotes healthy digestion and metabolism.

Reduce inflammation and arthritis-related problem - The combination of ginger, turmeric, and eucalyptus in Kadha is excellent for alleviating joint and muscular pain[58], [59]

Conclusion

The Kadha mentioned in this article was clinically proven to have anti-bacterial, and anti-inflammatory properties. Also scientifically proven that it has one of the immune-boosting properties. Since ancient times, people in India have used spices and herbs for their flavour, antiviral, antibacterial, antioxidant, and immunity-boosting characteristics. We conclude that the herb used for the preparation of Kadha shows a significant Demulcent action in antiviral infection. Using herbs to prepare Kadha has a significant role in managing respiratory conditions. The natural ingredients used in preparing Kadhas are safe for kids and adults. They also have the Demulcent property to retain the phytochemical constituent in the mucus membrane and help to increase the retention time of the Drug. Kadha is also an alternative treatment for boosting immunity and anti-inflammatory action in respiratory conditions.

Bibo Health by Hilt Brands India Pvt. Ltd. Has a novel and innovative Demulcent base KADHA (BIBO KADHA SHOTS) which helps to boost your immunity, increase the drug retention time in the mucus membrane, provides anti-viral action, and has antioxidant properties.

Reference

[1] D. K. Maurya and D. Sharma, "Evaluation of traditional ayurvedic Kadha for prevention and management of the novel Coronavirus (SARS-CoV-2) using in silico approach," *J Biomol Struct Dyn*, vol. 40, no. 9, p. 1, 2020, doi: 10.1080/07391102.2020.1852119.

[2] L. Chen *et al.*, "Inflammatory responses and inflammation-associated diseases in organs," *Oncotarget*, vol. 9, no. 6, pp. 7204–7218, 2017, doi: 10.18632/ONCOTARGET.23208.

[3] C. I. Paules, H. D. Marston, and A. S. Fauci, "Coronavirus Infections-More Than Just the Common Cold," *JAMA*, vol. 323, no. 8, pp. 707–708, Feb. 2020, doi: 10.1001/JAMA.2020.0757.

[4] Y. Zhou, Y. Hou, J. Shen, Y. Huang, W. Martin, and F. Cheng, "Network-based drug repurposing for novel coronavirus 2019-nCoV/SARS-CoV-2," *Cell Discov*, vol. 6, no. 1, Dec. 2020, doi: 10.1038/S41421-020-0153-3.

[5] L. M. Alleva, C. Cai, and I. A. Clark, "Using Complementary and Alternative Medicines to Target the Host Response during Severe Influenza," *Evid Based Complement Alternat Med*, vol. 7, no. 4, p. 501, Dec. 2010, doi: 10.1093/ECAM/NEP152.

[6] C. Baudouin *et al.*, "Randomized, phase III study comparing osmoprotective carboxymethylcellulose with sodium hyaluronate in dry eye disease," *Eur J Ophthalmol*, vol. 22, no. 5, pp. 751–761, Sep. 2012, doi: 10.5301/EJO.5000117.

[7] M. Safarzadeh, P. Azizzadeh, and P. Akbarshahi, "Comparison of the clinical efficacy of preserved and preservative-free hydroxypropyl methylcellulose-dextran-containing eyedrops," *J Optom*, vol. 10, no. 4, pp. 258–264, Oct. 2017, doi: 10.1016/J.OPTOM.2016.11.002.

[8] "(PDF) Unique methods of Swarasa (Juice) extraction in Ayurveda." https://www.researchgate.net/publication/317617676_Unique_methods_of_Swarasa_Juice_extraction_in_Ayurveda (accessed Jul. 21, 2023).

[9] P. Chowdhury, "In silico investigation of phytoconstituents from Indian medicinal herb ' Tinospora cordifolia (giloy)' against SARS-CoV-2 (COVID-19) by molecular dynamics approach," *J Biomol Struct Dyn*, vol. 39, no. 17, pp. 6792–6809, 2021, doi: 10.1080/07391102.2020.1803968.

[10] D. Sen, P. Debnath, B. Debnath, S. Bhaumik, and S. Debnath, "Identification of potential inhibitors of SARS-CoV-2 main protease and spike receptor from 10 important spices through structure-based virtual screening and molecular dynamic study," *J Biomol Struct Dyn*, vol. 40, no. 2, pp. 941–962, 2022, doi: 10.1080/07391102.2020.1819883.

[11] P. Shree *et al.*, "Targeting COVID-19 (SARS-CoV-2) main protease through active phytochemicals of ayurvedic medicinal plants - Withania somnifera (Ashwagandha), Tinospora cordifolia (Giloy) and Ocimum sanctum (Tulsi) - a molecular docking study," *J Biomol Struct Dyn*, vol. 40, no. 1, pp. 190–203, 2022, doi: 10.1080/07391102.2020.1810778.

[12] C. S. Hoffman, "Clinical aids.," *J Clin Orthod*, vol. 6, no. 2, p. 107, Feb. 1972, doi: 10.1016/B978-0-7020-5109-8.00004-3.

[13] J. Weng, M. K. Fink, and A. Sharma, "A Critical Appraisal of the Physicochemical Properties and Biological Effects of Artificial Tear Ingredients and Formulations," *Int J Mol Sci*, vol. 24, no. 3, Feb. 2023, doi: 10.3390/IJMS24032758.

[14] Q. Q. Mao *et al.*, "Bioactive Compounds and Bioactivities of Ginger (Zingiber officinale Roscoe)," *Foods*, vol. 8, no. 6, Jun. 2019, doi: 10.3390/FOODS8060185.

[15] P. Ballester, B. Cerdá, R. Arcusa, J. Marhuenda, K. Yamedjeu, and P. Zafrilla, "Effect of Ginger on Inflammatory Diseases," *Molecules*, vol. 27, no. 21, Nov. 2022, doi: 10.3390/MOLECULES27217223.

[16] L. P. Nan *et al.*, "6-gingerol protects nucleus pulposus-derived mesenchymal stem cells from oxidative injury by activating autophagy," *World J Stem Cells*, vol. 12, no. 12, p. 1603, Dec. 2020, doi: 10.4252/WJSC.V12.I12.1603.

[17] T. Bandara, I. Uluwaduge, and E. R. Jansz, "Bioactivity of cinnamon with special emphasis on diabetes mellitus: a review," *Int J Food Sci Nutr*, vol. 63, no. 3, pp. 380–386, May 2012, doi: 10.3109/09637486.2011.627849.

[18] Y. Shen, L. N. Jia, N. Honma, T. Hosono, T. Ariga, and T. Seki, "Beneficial effects of cinnamon on the metabolic syndrome, inflammation, and pain, and mechanisms underlying these effects - a review," *J Tradit Complement Med*, vol. 2, no. 1, pp. 27–32, 2012, doi: 10.1016/S2225-4110(16)30067-0.

[19] S. Pagliari *et al.*, "Antioxidant and Anti-Inflammatory Effect of Cinnamon (Cinnamomum verum J. Presl) Bark Extract after In Vitro Digestion Simulation," *Foods*, vol. 12, no. 3, Feb. 2023, doi: 10.3390/FOODS12030452.

[20] S. R. Niphade, M. Asad, G. K. Chandrakala, E. Toppo, and P. Deshmukh, "Immunomodulatory activity of Cinnamomum zeylanicum bark," *Pharm Biol*, vol. 47, no. 12, pp. 1168–1173, Dec. 2009, doi: 10.3109/13880200903019234.

[21] M. M. Cohen, "Tulsi - Ocimum sanctum: A herb for all reasons," *J Ayurveda Integr Med*, vol. 5, no. 4, p. 251, Oct. 2014, doi: 10.4103/0975-9476.146554.

[22] M. J. Saharkhiz, A. A. Kamyab, N. K. Kazerani, K. Zomorodian, K. Pakshir, and M. J. Rahimi, "Chemical Compositions and Antimicrobial Activities of Ocimum sanctum L. Essential Oils at Different Harvest Stages," *Jundishapur J Microbiol*, vol. 8, no. 1, p. 13720, Jan. 2015, doi: 10.5812/JJM.13720.

[23] P. Pattanayak, P. Behera, D. Das, and S. Panda, "Ocimum sanctum Linn. A reservoir plant for therapeutic applications: An overview," *Pharmacogn Rev*, vol. 4, no. 7, pp. 95–105, Jan. 2010, doi: 10.4103/0973-7847.65323.

[24] S. Afzal *et al.*, "Use of Medicinal Plants for Respiratory Diseases in Bahawalpur, Pakistan," *Biomed Res Int*, vol. 2021, 2021, doi: 10.1155/2021/5578914.

[25] Jyoti and V. Garg, "Acacia catechu Willd. and Acacia arabica Willd. decrease the extent of anxiety behavior by reducing oxidative stress and moderating neurochemicals," *J Ethnopharmacol*, vol. 312, Aug. 2023, doi: 10.1016/J.JEP.2023.116496.

[26] D. S. Mandlik and A. G. Namdeo, "Pharmacological evaluation of Ashwagandha highlighting its healthcare claims, safety, and toxicity aspects," *J Diet Suppl*, vol. 18, no. 2, pp. 183–226, 2021, doi: 10.1080/19390211.2020.1741484.

[27] N. J. Dar, A. Hamid, and M. Ahmad, "Pharmacologic overview of Withania somnifera, the Indian Ginseng," *Cellular and Molecular Life Sciences*, vol. 72, no. 23, pp. 4445–4460, Aug. 2015, doi: 10.1007/s00018-015-2012-1.

[28] P. K. Mukherjee, S. Banerjee, S. Biswas, B. Das, A. Kar, and C. K. Katiyar, "Withania somnifera (L.) Dunal - Modern perspectives of an ancient Rasayana from Ayurveda," *J Ethnopharmacol*, vol. 264, Jan. 2021, doi: 10.1016/j.jep.2020.113157.

[29] G. Pastorino, L. Cornara, S. Soares, F. Rodrigues, and M. B. P. P. Oliveira, "Liquorice (Glycyrrhiza glabra): A phytochemical and pharmacological review," *Phytotherapy Research*, vol. 32, no. 12, pp. 2323–2339, Dec. 2018, doi: 10.1002/ptr.6178.

[30] G. E. S. Batiha, A. M. Beshbishy, A. El-Mleeh, M. M. Abdel-Daim, and H. P. Devkota, "Traditional uses, bioactive chemical constituents, and pharmacological and toxicological activities of Glycyrrhiza glabra L. (fabaceae)," *Biomolecules*, vol. 10, no. 3, Mar. 2020, doi: 10.3390/biom10030352.

[31] C. D. S. Leite, G. A. Bonafé, J. C. Santos, C. A. R. Martinez, M. M. Ortega, and M. L. Ribeiro, "The Anti-Inflammatory Properties of Licorice (Glycyrrhiza glabra)-Derived Compounds in Intestinal Disorders," *Int J Mol Sci*, vol. 23, no. 8, Apr. 2022, doi: 10.3390/IJMS23084121.

[32] M. H. Kang *et al.*, "Antioxidant and Anti-Melanogenic Activities of Heat-Treated Licorice (Wongam, Glycyrrhiza glabra × G. uralensis) Extract," *Curr Issues Mol Biol*, vol. 43, no. 2, pp. 1171–1187, Sep. 2021, doi: 10.3390/CIMB43020083.

[33] S. Wahab, I. Ahmad, S. Irfan, A. Siddiqua, S. Usmani, and Md. P. Ahmad, "Pharmacological Efficacy and Safety of Glycyrrhiza glabra in the Treatment of Respiratory Tract Infections," *Mini Rev Med Chem*, vol. 22, no. 11, pp. 1476–1494, Sep. 2022, doi: 10.2174/1389557521666210927153001.

[34] A. Jafri *et al.*, "Induction of apoptosis by piperine in human cervical adenocarcinoma via ROS mediated mitochondrial pathway and caspase-3 activation," *EXCLI J*, vol. 18, p. 154, 2019, doi: 10.17179/EXCLI2018-1928.

[35] P. N. Ravindran, "Black pepper : piper nigrum," 2000.

[36] K. Rajagopal, G. Byran, S. Jupudi, and R. Vadivelan, "Activity of phytochemical constituents of black pepper, ginger, and garlic against coronavirus (COVID-19): An in silico approach," *International Journal of Health & Allied Sciences*, vol. 9, no. 5, p. 43, 2020, doi: 10.4103/IJHAS.IJHAS_55_20.

[37] A. Nag and R. R. Chowdhury, "Piperine, an alkaloid of black pepper seeds can effectively inhibit the antiviral enzymes of Dengue and Ebola viruses, an in silico molecular docking study," *Virusdisease*, vol. 31, no. 3, pp. 308–315, Sep. 2020, doi: 10.1007/S13337-020-00619-6.

[38] N. Kaur, B. Kaur, and G. Sirhindi, "Phytochemistry and Pharmacology of Phyllanthus niruri L.: A Review," *Phytotherapy Research*, vol. 31, no. 7, pp. 980–1004, Jul. 2017, doi: 10.1002/ptr.5825.

[39] G. Bagalkotkar, S. R. Sagineedu, M. S. Saad, and J. Stanslas, " Phytochemicals from Phyllanthus niruri Linn. and their pharmacological properties: a review ," *Journal of Pharmacy and Pharmacology*, vol. 58, no. 12, pp. 1559–1570, Feb. 2010, doi: 10.1211/jpp.58.12.0001.

[40] E. Colpo *et al.*, "Antioxidant effects of Phyllanthus niruri tea on healthy subjects," *Asian Pac J Trop Med*, vol. 7, no. 2, pp. 113–118, 2014, doi: 10.1016/S1995-7645(14)60005-5.

[41] R. Bhattacharjee and P. C. Sil, "The protein fraction of Phyllanthus niruri plays a protective role against acetaminophen induced hepatic disorder via its antioxidant properties," *Phytotherapy Research*, vol. 20, no. 7, pp. 595–601, Jul. 2006, doi: 10.1002/ptr.1933.

[42] "(PDF) New steroidal lactones and homomonoterpenic glucoside from fruits of Malva sylvestris L." https://www.researchgate.net/publication/51198260_New_steroidal_lactones_and_homomonoterpenic_glucoside_from_fruits_of_Malva_sylvestris_L (accessed Jul. 24, 2023).

[43] H. Bouriche, H. Meziti, A. Senator, and J. Arnhold, "Anti-inflammatory, free radical-scavenging, and metal-chelating activities of Malva parviflora," *Pharm Biol*, vol. 49, no. 9, pp. 942–946, Sep. 2011, doi: 10.3109/13880209.2011.558102.

[44] "(PDF) Antioxidant properties and some phytochemical components of the edible medicinal Malva sylvestris L." https://www.researchgate.net/publication/331286748_Antioxidant_properties_and_some_phytochemical_components_of_the_edible_medicinal_Malva_sylvestris_L (accessed Jul. 24, 2023).

[45] S. Delfine *et al.*, "Variation of Malva sylvestris essential oil yield, chemical composition and biological activity in response to different environments across Southern Italy," *Ind Crops Prod*, vol. 98, pp. 29–37, Apr. 2017, doi: 10.1016/J.INDCROP.2017.01.016.

[46] "(PDF) Antibacterial Activity in Herbal Products Used in Pakistan." https://www.researchgate.net/publication/240614693_Antibacterial_Activity_in_Herbal_Products_Used_in_Pakistan (accessed Jul. 24, 2023).

[47] J. M. Bokelmann, "Calendula (Calendula officinalis)," *Medicinal Herbs in Primary Care*, pp. 263–267, 2022, doi: 10.1016/B978-0-323-84676-9.00034-9.

[48] V. Tavallali, N. Alhavi, H. Gholami, and F. Mirazimi Abarghuei, "Developmental and phytochemical changes in pot marigold (Calendula officinalis L.) using exogenous application of polyamines," *Plant Physiol Biochem*, vol. 183, pp. 128–137, Jul. 2022, doi: 10.1016/J.PLAPHY.2022.05.011.

[49] A. Varshney, P. Dahiya, and S. Mohan, "Growth, biochemical, and antioxidant response of pot marigold (Calendula officinalis L.) grown in fly ash amended soil," *Int J Phytoremediation*, vol. 25, no. 1, pp. 115–124, 2023, doi: 10.1080/15226514.2022.2063794.

[50] S. Gharouni-Kardani, M. Ashnayi, and A. Bertaccini, "Detection of 16SrVI and 16SrIX phytoplasma groups in pot marigold and tickseed plants in northeastern Iran," *Folia Microbiol (Praha)*, vol. 65, no. 4, pp. 697–703, Aug. 2020, doi: 10.1007/S12223-020-00772-X.

[51] H. Fatma and H. R. Siddique, "Herbal medicine to cure male reproductive dysfunction," *Herbal Medicines: A Boon for Healthy Human Life*, pp. 409–435, Jan. 2022, doi: 10.1016/B978-0-323-90572-5.00023-8.

[52] B. A. Magnuson, A. Roberts, and E. R. Nestmann, "Critical review of the current literature on the safety of sucralose," *Food Chem Toxicol*, vol. 106, no. Pt A, pp. 324–355, Aug. 2017, doi: 10.1016/J.FCT.2017.05.047.

[53] O. A. A. AlDeeb, H. Mahgoub, and N. H. Foda, "Sucralose," *Profiles Drug Subst Excip Relat Methodol*, vol. 38, pp. 423–462, 2013, doi: 10.1016/B978-0-12-407691-4.00010-1.

[54] V. L. Grotz and I. C. Munro, "An overview of the safety of sucralose," *Regul Toxicol Pharmacol*, vol. 55, no. 1, pp. 1–5, Oct. 2009, doi: 10.1016/J.YRTPH.2009.05.011.

[55] W. Health. Organization, "Evaluation of Certain Food Contaminants : Sixty-fourth Report of the Joint FAO/WHO Expert Committee on Food Additives.," p. 109, 2006.

[56] WHO and FAO, "Principles and Methods for the Risk Assessment of Chemicals in Food," *International Journal of Environmental Studies*, p. 187, 2011, Accessed: Aug. 16, 2023. [Online]. Available: http://www.tandfonline.com/doi/full/10.1080/00207233.2010.549617

[57] "CFR - Code of Federal Regulations Title 21".

[58] N. A. Singh, P. Kumar, Jyoti, and N. Kumar, "Spices and herbs: Potential antiviral preventives and immunity boosters during COVID-19," *Phytother Res*, vol. 35, no. 5, pp. 2745–2757, May 2021, doi: 10.1002/PTR.7019.

[59] D. K. Maurya and D. Sharma, "Evaluation of traditional ayurvedic Kadha for prevention and management of the novel Coronavirus (SARS-CoV-2) using in silico approach," *J Biomol Struct Dyn*, vol. 40, no. 9, pp. 3949–3964, 2022, doi: 10.1080/07391102.2020.1852119.