

Honey Turmeric Latte- An Immunity Boosting Product in Covid-19 Times: A Review

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Abstract:

Honey Turmeric latte is an attempt to infuse coffee with traditional spices and condiments that have medicinal benefits and improves immunity during Covid-19 times. A latte is a coffee drink made with espresso and steamed milk, topped with frothed milk. Turmeric, honey, and black pepper are the main ingredients in the drink. Turmeric includes curcumin, a yellow bioactive component with a wide spectrum of biological actions in the body that are favorable. Natural antibacterial, digestive assistance, hypotensive, and hypocholesteremic actions are only a few of the benefits. Black pepper is an antibacterial and promotes blood circulation, as well as treating rheumatism and cardiovascular problems. Honey is a natural sweetener that has been shown to have a variety of vitamins and minerals that help to treat ulcers, diuretic effects, and antibacterial and skin disorders. With a blend of spices, the turmeric latte made has a rich and distinct flavor.

Keywords--- Honey Turmeric latte, curcumin, bioactive components, biological actions, natural sweetener, diuretic effect.

I. Introduction

Honey Turmeric Latte is a traditional Indian beverage made with steamed milk, honey, turmeric, and sometimes ginger or black paper. Turmeric-fortified milk boosts immunity, relaxes the body for sleep, and keeps the skin healthy. This miracle drink, formerly known as "Haldidoodh" in India, is quickly becoming a favourite beverage among consumers all over the world (Dorothy et al., 2020). Furthermore, the most powerful trend among consumers is their desire for "naturally functional" foods and ingredients, which is seeing rapid growth in terms of different products, such as Honey Turmeric Latte – a drink made with dairy milk and high doses of turmeric (Sahoo et al., 2021). As we all know, Covid-19 wreaked havoc on the world, drastically altering our lives and forcing us to stay indoors. This compelled us to turn to our ancient science in the form of home remedies and natural food supplements, which led us to our kitchens and forced us to follow Ayurveda's 5000-year-old history to boost our immunity, combat diseases, and find ways to live a healthy and safe lifestyle. Honey Turmeric Latte is a mixture of numerous traditional condiments and spices that is proven to boost immunity and general health (Singh et al., 2017). This paper basically reviews, summarizes and provides an updated knowledge on the existing uses of turmeric and honey as therapeutic products; and further provides an updated insight on the usefulness of Honey-Turmeric Latte as a medicinal and immunity boosting product.

II. Medicinal Properties Of Turmeric

Turmeric is an herbaceous evergreen plant within Zingiberaceae (ginger) family. India is the world's top turmeric consumer, producer and exporter. The country consumes the most of its turmeric production (80%) and sells the rest. Turmeric is cultivated in 25 Indian states, with the main producers being Andhra Pradesh, Tamil Nadu, Karnataka, and Odisha. Turmeric has been used for at least 2400 years (Sahoo et al., 2021). Turmeric is a tropical and subtropical plant that grows all over the world (Prasath et al., 2018). Turmeric has a long history of therapeutic uses in the South-east Asia, according to ancient medical treatises and Ayurvedic and Unani traditions.

TABLE 1

Biochemical content in dried turmeric rhizomes

Curcumin	3.1-3.4%
Anthocyanins	18.9-37.0 g/g
Phenols	0.15-0.62%
Tannins	0.32-0.76%
Protein content	3.6-6.8%
Sugars	20.5-43.4%
Oil	3.7-5.3%
Ash	6.9-9.8%
Moisture	90.2-91.3%

Source: Niranjana et al., 2003

To cure the effects of poisoned food, Ayurvedic Compendium, which dates back to 220 B.C., prescribes a turmeric ointment (Pan et al., 2014). Southern Asia, notably India, is where it is most usually found. Turmeric is a plant that is sterile, which means it is not able to produce seeds. The plant can reach a height of 4-6 feet and has dull yellow blooms. Turmeric's rhizome, which is a thick, meaty underground stem surrounded with the roots of ancient leaves, has therapeutic properties (Ugorji et al., 2021). The potential Curcumin's anti-coronavirus therapeutic actions and molecular mechanism are proven (Zahedipour et al., 2021). Curcumin, the bioactive ingredient of *Curcuma longa* (turmeric), has been examined in numerous clinical and experimental researches. Curcumin may have a function to play in the treatment of COVID-19, according to scientific research (Nilashi et al., 2020). As a result, the use of curcumin as a new therapy option in a clinical trial should be examined. Curcumin could be used to treat COVID-19 as a possible treatment (Babaei et al., 2020). Curcumin is hydrophobic and *Curcuma longa* (turmeric) has a polyphenol in its rhizomes. To manufacture the characteristic bright yellow spice, rhizomes are boiled, dried, and powdered. Turmeric powder has a faint aroma that is reminiscent of orange and ginger and has a peppery bitter flavor. It also contributes to the vivid yellow colour of ballpark mustard. Curcumin is a powerful anticarcinogenic agent. Induction of apoptosis is one of the processes involved in its anticarcinogenic actions (Fabianowska et al., 2021). Turmeric has been used in ancient medications for thousands of years, with diverse biological applications. Researchers are interested in using natural products to treat a variety of disorders. Although some research has been done on potential pharmaceutical applications, there hasn't been much research done on medication development as of yet.

Turmeric has 69.4 percent carbohydrate, 6.3 percent protein, 5.1 percent fat, 3.5 percent mineral content and of 13.1 percent moisture (Thangavel et al., 2019). The essential oil obtained by steam distillation contains sesquiterpenes (52%), zingiberene (24%), a-phellandrene (2%), sabinene (0.6%), cineol (1.5%), and borneol (5.8 percent). Curcumin (3–4%) is responsible for the yellow colour and is made up of curcumin I (93%), curcumin II (7%), and curcumin III (3%) (Paultre et al., 2021). Turmeric has also yielded Demethoxy and bisdemethoxy compounds of curcumin. For the evaluation of curcumin in numerous sold spices samples of turmeric powder, an efficient, sensitive, and exact high-performance thin-layer chromatography (HPTLC) approach was devised and compared to an in-house turmeric powder (Ali et al., 2021). Turmeric powder had 7.88 percent curcumin, according to a chemical study (Bukhari et al., 2014). Turmeric can also aid with digestive problems, liver illness, cancer, and atherosclerosis, as well as osteoarthritis, women's menstruation problems, bacterial infections, and eye problems. Turmeric soothes the mucous membranes that line the throat, lungs, stomach, and intestine. Turmeric has a number of gastrointestinal-protective properties.

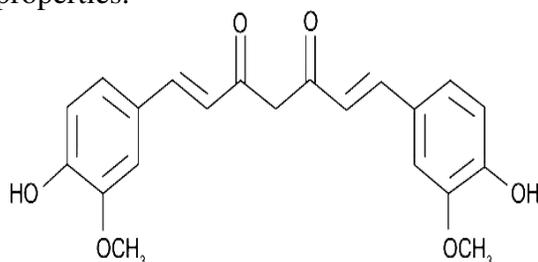


Fig. 1: Chemical structure of curcumin.

Turmeric also prevents ulcer formation in rats exposed to gastrointestinal irritants such as stress, alcohol, indomethacin, reserpine, and pyloric ligation by increasing stomach wall mucus (Yadav et al., 2013). It also reduces intestinal spasm and boosts the release of bicarbonate, gastrin, secretin, and pancreatic enzymes (Rolfe et al., 2020). Curcumin is a nontoxic, high-potential natural antioxidant with a diverse set of biological consequences. Pure curcumin is now available, demonstrating a broad range of biological functions. These findings show that curcumin may be useful in treating COVID-19-induced myalgia and fatigue (Horowitz et al., 2020). Following significant research into it has a huge impact and develops a mode of action which will be easier to build new medications based on this. Curcumin is likely to be used in the upcoming years, as a novel treatment for treating a variety of diseases, illnesses, and oxidative stress (Soleimani et al., 2018).



Fig. 2: Turmeric.



Fig. 3: Honey.

III. Medicinal Properties Of Honey

Honey is an antioxidant-rich food that contains flavonoids and other natural antioxidant compounds, which have anti-cancer and anti-inflammatory characteristics (Nweze et al., 2020). Although honey has been used for medical purposes for a long time, there are few investigations in the cellular level (Eteraf-Oskouei et al., 2013). The honey bee (*Apis mellifera*) is a vital pollinator of both commercial and domestic crops, as well as a source of honey, a high-value nutritional commodity (Saranraj et al., 2018). Water and carbs make up the majority of honey. There is also contribution on its anti-inflammatory action at levels of a number of minerals and vitamins in it. Honey contains a variety of minerals including niacin, calcium, copper, riboflavin, iron, magnesium, potassium, and zinc (Purbafrani et al., 2014).

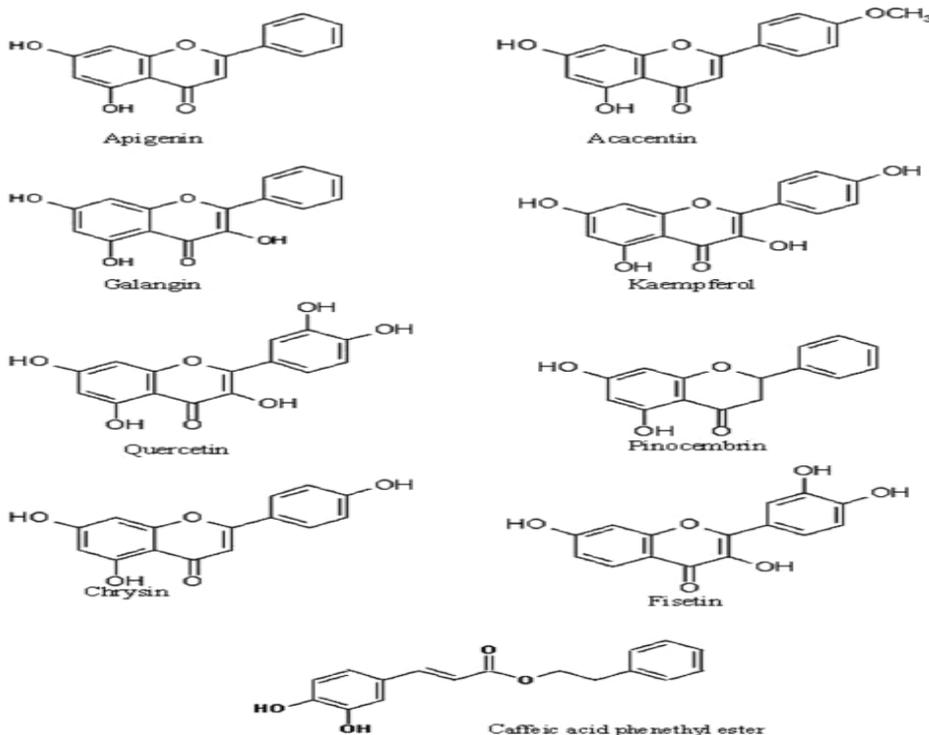


Fig. 4:Chemical structures of the most important flavonoids found in honey.

Honey's sugar content also eliminates the disagreeable odour associated with significant burns and skin ulcers, as the infecting bacteria prefer honey's sugar from serum and dead cells, which are used to make amines and sulphur compounds (Ali et al., 2021). Treatment of wound infections and topical prophylaxis at places where microorganisms may cause infection, such as catheter insertion sites, are two important indications for honey application (Leonard et al., 2020). The turmeric-wild honey combination was effective in mending ulcers and increasing the group's body weight. Although several bioactive chemicals in honey have been demonstrated to have antiviral properties or to boost antiviral immune responses, their mechanisms of action are unknown (Corbera et al., 2020). Honey not only has antioxidative properties, but it also has anti-inflammatory properties. PGE2 levels were found to be lower following honey consumption in previous investigations (Navaei et al., 2021). Honey dressings have been found in numerous studies to help treat these difficult-to-heal wounds. Inflammation, swelling, and discomfort fade quickly, smells fade away, and debridement improves because honey dressings remove dead tissue softly and without hurting regrowing cells. Honey's antiviral qualities must be harnessed if it is to be used as the treatments for current pandemic (Marić et al., 2021). Honey's capacity to act as an antioxidant, as well as its bone-protective properties, has

seen a resurgence of study in recent years. Tualang honey has anti-oxidant and anti-radical properties (Ilia et al., 2021). Clinical and histological studies have revealed an anti-inflammatory effect as well as angiogenesis, granulation tissue creation, and epithelial cell formations are all stimulated. Honey also protects the cardiovascular system, the neurological system, the respiratory system, and the gastrointestinal system by preventing the oxidation of low-density lipoproteins. Honey has been shown to have a positive effect on athletes (El-Senduny et al., 2021). Honey contains phenolic components such as flavonoids and non-flavonoid phenolic compounds (Almasaudi et al., 2021). These substances come from the plants that bees eat and from the bees themselves. Furthermore, some studies suggest that honey can help boost immune system, improve overall wellbeing, lower cholesterol, and prevent colon cancer by increasing the populations of probiotic bacteria in the gut (Wang et al., 2021). Tualang honey has been found to be an excellent source of antioxidants that can scavenge free radicals, resulting in reduced bone resorption activity by osteoclasts and so maintaining bone health. Honey, on the other hand, suppresses the expression of pro-inflammatory cytokines and possesses anti-inflammatory properties. The antioxidant activity, the production of cytokines and matrix metalloproteinase expression, and the epithelial-mesenchymal transition in damaged epidermis are all mechanisms of action conditioned by botanical sources (Corbera et al., 2020). Honey's osmotic pressure is usually high due to its high sugar content, resulting in low water activity (a_w) reported range (Marić et al., 2021), giving osmolarity an important role, when the water activity (a_w) is in the range of 0.94 - 0.99, the antibacterial activity of undiluted honeys is fully suppressed; for example, when the (a_w) is in the range of 0.94 - 0.99, the growth of many bacterial species is completely inhibited (Ilia et al., 2021). Hydrogen peroxide (H_2O_2) was discovered to be a major antibacterial ingredient in honey in the 1960s. Hydrogen peroxide is a prominent ingredient in cleaning goods like bleach, and it is also formed naturally when honey's glucose is oxidized (El-Senduny et al., 2021). Hydrogen peroxide is also a significant contributor to the acidity and sterility of honey. Honey can be used to treat gastrointestinal issues. Honey consumption boosts HIV patients' immunity by increasing lymphocyte proliferation and generally improves their haematological and biochemical state, according to previous studies (Al-Hatamleh et al., 2020). Honey's antiviral potential could also be proved via the nitric oxide (NO) pathway.

TABLE 2

Main mechanism of controlling coronavirus by the main honey components. Source: Abedi et al., 2021

Honey or its main components	Target	Effect
Chrysin	-S protein with ACE2 -3-chymotripsin-like cysteine enzyme	Inhibition of virus entry into host cells and virus replication
Kaempferol	-SARS-CoV-2 3 CL hydrolase -ORF3a of SARS-CoV -PI3K-Akt, JAK/STAT, MAPK signaling pathway -COX-2, TNF, mPGES-I, AKT-I, MAPK I, JUN, IL-6, CASP3, EGFR, ILI B, NOS2, PTGS2, HSP90ABI, mPGES-I, LTA4 H	Inhibition of the virus adsorption, invasion and replication

Quercetin	-SARS-CoV-2 3CL hydrolase -H+-ATPase of the lysosomal membrane -PI3K-Akt and JAK/STAT signaling pathway -PI3K-Akt, JAK/STAT, MAPK signalling pathway -COX-2, TNF, mPGES-I, AKT I, MAPK I, JUN, IL-6, CASP3, EGFR, ILI B, NOS 2, PTGS2, HSP90ABI, mPGES-I, LTA4H	Inhibition of the virus coating, adsorption, invasion and replication
Galangin	3-chymotrypsin like cysteine enzyme	Inhibition of the virus adsorption, invasion and replication
Caffeic acid		Inhibition of the virus adsorption, invasion and replication

Honey has been shown to increase nitric oxide, an important cellular neurotransmitter involved in a variety of physiological functions. Nitric oxide has also been claimed to have therapeutic potential in certain pathological diseases, such as viral infections (Almasaudi et al., 2021). It is used to treat gastritis, as well as stomach and duodenal ulcers. To put it another way, disorders are accompanied by an increase in acidity. Oxidative damage causes bacterial growth suppression and DNA destruction (Fujianti et al., 2021). Honey in combination with other natural ingredients high in antibacterial and immune-boosting properties (such as cinnamon, garlic, and ginger) has shown to be more effective (Dasgupta et al., 2019). Hydrogen peroxide and honey phenolics with pro-oxidant activity are implicated. Although honey's antibacterial properties have been widely explored against a variety of bacteria and fungi, its antiviral properties have yet to be thoroughly investigated so that it can be utilized to prevent and treat viral infections. Despite the fact that a wet environment encourages the growth of infectious germs, honey's antibacterial capabilities prevent infection. As a result, honey is expected to play an important role in bolstering the immune system as a treatment for COVID-19 affected patients, as well as a preventive step for healthy people (Ahmed et al., 2020). Honey, unlike other antiseptics, is not toxic to tissues and actually helps the wound heal by speeding up the creation of new tissue. Honey, which has anti-oxidant and anti-inflammatory properties, has been shown to be useful against viral infectious diseases in a variety of ways. It helps to enhance the immune system while also reducing oxidative damage caused by infections and honey and its primary ingredients have antiviral properties due to their modulatory effects on several molecular targets involved in cellular signalling pathways like death and inflammation (Abedi et al., 2021). Honey containing hesperidin may have the capacity to prevent the virus from adhering to the target cells (Al-Hatamleh et al., 2020). Some organic acids in honey include aspartic acid, butyric acid, citric acid, acetic, formic acid, fumaric acid, galacturonic acid, butyric acid, formic acid, glutamic acid, glyoxylic acid, glutaric acid, 2-hydroxybutyric acid, hydroxyglutaric acid, malonic acid, lactic acid, pyruvic acid, isocitric acid, ketoglutaric acid, malic acid, while the most important acid in honey is gluconic acid (Değirmencioğlu et al., 2020). Using in vitro antimicrobial assays, the majority of research to date has confirmed honey's antibacterial activity against a variety of microbial species, including clinical isolates (Eteraf-Oskouei et al., 2013). Honey has been demonstrated to aid in the healing of partial thickness burn wounds in clinical studies, although its efficiency in the treatment of non-

burn acute and chronic wounds has been questioned (Nweze et al., 2020). Honey combined with cinnamon powder was recorded in Quranic medicine in Pakistan as a treatment for pustules, eczema, ringworm, and a variety of other skin diseases; and indigenous people in Burkina Faso, Africa, have also been reported to use honey as a skin cleansing agent and as a treatment for measles rash (McLoone et al., 2016). Honey is highly regarded by users as an alternative medication for therapeutic purposes, particularly by those with metabolic disorders. Darker honeys have been found to have higher antioxidant content than lighter honeys. Acacia honey had an ORAC value of 3.4 mol TE/g, while Illinois buckwheat honey had an ORAC value of 15 mol TE/g. There was no antioxidant activity in the sugar analogue (Nguyen et al., 2019).

IV. Honey-Turmeric Latte As A Composite Immune Boosting Product:

During Covid-19 times, incorporating 'immunity boosters,' such as established food ingredients/herbs, is recommended in addition to preventive measures. Both PNI modulation and 'meaning response' have been used to predict the potential of curcumin-containing nutraceuticals in COVID-19 (Rolfe et al., 2020). Because the immune system developed antibodies, a person with a robust immune system and good physical health should be able to recover from severe acute respiratory syndrome corona virus infections without difficulties (Kishor et al., 2021). Immunity will be "our saviour" when it comes to fighting the virus. Honey boosts the immune system and aids in the battle against illnesses (Biluca et al., 2020). Honey Turmeric Latte is a composite immune boosting product which proves to be a boon to mankind by having no side effects on the body, while in this present era where synthetic drugs have side effects. The polyherbal method is a popular one that is both compatible with excipients and promising for immunity-building protocols (Floris et al., 2021). Water, minerals like magnesium and zinc, micronutrients, herbs, foods high in vitamins C, D, and E, and a healthier lifestyle can all help to promote health and overcome infection (Hossain et al., 2020).

V. Advantages

Honey Turmeric Latte is easily absorbed by the gastrointestinal lining. It has a low protein content, which means bacteria cannot develop owing to a lack of nitrogen. As a result, it aids in the fight against germs by converting oxygen in the system into hydrogen peroxide, a good disinfectant (Doldolova et al., 2021). It can also help with a variety of stomach issues. Its anti-inflammatory effects aid in the healing of wounds and reduce intestinal irritation. Coughs, colds, throat inflammation, diarrhea, cholesterol, indigestion, obesity, toothache, urinary tract infection, low immunity, stomach disturbances, constipation, ulcers, and infections are some of the diseases it may help with (Poddar et al., 2020). Vitamin C and antioxidant-rich fresh fruits and vegetables may assist us boost our immunity (Yadav et al., 2016). The Government of India (GOI) and AYUSH provided extremely basic, at-home instructions on intake of immunity-boosting foods, honey turmeric latte, warm water intake, a nutritious diet, and physical activity, among other things (Sandhu et al., 2020). The greatest and cheapest plan for health is to eat a home-cooked, balanced, and nutritious food, exercise regularly, and incorporate basic herbs into daily routines (Clark et al., 2019).

VI. Conclusion:

Honey Turmeric Latte has been utilised in Ayurvedic medicine for centuries, with numerous biological applications. It's been the topic of a lot of phytochemical, experimental, and clinical research. Turmeric and honey has a wide range of therapeutic properties. Curcumin, a component of turmeric, may be used medically to treat a number of dermatologic conditions, according to numerous researches. Turmeric's phytochemical research revealed a slew of substances, including starch, protein, vitamins, volatile oils, vital elements curcumin and curcuminoids, all of which have been discovered to have a variety of positive pharmacological effects. Honey is a natural ingredient that has been used for medicinal purposes since

ancient times. Because of the significant antioxidant and anti-inflammatory characteristics of flavonoids and phenolic acids, they play an important role in human health. Honey Turmeric Latte has antibacterial and anticancer properties against a variety of malignancies, working on a variety of molecular pathways involved in cellular proliferation. In addition, the reduction of glucose, fructosamine, and glycosylated haemoglobin serum concentrations has been emphasized as an antidiabetic activity. Overall, there is preliminary evidence that composite honey and turmeric products and supplements, both oral and topical, can improve skin health. Turmeric is one of the top ten herbs for treating poisoning and purifying the blood. It cleanses the body and mind, assisting the body in healing itself. Researchers are becoming more interested in discovering natural solutions for curing illnesses. Immunity boosting is critical during the Covid-19 period for sustaining optimal health. Ayurvedic immunity boosting measures include drinking Honey Turmeric Latte one to two times each day. It is really easy and quick to prepare. It is high in antioxidants, which are crucial for developing resistance and immunity throughout this epidemic, as prevention is always preferable to cure. However, thorough clinical tests across population can be undertaken in future to clinically prove and quantify the usefulness of Honey Turmeric latte to specific diseases.

References:

- [1] Abedi, F., Ghasemi, S., Farkhondeh, T., Azimi-Nezhad, M., Shakibaei, M. and Samarghandian, S., 2021. Possible Potential Effects of Honey and Its Main Components Against Covid-19 Infection. *Dose-Response*, 19(1), p.1559325820982423.
- [2] Abinaya, S., Devi, R.G. and Lakshmanan, G., 2020. Knowledge and awareness about ginger and turmeric as an herbal cure for COVID-19. *International Journal of Pharmaceutical Research*, 12.
- [3] Ahmed, I., Hasan, M., Akter, R., Sarkar, B.K., Rahman, M., Sarker, M.S. and Samad, M.A., 2020. Behavioral preventive measures and the use of medicines and herbal products among the public in response to Covid-19 in Bangladesh: A cross-sectional study. *PloS one*, 15(12), p. e0243706.
- [4] Al-Hatamleh, M.A., Hatmal, M.M.M., Sattar, K., Ahmad, S., Mustafa, M.Z., Bittencourt, M.D.C. and Mohamud, R., 2020. Antiviral and immunomodulatory effects of phytochemicals from honey against COVID-19: Potential mechanisms of action and future directions. *Molecules*, 25(21), p.5017.
- [5] Ali, A., Ali, A., Tahir, A., Bakht, M. and Ahsan, M.J., 2021. Molecular Engineering of Curcumin, an Active Constituent of *Curcuma longa* L.(Turmeric) of the Family Zingiberaceae with Improved Antiproliferative Activity. *Plants*, 10(8), p.1559.
- [6] Ali, A.M. and Kunugi, H., 2021. Propolis, bee honey, and their components protect against Coronavirus Disease 2019 (COVID-19): A review of in silico, in vitro, and clinical studies. *Molecules*, 26(5), p.1232.
- [7] Almasaudi, S., 2021. The antibacterial activities of honey. *Saudi journal of biological sciences*, 28(4), p.2188.
- [8] Babaei, F., Nassiri-Asl, M. and Hosseinzadeh, H., 2020. Curcumin (a constituent of turmeric): New treatment option against COVID-19. *Food science & nutrition*, 8(10), pp.5215-5227.
- [9] Biluca, F.C., da Silva, B., Caon, T., Mohr, E.T.B., Vieira, G.N., Gonzaga, L.V., Vitali, L., Micke, G., Fett, R., Dalmarco, E.M. and Costa, A.C.O., 2020. Investigation of phenolic compounds, antioxidant and anti-inflammatory activities in stingless bee honey (Meliponinae). *Food Research International*, 129, p.108756.
- [10] Bukhari, S.N.A., Jantan, I., Unsal Tan, O., Sher, M., Naeem-Ul-Hassan, M. and Qin, H.L., 2014. Biological activity and molecular docking studies of curcumin-related α , β -unsaturated carbonyl-based synthetic compounds as anticancer agents and mushroom tyrosinase inhibitors. *Journal of agricultural and food chemistry*, 62(24), pp.5538-5547.

- [11] Ch'ng, E.S. and Tang, T.H., 2020. Anti-inflammatory properties of stingless bee honey may reduce the severity of pulmonary manifestations in COVID-19 infections. *The Malaysian Journal of Medical Sciences: MJMS*, 27(3), p.150.
- [12] Clark, N., 2019. *Nancy Clark's sports nutrition guidebook*. Human Kinetics.
- [13] Corbera, E., Anguelovski, I., Honey-Rosés, J. and Ruiz-Mallén, I., 2020. Academia in the Time of COVID-19: Towards an Ethics of Care. *Planning Theory & Practice*, 21(2), pp.191-199.
- [14] Dasgupta, A., 2019. Antiinflammatory herbal supplements. In *Translational inflammation* (pp. 69-91). Academic Press.
- [15] Değirmencioğlu, N., Yildiz, E., Guldaz, M. and Gurbuz, O., 2020. Health benefits of kombucha tea enriched with olive leaf and honey. *J Obes Chronic Dis*, 4(1), pp.1-5.
- [16] Doldolova, K., Bener, M., Lalikoğlu, M., Aşçı, Y.S., Arat, R. and Apak, R., 2021. Optimization and modeling of microwave-assisted extraction of curcumin and antioxidant compounds from turmeric by using natural deep eutectic solvents. *Food Chemistry*, 353, p.129337.
- [17] Dorothy, R., Latha, K.S., Joany, R.M., Sasilatha, T., Rajendran, S., Singh, G. and Kumaran, S.S., 2020. Multifunctional drinks from all natural ingredients. In *Nanotechnology in the Beverage Industry* (pp. 413-431). Elsevier.
- [18] El-Senduny, F.F., Hegazi, N.M., Abd Elghani, G.E. and Farag, M.A., 2021. Manuka honey, a unique mono-floral honey. A comprehensive review of its bioactives, metabolism, action mechanisms, and therapeutic merits. *Food Bioscience*, p.101038.
- [19] Eteraf-Oskouei, T. and Najafi, M., 2013. Traditional and modern uses of natural honey in human diseases: a review. *Iranian journal of basic medical sciences*, 16(6), p.731.
- [20] Fabianowska-Majewska, K., Kaufman-Szymczyk, A., Szymanska-Kolba, A., Jakubik, J., Majewski, G. and Lubecka, K., 2021. Curcumin from Turmeric Rhizome: A Potential Modulator of DNA Methylation Machinery in Breast Cancer Inhibition. *Nutrients*, 13(2), p.332.
- [21] Fletcher, M.T., Hungerford, N.L., Webber, D., de Jesus, M.C., Zhang, J., Stone, I.S., Blanchfield, J.T. and Zawawi, N., 2020. Stingless bee honey, a novel source of trehalulose: a biologically active disaccharide with health benefits. *Scientific reports*, 10(1), pp.1-8.
- [22] Floris, I., Pusceddu, M. and Satta, A., 2021. The Sardinian Bitter Honey: From Ancient Healing Use to Recent Findings. *Antioxidants*, 10(4), p.506.
- [23] Fujianti, D., Daffa, M., Darmalaksana, W., Amalia, V. and Khaerani, I.F.S.R., 2021, July. Takhrij and Syarah Hadith of Chemistry: Benefits of Honey for Health in the Study of Hadith and Chemical Perspective. In *Gunung Djati Conference Series* (Vol. 5, pp. 41-49).
- [24] Gupta, H., Gupta, M. and Bhargava, S., 2020. Potential use of turmeric in COVID-19. *Clinical and experimental Dermatology*.
- [25] Hadi, A., Pourmasoumi, M., Ghaedi, E. and Sahebkar, A., 2019. The effect of Curcumin/Turmeric on blood pressure modulation: A systematic review and meta-analysis. *Pharmacological research*, 150, p.104505.
- [26] Honey-Rosés, J., Anguelovski, I., Chireh, V.K., Daher, C., Konijnendijk van den Bosch, C., Litt, J.S., Mawani, V., McCall, M.K., Orellana, A., Oscilowicz, E. and Sánchez, U., 2020. The impact of COVID-19 on public space: an early review of the emerging questions—design, perceptions and inequities. *Cities & Health*, pp.1-17.
- [27] Horowitz, R.I. and Freeman, P.R., 2020. Three novel prevention, diagnostic, and treatment options for COVID-19 urgently necessitating controlled randomized trials. *Medical hypotheses*, 143, p.109851.

- [28] Hossain, K.S., Hossain, M.G., Moni, A., Rahman, M.M., Rahman, U.H., Alam, M., Kundu, S., Rahman, M.M., Hannan, M.A. and Uddin, M.J., 2020. Prospects of honey in fighting against COVID-19: pharmacological insights and therapeutic promises. *Heliyon*, 6(12), p.e 05798.
- [29] Ilija, G., Simulescu, V., Merghes, P. and Varan, N., 2021. The health benefits of honey as an energy source with antioxidant, antibacterial and antiseptic effects. *Science & Sports*.
- [30] Kishor, R.S., Rajendra, B.M., Ramhari, B.M. and Siddheshwar, S.S., 2021. Review paper on Ayush system of medicine against COVID-19. *Research Journal of Pharmacognosy and Phytochemistry*, 13(2), pp.103-106.
- [31] Leonard, S.P., Powell, J.E., Perutka, J., Geng, P., Heckmann, L.C., Horak, R.D., Davies, B.W., Ellington, A.D., Barrick, J.E. and Moran, N.A., 2020. Engineered symbionts activate honey bee immunity and limit pathogens. *Science*, 367(6477), pp.573-576.
- [32] Marić, A., Jovanov, P., Sakač, M., Novaković, A., Hadnađev, M., Pezo, L., Mandić, A., Milićević, N., Đurović, A. and Gadžurić, S., 2021. A comprehensive study of parameters correlated with honey health benefits. *RSC Advances*, 11(20), pp.12434-12441.
- [33] McLoone, P., Oluwadun, A., Warnock, M. and Fyfe, L., 2016. Honey: a therapeutic agent for disorders of the skin. *Central Asian journal of global health*, 5(1).
- [34] Munekata, P.E., Pateiro, M., Zhang, W., Dominguez, R., Xing, L., Fierro, E.M. and Lorenzo, J.M., 2021. Health benefits, extraction and development of functional foods with curcuminoids. *Journal of Functional Foods*, 79, p.104392.
- [35] Navaei Alipour, N., Mastali, M., Ferns, G.A., Saberi Karimian, M. and Ghayour Mobarhan, M., 2021. The effects of honey on pro and anti-inflammatory cytokines: A narrative review. *Phytotherapy Research*.
- [36] Nguyen, H.T.L., Panyoyai, N., Kasapis, S., Pang, E. and Mantri, N., 2019. Honey and its role in relieving multiple facets of atherosclerosis. *Nutrients*, 11(1), p.167.
- [37] Nilashi, M., Samad, S., Yusuf, S.Y.M. and Akbari, E., 2020. Can complementary and alternative medicines be beneficial in the treatment of COVID-19 through improving immune system function. *Journal of infection and public health*, 13(6), p.893.
- [38] Normando, A.G.C., de Meneses, A.G., de Toledo, I.P., Borges, G.Á., de Lima, C.L., Dos Reis, P.E.D. and Guerra, E.N.S., 2019. Effects of turmeric and curcumin on oral mucositis: A systematic review. *Phytotherapy Research*, 33(5), pp.1318-1329.
- [39] Nweze, A.J., Olovo, C.V., Nweze, E.I., John, O.O. and Paul, C., 2020. Therapeutic Properties of Honey. *Honey Anal. New Adv. Chall*, pp.1-21.
- [40] Otero, M.C.B. and Bernolo, L., 2020. Honey as Functional Food and Prospects in Natural Honey Production. In *Functional Foods and Nutraceuticals* (pp. 197-210). Springer, Cham.
- [41] Pan, S.Y., Litscher, G., Gao, S.H., Zhou, S.F., Yu, Z.L., Chen, H.Q., Zhang, S.F., Tang, M.K., Sun, J.N. and Ko, K.M., 2014. Historical perspective of traditional indigenous medical practices: the current renaissance and conservation of herbal resources. *Evidence-Based Complementary and Alternative Medicine*, 2014.
- [42] Paultre, K., Cade, W., Hernandez, D., Reynolds, J., Greif, D. and Best, T., 2021. Therapeutic effects of turmeric or curcumin extract on pain and function for individuals with knee osteoarthritis: a systematic review. *BMJ Open Sport & Exercise Medicine*, 7(1), p.e 000935.
- [43] Peterson, C.T., Vaughn, A.R., Sharma, V., Chopra, D., Mills, P.J., Peterson, S.N. and Sivamani, R.K., 2018. Effects of turmeric and curcumin dietary supplementation on human gut microbiota: A double-blind, randomized, placebo-controlled pilot study.

- [44] Poddar, S., Sarkar, T., Choudhury, S., Chatterjee, S. and Ghosh, P., 2020. Indian traditional medicinal plants: A concise review. *International Journal of Botany Studies*, 5(5), pp.174-190.
- [45] Prajapati, S.K., Mishra, G., Malaiya, A., Jain, A., Mody, N. and Raichur, A.M., 2021. Antimicrobial Application Potential of Phytoconstituents from Turmeric and Garlic. In *Bioactive Natural Products for Pharmaceutical Applications* (pp. 409-435). Springer, Cham.
- [46] Prasath, D., Kandiannan, K., Leela, N.K., Aarthi, S., Sasikumar, B. and Babu, K.N., 2018. Turmeric: Botany and production practices. *Horticultural Reviews*, 46, pp.99-184.
- [47] Purbafrani, A., Ghazizade Hashemi, S.A., Bayyenat, S., Moghaddam, H.T. and Saeidi, M., 2014. The benefits of honey in Holy Quran. *International Journal of Pediatrics*, 2(3), pp.67-73.
- [48] Qin, S., Huang, L., Gong, J., Shen, S., Huang, J., Ren, H. and Hu, H., 2017. Efficacy and safety of turmeric and curcumin in lowering blood lipid levels in patients with cardiovascular risk factors: a meta-analysis of randomized controlled trials. *Nutrition journal*, 16(1), pp.1-10.
- [49] Rajagopal, K., Varakumar, P., Baliwada, A. and Byran, G., 2020. Activity of phytochemical constituents of *Curcuma longa* (turmeric) and *Andrographis paniculata* against coronavirus (COVID-19): an in silico approach. *Future Journal of Pharmaceutical Sciences*, 6(1), pp.1-10.
- [50] Rolfe, V., Mackonochie, M., Mills, S. and McLennan, E., 2020. Turmeric/curcumin and health outcomes: A meta-review of systematic reviews. *European Journal of Integrative Medicine*, p.101252.
- [51] Sahoo, J.P., Behera, L., Praveena, J., Sawant, S., Mishra, A., Sharma, S.S., Ghosh, L., Mishra, A.P., Sahoo, A.R., Pradhan, P. and Sahu, S., 2021. The Golden Spice Turmeric (*Curcuma longa*) and Its Feasible Benefits in Prospering Human Health—A Review. *American Journal of Plant Sciences*, 12(03), p.455.
- [52] Sandhu, K., 2020. Impact of COVID-19 lockdown on the Dietary Pattern and Physical Activity of People Kanchan Sandhu¹ and Baljeet Kaur². *Horizon*, 2, pp.205-216.
- [53] Saranraj, P. and Sivasakthi, S., 2018. Comprehensive review on honey: Biochemical and medicinal properties. *J. Acad. Ind. Res*, 6(10), p.165.
- [54] Shankhdhar, P.K., Mishra, P., Kannoja, P. and Joshi, H., 2020. Turmeric: Plant immunobooster against covid-19. *Research Journal of Pharmacognosy and Phytochemistry*, 12(3), pp.174-177.
- [55] Singh, C., Kumar, R. and Umeshbhai, J.N., 2020. Role of spices and herbs in human health: A review. *Indian Journal of Health & Wellbeing*, 11.
- [56] Singh, R.P., Gangadharappa, H.V. and Mruthunjaya, K., 2017. *Cuminum cyminum*—A popular spice: An updated review. *Pharmacognosy Journal*, 9(3).
- [57] Soleimani, V., Sahebkar, A. and Hosseinzadeh, H., 2018. Turmeric (*Curcuma longa*) and its major constituent (curcumin) as nontoxic and safe substances. *Phytotherapy Research*, 32(6), pp.985-995.
- [58] Thangavel, K. and Dhivya, K., 2019. Determination of curcumin, starch and moisture content in turmeric by Fourier transform near infrared spectroscopy (FT-NIR). *Engineering in Agriculture, Environment and Food*, 12(2), pp.264-269.
- [59] Ugorji, B.N., Meludu, S.C., Ogbu, I.S.I., Chikezie, D.O., Ogbodo, E.C., Igwebuobi, C.F. and Nduka, N.S., 2021. Changes in lipid profile and some biochemical parameters in perimenopausal women treated with turmeric. *Journal of Pharmaceutical and Biological Sciences*, 9(1), p.24.
- [60] Wang, L., Ning, F., Liu, T., Huang, X., Zhang, J., Liu, Y., Wu, D. and Luo, L., 2021. Physicochemical properties, chemical composition, and antioxidant activity of *Dendropanax dentiger* honey. *LWT*, 147, p.111693.
- [61] White, C.M., Pasupuleti, V., Roman, Y.M., Li, Y. and Hernandez, A.V., 2019. Oral turmeric/curcumin effects on inflammatory markers in chronic inflammatory diseases: a systematic review and meta-analysis of randomized controlled trials. *Pharmacological research*, 146, p.104280.

- [62] Yadav, A., Kumari, R., Yadav, A., Mishra, J.P., Srivatva, S. and Prabha, S., 2016. Antioxidants and its functions in human body-A Review. *Research in environment and life sciences*, 9(11), pp.1328-1331.
- [63] Yadav, S.K., Sah, A.K., Jha, R.K., Sah, P. and Shah, D.K., 2013. Turmeric (curcumin) remedies gastroprotective action. *Pharmacognosy reviews*, 7(13), p.42.
- [64] Zahedipour, F., Hosseini, S.A., Sathyapalan, T., Majeed, M., Jamialahmadi, T., Al-Rasadi, K., Banach, M. and Sahebkar, A., 2020. Potential effects of curcumin in the treatment of COVID-19 infection. *Phytotherapy Research*, 34(11), pp.2911-2920.