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The sustainable opportunity for metabolic health: Study of the most important plants of the Middle East

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Abstract. Application of medicinal and aromatic plants and herbs in the Middle East, West of Asia, and North Africa has related to the origin of human civilization. The keywords searched for "Traditional Medicine", "Neglected plants", "Natural products", "Frankincense", "Garlic", "Mandrake", "Milk thistle", "Myrrh", "Mint", "Mustard seed", "Nard", "Turmeric", "Saffron", "Coriander", "Wild lettuce", "Wild endive", "Pistachio" and "Almond" were performed by using Web of Science, Scopus, Google scholar, and PubMed. Medicinal foods and plants may provide phytotherapy a latest dimension and make them able in their consumption to treat and prevent various diseases. Traditional herbal medicines have been known as an essential source of healing treatment, as their chemical constituents are applied to promote health and prevent many sicknesses. Some of the notable medicinal herbs, and plants of North Africa and the Middle East which have been also mentioned are frankincense, garlic, mandrake, milk thistle, myrrh, mint, mustard seed, nard, turmeric, saffron, coriander, wild lettuce, wild endive, pistachio, and almond. The goal of this article was to review the important health advantages and pharmaceutical benefits of medicinal and aromatic plants and herbs in the Middle East. Medicinal herbs and plants can be used for treatment and alleviation of the negative impacts of several diseases.

Keywords: traditional herbal medicine, medicinal plants, natural products, garlic, mint, turmeric.

INTRODUCTION

Medicinal plants and herbs have been used for the millennium because of their medicinal and culinary advantages (Shahrajabian et al., 2020a,b,c,d,e). The principal health benefits of natural products are effective, safety, cost-effective, and they present the best for the maintenance and nourishment of both heath and bodily functioning (Sun et al., 2019a,b). The basic elements in most medicinal plants are hydrogen, carbon, nitrogen, sulfur, phosphorus, calcium, potassium, iron, magnesium, boron, copper, manganese, chlorine, zinc, silicon and sodium. Phytochemical are active ingredients which possess therapeutic properties and are considered as a medicine or drug, and the most important phytochemicals are chlorophyll, protein, flavonoids, alkaloids, tannins, steroids, etc. (Shahrajabian et al., 2023a,b; Shahrajabian, Sun, 2023a,b,c; Sun, Shahrajabian, 2023). The medicinal plant is any plant which in one or more of its organs, contains substances which can be applied for therapeutic purposes or which are precursors for the synthesis of useful drugs (Cui et al., 2023; Sun et al., 2023).

METHODS

The electronic databases Cochrane Library, Google Scholar, Scopus, Web of Science, and MEDLINE/PubMed were searched to evaluate and assess all the relevant manuscripts published in English up to March 2023. Combinations or single words of "Traditional Medicine", "Neglected plants", "Natural products", "Frankincense", "Garlic", "Mandrake", "Milk thistle", "Myrrh", "Mint", "Mustard seed", "Nard", "Turmeric", "Saffron", "Coriander", "Wild lettuce", "Wild endive", "Pistachio", and "Almond" were searched. The advanced search inputs were done in order to obtain more pertinent findings. Then, irrelevant articles, review articles, articles on unclassified information, and articles related to medicinal plants which are not related to the Middle east were removed. The selection criterion was to include research papers on the most medicinal plants, using *in vitro* or *in vivo* studies.

RESULTS

Frankincense (*Boswellia sacra, B. carteri*)

Frankincense has a special odor, and its components change according to the species of tree from which the resin is obtained (Teshome et al., 2017). It is an oleo gum resin obtained from trees of *Boswellia*. It has been traded and applied for many years and it is still frequently used in both religious and secular parts because of its pleasurable odor (Al-Harrasi et al., 2014; Niebler, Buettner, 2015). *Boswellia* products come in the form of extracts, resins and essential oils, and many volatiles in frankincense (Turk et al., 2018). Frankincense yield improved with total resin-canal area in the stem diameter, bark, tree age and tree leaf area (Eshete et al., 2012; Tolera et al., 2015; Alotaibi, 2019). Mumin et al. (2020) reported that application of Boswellia *carteri*-Peste des petits ruminants (PPR) vaccine mixture through subcutaneous or intranasal route, elicited similar antibody titre, indicating that the intranasal route may be used as a non-invasive substitute delivery in PPR vaccination of small ruminants. Frankincence has the potential to support brain function and memory (Beheshti et al., 2018). The most important chemical constituent present in frankincense are acid resin, soluble in alcohol and having the formula $C_{20}H_{32}O_4$, gum (similar to gum Arabic), 4-O-methyl-glucuronic acid, incensole acetate, alpha-boswellic acid, 3-acetyl-beta-boswellic acid, and phellandrene (Woolley et al., 2012).

Lipophilic extracts of gum resins of *Boswellia* species are used in folk medicine to treat numerous inflammatory disorders and infections (Henkel et al., 2012; Zaki et al., 2014; Pavela et al., 2020). Boswellic acids also have positive functions in treatment of asthma, cancer, hypolipidemia, and Crohn's disease (Roy et al., 2019). The results show that the polysaccharides separated from frankincense have the potential to be applied as an immunological stimulant or nutraceutical (Qurishi et al., 2010; Hosain et al., 2019). Frankincense may be effective in the treatment of heavy menstrual bleeding consideration their anti-inflammatory characteristics (El-Nagerabi et al., 2013). Frankincense oil (FO) can be used as antibacterial edible films with considerable physical properties (Eshaghian et al., 2019). Frankincense essential oil contains promising potential to regulate the biological processes of inflammation and tissue remodeling in human skin (Masoud et al., 2017). It may have a potential capability to be used as the substitute natural medicine for both chronic and inflammatory diseases, and also for memory and brain disorders (Han, Parker, 2017). The methanol extract and ethyl acetate extract as well as indispensable oil of *B. carteri* resin may be considered as a natural source for antioxidant and antimicrobial agents and could be used in pharmaceutical and food industries (Frank et al., 2009; Hamidpour et al., 2013; Mohamed et al., 2015; Asad, Alhomoud, 2016). The aqueous extract of *Boswellia sacra* may affect and restrict the cancerous cell line, which makes it a good substitute of other drugs on patients (Ni et al., 2012).

Garlic (*Allium sativum)*

Garlic is an economic spice, vegetable, and medicinal crop that produces bulbs and tremendous organosulfur compounds (Jasim et al., 2019). It is considered as both functional food with considerable health-promoting activities (Ricciutelli et al., 2020; Ramirez et al., 2021). Garlic aqueous extract is a source of emulsifiers, namely saponins, and proteins (Huang et al., 2019). Allicin from garlic has been reported to have antioxidative activity (Bravo-Nunez et al., 2019). The most important functionalities of allicin are antimicrobial activity, antioxidant activity, anticancer activity, reducing cardiovascular diseases, increasing immune function, and influence on fat profile and protein (Hirata, Matsushita, 1996). Garlic has ability to ameliorate oxidative stress, core function in cardiovascular cure, chemopreventive properties which show its prospective capacity as an immune booster (Rahman, 2007). Raw crushed garlic has important impacts on constituents of metabolic syndrome, which can be a promising remedy for treatment and prevention of patients with metabolic syndrome (Butt et al., 2009). The broad range of antioxidant, anti-apoptotic, and anti-atherogenic protection by garlic may be extended to its neuroprotective action which may assist to decrease the risk of dementia such as vascular dementia and Alzheimer's disease (Choudhary et al., 2018). Pharmaceutical benefits of garlic are shown in Table 1.

Mandrake (*Mandragora officinarum*)

Mandragora L. (Solanaceae) is the only genus of the tribe Mandragoreae, one of the two tribes of the cosmo-

Table 1. Pharmaceutical benefits of garlic.

Benefits	Mechanism and impacts	Reference
Antioxidant activity	– The effectivity and strength of diallyl disulfide as an antioxidant has been proved.	Moosavian et al. (2020)
Anti-inflammatory activity	– Aged black garlic extract has anti-inflammatory and antioxidant properties.	Yu et al. (2020)
Antimicrobial activity	– The order for antimicrobial activity was reported as: allyl ≥methyl>propenyl. – The elephant garlic oil retarded the growth of the bacteria or decreased the bacterial cell load in the food model, which depends on its concentration.	Rahman et al. (2006) Lee et al. (2019)
Anti-fungal activity	– Garlic has shown significant anti-fungal activity	Piletti et al. (2019)
Anti-cancer activity	– Garlic has anticarcinogenic effects through a number of mechanisms. – The diallyl trisulfide of garlic might offer a novel technique for the treatment of human breast cancer. – S-allylmercaptocysteine from aged garlic has anti-cancer properties. – High onion and garlic consumption is protective against breast cancer.	Tedeschi et al. (2007) Lv et al. (2019)
Anti-atherogenic activity	– Garlic powder manages direct anti-atherogenic-related action in both *in vitro* and *in vivo*.	Shabani et al. (2019)
Anti-stress and anti-depression activity	– Garlic decreases depression and anxiety and depression-related behaviors in the diabetic rats possibly.	Orekhov et al. (1995)
Immunostimulatory activity	– The immunostimulatory activities of garlic extract can be highly connected with the antioxidant and anticancer activities.	Rahmani et al. (2020)
Wound healing	– Different concentrations of aged garlic solution had positive impacts on wound healing. – The incorporation of garlic into the polyurethane (PU) blended with grapes may serve as a beneficial candidate for wound dressing applications.	Ejaz et al. (2009) Purev et al. (2012)

politan nightshade family (Mani, Jaganthan, 2019). *Mandragora* genus is represented by 2 important species, namely *M. autumnalis* and *M. officinarum* (Volis et al., 2018). Mandrake has a long history of medicinal application and the root is narcotic and hallucinogenic. Mandrake is one of the most ancient herbs known to humankind and yet continues one of the most misunderstood plants on the earth (Schlesinger et al., 2010; Uysal et al., 2016). Six mandragorolide identified in *Mandragora officinarum* of Jordanian origin were mandragorolide A, mandragorolide B, withanolide B, salpichrolide C, datura lactone 2, and withanicandrin (Fleisher, Fleisher, 1992). Composition of major volatile compounds from *Mandragora autumnalis* are acetic acid, benzyl benzoate, benzyl acetate, butyl butyrate, β-Ionone, butyl caprate, butyl cinnamate, butyl caprylate, caprylyl acetate, butyl laurate, cinnamic acid, docosane, δ-laurolactone (δ-dodecalactone), eicosane, ethyl caprylate, ethyl caprate, ethyl caproate, ethyl laurate, ethyl cinnamate, ethyl methylpropanethioate, ethyl oleate, ethyl myristate, eugenol, ethyl palmitate, hexadecane, hexacosane, hexatriacontane, hexyl caprylate, hexyl 2-methylbutanoate, isoeugenol, lauric acid, isopropyl myristate, methyl caprate, linoleic acid, myristic acid, methyl laurate, neophytadiene, *n*-hexyl butyrate, *n*-hexyl acetate, octacosane, palmitic acid, oleic acid, pentadecane, solavetivone and squalene (Suleiman et al., 2010).

Milk thistle (*Silybum marianum*)

Milk thistle (*Silybum marianum*) is a beneficial extensively used botanical used for various health advantages (Hanus et al., 2005). It is an annual plant belonging to the Asteraceae family whose ripe seeds consist flavonoid contents (Hammami et al., 2020; Zhang et al., 2020). Milk thistle contains high amount of protein, fat, flavonolignans, oleic acid, and linoleic acid (Omer et al., 1993). Some of the most notable therapeutic applications of silymarin are anti-diabetes, anti-parkinson, anti-cancer, anti-dermatitis, anti-alzheimer, and hepatoprotective impacts (Albassam et al., 2017). Milk thistle seed reduced high-energy diet

Table 2. Pharmaceutical benefits of Milk thistle.

Benefits		Mechanism and impacts	Reference
Antioxidant activity	–	Milk thistle has high antioxidant property.	Tournas et al. (2013)
Liver protective impacts	–	Milk thistle seems to be relatively safe, with long-term use for its potentially protective impacts on the liver.	Abenavoli, Bellentani (2013)
Anti-diabetic activity	–	It has revealed high anti-diabetic characteristic.	Le et al. (2018)
Anti-melanogenesis	–	Milk thistle has a potent potential to tyrosinase inhibition.	Maghrani et al. (2004)
Anti-cancerogenic	–	The silymarin constituents are anticancerogenic components.	Kim et al. (2019)
Hepatoprotective effects	–	Silibin has shown hepatoprotective activity.	Brandon-Warner et al. (2012)
Antiviral effects	–	Silymarin flavonolignans had antiviral effects.	El-Gazayerly et al. (2014)
Anti-inflammatory impacts	–	Milk thistle has shown high anti-inflammatory activities.	Ramasany, Agrarwal (2008)
Anti-aflatoxin activity	–	Milk thistle has favourable effect on poultry growth performance in experimentally induced aflatoxicosis.	Touranas et al. (2012)

(HED)-induced increments in metabolic blood parameters and lipid peroxidation (LPO) (Jacobs et al., 2002). Its seed is a very favorable natural drug (Ceribasi et al., 2020). Milk thistle botanical supplements were found to consist of an extensive variety of fungal species and its seeds harbored the maximum levels of fungi (Bhattacharya, 2020). Pharmaceutical advantages of Milk Thistle are shown in Table 2.

Myrrh (*Commiphora* spp.)

The genus *Commiphora* consists of 190 plant species and spread in northeastern Africa (Somalia, Ethiopia, Sudan), southern Arabia (Yemen, Oman), and subcontinent (India, Pakistan) (Alhidary et al., 2017). It is an herbal product, which has been used since ancient ages for traditional medication and other goals. Myrrh essential oil is also a hopeful antibacterial and cytotoxic agent, which can be defined in suitable dosage forms (Shen et al., 2012).

Anti-inflammatory characteristic of dual combinations of myrrh and chamomile is reported (Shalaby, Hammouda, 2014). Myrrh provides new indications as to its possible applicability for itch treatment, which cannot be treated with histamine receptor blockers alone (Mahboubi, Kashani, 2016). Myrrh also helped keep elevated white blood cell (WBC) levels throughout the healing period (Vissiennon et al., 2017). Local myrrh application for serious vulvar edema in ovarian hyperstimulation syndrome may lead to substantial improvement, and myrrh could be utilized as the suitable choice for the management of vulvar edema (Shin et al., 2019).

Mint (*Mentha spicata* L.)

Mints (*Mentha* species) have multiple used including perfumery, pharmaceutical, food and confectionery (Hashem et al., 2013). *Mentha spicata* is a species of mint native to Southeast Asia, and Europe (Haffor, 2010). The main essential oil of *Mentha spicata* L. was piperitenone oxide, limonene, carvone, menthone, isomenthone, and 1,8-cineole (Hijazi, Al-Jaroudi, 2017). Kofidis et al. (2004) reported that the important oil extracted from the leaves of *Mentha spicata* was characterized by a very high content in linalool. *Mentha spicata* can boost lipid profile of blood, the meat quality and microbial populations in small intestine of Japanese quail (Ghazaghi et al., 2014). Its oil can reduce pain in osteoarthritis patients (Mahboubi, 2017). Pharmaceutical advantages of mint are indicated in Table 3.

Table 3. Pharmaceutical benefits of Mint.

Benefits		Mechanism and impacts	Reference
Antimicrobial activity	–	*Mentha spicata* essential oil has antimicrobial properties.	Verma et al. (2010)
Anti-bacterial	–	Its essential oil has antibacterial properties.	Shahbazi and Shavisi (2016)
Antibiotics	–	Its oil has shown high antibiotics activities.	Elansary, Ashmawy (2013)
Anti-fungal activity	–	The extract of *M. spicata* L. has anti-fungal activity.	Singh et al. (1994)
Anti-inflammatory	–	Two monoterpenoid glycosides, spicatoside B and spicatoside A have shown high anti-inflammatory characteristics.	Arumugam et al. (2008)
Antioxidant activity	–	S-Carvone isolated from *M. spicata* contains high antioxidant characteristic in comparison with α-tocopherol.	Nakamura et al. (2014)

Table 4. Pharmaceutical benefits of mustard.

Benefits	Mechanism and impacts	Reference
Anti-inflammatory activity	– Its anti-inflammatory impacts may be mediated by blocking the mRNA expression of a panel of inflammatory mediators including IL-6, TNF-α, and IL-1β.	Xian et al. (2018)
Antiproliferative	– It has antiproliferative, antioxidant, and antimicrobial properties with high potential benefits in food preservation and chemoprevention.	Boscaro et al. (2018)
Antioxidant	– It has antioxidant, antiproliferative, and antimicrobial, properties with great potential benefits in chemoprevention and food preservation.	Weldu et al. (2019)
Antimicrobial activity	– The oil showed strong antimicrobial activity against three Gram-positive bacteria and six Gram-negative bacteria. – An antimicrobial system generated with thiocyanate obtained from *Sinapis alba* seed meal.	Duran Blanco et al. (2017)
Antifungal	– It has revealed the significant antifungal characteristics.	Morra et al. (2018)
Bioherbicidal activity	– *S. alba* seed includes components that are phytotoxic. Its extracts are viable bioherbicides particularly for pre-emergence weed control.	Mitrovic et al. (2020)
Biodiesel production	– It can be used in biodiesel production.	Kaur and Pareek (2018)

Mustard seed (*Sinapis* spp.)

Sinapis alba is an efficient and considerable plant of *Brassicaceae*, a large family of 350 genera and 3000 species, which is usually known as white or yellow and growing well in dry and hot environments, and it can be considered as a suitable and new oil crop for industrial goals (Abbasi et al., 2011). It has good adaptation to drought and heat and it is resistant to a number of important pests, insects, and diseases (Jankowski et al., 2020). Sinalbin is biologically active component of mustard which has shown some bactericidal, antifungal, and anticarcinogenic activities (Fimognari, Hrelia, 2007). Tyrosinase inhibition by *S. alba* extracts is also another importance of bioactive compounds from mustard seed (Popova, Morra, 2018). The mustard seed proteins have good functional possessions, particularly mustard seed protein which has better functional properties such as protein solubility, stability, and emulsion capacity, and foam expansion when compared with yellow mustard protein (Silva, Domingues, 2017). White mustard seed oil are used for biodiesel production (Kostic et al., 2018). Yellow mustard seeds have enzymes, which can be applied in reduction reactions of carbonyl compounds (De Sousa et al., 2019). Pharmaceutical benefits of mustard are presented in Table 4.

Nard (*Nardostachys jatamansi*)

Nardostachys jatamansi DC belongs to the Valerianaceae family and is a prominent Ayurvedic herb, and the roots of rhizomes of Jatamansi are applied in many Asian countries from ancient time (Nakoti et al., 2018). Nardostachys species is an erect, hairy, perennial rooted herb, with stout woody main root; rootstock is long, thick, covered with remnants of petioles of withered leaves, and stems are usually pubescent upward, and glabrate below. *Nardostachys jatamansi* is categorized as hypno-sedative Ayurveda which is used in treatment of hysteria, insomnia, and depressive illness with important pharmacological activities such as cardioprotective, hepatoprotective, hypolipidemic and antifungal (Amatya, Sthapit, 1994). It includes a number of bioactive chemicals, such as jatamansic acid, crystalline acid, hydrocarbons, a polyoxygenated crystalline solid together with B-eudesmol, A-endesmol, angelicin, and ethanol, The rhizome essential oil of other species was mainly composed of calarene (9.4%), nardol A (6.0%), balerena-4,7(11)-diene (7.1%), valeranal (5.6%), jatamansone (7.9%), 1(10)-aristolen-9β-0l (11.6%), and *cis*-valerinic acid (5.7%) (Satyla *et al*., 2015). Singh et al. (2018) reported the antibacterial and antifungal activity of *Nardostachys jatamansi* Rhizomes.

Turmeric (*Curcuma longa* L.)

Turmeric (*Curcuma longa*) is considered as both an important medicinal plant, and a culinary spice (Ma, Gang, 2006). Curcumin is the main constituent of turmeric, and both turmeric and curcumin are nongenotoxic and nonmutagenic (Soleimani et al., 2018). Turmeric contains protein, minerals, fat, and carbohydrates. The essential oil of turmeric contains α-phellandrene, sabinene, zingiberene, cineol, borneol, and sesquiterpene (Cooksey, 2017). Curcumin is considered to have anticancer, anti-inflammatory, and antioxidant effects which have an important function

Table 5. Pharmaceutical benefits of turmeric.

Benefits	Impacts and mechanisms	Reference
Antiviral activity	– Its aqueous extract can be applied as a safe and specific drug for patients with liver diseases caused by HBV infection. – Some curcuminoids compounds of *Curcuma longa* blocked the neuraminidases from influenza A viruses.	Kim et al. (2009)
Anticancer activity	– Turmeric extracts can be considered as a potential source of bioactive constituent for the treatment of cancer-related diseases. – The mix of natural extracts of ginger, turmeric, and garlic has anti-cancer activities. – Turmeric extracts can be used as an effective treatment to cure breast cancer without any side effects.	Dao et al. (2012)
Antifungal activity	– Turmeric essential oil is important in the treatment of dermatophytic infections and as anti-skin disease agents.	Sharma and Sharma (2011)
Antibacterial activity	– Turmeric leaf essential oils has antibacterial effect against *Shigella* spp.	Akter et al. (2019)
Antimicrobial activity	– The ability of rhizome of *C. longa* extracts to suppress the growth of some pathogens is an indication of its broad-spectrum antimicrobial potential, which can be applied in the management of microbial infections.	Behera and Rath (2011)
Antioxidant activity	– Antioxidant and antifungal actions of *C. longa* essential oil were reported. – Tumeric extract has the ability to prevent the deposition of triacylglycerols in the liver.	Jayarambabu et al. (2020)
Antiinflammatory activity	– Some essential oils exhibited excellent anti-inflammatory effect by down-regulating expression of COX-2 and TNF-α.	Fernandes et al. (2017)
Antiepileptogenic effects	– Curcumin pretreatment can lower some oxidative stress markers, attenuate seizures, and prevent hippocampal neuronal loss and mossy fiber sprouting (MFS) in the kainite-induced model of temporal lobe epilepsy (TLE).	Da Mata et al. (2020)
Skin care	– The extract derived from the rhizomes of turmeric plant can be used in skin health treatment.	Kiasalari et al. (2013)
Antibiotic effects	– Turmeric is a natural agent to antibiotic growth promoters in order to keep bird, performance and health.	Zaman and Akhtar (2013)
Antidiabetic effects	– Turmeric can be used for effective wound dressings in both diabetic and non-diabetic wounds.	Sami et al. (2020)
Immunomodulatory effects	– The turmeric boosts the capability of speel cells in young mice to proliferate, *in vitro*.	Mustafa and Blumenthal (2017)
Chemopreventive effects	– It has shown high chemopreventive impacts.	Chaaban et al. (2019)
Antiaging properties	– It can decrease cutaneous photoaging in a UVB-irradiated nude mouse model.	Farag et al. (2020)

in treatment and prevention of different illnesses ranging notably from cancer to autoimmune, cardiovascular diseases, neurological diseases, and diabetic (Wang et al., 2015). Curcumin has the potential to be effective and safe parasiticide for controlling ichthyophthiriasis in fish farming industry (Maurya et al., 2011). Pharmaceutical benefits of turmeric are shown in Table 5.

Saffron (*Crocus sativus* L.)

Saffron, stigmas of *Crocus sativus*, is one of the main valuable spices used as food colorant and flavoring agent (Kumar et al., 2008), which is a promising raw material for dietary supplements and creating drugs (El-Caid et al., 2020). It is sterile and asexually propagated through prog-

Table 6. Pharmaceutical benefits of Saffron.

Benefits	Mechanism and impacts	Reference
Anticancer activity	– Saffron has free radical-scavenging properties and antitumor activities.	Karimi-Nazari et al. (2019) Nguyen et al. (2020)
Antiinflammatory activity	– *Crocus sativus* and its constituent safranal showed a preventive effect on lung inflammation of sensitized guinea pigs. – Saffron has been found to have anti-inflammatory impacts.	Mobasseri et al. (2020)
Antioxidant activity	– Saffron can be used as an antioxidant food supplement. – Crocus anthers are an important source of antioxidant compounds.	Joukar et al. (2013)
Antidiabetic activity	– Saffron intake significantly declined inflammation especially IL-6 and TNF-a levels. – Saffron as a food ingredient may stimulate several beneficial physiological impacts in diabetic patients.	Ghaderi et al. (2020)
Antifungal activity	– Saffron contains antifungal activity.	Patel et al. (2017)
Antimicrobial activity	– Tepals showed the best antimicrobial activity at the quantity of 5 mg of extract.	Khorasanchi et al. (2018)
Antiarrhythmic activity	– It has revealed notable anti-arrhythmic characteristic.	Pintado et al. (2011)
Mental health	– The petal of Saffron has positive effects on mothers suffering from mild-to-moderate postpartum depressive disorder. – Saffron reduced anxiety and depressive signs in youth. – Antidepressant efficacy of saffron and crocin is comparable to those of standard drugs. – Saffron appears an important alternative to synthetic antidepressants such as sertraline. – Saffron in patients with mental health disorders improved condition in depression and anxiety.	Parray et al. (2015)
Antibacterial activity	– It has high anti-bacterial activity.	Barros et al. (2012)
Reduce blood sugar	– Saffron can decrease blood glucose levels.	Sathishkumar et al. (2016)
Cardioprotective function	– Saffron is a medicinal plant with cardioprotective functions.	Chung et al. (2012)

eny corms (Parizad et al., 2019; Sarfarazi et al., 2020). It is a rich source of bioactives including carotenoids, phenolics, and essential oils (Cardone et al., 2020). Its secondary metabolites vary by various geographical origin (Reddy et al., 2020). The crocin contents in saffron may decrease significantly by increasing time and temperature (Tirillini et al., 2006). Like crocin, picrocrocin and safranal are the main chemical constituents of saffron (Asbaghi et al., 2019). The moderate and light soil texture and shorter irrigation intervals are important parameters for boosting flower and corm yield of saffron (Mir et al., 2020). Its yield is more sensitive to water stress than to salinity stress (Hosseini et al., 2018). Pharmaceutical advantages of saffron are presented in Table 6.

Coriander seeds (*Coriandrum sativum* L.)

Coriander is one of the commonest food and medicinal plants in various countries (Khani, Rahdari, 2012). It is an herbaceous annual plant, aromatic, and belongs to the family Apiaceae (Khani, Rahdari, 2012). Coriander consists of petroselinic acid, an isomer fatty acid of oleic acid, and stressed conditions reduced oil and fatty acids accumulation in coriander fruits (Nadeem et al., 2013). *Coriandrum sativum* L. is a source of variety of polyphenols (Zargari, 1978).

Wild lettuce (*Lactuca virosa* L.)

Wild lettuce (*Lactuca virosa* L.) belongs to family *Asteraceae*, is native to different regions in the world such as the Middle East, Europe and North America. Wild lettuce is promoted as a natural treatment for a variety of conditions, such as respiratory conditions, anxiety, arthritis, menstrual cramps, poor circulation, cancer, insomnia, restlessness and urinary infections. Some of the side effects of raw wild lettuce are dizziness, extreme sensitivity to light, heart complications, anxiety, sweating, auditory hallucinations, breathing issues, urinary retention, nausea and vomiting (Besharat et al., 2009). They have noted that conservative treatment, vital sign monitoring, control of patient intake and output, and reducing patient agitation provided the basis of treatment. In the US, there have been reports of the herb being used as a substitute for opium (Mullins, Horoqitz, 1998).

Wild endive (*Cichorium endivia* L.)

It is a biennial or annual salad crop belongs to the family Compositae (Asteraceae). It is grown in many countries of Europe and in North America, mainly used as salad. It has achieved popularity because of its nutritional value and bitter taste caused by presence of sesquiterpene lactones (Koudela, Petrikova, 2007). The edible part of endive is leaf rosette (Gajc-Wolska et al., 2012). *Cichorium endivia* roots is a viable substitute source for the reuse of agricultural waste, and on the basis of *in vitro* prebiotic test, *C. endivia* fructooligosaccharides is a promising source of prebiotic fructans (Mariano et al., 2020). Ibrahim et al. (2019) reported that *C. endivia* parts extracted with aqueous ethanol achieved considerable antioxidant activity, and this high activity can be confirmed via containing the highest amount of total phenolic and flavonoids. Kamel et al. (2011) reported the function of oxidative stress in induction of diabetes and show the ameliorative impacts of *C. endivia* leaves powder aqueous suspension, very close to the diabetic drug (glibenclamide).

Pistachio (*Pistacia vera* L.)

Pistachio nuts are rich sources of nutrients such as phenol compounds, protein, vitamins, minerals, and antioxidants, which are important for human well-being (Aliakbarkhani et al., 2017). Poor quality of irrigation water with high salinity may reduce the yields of pistachio (Fekri et al., 2015), and fertilization of phosphorus can limit some negative impacts of high salinity on growth and chemical components of pistachio seedlings (Fekri et al., 2016). Pistachio seedlings grew better with increasing amounts of water (Paroni et al., 2019). Pistachios are richer in melatonin and sphingolipids than almonds (Demirkoz et al., 2018). Wild pistachio kernels are a good source of fat (50–56%) and contain unsaturated fatty acids such as linoleic, linolenic and oleic acids, which are essential for human diet. Irradiation could increase the phenolic content, antioxidant, anthocyanin activity of pistachio nuts (Akbari et al., 2018). Among nuts, pistachios have the highest amounts of potassium, vitamin K, γ-tocopherol, phytosterols, and xanthophylls carotenoids (Sahan, Bozkurt, 2020). Pistachio gum is obtained from *Pistacia vera* L., as and exudates after hurting the trunk and branches (Sahan, Bozkurt, 2020), which has showed antibacterial activity (Arjeh et al., 2020). Pistachio has special bioactives contents with promoting skin health (Alma et al., 2004). Pistachio supplementation significantly decreases fasting blood glucose in patients with dysglycemia (Hernandez-Alonso et al., 2014).

Almond (*Prunus dulcis* (Miller) D.A.)

Almonds (are a low moisture food with high levels of natural antioxidants, which has a comparatively long shelf life (Barreca et al., 2020). Major polyphenols present in whole almonds are hydrolysable tannis (ellagitannins, gallotannins, and ellagic acid), lignans, proanthocyanidins (procyanidin, flavonoids such as anthocyanidins, isoflavones, flavanones, flavonols, and flavanols, stilbene (resveratrol-3-O-glucoside), and phenolic acids (hydroxyl cinnamic acids, chlorogenic acids, hydroxybenzoic acids, vanillic acid, protocatehuic acid, p-hydroxy benzoic acid, ferulic acid, 5-hydroxy benzoic acid, neochlorogenic acid, caffeic acid, gallic acid, sinapic acid, cryptochlorogenic acid) (Maguire et al., 2004). Both its seeds and drupe are a cheap and readily available source of nutraceutical in the management of erectile dysfunction associated with diabetes (Al-Tikrity et al., 2017; Adebayo et al., 2019). The application of almond shell residues as dye biosorbent and agro-waste material could be an important option from both economic and environmental point of view (Davis, Iwahashi, 2001). Generation of oligosaccharides (OAG) generated by enzymatic hydrolysis of almond gum may exhibit notable antioxidant and antimicrobial activities (Nabarlatz et al., 2007). On the basis of meta-analysis, almonds showed reduce effect on systolic blood pressure (Bhardwaj et al., 2018; Li et al., 2020; Shahrajabian, Sun, 2024a,b,c).

CONCLUSION

The most important health benefits of **frankincense** are reducing arthritis, improve gut function, improved asthma, maintain oral health and fight certain cancers.

The most important pharmaceutical benefits of **garlic** are anti-bacterial, antibiotic, anthelmintic, antioxidant, antispasmodic, anti-cancerous activities, blood thinner, carminative, anticoagulant, antiseptic, anti-tumor, anti-viral, digestive, cholagogue, diaphoretic, expectorant, diuretic, febrifuge, stomachic, and stimulant.

Mandrake is an excellent sedative or narcotic, anesthetic, aphrodisiac; relieve rheumatic pains, appropriate for madness and delirium, convulsions, melancholy, and mania. Its phytochemical compositions are alkaloids (hyoscyamine, cuscohygine, apoatropine, 3-alpha-tigloyloxytropane, and belladonine), non-alkaloids (sitosterol, betamethylesculetin), and sugar (rhamnose, glucose, fructose, and sucrose). It may fix brain fog and boost cognition, it is appropriate for stress, depression and anxiety, appropriate for diabetes, it can also reduce oxidative damage to DNA and fats in cell-based studies, furthermore, it has anti-inflammatory effects, protecting the pancreas, protecting the stomach and the liver, with tremendous antimicrobial effects.

Milk thistle seed meal is extracted for the flavonolignans, silychristin, silydianin, silybinin B, silybinin A, isosilybinin A and isosilybinin B, which are collectively known as the silymarin complex.

Myrrh oil has many health benefits, but the most important benefits are anti-cancer, anti-fungal, anti-bacterial, and astringent, relief for upper respiratory problems, skin and mouth health, relaxation, it may help reduce swelling and inflammation, good for digestive problems such as indigestion, diarrhea, and inflammatory bowel disease. The medicinal values of the resinous exudates of the genus *Commiphora* have been gradually known by scholars and they are used in various medicines for the treatment of wound, arthritis, pain, fractures, obesity, parasitic infections and gastrointestinal diseases.

Mint is a calming herb, which has been used for many years to help soothe and upset stomach or indigestion. Mints is easy to grow and its leaves are a tender herb with gentle stems; the most important health benefits of mint are relieve symptoms of cold, alleviate allergies and regulate digestion, hay fever, aid in breastfeeding, give relief from respiratory disorders, skin care, it helps to lose weight, boost memory, it is good to relieve nausea and headache, decrease headaches, and it is suitable to relieve stress.

The most important health advantages of **mustard** seeds are cancer treatment, respiration congestion, rheumatic arthritis, migraine, nightshades, disease prevention, dietary fiber, it contains high antioxidant levels which makes it appropriate as cancer risk prevention, blood pressure and menopausal relief, asthma; it is also natural scrub, hydrates skin, slow ageing, it helps ward off skin infectious, it is also appropriate for hair growth and strengthens hair.

Nard is used as a bitter tonic, stimulant, antispasmodic epileptic treatment, and for hysteria. It has also shown antifungal activity, hepatoprotective activity, central nervous system activity, anticonvulsant activity, neuroprotective activity, antioxidant activity, antidiabetic activity, tranquilizing activity, and antiestrogenic activity.

Turmeric is the spice that gives curry its yellow color, and it contains curcumin, a substance with great anti-inflammatory and antioxidant properties.

The two major carotenoids in **saffron**, crocin and crocetin may have antitumor effects. The notable health benefits of saffron are reduce cancer risk, fight inflammation and arthritis, promote brain health, boost vision health, help in insomnia treatment, improve digestive health, they may heal burn wounds, relief from menstrual symptoms, increase immunity, improve heart health, protect the liver, and acts as an aphrodisiac.

Coriander seeds are rich in immune-boosting antioxidants.

Wild lettuce is said to be an herbal remedy for the following health conditions such as asthma, joint pain, atherosclerosis, cough, insomnia, and menstrual pain.

Wild endive is used as a resolvent and cooling medicine, and in the treatment of bilious complaints, which has a similar but milder effect to chicory, and so is a very beneficial tonic to the liver and digestive system. Moreover, its root is demulcent and tonic.

Pistachios are rich in nutrients with low calories; Pistachios may aid weight loss, enhance gut health, improve heart health, aid diabetes treatment, beneficial during pregnancy and breastfeeding, improve vision health, combat inflammation, boost cognitive function, enhance sexual health, increase estrogen levels, it also contains vitamin E and copper which may prevent the formation of wrinkles and treats sagging skin.

Almonds are rich in proteins, fiber and nutrients, which can reduce cholesterol, regulate blood sugar, good for heart, they contain higher levels of vitamin E which is an antioxidant that protects cells from getting toxic, good for eyes, reduce weight, prevent cancer, nourishes skin, improve brain power, appropriate for nerves, treating anemia, treat acne and blackheads, treat stretch marks, prevent gray hair, good for hair growth and natural anesthetics, improve mental alertness and prevent birth defects.

REFERENCES

Abbasi B.H., Rashid A., Khan M.A., Ali M., Shinwari Z.K., Ahmad N., Mahmood T., 2011. In vitro plant regeneration *Sinapis Alba* and evaluation of its radical scavenging activity. Pakistan Journal of Botany, 43: 21-27, https://doi.org/10.1007/s11240-010-9692-x.

Abenavoli L., Bellentani S., 2013. Milk thistle to treat non-alcoholic fatty liver disease: dream or reality? Expert Review of Gastroenterology and Heptaology, 7(8): 677-679, https://doi.org/10.1586/17474124.2013.842893.

Adebayo A.A., Oboh G., Ademosun A.O., 2019. Almond-supplemente diet improves sexual functions beyond phosphodiesterase-5 inhibition in diabetic male rats. Heliyon, 5: e03035, https://doi.org/10.1016/j.heliyon.2019.e03035.

Akbari M., Farajpour M., Aalifar M., Sadat Hosseini M., 2018. Gamma irradiation affects the total phenol, anthocyanin and antioxidant properties in three different Persian pistachio nuts. Natural Product Research, 32(3): 322-326, https://doi.org/10.1080/14786419.2017.1346647.

Akter J., Islam Md.Z., Takara K., Hossain Md.A., Sano A., 2019. Isolation and structural elucidation of antifungal compounds from Ryudai gold (*Curcuma longa*) against *Fusarium solani sensu lato* isolated from American manatee. Comparative Biochemistry and Physiology Part C: Toxicology and Pharmacology, 219: 87-94, https://doi.org/10.1016/j.cbpc.2019.02.011.

Albassam A.A., Frye R.F., Markowitz J.S., 2017. The effect of milk thistle (*Silybum marianum*) and its main flavonolignans on CYP2C8 enzyme activity in human liver microsomes.

Chemico-Biological Interactions, 271: 24-29, https://doi.org/10.1016/j.cbi.2017.04.025.

Al Harrasi A., Ali L., Hussain J., Rehman N.U., Mehjabeen Ahmed M., Al Rawahi A., 2014. Analgesic effects of crude extracts and fractions of Omani frankincense obtained from traditional medicinal plant *Boswelliasacra* on animal models. Asian Pacific Journal of Tropical Medicine, 7(Suppl 1): S485-S490, https://doi.org/10.1016/s1995-7645(14)60279-0.

Alhidary I.A., Rehman Z., Khan R.U., Tahir M., 2017. Anti-aflatoxin activities of milk thistle (*Silybum marianum*) in broiler. World 's Poultry Science Journal, 73(3): 559-566, https://doi.org/10.1017/s0043933917000514.

Al-Tikrity E.T.B., Fadhil A.B., Ibraheem K.K., 2017. Biodiesel production from bitter almond oil as new non-edible oil feedstock. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, 39(7): 649-656, https://doi.org/10.1080/15567036.2016.1243172.

Aliakbarkhani S.T., Farajpour M., Asadian A.H., Aalifar M., Ahmadi S., Akbari M., 2017. Variation of nutrients and antioxidant activity in seed and exocarp layer of some Persian pistachio genotypes. Annals of Agricultural Sciences, 62: 39-44, https://doi.org/10.1016/j.aoas.2017.01.003.

Alma M.H., Nitz S., Kollmannsberger H., et al., 2004. Chemical composition and antimicrobial activity of the essential oils from the gum of Turkish pistachio (*Pistacia vera* L.). Journal of Agricultural and Food Chemistry, 52: 3911-3914, https://doi.org/10.1021/jf040014e.

Alotaibi S.H., 2019. Biophysical properties and finger print of *Boswellia* Sp. Burseraceae. Saudi Journal of Biological Science, 26: 1450-1457, https://doi.org/10.1016/j.sjbs.2019.09.019.

Amatya G., Sthapit V.M., 1994. A note on *Nardostachys jatamansi*. Journal of Herbs, Spices and Medicinal Plants, 2(2): 39-47.

Arjeh E., Akhavan H.-R., Barzegar M., Carbonell-Barrachina A.A., 2020. Bio-active compounds and functional properties of pistachio hull: A review. Trends in Food Science and Technology, 97: 55-64, https://doi.org/10.1016/j.tifs.2019.12.031.

Arumugam P., Priya N.G., Subathra M., Ramesh A., 2008. Anti-inflammatory activity of four solvent fractions of ethanol extract of *Mentha spicata* L. investigated on acute and chronic. Environmental Toxicology and Pharmacology, 26(1): 92-95, https://doi.org/10.1016/j.etap.2008.02.008.

Asad M., Alhomoud M., 2016. Proulcerogenic effect of water extract of *Boswellia sacra* oleo gum resin in rats. Pharmaceutical Biology, 54(2): 225-230, https://doi.org/10.3109/13880209.2015.1028553.

Asbaghi O., Soltani S., Norouzi N., Milajerdi A., ChoobkarS., Asemi Z., 2019. The effect of saffron supplementation on blood glucose and lipid profile: A systematic review and meta-analysis of randomized controlled trials. Complementary Therapies in Medicine, 47: 102158, https://doi.org/10.1016/j.ctim.2019.07.017.

Barreca D., Nabavi S.M., Sureda A., Rasekhian M., Raciti R., Silva A.S., Annunziata G., Arnone A., Tenore G.C., Suntar I., Mandalari G., 2020. Almonds (*Prunus dulcis* Mill. D. A. Webb): A source of nutrients and health-promoting compounds. Nutrients, 12(672): 1-22, https://doi.org/10.3390/nu12030672.

Barros L., Duenas M., Dias M.I., Sousa M.J., Santos-Buelga C., Ferreira I.C.F.R. 2012. Phenolic profiles of *in vivo* and *in vitro* grown *Coriandrum sativum* L. Food Chemistry, 132(2): 841-848, https://doi.org/10.1016/j.foodchem.2011.11.048.

Behera R., Rath C.C., 2011. Evaluation of antibacterial activity of turmeric (*Curcuma longa* L.) leaf essential oils of three different states of India against *Shigella spp*. Journal of Biologically Active Products from Nature, 1(2): 125-131, https://doi.org/10.1080/22311866.2011.10719079.

Beheshti S., Skakakomi A.G., Ghaedi K., Dehestani H., 2018. Frankincense upregulates the hippocampal calcium/calmodulin kinase II-α during development of the rat brain and improves memory performance. International Journal of Developmental Neuroscience, 69: 44-48, https://doi.org/10.1016/j.ijdevneu.2018.06.011.

Besharat S., Besharat M., Jabbari A., 2009. Wild lettuce (*Lactuca virosa*) toxicity. BMJ Case Reports, 2009, https://doi.org/10.1136/bcr.06.2008.0134.

Bhardwaj R., Dod H., Sandhu M.S., Bedi R., Dod S., Konat G., Chopra H.K., Sharma R., Jain A.C., Nanda N., 2018. Acute effects of diets rich in almonds and walnuts on endothelial function. Indian Heart Journal, 70: 497-501, https://doi.org/10.1016/j.ihj.2018.01.030.

Bhattacharya S., 2020. Milk thistle seeds in health. In book: Nuts and seeds in health and disease prevention, 2020: 429-438, https://doi.org/10.1016/b978-0-12-818553-7.00030-9.

Boscaro V., Boffa L., Binello A., Amisano G., Fornasero S., Cravotto G., Gallicchio M., 2018. Antiproliferative, proapoptotic, antioxidant and antimicrobial effects of *Sinapis nigra* L and *Sinapis albal* L. extracts. Molecules, 23: 3004, https://doi.org/10.3390/molecules23113004.

Brandon-Warner E., Eheim A.L., Foureau D.M., Walling T.L., Schrum L.W., McKillop I.H., 2012. Silibinin (Milk Thistle) potentiates ethanol-dependent hepatocellular carcinoma progression in male mice. Cancer Letters, 326(1): 88-95, https://doi.org/10.1016/j.canlet.2012.07.028.

Bravo-Nunez A., Golding M., McGhie T.K., Gomez M., Matia-Merino L., 2019. Emulsification properties of garlic aqueous extract. Food Hydrocolloids, 93: 111-119, https://doi.org/10.1016/j.foodhyd.2019.02.029.

Butt M.S., Sultan M.T., Butt M.S., Iqbal J., 2009. Garlic: Nature 's protection against physiological threats. Critical Reviews in Food Science and Nutrition, 49(6): 538-551, https://doi.org/10.1080/10408390802145344.

Cardone L., Castronuovo D., Perniola M., Cicco N., Candido V., 2020. Saffron (*Crocus sativus* L.), the king of spices: An overview. Scientia Horticulturae, 272: 109560, https://doi.org/10.1016/j.scienta.2020.109560.

Ceribasi S., Turk G., Ozcelik M., Dogan G., Ceribasi A.O., Mutlu S.I., Erisir Z., Guvenc M., Gungoren G., Acisu T.C., Akarsu S.A., Kaya S.O., Sonmez M., Yuce M., Yuce A., Ciftci M., Cambay Z., Bagci E., Azman M.A., Simsek U.G., 2020. Negative effect of feeding with high energy diets on testes and metabolic blood parameters of make Japanese quails, and positive role of milk thistle seed. Theriogenology, 144: 74-81, https://doi.org/10.1016/j.theriogenology.2019.12.021.

Chaaban A., Richardi V.S., Carrer A.R., Brum J.S., Cipriano R.R., Martings C.E.N., Silva M.A.N., Deschamps C., Molento M.B., 2019. Insecticide activity of *Curcumalonga* (leaves) essential oil and its major compound α-phellandrene against *Lucilia cuprina* larvae (Diptera: Calliphoridae): Histological and ultrastructural biomarkers assessment. Pesticide Biochemistry and Physiology, 153: 17-27, https://doi.org/10.1016/j.pestbp.2018.10.002.

Choudhary P.R., Jani R.D., Sharma M.S., 2018. Effect of raw crushed garlic (*Allium sativum* L.) on components of metabolic syndrome. Journal of Dietary Supplements, 15(4): 499-506, https://doi.org/10.1080/19390211.2017.1358233.

Chung I.-M., Ahmad A., Kim E.-H., Kim S.-H., Jung W.-S., Kim J.-H., Nayeem A., Nagella P., 2012. Immunotoxicity activity from the essential oils of coriander (*Coriandrum sativum*) seeds. Immunopharmacology and Immunotoxicology, 34(3): 499-503, https://doi.org/10.3109/08923973.2011.637500.

Cooksey C.J., 2017. Turmeric: old spice, new spice. Biotechnic and Histochemistry, 92(5): 309-314, https://doi.org/10.1080/10520295.2017.1310924.

Cui H., Shahrajabian M.H., Kuang Y., Zhang H., Sun W., 2023. Heterologous expression and function of cholesterol oxidase: A review. Protein and Peptide Letters, 30(7): 531-540, https://doi.org/10.2174/0929866530666230525162545.

Da Mata I.R., Da Mata S.R., Menezes R.C.R., Faccioli L.S., Bandeira K.K., Bosco S.M.D., 2020. Benefits of turmeric supplementation for skin health in chronic diseases: a systematic review. Critical Reviews in Food Science and Nutrition, 61(20): 3421-3435, https://doi.org/10.1080/10408398.2020.1798353.

Dao T.T., Nguyen P.H., Won H.K., Kim E.H., Park J., Won B.Y., Oh W.K., 2012. Curcuminoids from *Curcuma longa* and their inhibitory activities on influenza A neuraminidases. Food Chemistry, 134(1): 21-28, https://doi.org/10.1016/j.foodchem.2012.02.015.

Davis P.A., Iwahashi C.K., 2001. Whole almonds and almond fractions reduce aberrant crypt foci in a rat model of colon carcinogenesis. Cancer Letters, 165(1): 27-33, https://doi.org/10.1016/s0304-3835(01)00425-6.

Demirkoz A.B., Karakas M., Bayramoglu P., Uner M., 2018. Analysis of volatile flavor components by dynamic headspace analysis/gas chromatography-mass spectrometry in roasted pistachio extracts using supercritical carbon dioxide extraction and sensory analysis. International Journal of Food Properties, 21(1): 973-982, https://doi.org/10.1080/10942912.2018.1466322.

De Sousa E.Y., Da Silva F.F.M., De Sourza M.O., Ferreira D.A., De Lemos T.L.G., Monte F.J.Q., 2019. Preparation of chiral alchohols by enantioselective reduction of prochiral ketones with *Sinapis alba* seeds as biocatalyst. Industrial Crops and Products, 141: 111729, https://doi.org/10.1016/j.indcrop.2019.111729.

Duran Blanco M., Arias Palacios J., Rodriguez Aguirre O., 2017. Determination of the antifungal capacity of total extracts of *Sinapis alba* L. by the method of plates and wells. Asian Journal of Science and Technology, 8(12): 7197-7200.

Ejaz S., Chekarova I., Cho J.W., Lee S.Y., Ashraf S., Lim C.W., 2009. Effect of aged garlic extract on wound healing: A new frontier in wound management. Drug and Chemical Toxicology, 32(3): 191-203, https://doi.org/10.1080/01480540902862236.

Elansary H.O., Ashmawy N.A., 2013. Essential oils of mint between benefits and hazards. Journal of Essential Oil Bearing Plants, 16(4): 429-438, https://doi.org/10.1080/0972060x.2013.813279.

El Caid M.B., Salaka L., El Merzougui S., Lachguer K., Lagram K., El Mousadik A., Serghini M.A., 2020. Multi-site evaluation of the productivity among saffron (*Crocus sativus* L.) for clonal selection purposes. Journal of Applied Research on Medicinal and Aromatic Plants, 17: 100248, https://doi.org/10.1016/j.jarmap.2020.100248.

El-Gazayerly O.N., Makhlouf A.I.A., Soelm A.M.A., Mohmoud M.A., 2014. Antioxidant and hepatoproective effects of silymarin phytosomes compared to milk thistle extract in CCl_4 induced hepatotoxicity in rats. Journal of Microencapsulation, 31(1): 23-30, https://doi.org/10.3109/02652048.2013.805836.

El-Nagerabi S.A.F., Elshafie A.E., Alkhanjari S.S., Al-Bahry S.N., Elamin M.R., 2013. Biological activities of *Boswellia* sacra extracts on the growth and aflatoxins secretion of two aflatoxigenic species of Aspergillu species. Food Control, 34(2): 763-769, https://doi.org/10.1016/j.foodcont.2013.06.039.

Eshaghian R., Mazaheri M., Ghanadian M., Rouholamin S., Feizi A., Babaeian M., 2019. The effect of frankincense (*Boswellia serrata*, oleoresin) and ginger (*Zingiber officinale*, rhizome) on heavy menstrual bleeding: A randomized, placebo-controoled, clinical trial. Complementary Therapies in Medicine, 42: 42-47, https://doi.org/10.1016/j.ctim.2018.09.022.

Eshete A., Sterck F.J., Bongers F., 2012. Frankincense production is detrmined by tree size and trapping frequency and intensity. Forest Ecology and Management, 274: 136-142, https://doi.org/10.1016/j.foreco.2012.02.024.

Farag M.A., Hegazi N., Dokhalahy E., Khattab A.R., 2020. Chemometrics based GC-MS aroma profiling for revealing freshness, origin and roasting indices in saffron spice and its adulteration. Food Chemistry, 331: 127358, https://doi.org/10.1016/j.foodchem.2020.127358.

Fekri M., Gharanjig L., Soliemanzadeh A., 2015. Responses of growth and chemical composition of pistachio seedling to phosphorus fertilization under saline conditions. Journal of Plant Nutrition, 38(12): 1836-1848, https://doi.org/10.1080/01904167.2015.1043375.

Fekri M., Gharanjig L., Soleimanzadeh A., 2016. Effects of salinity and pistachio waste application on growth and physiological responses of pistachio seedlings. Communications in Soil Science and Plant Analysis, 47(1): 112-120, https://doi.org/10.1080/00103624.2015.1103253.

Fernandes M.G., Cervi C.B., De Carvalho R.A., Lapa-Guimaraes J., 2017. Evaluation of tuermeric extract as an antioxidant for frozen streaked prochilod (*Prochilodus lineatus*) fillets. Journal of Aquatic Food Product Technology, 26(9): 1057-1069, https://doi.org/10.1080/10498850.2017.1376025.

Fimognari C., Hrelia P., 2007. Sulforaphane as a promising molecule for fighting cancer. Mutation Research, 635: 90-104, https://doi.org/10.1016/j.mrrev.2006.10.004.

Fleisher Z., Fleisher A., 1992. The odoriferous principles of Mandrake, *Mandragora officinaum* L. Journal of Essential Oil Research, 4(2): 187-188, https://doi.org/10.1080/10412905.1992.9698041.

Frank M.B., Yang Q., Osban J., Azzarello J.T., Saban M.R., Saban R., Ashley R.A., Welter J.C., Fung K.-M., Lin H.-K., 2009. Frankincense oil derived from *Boswellia carteri* induces tumor cell specific cytotoxicity. BMC Complementary and Alternative Medicine, 9(6): 1-11, https://doi.org/10.1186/1472-6882-9-6.

Gajc-Wolska J., Kowalczyk K., Nowecka M., Mazur K., Metera A., 2012. Effect of organic-mineral fertilizers on the yield and quality of endive (*Cichorium endivia* L.). Acta Scientiarum Polonorum Hortum Cultus, 11(3): 189-200.

Ghaderi A., Asbaghi O., Reiner Z., Kolahdooz F., Amirani E., Mirzaei H., Banafshe H.R., Dana P.M., Asemi Z., 2020. The effects of saffron (*Crocus sativus* L.) on mental health parameters and C-reactive protein: A meta-analysis of randomized clinical trials. Complementary Therapies in Medicine, 48: 102250, https://doi.org/10.1016/j.ctim.2019.102250.

Ghazaghi M., Mehri M., Bagherzadeh-Kasmani F., 2014. Effects of dietary *Mentha spicata* on performance, blood metabolites, meat quality and microbial ecosystem of small intestine in growing Japanese quail. Animal Feed Science and Technology, 194: 89-98, https://doi.org/10.1016/j.anifeedsci.2014.04.014.

Haffor A.-S.A. 2010. Effect of myrrh (*Commiphora molmol*) on leukocyte levels before and during healing from gastric ulcer or skin injury. Journal of Immunotoxicology, 7(1): 68-75, https://doi.org/10.3109/15476910903409835.

Hamidpour R., Hamidpour S., Hamidpour M., Shahlari M., 2013. Frankincense (Ru Xiang; *Boswellia* Species): from the selection of traditional applications to the novel phytotherapy for the prevention and treatment of serious diseases. Journal of Traditional and Complementary Medicine, 3(4): 221-226, https://doi.org/10.4103/2225-4110.119723.

Hammami H., Saadatian B., Hosseini S.A.H., 2020. Geographical variation in seed germination and biochemical response of milk thistle (*Silybum marianum*) ecotypes exposed to osmotic and salinity stresses. Industrial Crops and Products, 152: 112507, https://doi.org/10.1016/j.indcrop.2020.112507.

Han X., Parker T.L., 2017. Antiinflammatory activity of cinnamon (*Cinnamomum zeylanicum*) bark essential oil in a human skin disease model. Phytotherapy Research, 31: 1034-1038, https://doi.org/10.1002/ptr.5822.

Hanus L.O., Rezanka T., Spizek J., Dembitsky V.M., 2005. Substances isolated from *Mandragora* species. Phytochemistry, 66(20): 2408-2417, https://doi.org/10.1016/j.phytochem.2005.07.016.

Hashem F.M., Massoud A.M.A., Melokheya A.M., Emad H., El-Fattah Badr K.A., Dawoud M., 2013. Formulation and clinical efficacy of myrrh extract in hard gelatin capsules. Journal of Biologically Active Products from Nature, 3(1): 72-86, https://doi.org/10.1080/22311866.2013.782763.

Henkel A., Kather N., Monch B., Northoff H., Jauch J., Werz O., 2012. Boswellic acids from frankincense inhibit lipopolysaccharide functionality through direct molecular interference. Biochemical Pharmacology, 83(1): 115-121, https://doi.org/10.1016/j.bcp.2011.09.026.

Hernandez-Alonso P., Salas-Salvado J., Baldrich-Mora M., Juanola-Falgarona M., Bullo M., 2014. Beneficial effect of pistachio consumption on glucose metabolism, insulin resistance, inflammation, and related metabolic risk markers: a randomized clinical trial. Diabetes Care, 37(11): 3098-3105, https://doi.org/10.2337/dc14-1431.

Hijazi A., Al-Jaroudi D., 2017. Myrrh for treatment of severe vulvar edema in ovarian hyperstimulation syndrome. Case Reports in Women ׳s Health, 15: 8-10, https://doi.org/10.1016/j.crwh.2017.06.002.

Hirata R., Matsushita S., 1996. Reducing activity level of Alliin. Bioscience, Biotechnology and Biochemistry, 60(3): 484-485, https://doi.org/10.1271/bbb.60.484.

Hosain N.A., Ghosh R., Bryant D.L., Arivett B.A., Farone A.L., Kline P.C., 2019. Isolation, structure elucidation, and immunostimulatory activity of polysaccharide fractions from *Boswellia carterii* frankincense resin. International Journal of Biological Macromolecules, 133: 76-85, https://doi.org/10.1016/j.ijbiomac.2019.04.059.

Hosseini S.A., Zilaee M., Shoushtari M.H., Ghasemi dehcheshmeh M., 2018. An evaluation of the effect of saffron supplementation on the antibody titer to heat-shock protein (HSP) 70, hs CRP and spirometry test in patients with mild and moderate persistent allergic asthma: A triple-blind, randomized placebo-controlled trial. Respiratory Medicine, 145: 28-34, https://doi.org/10.1016/j.rmed.2018.10.016.

Huang L., Zhang W., Cheng J., Lu Z., 2019. Antioxidant and physicochemical properties of soluble dietary from garlic straw as treated by energy-gathered ultrasound. International Journal of Food Properties, 22(1): 678-688, https://doi.org/10.1080/10942912.2019.1600544.

Ibrahim M.M., El-Bahr M.K., Rady M.R., 2019. *In vitro* adventitious root production of *Cichorium endivia* L. and antioxidants, total phenolic and total flavonoids assessments. Egyptian Pharmaceutical Journal, 18: 216-227, https://doi.org/10.4103/epj.epj_7_19.

Jacobs B.P., Dennehy C., Ramirez G., Sapp J., Lawrence V.A., 2002. Milk thistle for the treatment of liver disease: A systematic review and meta-analysis. The American Journal of Medicine, 113(6): 506-515, https://doi.org/10.1016/j.hermed.2016.06.002.

Jankowski K.J., Zaluski D., Sokolski M., 2020. Canola-quality white mustard: Agronomic management and seed yield. Industrial Crops and Products, 145: 112138, https://doi.org/10.1016/j.indcrop.2020.112138.

Jasim M.A., Ibrahim F.M., Khalifa N.H., 2019. Evaluation of the cytotoxic effects of *Boswellia sacra* and *Origanum majorana* against mice lymphocytes and RD cell lines *in vitro*. Iraq Medical Journal, 3(1): 23-26.

Jayarambabu N., Akshaykranth A., Venkatappa Rao T., Venkateswara Rao K., Kumar R.R., 2020. Green synthesis of Cu nanoparticles using *Curcuma longa* extract and their application in antimicrobial activity. Materials Letters, 259: 126813, https://doi.org/10.1016/j.matlet.2019.126813.

Joukar S., Ghasemipour-Afshar E., Sheibani M., Naghsh N., Bashiri A., 2013. Protective effects of saffron (*Crocus sativus*) against lethal ventricular arrhythmias induced by heart reperfusion in rat: A potential anti-arrhythmic agent. Pharmaceutical Biology, 51(7): 836-843, https://doi.org/10.3109/13880209.2013.767362.

Kamel Z.H., Daw I., Marzouk M., 2011. Effect of *Cichorium endivia* leaves on some biochemical parameters in streptozotocin-induced diabetic rats. Australian Journal of Basic and Applied Sciences, 5(7): 387-396.

Karimi-Nazari E., Nadjarzadeh A., Masoumi R., Marzban A., Mohajeri S.A., Ramezani-Jolfaie N., Salehi-Abargouei A., 2019. Effect of saffron (*Crocus sativus* L.) on lipid profile, glycemic indices and antioxidant status among overweight/obese prediabetic individuals: A double-blinded, randomized controlled trial. Clinical Nutrition ESPEN, 34: 130-136, https://doi.org/10.1016/j.clnesp.2019.07.012.

Kaur A., Pareek R.K., (2018). An insight of *Nardostachys jatamansi* (Valerianaceae): A review. Journal of Emerging Technologies and Innovative Research, 5(11): 516-525.

Khani A., Rahdari T., 2012. Chemical composition and insecticidal activity of essential oil from Coriandrum sativum seeds against *Tribolium confusum* and *Callosobruchus maculates*. ISRN Pharmacology, 2012: 1-5, https://doi.org/10.5402/2012/263517.

Khorasanchi Z., Shafiee M., Kermanshahi F., Khazari M., Ryzhikov M., Parizadeh M.R., Kermanshahi B., Ferns G.A., Avan A., Hassanian S.M., 2018. *Crocus sativus* a natural food coloring and flavoring has potent anti-tumor properties. Phytomedicine, 43: 21-27, https://doi.org/10.1016/j.phymed.2018.03.041.

Kiasalari Z., Roghani M., Khalili M., Rahmati B., Baluchnejadmojarad T., 2013. Antiepileptogenic effect of curcumin on kainate-induced model of temporal lobe epilepsy. Pharmaceutical Biology, 51(12): 1572-1578, https://doi.org/10.3109/13880209.2013.803128.

Kim H.J., Yoo H.S., Kim J.C., Park C.S., Choi M.S., Kim M., Choi H., Min J.S., Kim Y.S., Yoon S.W., Ahn J.K., 2009. Antiviral effect of *Curcuma longa* Linn extact against hepatitis B virus replication. Journal of Ethnopharmacology, 124(2): 189-196, https://doi.org/10.1016/j.jep.2009.04.046.

Kim J.Y., Kim J.Y., Jenis J., Li Z.P., Ban Y.J., Baiseitova A., Park K.H., 2019. Tyrosinase inhibitory study of flavonolignans from the seeds of *Silybum marianum* (Milk thistle). Bioorganic and Medicinal Chemistry, 27(12): 2499-2507, https://doi.org/10.1016/j.bmc.2019.03.013.

Kofidis G., Bosabalidis A., Kokkini S., 2004. Seasonal variation of essential oils in a linalool-rich chemotype of *Mentha spicata* grown wild in Greece. Journal of Essential Oil Research, 16(5): 469-472, https://doi.org/10.1080/10412905.2004.9698773.

Kostic M.D., Djalovic I.G., Stamenkovic O.S., Mitrovic P.M., Adamovic D.S., Kulina M., Veljkovic V.B., 2018. Kinetic modeling and optimization of biodiesel production from white mustard (*Sinapis alba* L.) seed oil by quicklime-catalyzed transesterification. Fuel, 223: 125-139, https://doi.org/10.1016/j.fuel.2018.03.023.

Koudela M., Petrikova K., 2007. Nutritional composition and yield of endive cultivars- *Cichorium endivia* L. HortScience, 34(1): 6-10, https://doi.org/10.17221/1848-hortsci.

Kumar R., Singh V., Devi K., Sharma M., Singh M.K., Ahuja P.S., 2008. State of art of saffron (*Crocus sativus* L.) Agronomy: A comprehensive review. Food Reviews International, 25(1): 44-85, https://doi.org/10.1080/87559120802458503.

Lee T.W., Bae E., Kim J.H., Jang H.N., Cho H.S., Chang S.-H., Park D.J., 2019. The aqueous extract of aged black garlic ameliorates colistin-induced acute kidney injury in rats. Renal Failure, 41(1): 24-33, https://doi.org/10.1080/0886022x.2018.1561375.

Le Q.-U., Lay H.-L., Wu M.-C., Joshi R.K., 2018. Phytoconstituents and pharmacological activities of *Silybum marianum* (Milk Thistle): A critical review. American Journal of Essential Oils and Natural Products, 6(4): 41-47.

Li Z., Bhagavathula A.S., Batavia M., Clark C., Abdulazeem H.M., Rahmani J., Yin F., 2020. The effect of almonds consumption on blood pressure: A systematic review and dose-response meta-analysis of randomized control trials. Journal of King Saud University Science, 32: 1757-1763, https://doi.org/10.1016/j.jksus.2020.01.013.

Lv Y., So K.-F., Wong N.-K., Xiao J., 2019. Anti-cancer activities of S-allylmercaptocysteine from aged garlic. Chinese Journal of Natural Medicines, 17(1): 43-49, https://doi.org/10.1016/s1875-5364(19)30008-1.

Ma X., Gang D.R., 2006. Metabolic profiling of turmeric (*Curcuma longa* L.) plants derived from in vitro micropropagation and conventional greenhouse cultivation. Journal of Agricultural and Food Chemistry, 54(25): 9573-9583, https://doi.org/10.1021/jf061658k.

Maghrani M., Zeggwagh N.A., Lemhadri A., El Amraoui M., Michel J.B., Eddouks M., 2004. Study of the hypoglycaemic activity of Fraxinus excelsior and *Silybummarianum* in an animal model of type 1 diabetes mellitus. Journal of Ethnopharmacology, 91: 309-316, https://doi.org/10.1016/j.jep.2004.01.008.

Maguire L.S., O'Sullivan S.M., O'Connor T.P., O'Brien N.M., 2004. Fatty acid profile, tocopherol, squalene and phytosterol content of walnuts, almonds, peanuts, hazelnuts and the macadamia nut. International Journal of Food Sciences and Nutrition, 55(3): 171-178, https://doi.org/10.1080/09637480410001725175.

Mahboubi M., Kashani L.M.T., 2016. The anti-dermatophyte activity of *Commiphora molmol*. Pharmaceutical Biology, 54(4): 720-725, https://doi.org/10.3109/13880209.2015.1072831.

Mahboubi M., 2017. *Mentha spicata* as natural analgesia for treatment of pain in osteoarthritis patients. Complementary Therapies in Clinical Practice, 26: 1-4, https://doi.org/10.1016/j.ctcp.2016.11.001.

Mani M.P., Jaganathan S.K., 2019. Physicochemical and blood compatibility characteristics of garlic incorporated polyurethane nanofibrous scaffold for wound dressing applications. The Journal of Textile Institute, 110(11): 1615-1623, https://doi.org/10.1080/00405000.2019.1610145.

Mariano T.B., Higashi B., Lopes S.M.S., Carneiro J.W.P., Almeida R.T.R.D., Pilau E.J., Goncalves J.E., Goncalves R.A.C., Oliveira A.J.B.D., 2020. Prebiotic fructooligosaccharides obtained from escarole (*Cichorium endivia* L.) roots. Bioactive Carbohydrates and Dietary Fibre, 24: 100233, https://doi.org/10.1016/j.bcdf.2020.100233.

Masoud A., Al-Ghazali M., Al-Futini F., Al-Mansori A., Al-Subahi A., Farhan A., Al-Sharafi M., Al-absi R., Al-Matari S., 2017. Antioxidant effect of frankincense extract in the brain cortex of diabetic rats. Journal of the Association of Arab Universities for Basic Applied Sciences, 24: 95-100, https://doi.org/10.1016/j.jaubas.2016.10.003.

Maurya S., Singh A., Mishra A., Singh U.P., 2011. *Taphrina maculans* reduces the therapeutic value of turmetic (*Curcuma longa*). Archives of Phytopathology and Plant Protection, 44(2): 1142-1146, https://doi.org/10.1080/03235408.2010.482740.

Mir M.A., Ganai S.A., Mansoor S., Jan S., Mani P., Masoodi K.Z., Amin H., Rehman M.U., Ahmad P., 2020. Isolation, purification and characterization of naturally derived crocetin beta-D-glucosyl ester from *Crocus sativus* L. against breast cancer and its binding chemistry with ER-alpha/HDAC2. Saudi Journal of Biological Science, 27: 975-984, https://doi.org/10.1016/j.sjbs.2020.01.018.

Mitrovic P.M., Stamenkovic O.S., Bankovic-Ilic I., Djalovic I.G., Njezic Z.B., Farooq M., Siddique K.H.M., Veljkovic V.B., 2020. White mustard (*Sinapis alba* L.) oil in biodiesel production: A review. Frontiers in Plant Science, 11: 299, https://doi.org/10.3389/fpls.2020.00299.

Mobasseri M., Ostadrahimi A., Tajaddini A., Asghari S., Barati M., Akbarzadeh M., Nikpayam O., Houshyar J., Roshanravan N., Alamdari N.M., 2020. Effects of saffron supplementation on glycemia and inflammation in patients with type 2 diabetes mellitus: A randomized double-blind, placebo-controlled clinical trial study. Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14(4): 527-534, https://doi.org/10.1016/j.dsx.2020.04.031.

Mohamed A.A., Ali S.I., Kabiel H.F., Hegazy A.K., Kord M.A., El-Baz F.K., 2015. Assessment of antioxidant and antimicrobial activities of essential oil and extracts of *Boswellia carteri* resin. International Journal of Pharmacognosy and Phytochemical Research, 7(3): 502-509.

Moosavian S.P., Arab A., Paknahad Z., Moradi S., 2020. The effects of garlic supplementation on oxidative stress markers: A systematic review and meta-analysis of randomized controlled trials. Complementary Therapies in Medicine, 50: 102385, https://doi.org/10.1016/j.ctim.2020.102385.

Morra M.J., Popova I.E., Boydston R.A., 2018. Bioherbicidal activity of *Sinapis alba*seed meal extracts. Industrial Crops and Products, 115: 174-181, https://doi.org/10.1016/j.indcrop.2018.02.027.

Mullins M.E., Horoqitz B.Z., 1998. The case of the salad shooters: intravenous of wild lettuce extract. Veterinary and Human Toxicology, 40: 290-291.

Mumin F.I., Emikpe B.O., Odeniyi M.A., 2020. Evaluation of mucoadhesive property and the effect of *Boswellia carteri* gum on intranasal vaccination against small ruminant morbillivirus infection (PPR). Journal of Immunoassay and Immunochemistry, 41(3): 311-321, https://doi.org/10.1080/15321819.2020.1734935.

Mustafa R., Blumenthal E., 2017. Immunomodulatory effects of turmeric: proliferation of spleen cells in mice. Journal of Immunoassay and Immunochemistry, 38(2): 1401-146, https://doi.org/10.1080/15321819.2016.1227835.

Nabarlatz D., Montane D., Kardosova A., Bekesova S., Hribalova V., Ebringerova A., 2007. Almond shell xylo-oligosaccharides exhibiting immunostimulatory activity. Carbohydrate Research, 342(8): 1122-1128, https://doi.org/10.1016/j.carres.2007.02.017.

Nadeem M., Anjum F.M., Khan M.I., Tehseen S., El-Ghorab A., Sultan J.I., 2013. Nutritional and medicinal aspects of coriander (*Coriandrum sativum* L.): a review. British Food Journal, 115(5): 743-755, https://doi.org/10.1108/00070701311331526.

Nakamura Y., Hasegawa Y., Shirota K., Suetome N., Nakamura T., Chomnawang M.T., Thirapanmethee K., Khuntayaporn P., Boonyaritthongchai P., Wongs-Aree C., Okamoto S., Shigeta T., Matsu T., Park E.Y., Sato K., 2014. Differentiation-inducing effects of piperitenone oxide, a fragrant ingredient of spearmint (*Mentha spicata*), but not carvone and menthol, against human colon cancer cells. Journal of Functional Foods, 8: 62-67, https://doi.org/10.1016/j.jff.2014.03.005.

Nakoti S.S., Juyal D., Josh A.K., 2017. A review on pharmacognostic and phytochemical study of a plant *Nardostachys Jatamansi*. The Pharma Innovation Journal, 6(7): 936-941.

Nguyen Q.-H., Talou T., Evon P., Cerny M., Merah O., 2020. Fatty acid composition and oil content during coriander fruit development. Food Chemistry, 326: 127034, https://doi.org/10.1016/j.foodchem.2020.127034.

Ni X., Suhail M.M., Yang Q., Cao A., Fung K.-M., Postier R.G., Woolley C., Young G., Zhang J., Lin H.-K., 2012. Frankincense essential oil prepared from hydrodistillation of *Boswellia sacra* gum resins induces human pancreatic cancer cell death in cultures and in a xenograft murine model. BMC Complementary and Alternative Medicine, 12(253): 1-14, https://doi.org/10.1186/1472-6882-12-253.

Niebler J., Buettner A., 2015. Identification of odorants in frankincense (*Boswelliasacra* Flueck.) by aroma extract dilution analysis and two-dimensional gas chromatography-mass spectrometry/olfactometry. Phytochemistry, 109: 66-75, https://doi.org/10.1016/j.phytochem.2014.10.030.

Omer E.A., Refaat A.M., Ahmed S.S., Kamel A., Hammouda F.M., 1993. Effect of spacing and fertilization on the yield and active constituents of milk thistle, *Silybum marianum*. Journal of Herbs, Spices and Medicinal Plants, 1(4): 17-23, https://doi.org/10.1300/j044v01n04_04.

Orekhov A.N., Tertov V.V., Sobenin I.A., Pivovarova E.M., 1995. Direct anti-atherosclerosis-related effects of garlic. Annals of Medicine, 27(1): 63-65, https://doi.org/10.3109/07853899509031938.

Parizad S., Dizadji A., Habibi M.K., Winter S., Kalantari S., Movi S., Tendero C.L., Alondo G.L., Moratalla-Lopez N., 2019. The effects of geographical origin and virus infection on the saffron (*Crocus sativus* L.) quality. Food Chemistry, 295: 387-394, https://doi.org/10.1016/j.foodchem.2019.05.116.

Parray J.A., Kamili A.N., Hamid R., Reshi Z.A., Qadri R.A., 2015. Antibacterial and antioxidant activity of methanol extracts of *Crocus sativus* L. c.v. Kashmirianus. Front Life Sciences, 8(1): 40-46, https://doi.org/10.1080/21553769.2014.951774.

Paroni R., Dei Cas M., Rizzo J., Ghidoni R., Montagna M.T., Rubino F.M., Iriti M., 2019. Bioactive phytochemicals of tree nuts. Determination of the melatonin and sphingolipid content in almonds and pistachios. Journal of Food Compost Anal, 82: 103227, https://doi.org/10.1016/j.jfca.2019.05.010 .

Patel S., Sarwat M., Khan T.H., 2017. Mechanism behind the anti-tumour potential of saffron (*Crocus sativus* L.): The molecular perspective. Critical Reviews in Oncology/Hematology, 115: 27-35, https://doi.org/10.1016/j.critrevonc.2017.04.010.

Pavela R., Maggi F., Giordani C., Cappellacci L., Petrelli R., Canale A., 2020. Insecticidal activity of two essential oils used in perfumery (ylang ylang and frankincense). Natural Product Research, 35(22): 4746-4752, https://doi.org/10.1080/14786419.2020.1715403.

Piletti R., Zanetti M., Jung G., De Mello J.M.M., Dalcanton F., Soares C., Riella H.G., Fiori M.A., 2019. Microencapsulation of garlic oil by β-cyclodextrin as a thermal protection method for antibacterial action. Materials Science and Engineering: C 94: 139-149, https://doi.org/10.1016/j.msec.2018.09.037.

Pintado C., Miguel A., De-Acevedo O., Nozal L., Luis J., 2011. Bactericidal effect of saffron (*Crocus sativus* L.) on Salmonella enterica during storage. Food Control, 22: 638-642, https://doi.org/10.1016/j.foodcont.2010.09.031.

Popova I.E., Morra M.J., 2018. *Sinapis alba* seed meal as feedstock for extracting the natural tyrosinase inhibitor 4-hydroxybenzyl alcohol. Industrial Crops and Products, 124: 505-509, https://doi.org/10.1016/j.indcrop.2018.07.083.

Purev U., Chung M.J., Oh D.-H., 2012. Individual differences on immunostimulatory activity of raw and black garlic extract in human primary immune cells. Immunopharmacology and Immunotoxicology, 34(4): 651-660, https://doi.org/10.3109/08923973.2011.649288.

Qurishi Y., Hamid A., Zargar M.A., Singh S.K., Saxena A.K., 2010. Potential role of natural molecules in health and disease: Importance of boswellic acid. Journal of Medicinal Plants Research, 4(25): 2778-2785.

Rahman M.S., Al-Sheibani H.I., Al-Riziqi M.H., Mothershaw A., Guizani N., Bengtsson G., 2006. Assessment of the antimicrobial activity of dried garlic powders produced by different methods of drying. International Journal of Food Properties, 9(3): 503-513, https://doi.org/10.1080/10942910600596480.

Ramirez D.A., Altamirano J.C., Camargo A.B., 2021. Multiphytochemical determination of polar and non-polar garlic bioactive compounds in different food and nutraceutical preparations. Food Chemistry, 337: 127648, https://doi.org/10.1016/j.foodchem.2020.127648.

Rahman M.S., 2007. Allicin and other functional active components in garlic: Health benefits and bioavailability. International Journal of Food Properties, 10(2): 245-268, https://doi.org/10.1080/10942910601113327.

Rahmani G., Farajdokht F., Mohaddes G., Babri S., Ebrahimi V., Ebrahimi H., 2020. Garlic (*Allium sativum*) improves anxiety- and depressive-related behaviors and brain oxidative stress in diabetic rats. Archives of Physiology and Biochemistry, 126(2): 95-100, https://doi.org/10.1080/13813455.2018.1494746.

Ramasany K., Agrarwal R., 2008. Mutitargeted therapy of cancer by silymarin. Cancer Letters, 269(2): 352-362, https://doi.org/10.1016/j.canlet.2008.03.053.

Reddy C.N., Bharate S.B., Vishwakarma R.A., Bharate S.S., 2020. Chemical analysis of saffron by HPLC based crocetin estimation. Journal of Pharmaceutical and Biomedical Analysis, 181: 113094, https://doi.org/10.1016/j.jpba.2020.113094.

Ricciutelli M., Nzekoue F.K., Caprioli G., Sagratini G., Alesi A., Vici G., Polzonetti V., 2020. Study of the effect of marination treatment on garlic bioactive compounds through an innovative HPLC-DAD-MS method for alliin and curcuminoids analysis. LWT, 131: 109788, https://doi.org/10.1016/j.lwt.2020.109788.

Roy N.K., Parama D., Banik K., Bordoloi D., Khwairakpam Devi A., Thakur K.K., Padmavathi G., Shakibaei M., Fan L., Sethi G., Kunnumakkara A.B., 2019. An update on pharmacological potential of boswellic acids against chronic diseases. International Journal of Molecular Sciences, 20(4101): 1-27, https://doi.org/10.3390/ijms20174101.

Sahan A., Bozkurt H., 2020. Effects of harvesting time and irrigation on aroma active compounds and quality parameters of pistachio. Scientia Horticulturae, 261: 108905, https://doi.org/10.1016/j.scienta.2019.108905.

Salama H.E., Abdel Aziz M.S., Sabaa M.W., 2019. Development of antibacterial carboxymethyl cellulose/chitosan biguanidine hydrochloride edible films activated with frankincense essential oil. International Journal of Biological Macromolecules, 139: 1162-1167, https://doi.org/10.1016/j.ijbiomac.2019.08.104.

Sami D.G., Abdellatif A., Azzazy H.M.E., 2020. Turmeric/oregano formulations for treatment of diabetic ulcer wounds. Drug Development and Industrial Pharmacy, 46(10): 1613-1621, https://doi.org/10.1080/03639045.2020.1811305.

Sarfarazi M., Jafari S.M., Rajabzadeh G., Galanakis C.M., 2020. Evaluation of microwave-assisted extraction technology for separation of bioactive components of saffron (*Crocus sativus* L.). Industrial Crops and Products, 145: 111978, https://doi.org/10.1016/j.indcrop.2019.111978.

Sathishkumar P., Preethi J., Vijayan R., Yusoff A.R.M., Ameen F., Suresh S., Balagurunathan R., Palvannan T., 2016. Anti-acne, anti-dandruff and anti-breast cancer efficacy of green synthesized silver nanoparticles using *Coriandrum sativum* leaf extract. Journal of Photochemistry and Photobiology B Biology, 163: 69-76, https://doi.org/10.1016/j.jphotobiol.2016.08.005.

Satyla P., Chhetri B.K., Dosoky N.S., Poudel A., Setzer W.N., 2015. Chemical composition of *Nardostachysgrandiflora* rhizome oil from Nepal- A contribution to the chemotaxonomy and bioactivity of *Nardostachys*. Natural Product Communication, 10(6): 1067-1070, https://doi.org/10.1177/1934578x1501000668.

Schlesinger D., Rikanati R.D., Volis S., Faigenboim A., Vendramin V., Cattonaro F., Hooper M., Oren E., Taylor M., Sitrit Y., Inbar M., Lewinsohn E., 2010. Alkaloid chemodiversity in *Mandragora* spp. is associated with losee-of-functionality of *MoH6H*, a hyoscyamine 6β-hydroxylase gene. Plant Science, 283: 301-310, https://doi.org/10.1016/j.plantsci.2019.03.013.

Shabani E., Sayemiri K., Mohammadpour M., 2019. The effect of garlic on lipid profile and glucose parameters in diabetic patients: A systematic review and meta-analysis. Primary Care Diabetes, 13(1): 28-42, https://doi.org/10.1016/j.pcd.2018.07.007.

Shahbazi Y., Shavisi N., 2016. Interactions of *Ziziphora clinopodioides* and *Mentha spicata* essential oils with chitosan and ciprofloxacin against common food-related pathogens. LWT Food Science and Technology, 71: 364-369, https://doi.org/10.1016/j.lwt.2016.04.011.

Shahrajabian M.H., Sun W., Soleymani A., Cheng Q., 2020a. Traditional herbal medicines to overcome stress, anxiety and improve mental health in outbreaks of human coronaviruses. Phytotherapy Research, 2020(1): 1-11, https://doi.org/10.1002/ptr.6888.

Shahrajabian M.H., Sun W., Cheng Q., 2020b. Exploring *Artemisia annua* L., artemisinin and its derivatives, from traditional Chinese wonder medicinal science. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 48(4): 1719-1741, https://doi.org/10.15835/nbha48412002.

Shahrajabian M.H., Sun W., Cheng Q., 2020c. Chemical components and pharmacological benefits of Basil (*Ocimum Basilicum*): a review. International Journal of Food Properties, 23(1): 1961-1970, https://doi.org/10.1080/10942912.2020.1828456.

Shahrajabian M.H., Sun W., Cheng Q., 2020d. Traditional herbal medicine for the prevention and treatment of cold and flu in the Autumn of 2020, overlapped with COVID-19. Natural Product Communications, 15(8): 1-10, https://doi.org/10.1177/1934578x20951431.

Shahrajabian M.H., Sun W., Cheng Q., 2020e. Product of natural evolution (SARS, MERS and SARS-CoV-2); deadly diseases, from SARS to SARS-CoV-2. Human Vaccines & Immunotherapeutics, 17(1): 62-83, https://doi.org/10.1080/21645515.2020.1797369.

Shahrajabian M.H., Petropoulos S.A., Sun W., 2023a. Survey of the influence of microbial biostimulants on horticultural crops: Case studies and successful paradigms. Horticulturae, 9(193): 1-24, https://doi.org/10.3390/horticulturae9020193.

Shahrajabian M.H., Cheng Q., Sun W., 2023b. Vitamin C and D supplements to prevent the risk of Covid-19. Natural Product Journal, 13(1): 47-59, https://doi.org/10.2174/2210315512666220414104141.

Shahrajabian M.H., Sun W., 2023a. Great health benefits of essential oil of pennyroyal *(Mentha pulegium* L.): A natural and organic medicine. Current Nutrition and Food Science, 19(4): 340-345, https://doi.org/10.2174/1573401318666220145213.

Shahrajabian M.H., Sun W., 2023b. Assessment of wine quality, traceability and detection of grapes wine, detection of harmful substances in alcohol and liquor composition analysis. Letters in Drug Design and Discovery, 2023: 20, https://doi.org/10.2174/1570180820666230228115450.

Shahrajabian M.H., Sun W., 2023c. Survey on multi-omics, and multi-omics data analysis, integration and application. Current Pharmaceutical Analysis, 19(4): 267-281, https://doi.org/10.2174/1573412919666230406100948.

Shahrajabian M.H., Sun W., 2024a. Study on rapid, quantitative, and simultaneous detection of drug residues and immunoassay in chickens. Reviews on Recent Clinical Trials, https://doi.org/10.2174/0115748871305331240724104132.

Shahrajabian M.H., Sun W., 2024b. Multidimensional uses of bitter melon (*Momordica charantia* L.) considering the importance functions of its chemical components. Current Organic Synthesis, https://doi.org/10.2174/0115701794285586240523101245.

Shahrajabian M.H., Sun W., 2024c. Introduction of honeycomb (*Nidus vespae*), and some of its most important pharmacological benefits. Current Nutrition and Food Sciences, 20(8): 982-987, https://doi.org/10.2174/0115734013279576240124072234.

Shalaby M.A., Hammouda A.A.-E., 2014. Analgesic, anti-inflammatory and anti-hyperlipidemic activities of *Commiphora molmol* extract (Myrrh). Journal of International Ethnopharmacology, 3(2): 56-62, https://doi.org/10.5455/jice.20140130015014.

Sharma M., Sharma R., 2011. Synergistic antifungal activity of *Curcuma longa* (Tumeric) and *Zingiber officinale* (Ginger) essential oils against dermatophyte infections. Journal of Essential Oil Bearing Plants, 14(1): 38-47, https://doi.org/10.1080/0972060x.2011.10643899.

Shen T., Li G.H., Wang X.-N., Lou H.-X. 2012. The genus *Commiphora*: a review of its traditional uses, phytochemistry and pharmacology. Journal of Ethnopharmacology, 142: 319-330, https://doi.org/10.1016/j.jep.2012.05.025.

Shin J.Y., Che D.N., Cho B.O., Kang H.J., Kim J., Jiang S.I., 2019. *Commiphora myrrha* inhibits itch-associated histamine and IL-31 production in stimulated mast cells. Experimental and Therapeutic Medicine, 18: 1914-1920, https://doi.org/10.3892/etm.2019.7721.

Silva F., Domingues F.C., 2017. Antimicrobial activity of coriander oil and its effectiveness as food preservative. Critical Reviews in Food Science and Nutrition, 57(1): 35-47, https://doi.org/10.1080/10408398.2013.847818.

Singh J., Dubeyd A.K., Tripathi N.N., 1994. Antifungal activity of *Mentha spicata*. International Journal of Pharmacognosy, 32(4): 314-319. https://doi.org/10.3109/13880209409083009

Singh V., Rana N., Ali M., 2018. GC-MS analysis and antimicrobial activities of volatile oil of *Nardostachys jatamansi* D.C. rhizomes obtained from Haridwar region, Uttrakhand. Pharmacognosy Journal, 10(2): 230-234, https://doi.org/10.5530/pj.2018.2.40.

Soleimani V., Sahebkar A., Hosseinzadeh H., 2018. Turmeric (*Curcuma longa*) and its major constituent (curcumin) and nontoxic and safe substances: Review. Phytotherapy Research, 32(6): 985-995, https://doi.org/10.1002/ptr.6054.

Suleiman R.K., Zarga M.A., Sabri S.S., 2010. New withanolides from *Mandragora officinarum*: First report of withanolides from the genus *Mandragora*. Fitoterapia, 81(7): 864-868, https://doi.org/10.1016/j.fitote.2010.05.013.

Sun W., Shahrajabian M.H., Cheng Q., 2019a. Anise (*Pimpinella anisum* L.), a dominant spice and traditional medicinal herb for both food and medicinal purposes. Cogent Biology, 5(1673688): 1-25, https://doi.org/10.1080/23312025.2019.1673688.

Sun W., Shahrajabian M.H., Cheng Q., 2019b. The insight and survey on medicinal properties and nutritive components of shallot. Journal of Medicinal Plant Research, 13(18): 452-457, https://doi.org/10.5897/jmpr2019.6836.

Sun W., Shahrajabian M.H., 2023. Therapeutic potential of phenolic compounds in medicinal plants-natural health products for human health. Molecules, 28(1845): 1-47, https://doi.org/10.3390/molecules28041845.

Sun W., Shahrajabian M.H., Petropoulos S.A., Shahrajabian N., 2023. Developing sustainable agriculture systems in medicinal and aromatic plant production by using chitosan and chitin-based biostimulants. Plants, 12(13): 2469, https://doi.org/10.3390/plants12132469.

Tedeschi P., Maietti A., Boggian M., Vecchiati G., Brandolini V., 2007. Fungitoxicity of lyophilized and spray-dried garlic extract. Journal of Environmental Science and Health B, 42(7): 795-799, https://doi.org/10.1080/03601230701551459.

Teshome M., Eshete A., Bongers F., 2017. Uniquely regenerating frankincense tree populations in western Ethiopia. Forest Ecology and Management, 389: 127-135, https://doi.org/10.1016/j.foreco.2016.12.033.

Tirillini B., Pagiotti R., Menghini L., Miniati E., 2006. The volatile organic compounds from tepals and anthers of saffron flowers (*Crocus sativus* L.). Journal of Essential Oil Research, 18(3): 298-300, https://doi.org/10.1080/10412905.2006.9699095.

Tolera M., Sass-Klaassen U., Eshete A., Bongers F., Sterck F., 2015. Frankincense yield is related to tree size and resin-canal characteristics. Forest Ecology and Management, 353: 41-48, https://doi.org/10.1016/j.foreco.2015.05.013.

Tournas V.H., Sapp C., Trucksess M.W., 2012. Occurrence of aflatoxins in milk thistle herbal supplements. Food Additives and Contaminants, 29(6): 994-999, https://doi.org/10.1080/19440049.2012.664788.

Tournas V.H., Calo J.R., Sapp S., 2013. Fungal profiles in various milk thistle botanicals from US retail. International Journal of Food Microbiology, 164(1): 87-91, https://doi.org/10.1016/j.ijfoodmicro.2013.03.026.

Turk M., Mathe C., Fabiano-Tixier A.-S., Carnaroglio D., Chemat F., 2018. Parameter optimization in microwave-assisted distillation of frankincense essential oil. Comptes Rendus Chimie, 21: 622-627, https://doi.org/10.1016/j.crci.2018.03.001.

Uysal S., Zengin G., Aktumsek A., 2016. Antioxidant properties and enzymes inhibitory effects of extracts from *Mandragora autumnalis* and its fatty acid composition. Marmara Pharmaceutical Journal, 20: 144-151, https://doi.org/10.12991/mpj.201620206523.

Verma R.S., Pandey V., Padalia R.C., Saikia D., Krishna B., 2010. Chemical composition and antimicrobial potential of aqueous distillate volatiles of Indian peppermint (*Mentha piperita*) and spearmint (*Mentha spicata*). Journal of Herbs, Spices & Medicinal Plants, 17(3): 258-267, https://doi.org/10.1080/10496475.2011.591519.

Vissiennon C., Hammoud D., Goos K.-H., Nieber K., Arnhold J., 2017. Synergistic interactions of chamomile flower, myrrh and coffee charcoal in inhibiting pro-inflammatory chemokine release from activated human macrophages. Synergy, 4: 13-18, https://doi.org/10.1016/j.synres.2017.03.001.

Volis S., Fogel K., Tu T., Sun H., Zaretsky M., 2018. Evolutionary history of biogeography of *Mandragora* L. (Solanaceae). Molecular Phylogenetics and Evolution, 129: 85-95, https://doi.org/10.1016/j.ympev.2018.08.015.

Wang H., Su G., Cheng G., Bai J., Pei Y., 2015. ^{1}H NMR-based metabonomics of the protective effect of *Curcuma longa* and curcumin on cinnabar-induced hepatotoxicity and nephrotoxicity in rats. Journal of Functional Foods, 17: 459-467, https://doi.org/10.1016/j.jff.2015.04.014.

Weldu H., Mehari A., Alem L., 2019. Evaluation of antimicrobial activities of *Sinapis alba* and *Brassica nigra* leaves against selected microorganisms. Pharmaceutical and Bioscience Journal, 7(2): 1-6, https://doi.org/10.20510/ukjpb/7/i2/182377.

Woolley C.L., Suhail M.M., Smith B.L., Boren K.E., Taylor L.C., Schreuder M.F., Chai J.K., Casabianca H., Haq S., Lin H.-K., Al-Shahri A.A., Al-Hatmi S., Young D.G., 2012. Chemical differentiation of *Boswellia sacra* and *Boswellia carterii* essential oils by gas chromatography and chiral gas chromatography-mass spectrometry. Journal of Chromatography A, 1261: 158-163, https://doi.org/10.1016/j.chroma.2012.06.073.

Xian Y.-F., Hu Z., Ip S.-P., Chen J.-N., Su Z.-R., Lai X.-P., Lin Z.-X., 2018. Comparison of the anti-inflammatory effects of *Sinapis alba* and *Brassica juncea* in mouse models of inflammation. Phytomedicine, 50: 196-204, https://doi.org/10.1016/j.phymed.2018.05.010.

Yu J., Shan Y., Li S., Zhang L., 2020. Potential contribution of Amadori compounds to antioxidant and angiotensin I converting enzyme inhibitory activities of raw and black garlic. LWT, 129: 109553, https://doi.org/10.1016/j.lwt.2020.109553.

Zaki A.A., Hashish N.E., Amer M.A., Lahloub M.-F., 2014. Cardiopreotective and antioxidant effects of oleogum resin "Olibanum" from *Boswellia carteri* Birdw. (Bursearceae). Chinese Journal of Natural Medicines, 12(5): 345-350, https://doi.org/10.1016/s1875-5364(14)60042-x.

Zaman S.U., Akhtar N., 2013. Effect of turmeric (*Curcuma longa* Zingiberaceae) extract cream on human skin sebum secretion. Tropical Journal of Pharmaceutical Research, 12(5): 665-669, https://doi.org/10.4314/tjpr.v12i5.1.

Zargari A., 1978. Medicinal plants. Tehran University Publications. 3: 223-228.

Zhang Y., Liu X., Ruan J., Zhuang X., Zhang X., Li Z., 2020. Phytochemicals of garlic: Promising candidates for cancer therapy. Biomedicine and Pharmacotherapy, 123: 109730, https://doi.org/10.1016/j.biopha.2019.109730.

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