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Traditional Medicinal Plants and Rheumatoid

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Abstract

Rheumatoid arthritis, classified as an immune system disorder, stands as a prevalent condition that presents considerable challenges to healthcare systems worldwide. This study delved into traditional medicine to explore the use of medicinal plants to treat rheumatoid arthritis and immune system disorders in the world. With a focus on ethno pharmacological insights, a comprehensive survey conducted containing 372 participants, including herbalists and patients, to document the local knowledge and practices associated with these conditions. The findings cleared a noteworthy reliance on traditional medicinal knowledge, with a prominent role played by females across different age groups. A diverse spectrum of 88 plant species hailing from 45 distinct families identified, where the Myrtaceae, Oleaceae, and Zingibneraceae families garnered prominence as the most endorsed choices. Zingiber officinale and Curcuma longa emerged as highly favored species, boasting robust anti-inflammatory and immunomodulatory attributes. Nevertheless, the observed variability in dosage utilization underscores the traditional therapeutic paradigms' intricacies. Moreover, some studies identified endemic species such as Allium sativa, Black pepper, Capsicum annum, Cinnamomum verum, Green tea, Lavandula angistifolia, Thymus vulgaris, and Rosmarinus officinallis—ethno-pharmacological Relevance. Traditional medicinal plants used worldwide to treat arthritis, especially in developing countries where resources are meager. Herbal plants have utilized since ancient times and are the base for massive bioactive compounds with flaunting therapeutic potential, many advanced drugs that consumed worldwide to treat countless ailments.

Keywords: Medicinal Plants, Disease, Rheumatoid, Herbal Uses

1. Introduction

Rheumatoid arthritis (RA) is a systemic autoimmune inflammatory disease that affects 0.5–1.0% of the world population [1]. The latter appears to be a major contributor to the increased risk of disability in elderly patients with RA [2]. Moreover, RA has a high incidence of complications, such as cardiovascular disease and osteoporosis, due to its direct and indirect effects on other systemic symptoms and inflammation [3]. Genetics, infectious diseases, environmental variables, and hormonal influences are all factors that contribute to RA [2]. They added that research indicates that the pathogenesis of RA influenced by interactions and the activation of innate and adaptive immune cells. However, the underlying mechanisms of RA remain unknown.

Disease-modifying antirheumatic drugs (DMARDs) used to prevent joint damage during the early stages of RA. Anti-rheumatic drugs sometimes used to bring about remission or slow the progression of RA [3]. These, hydroxychloroquine, sulfasalazine, and leflunomide. 6 High doses of these drugs can cause gastrointestinal irritation and other side effects, which can lead to the development of ulcers and perforations in some cases [4]. Liver and kidney damage caused by arthritis medication can also cause skin rashes, urticaria, headache, dizziness, and drowsiness, with some patients experiencing hypertension and edema [5]. Thus, finding effective alternative medicines with rare side effects.

Ginger

Ginger obtained from rhizomes of *Zingiber officinale*. The plant belongs to the Zingiberaceae family. Since ancient times, it has been widely used as a medicinal herb and spice [6]. It reported that 100,000 tons of gingers annually produced, and 80% of this produced in China [7]. More than 40 antioxidants have been isolated from ginger rhizome. The major pharmacological activity of ginger comes from its phenolic active ingredients such as gingerols and shogaols [8] in traditional medicine, ginger intake recommended for patients with arthritis muscle pain such as rheumatoid arthritis and osteoarthritis [9].

Ginger has anti-inflammatory properties. It includes suppressing inflammatory molecules called leukotrienes and synthesizing prostaglandins, hormone-like substances that cause pain and inflammation, which appeared in numerous studies. These researchers cleared that ginger might improve RA symptoms by affecting the expression of certain genes.

It is scientifically palpable that *Zingiber officinale* Roscoe (Zingiberaceae) has a cure role in lessening the unbearable pain and inflammation associated with RA. Evidence reports that the consumption of ginger aids in relieving pain in joints associated with rheumatoid arthritis [9].

Thyme

Thymus vulgaris commonly known as thyme has been used for centuries for its flavoring, culinary, and medicinal properties [10]. Many studies have conducted on thyme species to identify their chemical composition. Various chemical compounds and essential oils constitute the main composition of thyme. Investigations have reported that thyme contains 56.53% monoterpenes, 28.69% monoterpene hydrocarbons, 5.04% sesquiterpene hydrocarbons, and 1.84% oxygenated sesquiterpenes [11]. Thyme is rich in many flavonoids and phenolic antioxidants like zeaxanthin, lutein, pigenin, naringenin, luteolin, and thymonin [12].

Thymol, the main essential oil constituent in thyme, well known for its antioxidant, anti-inflammatory, and antimicrobial activity [13, 14]. (Golbahari et al, 2019) conducted a study on 50 rats with rheumatoid arthritis to evaluate the anti-inflammatory effects of thymol and found a positive response. From the previous results obtained by many studies, show that thyme fragrant herb that has high antioxidant contents and it has a rich history as a food flavoring. It has anti-inflammatory and antimicrobial properties that could be therapeutic for rheumatoid arthritis; in addition, Thyme is the most commonly used herbal medicine among people with RA.

Turmeric

Turmeric (*Curcuma longa*) is a perennial herb belonging to the genus Curcuma in the family Zingiberaceae. Curcumin is the most important chemical component of turmeric, and it can exert antioxidant, anti-inflammatory, anti-angiogenic, and anti-tumor pharmacological effects without significant adverse effects. Curcumin in turmeric can effectively inhibit inflammatory reactions and reduce symptoms such as pain and swelling. In recent years, it found that curcumin could cure some symptoms in some autoimmune diseases such as rheumatoid arthritis and inflammatory bowel disease [15]. Researchers have conducted numerous studies to evaluate the pharmacological effects and clinical applications of turmeric and curcumin on rheumatoid arthritis treatment [16], curcumin could be used as a preventive measure in individuals at high risk of early or developing rheumatoid arthritis [17].

Many studies evaluated the safety of curcumin and found that it could improve the outcomes of RA patients. From the previous publishers clear that Turmeric used for various conditions, including arthritis and musculoskeletal disorders, and found that curcumin is the active ingredient that gives turmeric its yellow color, which has anti-inflammatory effects on RA.

Green Tea

Green tea contains polyphenols, which are antioxidant-rich substances that can help reduce inflammation, protect joints, and trigger changes in immune responses that would ease the severity of arthritis. Green tea may help prevent and treat rheumatoid arthritis (RA). It is believed that due to the antioxidants contained. These antioxidants, called Polyphenols, are a type of catechin. These substances stabilize molecules that have become unstable for a variety of reasons. Free radicals lead to oxidative stress. They implicated in many diseases, including RA.

Among natural compounds of particular interest, (−)-epigallocatechin-3-gallate (EGCG) has gained significant attention in the past decade for its health benefits [18]. EGCG is a major catechin present in green tea that is prepared from dried leaves of the plants Camellia sinesis and Camellia assamica, which are members of the Theacease family [19]. Studies have proven that the majority of beneficial effects attained through drinking green tea attributed to the high content of EGCG, among other flavonoid-containing catechins [20]. Therapeutic benefits from green tea consumption have seen in neurodegenerative diseases, inflammatory diseases, cardiovascular diseases and several types of cancer [21]. Despite the recent understanding of the in-vivo effects of EGCG, the extensive in vitro research has shown significant promise for the use of EGCG in the treatment of RA. In vitro studies have shown that EGCG has differential modulatory effects on cartilage, bone, and synovial fibroblast activity [22].

Tea has remarkable performance due to its antioxidant and inflammatory properties. Therefore, it can be a promising candidate when used as a novel anti-inflammatory or antioxidant agent [23]. Green tea contains polyphenols, which are antioxidant-rich substances that can help reduce inflammation, protect joints, and trigger changes in immune responses that would ease the severity of arthritis.

Cinnamon

The *Cinnamomum* plants have studied for their phytoconstituents and pharmacological properties. Traditional medicinal significance. *Cinnamomum verum*, known as the true cinnamon tree and Ceylon cinnamon tree is an evergreen small, tree that belongs to the Lauraceae family. Along with other cinnamon species, such as *Cinnamomum cassia, Cinnamomum verum*, etc., the tree bark used to obtain cinnamon [24].

Cinnamon is a delicious spice with powerful antioxidant properties that help inhibit cell damage from free radicals. Many studies also found that supplementation with cinnamon lessened C-reactive protein levels and other biomarkers for inflammation and oxidative stress, which occur in people with RA. The authors of this research concluded that cinnamon supplementation may enhance the reduction of inflammation and oxidative stress levels in humans.

The most important constituents of cinnamon are cinnamaldehyde and *trans*-cinnamaldehyde (Cin), which are present in the essential oil, thus contributing to the fragrance and the various biological activities observed with cinnamon [25]. A study on *Cinnamomum osmophloeum* (*C. osmophloeum*) in-

dicated that the essential oil from cinnamon leaves contains a high level of Cin. Consequently, C. *osmophloeum* is also an alternative spice for C. cassia [26]. One of the major constituents of essential oil extracted from C. *zeylanicum* named (E)-cinnamaldehyde has an antityrosinase activity, while cinnamaldehyde is the principal compound responsible for this activity [27, 28].

Cinnamon bark contains procyanidins and catechins [29]. The components of procyanidins include both procyanidin A-type and B-type linkages [30]. These procyanidins extracted from cinnamon and berries possess antioxidant activities [31]. There several flavonoid compounds (e.g., gossypin, gnaphalin, hesperidin, hibifolin, hypolaetin, oroxindin, and quercetin) have been isolated and have anti-inflammatory activities [28].

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Garlic

Garlic (*Allium sativa*) is a member of the Alliacea family, often known as a functional food and medicinal herb. A growing body of evidence indicated the considerable biological functions of garlic, including anti-obesity, anti-diabetic, cardiovascular protective, anticancer, anti-inflammatory, and antibacterial properties [32]. Furthermore, several biological benefits of garlic, including antioxidants, reductions in serum lipids, and anti-inflammatory properties, have reported previously [33]. Given the antioxidant effects of garlic, this plant can consider as an appropriate alternative anti-arthritis agent.

Fresh garlic might help ease rheumatoid arthritis pain. Garlic contains daily disulfide, an anti-inflammatory compound that decreases the effects of pro-inflammatory cytokines. Research has found that the administration of garlic has anti-arthritic activity, preventing cartilage destruction and reducing inflammation in arthritis-induced rats.

Garlic (*Allium sativa*) is one of the functional foods that has used all over the world for thousands of years. It is rich in bioactive compounds, including allicin, ajoene, s-allylcysteine, s-methylcysteine, diallyl disulphide (DADS), diallyl sulphide (DAS), alliin, amino acids, polysaccharides, and different polyphenols [34]. Garlic has more phenolic compounds than many common vegetables [35]. The main phenolic compounds are β-resorcylic acid, gallic acid, pyrogallol, quercetin, rutin, and protocatechuic acid [36]. Several studies have shown the anti-inflammatory effects of allicin and DAS [37]. At this time, research on flavonoid-health foods, such as quercetin and resveratrol, have been shown to increase total antioxidant capacity (TAC), as well as reduce oxidative stress, levels of inflammation, and levels of muscle damage [38].

Black Pepper

Black pepper (*Piper nigrum*) commonly used as a spice in human diets, but it is also used as a medicine, a preservative, and a perfume in many Asian countries. An extract of the active phenolic component, piperine, is well known to provide beneficial physiological effects [39]. It stimulates the digestive enzymes of the pancreas, protects against oxidative damage, lowers lipid peroxidation, and enhances the bioavailability of several therapeutic drugs. In addition, its anti-inflammatory activities have demonstrated in rat models of carrageenan-induced rat paw edema, cotton pellet-induced granuloma, and a croton oil-induced granuloma pouch [40]. Constituents of the piper species have shown in vitro inhibitory activity against the enzymes responsible for leukotriene and prostaglandin biosynthesis, 5-lipoxygenase and COX-1, respectively [41]. These effects of piperine show a benefit for inflammatory diseases accompanied by severe pain; for example, rheumatoid arthritis. Researchers cleared that black pepper has antioxidant, antimicrobial, anti-inflammatory, and gastro-protective effects.

Cayenne

Capsaicin is included in topical treatments aimed at the relief of different neuropathic pain conditions, although it can produce skin irritation. Capsaicin and its analogs have used in topical creams and patches to treat chronic pain syndromes such as post-herpetic neuralgia, musculoskeletal pain, diabetic neuropathy, osteoarthritis, and rheumatoid arthritis [42]. It has also used to treat pain from rashes, psoriasis, mastectomy, and bladder disorders. Adverse effects (burning, stinging, and erythema) are normally limited to the application site, although respiratory irritations from cream inhalation and occasional systemic effects have been reported [43]. Its actual efficacy in pain relief is still somewhat in doubt due to the small number of participants and diverse definitions of pain used in studies.

It has shown that capsaicin's stimulation in the early stages of arthritis produces chemical mediators and substance P, which induce pain in the inflamed joints [44]. An important distinctive feature of pepper fruits is the presence or absence of pungency. Hot peppers called chiles, chillis or chilis; conversely, non-pungent varieties referred to as sweet peppers, although the sugar content can vary greatly in the fruit. Hot peppers are characterised by different levels of pungency and other aroma and flavor molecules [45]. Hot peppers used fresh or dried in various pharmacological preparations and are widely used in cooking to enrich foods with their unique flavor. The spiciness of chili peppers is due to the presence of lipophilic alkaloids at different concentrations, collectively called capsaicinoids [46], Capsaicin and dehydrocapsaicin are the predominant molecules, representing ~90% of the total capsaicinoid content, and usually, the evaluation of their

quantity is fundamental for determining pungency. Some additional related compounds, such nordihydrocapsaicin, homocapsaicin, and homodihydrocapsaicin, are also present in minor concentrations in the fruits [47]. Capsaicinoids are synthesized and accumulated in the epidermal cells of the placenta and are transported into the apoplast and stored in the vesicles of the placenta, also called blisters [48]. Several health benefits have been associated with polyphenols and capsaicinoids present in different *Capsicum* genotypes and include antioxidant, antimicrobial, anti-inflammatory, antihypertensive, antihyperglycemic, metal chelating and antitumoral activities [49].

Cayenne and other chili peppers contain capsaicinoids, which are natural compounds that have anti-inflammatory properties, according to the Arthritis Foundation. Hot red peppers contain spicy compounds called capsaicinoids, which include capsaicin, dihydrocapsaicin, nordihydrocapsaicin, and other compounds [50]. Capcesacine utilized to treat inflammatory disorders such as psoriasis and rheumatoid arthritis [51].

Lavender

The anti-inflammatory, cell regenerating and pain-relieving features of lavender oil make it an excellent choice as an essential oil for arthritis. Lavender oil helps reduce inflammation around joints, thereby easing the pain. It belongs to the family of Lamiaceae. It contains camphor, terpinen-4-ol, linalool, linalyl acetate, beta-ocimene, and 1, 8-cineole [52]. Its constituent varies in concentration and therapeutic effects with the different species. Linalool and linalyl acetate have maximum and great absorbing properties from the skin during massage with a depression of the central nervous system. Linalool shows sedative effects and linalyl acetate shows marked narcotic actions. These two actions may be responsible for its use in the relief of sleep disturbance patterns, improving the feeling of well-being, supporting mental alertness, and suppressing aggression and anxiety. Lavender oil shows its antibacterial and antifungal properties against many species of bacteria, especially when antibiotics fail to work, but the exact mechanisms are yet to be established. When talking about its use in aromatherapy, it used for the treatment of abrasions, burns, stress, and headaches, in promotion of new cell growth, skin problems, and painful muscles, and in boosting an immune system. This oil is used in the treatment of primary dysmenorrheal and has shown some promising results in one of the randomized, double-blind clinical trials [53].

Rosemary

Rosmarinus officinalis L. is a medicinal plant that belongs to the *Lamiaceae* family and commonly known as rosemary [54]. Besides the culinary uses due to the characteristic aroma, this plant is also widely employed by indigenous populations, where it grows wild [55].

Rosemary, *Rosmarinus officinalis* L. (Labiatae) has been used in folk medicine to alleviate several diseases including headache, dysmenorrhea, stomachache, epilepsy, rheumatic pain, spasms, nervous agitation, improvement of memory, hysteria, depression, as well as physical and mental fatigue [56]. Today, rosemary grown worldwide but is an evergreen perennial shrub native to southern Europe and Asia especially the Mediterranean region [57]. Recently, noticeable scientific interest focused on the beneficial therapeutic properties of different kinds of rosemary extracts and their main constituents, such as carnosic acid, carnosol, and rosmarinic acid. Many studies on animal models or cultured cells indicate the range of medicinal properties of rosemary and its compounds such as anti-inflammatory and anti-oxidant [58, 59].

Rosemary has been widely used not only in cooking, especially to modify and enhance flavors, but also in traditional medicine, being a highly appreciated medicinal plant to prevent and cure colds, rheumatism, pain of muscles and joints [60-69].

Conclusion

Many investigations indicated that human suffering from patients dissatisfied with face treatments of rare alternative therapies. Traditional and folklore appear as principal alternative sources of medicine for controlling diseases. Although conventional therapies for RA commonly alleviate the symptoms, the high incidence of adverse reactions to these drugs has resulted in the exploration of alternative methods, particularly traditional remedies, for symptomatic relief of RA. Numerous medicinal plants have traditionally used for the management of RA.

The plants present in the review article cleared available effects of synthetic drugs used from the various herbal medicinal plants, which are good sources of active chemical constituents exhibiting potent therapy for arthritis. Increasing damage of complementary medicines used in arthritis in either tablets, capsules, or oils to relieve arthritic symptoms of pain and inflammation encourages the comprehensive research of herbal plants. The clinical studies reported that the mechanism of herbal plants cleared the greatest effect of plant extract containing phytoconstituents like flavonoids, terpenoids, alkaloids, and sterols doing antioxidant and anti-inflammatory activity. The reports of previous studies in the review article concluded the effective usage of herbal plants in arthritis.

References

1. Smolen J.S. D. Aletaha, I.B. Arthritis Lancet, 388 (10055) (2016), pp. 2023-2038.
2. Jihye B., H. Eunyoung, H. Jian Expression of pain receptors by arthritis treatment in collagen induced murine model of rheumatoid arthritis J. *Rheum. Dis., 22* (2) (2015), pp. 85-92.
3. Choy E.H., G.S. Panayi Cytokine pathways and joint inflammation in rheumatoid arthritis N. Engl. *J. Med., 344* (12) (2001), pp. 907-916
4. Cryer B., K.W. Mahaffey Gastrointestinal ulcers, role of aspirin, and clinical outcomes: pathobiology, diagnosis, and treatment *J. Multidiscip. Health, 7* (2014), pp. 137-146.
5. Wang X., X. Chen, W. Huang, P. Zhang, Y. Guo, H.

Körner, H. Wu, W. Wei.Losartan suppresses the inflammatory response in collagen-induced arthritis by inhibitiThomsonng the MAPK and NF-κB pathways in B and T cells Inflammopharmacology, 27 (3) (2019), pp. 487-502.
6. White B. Ginger: an overview. *The American Family Physician. 2007; 75*(11):1689–1691.
7. Altman RD, Marcussen KC. Effects of a ginger extract on knee pain in patients with osteoarthritis. *Arthritisam and Rheumatism. 2001;44*(11):2531–2538.
8. Arablou T, Aryaeian N, Valizadeh M, Sharifi F, Hosseini A, Djalali M. The effect of ginger consumption on glycemic status, lipid profile and some inflammatory markers in patients with type 2 diabetes mellitus. *Int J Food Sci Nutr. 2014;65*(4):515–20.
9. Haghighi M, Khalvat A, Toliat T, Jallaei S. Comparing the Effects of Ginger (Zingiber Officinale) Extract and Ibuprofen on Patients with Osteoarthritis. *Arch Iran Med. 2005;8*(4):267–71.
10. Stahl-Biskup E., Venskutonis R.P. Handbook of Herbs and Spices. Elsevier; Amsterdam. *The Netherlands:* 2012. Thyme; pp. 499–525.
11. Almanea A., El-Aziz G.S.A., Ahmed M.M.M. The Potential Gastrointestinal Health Benefits of Thymus vulgaris Essential Oil: A Review. Biomed. *Pharmacol. J. 2019;12*:1793–1799.
12. Dauqan E.M.A., Abdullah A. Medicinal and Functional Values of Thyme (Thymus vulgaris L.) Herb. J. App. Biol. *Biotechnol. 2017;*5:017–022.
13. Nieto G. A Review on Applications and Uses of Thymus in the Food Industry. *Plants.* 2020;9:961.
14. Golbahari S., Abtahi Froushani S.M. Synergistic Benefits of Nicotine and Thymol in Alleviating Experimental Rheumatoid Arthritis. Life Sci. 2019;239:117037.
15. Zeng L, Yang T, Yang K, Yu G, Li J, Xiang W, et al. Curcumin and curcuma longa extract in the treatment of 10 types of autoimmune diseases: a systematic review and meta -analysis of 31 randomized controlled trials. *Front Immunol* (2022) 13:896476.
16. Ju DT, Tsai BC, Sitorus MA, Kuo WW, Kuo CH, Chen TS, et al. Curcumin-pretreated adipose-derived stem cells enhance the neuroprotective ability to repair rheumatoid arthritis-induced damage in the rat brain. *Am J Chin Med (2022) 50*(5):1299–314.
17. Asteriou E, Gkoutzourelas A, Mavropoulos A, Katsiari C, Sakkas LI, Bogdanos DP. Curcumin for the management of periodontitis and early ACPA-positive rheumatoid arthritis: killing two birds with one stone. *Nutrients (2018) 10*(7):347-9.
18. Singh BN, Shankar S, Srivastava RK. Green tea catechin, epigallocatechin-3-gallate (EGCG): *mechanisms, perspectives and clinical applications. Biochem Pharmacol.* 2011;82:1807–1821.
19. Weinreb O, Amit T, Mandel S, Youdim MB. Neuroprotective molecular mechanisms of (-)-epigallocatechin-3-gallate: a reflective outcome of its antioxidant, iron chelating and neuritogenic properties. *Genes Nutr*. 2009; 4:283–296.
20. Wu D, Wang J, Pae M, Meydani SN. Green tea EGCG, T cells, and T cell-mediated autoimmune diseases. Mol Aspects Med. 2012;33:107–118.
21. Clement Y. Can green tea do that? A literature review of the clinical evidence. *Prev Med*. 2009;49:83–87.
22. Ahmed S. Green tea polyphenol epigallocatechin 3-gallate in arthritis: progress and promise. *Arthritis Res Ther.* 2010; 12:208.
23. Zhao, T, Li, C, Wang, S, andSong, X. Green tea (Camellia sinensis) : a review of its phytochemistry, pharmachology and toxicology. *Molecules*. (2022) 27:909.
24. Ribeiro-Santos R., Andrade M., Madella D., Martinazzo A. P., de Aquino Garcia Moura L., De Melo N. R., et al. (2017). Revisiting an Ancient Spice with Medicinal Purposes: Cinnamon. *Trends Food Sci. Tech. 62,* 154–169.
25. Yeh H-F, Luo C-Y, Lin C-Y, Cheng S-S, Hsu Y-R, Chang S-T. Methods for thermal stability enhancement of leaf essential oils and their main Constituents from Indigenous Cinnamon (Cinnamomum osmophloeum) *Journal of Agricultural and Food Chemistry. 2013;61*(26):6293–6298.
26. Chang C-W, Chang W-L, Chang S-T, Cheng S-S. Antibacterial activities of plant essential oils against Legionella pneumophila. *Water Research. 2008;42*(1-2):278–286.
27. Marongiu B, Piras A, Porcedda S, et al. Supercritical CO2 extract of Cinnamomum zeylanicum: chemical characterization and antityrosinase activity. *Journal of Agricultural and Food Chemistry. 2007;55*(24):10022–10027.
28. Cho N, Lee KY, Huh J, et al. Cognitive-enhancing effects of Rhus verniciflua bark extract and its active flavonoids with neuroprotective and anti-inflammatory activities. *Food and Chemical Toxicology.* 2013;58:355–361.
29. Nonaka G-I, Morimoto S, Nishioka I. Tannins and related compounds. Part 13. Isolation and structures of trimeric, tetrameric, and pentameric proanthicyanidins from cinnamon. *Journal of the Chemical Society, Perkin Transactions 1*. 1983:2139–2145.
30. Tanaka T, Matsuo Y, Yamada Y, Kouno I. Structure of polymeric polyphenols of cinnamon bark deduced from condensation products of cinnamaldehyde with catechin and procyanidins. *Journal of Agricultural and Food Chemistry.* 2008;56(14):5864–5870.
31. Peng X, Cheng K-W, Ma J, et al. Cinnamon bark proanthocyanidins as reactive carbonyl scavengers to prevent the formation of advanced glycation endproducts. *Journal of Agricultural and Food Chemistry. 2008;56*(6):1907–1911.
32. Tsai C-W, Chen H-W, Sheen L-Y, Lii C-K. Garlic: health benefits and actions. *BioMedicine. 2012*; 2: 17-29..
33. Lee HH, Han MH, Hwang HJ, Kim GY, Moon SK, Hyun JW, Kim WJ, Choi YH Diallyl risulfide exerts anti-inflammatory effects in lipopolysaccharide-stimulated RAW 264.7 *macrophages by suppressing the Toll-like receptor 4/nuclear factor-κB pathway Int J Mol Med, 35* (2015) 487-95
34. 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, 1*02385.
35. Liu, J., Ji, F., Chen, F., Guo, W., Yang, M., Huang, S.Liu, Y. (2018). Determination of garlic phenolic compounds using supercritical fluid extraction coupled to

supercritical fluid chromatography/tandem mass spectrometry. *Journal of Pharmaceutical and Biomedical Analysis, 159*, 513–523.
36. Nagella, P., Thiruvengadam, M., Ahmad, A., Yoon, J.-Y., & Chung, I.-M. (2014). Composition of polyphenols and antioxidant activity of garlic bulbs collected from different locations of Korea. *Asian Journal of Chemistry, 26*(3), 897–902.
37. Fu, E., Tsai, M. C., Chin, Y. T., Tu, H. P., Fu, M., Chiang, C. Y., & Chiu, H. C. (2015). The effects of diallyl sulfide upon Porphyromonas gingivalis lipopolysaccharide stimulated proinflammatory cytokine expressions and nuclear factor-kappa B activation in human gingival fibroblasts. *Journal of Periodontal Research, 50*(3), 380–388.
38. Tsao JP, Bernard JR, Hsu HC, et al. Short-term oral quercetin supplementation improves post-exercise insulin sensitivity, antioxidant capacity and enhances subsequent cycling time to exhaustion in healthy adults: a pilot study. *Front Nutr*. 2022; 9:875319.
39. Srinivasan K. Black pepper and its pungent principle-piperine: a review of diverse physiological effects. *Crit Rev Food Sci Nutr. 2007*;47:735–748.
40. Mujumdar AM, Dhuley JN, Deshmukh VK, Raman PH, Naik SR. Anti-inflammatory activity of piperine. *Jpn J Med Sci Biol. 1*990;43:95–100.
41. Stohr JR, Xiao PG, Bauer R. Constituents of Chinese Piper species and their inhibitory activity on prostaglandin and leukotriene biosynthesis in vitro. *J Ethnopharmacol. 2001;* 75:133–139.
42. Backonja, M.M.; Malan, T.P.; Vanhove, G.F.; Tobias, J.K. NGX-4010, a high-concentration capsaicin patch, for the treatment of postherpetic neuralgia: a randomized, double-blind, controlled study with an open-label extension. *Pain Med. 2010,* 11, 600–608.
43. Sawynok, J. Topical analgesics in neuropathic pain. Curr. Pharm. *Des. 2005, 11,* 2995–3004.
44. Engler A, Aeschlimann A, Simmen BR, Michel BA, Gay RE, Gay S, Sprott H. Expression of transient receptor potential vanilloid 1 (TRPV1) in synovial fibroblasts from patients with osteoarthritis and rheumatoid arthritis. *Biochem Biophys Res Communicat. 2007*;359:884–888.
45. Paran, I.; Ben-Chaim, A.; Kang, B.C.; Jahn, M. Capsicums. In Genome Mapping and Molecular Breeding in Plants; Kole, C., Ed.; Springer: Berlin/Heidelberg, Germany, 2007; Volume 5, pp. 209–226.
46. Arce-Rodríguez, M.L.; Ochoa-Alejo, N. Biochemistry and molecular biology of capsaicinoid biosynthesis: Recent advances and perspectives. *Plant Cell Rep. 2019, 38,* 1017–1030.
47. Giuffrida, D.; Dugo, P.; Torre, G.; Bignardi, C.; Cavazza, A.; Corradini, C.; Dugo, G. Characterization of Capsicum varieties by evaluation of their carotenoid profile and pungency determination. *Food Chem. 2013,* 140, 794–802.
48. Wahyuni, Y.; Ballester, A.R.; Tikunov, Y.; De Vos, R.C.; Pelgrom, K.T.; Maharijaya, A.; Sudarmonowati, E.; Bino, R.J.; Bovy, A.G. Metabolomics and molecular marker analysis to explore pepper (Capsicum sp.) biodiversity. *Metabolomics 2013*, 9, 130–144.
49. Alonso-Villegas, R.; González-Amaro, R.M.; Figueroa Hernández, C.Y.; Rodríguez-Buenfil, I.M. The Genus Capsicum: A Review of Bioactive Properties of Its Polyphenolic and Capsaicinoid Composition. *Molecules 2023,* 28, 4239.
50. Ludy M-J, Moore GE, Mattes RD. The effects of capsaicin and capsiate on energy. balance:critical review and meta-analyses of studies in humans. *Chem Senses. 2012; 37*:103–21.
51. Singletary K. Red pepper:overview of potential health benefits. *Nut Today. 2011;46*:33–47.
52. Price, S. The aromatherapy workbook Thorsons, London (1993) Koulivand, P.H. M.K. Ghadiri, A. Gorji Lavender and the nervous system Evid Based Complement Altern *Med (2013), 10*.1155/2013/681304
53. Ou M.C., T.F. Hsu, A.C. Lai, Y.T. Lin, C.C. Lin Pain relief assessment by aromatic essential oil massage on outpatients with primary dysmenorrhea: a randomized, double-blind clinical tria l*J Obstet Gynaecol Res, 38* (5) (2012), pp. 817-822.
54. Rotblatt M. Herbal medicine: expanded commission E monographs. *Ann. Intern. Med. 2000*;133(6):487.
55. Jardak M, Elloumi-Mseddi J, Aifa S, Mnif S. Chemical composition, anti-biofilm activity and potential cytotoxic effect on cancer cells of Rosmarinus officinalis L. essential oil from Tunisia. *Lipids Health Dis. 2017;16*(1):190.
56. Heinrich M, Kufer J, Leonti M, Pardo-de-Santayana M. 2006. Ethnobotany and ethnopharmacology-interdisciplinary links with the historical sciences. *J Ethnopharmacol. 2006;107:*157–160.
57. Al-Sereiti MR, Abu-Amer KM, Sen P. Pharmacology of rosemary (Rosmarinus officinalis Linn) and its therapeutic potentials. *Indian J Exp Biol. 1999;37*:124–130.
58. Kayashima T, Matsubara K. Antiangiogenic effect of carnosic acid and carnosol, neuroprotective compounds in rosemary leaves. *Biosci Biotechnol Biochem. 2012; 76*:115–119.
59. Bakirel T, Bakirel U, Keles OU, Ulgen SG, Yardibi H. In vivo assessment of antidiabetic and anti-oxidant activities of rosemary (Rosmarinus officinalis) in alloxan-diabetic rabbits. *J Ethnopharmacol. 2008*;116:64–73.
60. Zhang Y, Adelakun TA, Qu L, et al. New terpenoid glycosides obtained from Rosmarinus officinalis L. aerial parts. *Fitoterapia. 2014*;99:78–85.
61. Boyd A, Bleakley C, Gill C, McDonough S, Hurley DA, Bell P, McVeigh JG, Hannon- Fletcher M. Herbal medicinal products or preparations for neuropathic pain and fibromyalgia. *Cochrane Database Syst Rev. 2013*;5:CD010528.
62. Chandran B, Goel A. A randomized, pilot study to assess the efficacy and safety of curcumin in patients with active rheumatoid arthritis. *Phytother Res. 2012*;26:1719–1725.
63. Derry, S.; Lloyd, R.; Moore, R.A.; McQuay, H.J. Topical capsaicin for chronic neuropathic pain in adults. *Cochrane Database Syst. Rev*. 2009.
64. Engelhardt, UH. Tea chemistry, what do not we know? –a micro review. *Food Res Int. (2020) 132*:109120.
65. Garg G, Adams JD. Treatment of neuropathic pain with

plant medicines. Chin J Integr Med. 2012;18:565–570.
66. Knupp K, Parsons J. Nervous system disorders. In: Feldman HM, editor. Developmental-behavioral pediatrics. 4th ed. *Philadelphia: Saunders; 2009*. pp. 213–223.
67. Li JW, Vederas JC. Drug discovery and natural products: end of an era or an endless frontier? *Science. 2009; 325*:161–165.
68. Mustafa T, Srivastava KC. Ginger (Zingiber officinale) in migraine headache. *Journal of Ethnopharmacology. Clarifying the real bioactive constituents of garlic J Nutr, 136* (2006)
69. Thomson M, Al-Qattan KK, Al-Sawan SM, Alnaqeeb MA, Khan I, Ali M. The use of ginger (Zingiber officinale Rosc.) as a potential anti-inflammatory and antithrombotic agent. *Prostaglandins Leukotrienes and Essential Fatty Acids. 2002;67*(6):475–478.