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Phytotherapy: Considerations for athletes and athletic trainers

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Recently, the increased availability and popularity of herbal supplements have created an environment of misinformation for both patients and healthcare providers. The rich bioactive compounds found in plants, such as polyphenols, flavonoids, alkaloids, terpenes, and glycosides, have been shown to exhibit anti-inflammatory, antioxidant, antimicrobial, and immune-boosting effects. Each plant possesses a unique chemical structure and therapeutic properties. Notably, many plants contain antioxidant components that prevent cell damage and slow down the aging process. Research has demonstrated that these properties play a significant role in preventing chronic diseases and contributing to a healthy lifestyle. *Taraxacum officinale* exhibits antidiabetic effects, while *Panax ginseng* enhances physical and mental performance. Studies indicate that these plants have a wide range of potential effects due to the diverse and numerous bioactive compounds they contain. *Zingiber officinale* and *Taraxacum officinale* are effective in addressing digestive issues. Additionally, *Curcuma longa* stands out for its anti-inflammatory properties, *Hypericum perforatum* for its antidepressant effects, *Achillea millefolium* for promoting vitality, *Tribulus terrestris* for improving sexual health and performance, *Urtica dioica* for its anti-inflammatory and detoxifying effects, *Rhodiola rosea* for stress reduction, and *Echinacea purpurea* for boosting immunity. Of course, the effects of these herbal products on human health are not limited to the benefits mentioned above. All individuals using these products, particularly athletes and athletic trainers, must be able to identify their effectiveness and potential risks, as well as select the appropriate products and dosages. It's important to recognize that, despite their many benefits, these products can have adverse effects ranging from mild to life-threatening when used irresponsibly. Athletes tend to use herbal supplements more than non-athletes. Therefore, professional athletes, particularly those who are involved in sports competitions and have to exercise healthily, must pay attention to the warnings of their doctors and athletic trainers when using herbal supplements in order not to negatively affect their performance. This review aims to assess the health benefits and potential adverse effects of commonly used herbal products and offer relevant recommendations.

Keywords: herbal medicines; exercise; alternative medicine; adverse effects; medicinal plants.

Introduction

Since ancient times, humans have sought and utilized natural resources to improve their living conditions, support their health, and increase their chances of survival. Among these resources, herbal and bee products stand out. WHO estimates that 80% of the global population uses some form of herbal remedies for treating illnesses (Altun, 2022). With the development of social life, herbal products have become an important therapeutic resource through human use. The primary reason for this is that plants contain numerous biologically active substances that offer significant benefits in the treatment of various diseases.

The advancement of phytotherapeutic drugs is becoming increasingly important, as they provide a safe and sustainable alternative with molecules that have minimal environmental impact. Herbal products used in phytotherapy are regarded as safer options because they offer supportive treatment without contributing to problems like bacterial resistance or lingering chemical residues.

The number of beneficial effects associated with phytochemical supplementation to enhance sports training and physical exercise performance has been well-documented. These benefits include reductions in oxidative stress, inflammation, pain, and muscle damage (Wang et al., 2024).

Phytotherapy types and its role in human health

Phytotherapy is a treatment method that uses herbal products and has been employed for centuries in various civilizations to treat or prevent diseases. It involves the systematic use of plant-based products to address or prevent health issues. This approach includes the clinical use of herbal medicines and extracts and is typically administered by qualified healthcare professionals. These plants can also be used as supportive nutrients (Çankaya, 2022).

This method, practiced for approximately 5,000 years, has been adapted and applied through diverse approaches across various cultures (Borchardt, 2002). For instance, in Traditional Chinese Medicine, herbal treatment is embraced as a holistic approach aimed at preventing diseases (Elendu, 2024). The phytotherapeutic properties of plants stem from the bioactive components they contain. These components can have positive effects on health due to the diverse chemical compositions of the plants. The phytotherapeutic properties of plants originate from their bioactive components, which can benefit health due to the variety of chemical compositions present in the plants.

Plants contain bioactive components such as polyphenols, flavonoids, alkaloids and terpenes. These compounds exhibit anti-inflammatory, antioxidant, antimicrobial, and immune-boosting properties. The effectiveness of various plants in combatting different diseases is facilitated by their genetic diversity and the species that flourish in a range of climatic conditions. Each plant features a distinct chemical structure and therapeutic characteristics. Many plants also contain antioxidant components that help mitigate cellular damage and slow the aging process, potentially aiding in the prevention of numerous chronic diseases (Sharma, 2021). Furthermore, plants are rich in compounds that help reduce inflammation, making them beneficial for treating rheumatism, arthritis, and other inflammatory conditions (Rubio et al., 2013).

Herbal products contain components that strengthen the immune system. Plants such as echinacea, ginger, and garlic, in particular, can enhance the immune response (Shakya, 2015). Some plants are used

in the treatment of digestive issues due to their regulatory effects on the digestive system. For example, herbs like mint and fennel can aid digestion (Sidhu et al., 2007). Additionally, plants can have positive effects on mental states such as stress, anxiety, and depression. For instance, kava kava and lemon balm are known for their relaxing effects (Bakhshaei, 2017). These properties make plants valuable for use in the field of phytotherapy, while also requiring careful application of this treatment method. The effects of herbal products can vary from person to person and may cause side effects in some cases. Therefore, consulting a qualified healthcare professional is essential when practicing phytotherapy. If not used correctly or applied uncontrollably, herbal products can lead to serious health issues.

The benefits of herbal treatments for athletes are quite diverse and are generally used to enhance physical performance, accelerate the recovery process, and improve overall health (Parek et al., 2020). The use of certain herbs with anti-inflammatory effects can reduce muscle soreness and inflammation after exercise. Various herbal supplements may support the immune system. Some plants can also boost energy levels, enhancing athletes' performance. Herbs that help lower stress levels can improve mental focus. It is known that some herbal supplements contribute to muscle mass increase, particularly those containing amino acids, which support muscle repair (Zhang et al., 2024).

In addition, herbal products can accelerate the recovery process after exercise by regulating the digestive system. Some herbs may enhance motivation by improving mood. For example, kava kava and St. John's Wort can support emotional balance. Herbal products can be particularly useful for speeding up recovery after sports injuries. Plants like arnica can assist in reducing bruising and swelling (Koriem, 2021). For these benefits to be effective, proper use of herbal treatments and professional health consultation are essential. It's also important to keep in mind that individuals may respond differently to herbal remedies. Since many plants can be highly toxic, phytotherapy can pose an increased risk of side effects and toxicity compared to other complementary treatment methods. Nonetheless, side effects associated with the use of these plants can occur due to improper usage, contamination, or interactions with other herbs and medications (Bent & Ko., 2004; Sarışen & Çalışkan, 2005).

Although generally used in the treatment of diseases, herbal products with supplementary or therapeutic purposes are also utilized by athletes for different goals compared to other individuals. Ergogenic aids used for exercise purposes not only enhance athletic performance but also contribute to strengthening muscle tissue and increasing endurance. Additionally, these supplements, taken to reduce exercise-induced damage, protect immunity, and address vitamin and mineral deficiencies, help shorten the recovery period of the body after training and competition while also contributing to the improvement of motor skills such as conditioning and coordination (Bayir et al., 2023).

Athletes are generally more inclined to use supplement products compared to non-athletes. Therefore, this review evaluates the benefits and potential side effects of certain plants used in phytotherapy, particularly in athletes, and offers various recommendations.

Ginger (*Zingiber officinale* Roscoe)

Ginger, which can be consumed fresh or dried, is derived from its rhizome roots. This plant has been cultivated as a spice and medicinal herb in China and India for thousands of years, and today it is produced in many other countries for various purposes. In Chinese medicine, ginger is highly valued for its ability to help digestion, regulate bleeding, heal rheumatic diseases, and support respiratory function, while in traditional Indian medicine, it is used to prevent clotting and cholesterol and to alleviate joint inflammation (Gupta & Sharma, 2014). Ginger is widely used in traditional medicine and, due to its medicinal properties, is now preferred by many people in various forms. Its primary medicinal uses include the treatment of digestive issues such as nausea, indigestion, intestinal infections, and flatulence. Additionally, there are increasing reports of its use in the treatment of conditions such as diabetes, hemorrhoids, smallpox, hypertension, paralysis, and dysentery (Surh et al., 1999; Ojulari et al., 2014).

Ginger is widely recognized as a popular herbal supplement among athletes, primarily due to its anti-inflammatory and digestive-supporting properties. It has been reported that taking ginger for 1–2 weeks can reduce pain associated with eccentric resistance exercise and prolonged running (Wilson, 2015). Ginger, which is reported to increase resistance to diseases, may also have some side effects. It has been suggested that ginger can cause digestive problems such as nausea, diarrhea or indigestion in some people, and these effects become more pronounced when taken in excessive amounts. Although rare, some people may experience allergic reactions to ginger, leading to symptoms such as itching, rash, or difficulty breathing (Li et al., 2019).

Both antioxidant and antibacterial features of plant-derived feed additives play a critical role in health maintenance of human chellenfed with heavy physical exertion (Sulieman et al., 2024). Furthermore, ginger root extract can attenuate mitochondrial functioning, reduce oxidative stress, and ameliorate muscle mass decline (Appell et al., 2024). Another effect of *Zingiber officinale* supplement was reported in respect with the gut microbiota modulation in group of male athletes exposed to prolonged physical activity (Domínguez-Balmaseda et al., 2022). The protective effects of ginger combined with other phytochemicals have shown significant potential in reducing inflammation in middle-aged males (González-Gross et al., 2021).

Due to its anticoagulant properties, the use of ginger has been reported, especially by athletes taking anticoagulant medications, as possibly increasing the risk of bleeding (Taj Eldin et al., 2016). Therefore, it is recommended to exercise caution regarding ginger consumption in the pre- or post-operative period. Additionally, because ginger can lower blood glucose levels (Mashhadi et al., 2013), it may lead to excessively low blood glucose in diabetic athletes or those undergoing insulin treatment. It is also thought that, particularly in high amounts, ginger may adversely affect some athletes' concentration or energy levels. Ginger can cause mild diarrhea and may result in heartburn, as well as act as a stomach irritant when taken in doses exceeding 6 g. Inhaling ginger powder may trigger IgE-mediated allergies (Ali et al., 2008).

The effects of ginger on athletes can vary depending on factors such as individual tolerance and health status. Consulting a healthcare professional before using ginger supplements is important to prevent potential side effects and interactions.

Turmeric (*Curcuma longa* L.)

This plant is well-known for its anti-inflammatory, antithrombotic, antioxidant, antibacterial, antiviral, and antitumor effects, particularly due to its active component, curcumin, and it also has properties that support digestion (Altun, 2022). Turmeric has been used in traditional medicine for centuries and offers numerous benefits in modern medicine as well. Turmeric is widely used in herbal and traditional medicine for the treatment of rheumatoid arthritis, chronic anterior uveitis, conjunctivitis, skin cancer, smallpox, chickenpox, wound healing, urinary tract infections, and liver ailments. Additionally, it is preferred for purposes such as boosting overall energy, eliminating intestinal parasites, regulating menstruation, dissolving gallstones, healing wounds, and addressing various digestive disorders (Prasad & Aggarwal, 2011).

Athletes commonly use turmeric for its anti-inflammatory and antioxidant effects. A clinical study identifying the positive effects of curcumin, the active compound of turmeric on individuals who exercise and athletes found that curcumin supplementation significantly reduced exercise-induced muscle damage and creatine kinase levels following eccentric exercise, thereby markedly improving post-exercise recovery (Amalraj et al., 2020).

Curcumin supplementation has been demonstrated to enhance athletic performance, reduce exercise-induced muscle damage, and alleviate fatigue by lowering creatine kinase (CK) activity. Additionally, it is known to exert a strong anti-inflammatory and antioxidant effect by regulating pro-inflammatory cytokines (Nedzvetsky et al., 2018). Curcumin supplementation is considered safe and is believed to have the potential to support athletic performance. Notably, its

effectiveness when used before and after acute physical exercise in sedentary individuals has been scientifically proven (Dias, 2021).

Several molecular mechanisms of beneficial curcumin effect demonstrated the complex relationship between its antioxidant and anti-inflammatory features. Taking into the account that exercise-induced oxidative stress is accompanied by the initiation of delayed complications while the inflammation is the major driver, the inhibition of the main proinflammatory pathways can be a promising tool to alleviate similar abnormalities. Curcumin application inhibits the inflammatory process through the suppression of nuclear factor kappa-chain (NF-κB) and consequently prevents the release of inflammatory cytokines (Dias et al., 2022; Wang et al., 2024). The study of the effect of curcumin on interleukin production shows that the dosage and various regimens of curcumin supplementation can initiate different interleukin levels in comparison to placebo or unexposed groups of athletes (Sciberras et al., 2015). Recently combined turmeric plus vitamins blend supplementation has also been demonstrated as an effective anti-inflammatory tool to decrease the risk of illness in elite footballers (Clayton et al., 2024).

However, like any natural product, turmeric also has some potential side effects. Curcumin is not entirely harmless; human studies indicate that consuming curcumin at doses ranging from 0.9 to 3.6 g/day for 1–4 months can lead to adverse effects, including nausea and diarrhea, as well as increases in serum alkaline phosphatase and lactate dehydrogenase levels (Burgos-Moroón, 2010).

Excessive consumption of turmeric may elevate the risk of kidney stone formation by raising urinary oxalate levels in sensitive individuals (Liu et al., 2022). It can also inhibit iron absorption, causing iron deficiency and lead to increased liver enzymes and liver damage (Balaji & Chempakam, 2010). High consumption of turmeric may lead to symptoms such as heartburn, gas, bloating, or nausea. Because turmeric increases bile production (Parlakpınar, 2022), it can cause severe pain and discomfort in athletes with gallstones or gallbladder problems. This, in turn, can negatively affect the athlete's performance. Furthermore, since turmeric has the potential to lower blood glucose levels (Nishiyama et al., 2005), it may increase the risk of hypoglycaemia in athletes with diabetes or those taking medications to regulate blood sugar. The decrease in energy supply is one of the most important risks for athletes. These potential side effects of turmeric usually occur with excessive intake, so long-term or high-dose consumption should only be planned in consultation with a healthcare professional.

Dandelion (*Taraxacum officinale* (L.) Weber ex F. H. Wigg.)

Dandelion has numerous medicinal properties due to its phytochemicals, which include alkaloids, terpenoids, tannins, sterols, flavonoids, phenolic compounds, potassium, calcium, and vitamins A, B, and C found in its flowers, leaves, stems, and roots. *Taraxacum officinale* is widely used in traditional folk medicine and modern phytotherapy in Europe, Asia, and America due to its diuretic effects (Clare et al., 2009). Due to its anti-diabetic properties attributed to bioactive chemical components such as chicoric acid, taraxasterol (TS), chlorogenic acid, and sesquiterpene lactones, dandelion is used therapeutically in some countries for the control and treatment of type 2 diabetes (Wirngo et al., 2016).

Studies have shown that dandelion extract has a positive effect on kidney diseases, particularly in the treatment and prevention of kidney stones (Karakuş et al., 2017; Yousefi Ghale-Salimi et al., 2018). Additionally, it has been determined that dandelion is beneficial in preventing and treating liver diseases (Park et al., 2010). It also demonstrates therapeutic properties in ulcerative colitis in both *in vitro* and *in vivo* models (Ding & Wen, 2018), increases the immune response, and has antiviral, antifungal, antibacterial and antioxidant activities (Lis et al., 2020). Therefore, dandelion seems promising for the treatment and prevention of various diseases. It is used as a diuretic, to increase bile secretion, as an appetite stimulant, and in the treatment of dyspepsia (Diker & Çankaya, 2022).

A study demonstrated that dandelion extract has the potential to enhance the proliferation and activity of skeletal muscle cells in rats. Additionally, it was found that dandelion can suppress the expression of inflammatory cytokines such as IL-1β, IL-6, and TNF-α while increasing the expression of myogenic cytokines like myogenin and MyoD1. Therefore, it is suggested that dandelion may have a synergistic effect in supporting cell proliferation and reducing the inflammatory response during the alleviation of delayed-onset muscle soreness (Liu et al., 2018). It is stated that dandelion supports muscle cell regeneration and accelerates muscle recovery by increasing the expression of myogenic cytokines. Optimized doses of flowers from the Asteraceae family are rich in dietary fiber content that exhibit prebiotic properties, helping to regulate the microbiome when included in the daily diet of athletes (Jakubczyk et al., 2022). With these effects, it may be particularly beneficial for athletes during periods of intense training.

However, it should be noted that while dandelion is generally a beneficial plant for health, it may have adverse effects in some individuals. Patients with inflamed or infected gallbladders are also advised to avoid this plant. Some uses have been associated with issues such as heartburn and diarrhea. Excessive consumption of dandelion can lead to stomach discomfort, gas, and bloating. Since digestive issues can lower energy levels, this may negatively impact athletes' performance. Dandelion may interact with certain medications, such as clozapine (Orhan, 2022) and increases the likelihood of adverse effects in athletes who are on regular medication. Furthermore, because of its potential adverse effects related to gallbladder inflammation (Diker & Çankaya, 2022), dandelion is not recommended for athletes who are experiencing this condition.

Dandelion is recognized for its ability to regulate blood sugar level (Iddrisu et al., 2015). However, those taking medication for the same purpose are advised to refrain from consuming dandelion, as it may result in hypoglycaemia and potentially cause more harm than benefit to the body. Moreover, dandelion extract can lead to irritation, itching, and allergic reactions in the eyes, so it should be avoided in the eye area (Lovel & Rowan, 1991).

St. John's wort (*Hypericum perforatum* L.)

The use of plant products like St. John's wort in the treatment and prevention of various diseases has become popular today. St. John's wort has long been used as an herbal remedy for various ailments. In recent years, it has gained popularity as a widely used alternative treatment for depression. Additionally, it shows promising therapeutic potential for other conditions such as cancer, inflammation, and bacterial and viral infections. Research has focused on the pharmacology of its components and clinical trials. Pharmacological studies have demonstrated that St. John's wort extracts possess neuroactive properties. Moreover, most clinical studies demonstrate that *H. perforatum* is relatively safe, especially at typical dosages (Klemow et al., 2011).

Research has shown that St. John's wort extract contains many different biologically active components, including flavonoids, naphthodianthrones, phloroglucinols, proanthocyanidins, procyanidins, tannins, essential oils, amino acids, phenylpropanoids, xanthones, and other water-soluble compounds (Greeson et al., 2001). The most significant effect of St. John's Wort is undoubtedly its function as an antidepressant. This effect is believed to stem from its impact on central neurotransmitter receptors and its complex and unique pharmacology, which facilitates the reuptake inhibition of neurotransmitters such as serotonin, dopamine, norepinephrine, GABA, and glutamate (Nathan, 2001). In addition to its antidepressant effects, St. John's wort has been noted for its effects on pain, skin lesions, menopause, and bacterial infections, as well as its neuroprotective effects (Şengül et al., 2021).

St. John's wort is generally well tolerated when taken at recommended doses for 1–3 months. The most common side effects of this herb include gastrointestinal issues, skin reactions, allergic responses, fatigue, tiredness, sedation, restlessness, anxiety, dizziness, headaches, and dry mouth (Woelk et al., 1994).

St. John's wort can interact with many medications (such as anticoagulants, anticonvulsants, antidepressants, immunosuppressive agents, antimicrobial drugs, and hypoglycaemic agents), potentially

altering their effects when taken together (Borrelli & Izzo, 2009; Chen et al., 2012). Additionally, due to the high possibility of interactions with supplements or medications used by athletes (Izzo et al., 2016), it should be used under professional supervision. St. John's wort can cause gastrointestinal symptoms such as upset stomach, abdominal pain, or diarrhea in some people, which can be uncomfortable during training or performance (Hammernes et al., 2003). Therefore, athletes should be warned against using St. John's wort in conjunction with pharmaceutical drugs, and precautions should be taken considering the potential interactions between medications (Zhou et al., 2004).

Yarrow (*Achillea millefolium* L.)

Yarrow is considered one of the oldest medicinal plants and is used today in the treatment of various diseases. The reason for its widespread use in traditional medicine is due to its anti-inflammatory, antiseptic, and analgesic properties. Yarrow, one of the oldest and most widely used therapeutic herbs, is primarily employed for various purposes such as treating injuries, gastrointestinal disorders, chest illnesses, skin conditions, liver diseases, and as a mild sedative. Yarrow contains macro nutrients such as free sugars, organic acids, and fatty acids, as well as tocopherols, which are components with strong antioxidant activity. The sesquiterpene lactones found in this plant are known to be effective main compounds in cancer treatment (Dias et al., 2013). These components have effects on various tumor cells, including mammary epithelial adenocarcinoma, lung tumor cells, and hepatoma (Ali et al., 2017). A recent study highlighted the protective effects of yarrow extract against apoptosis and inflammatory changes (Raeisi et al., 2024). However, the efficacy of this phytochemical is dose-dependent. Furthermore, yarrow is used for its wound-healing, diuretic, menstrual-regulating properties, and to prevent gastric issues such as gastritis and ulcers. It is also thought to alleviate gallbladder discomfort, aid in passing kidney stones, cleanse the liver, and reduce inflammation, as well as being beneficial in the treatment of prostate issues (Göktaş & Gıdık, 2019; Saraç et al., 2021). Yarrow is generally considered a safe plant. However, it may cause allergic reactions in some individuals, particularly in those who are allergic to the Asteraceae family. These reactions can manifest as symptoms such as skin redness, itching, hives, or respiratory problems.

It may cause stomach discomfort in some people when used in high doses and for extended periods. Digestive issues such as nausea, vomiting, abdominal pain, or diarrhea may occur. Therefore, athletes should avoid using yarrow or its components in high doses or for prolonged periods, as it may impact their performance.

Pumpkin seeds (*Cucurbita pepo* L.)

Pumpkin seeds are rich in essential minerals such as protein, omega-3 fatty acids, zinc, calcium, magnesium, and iron. They also contain many bioactive compounds, including phenolic compounds, squalene, phytosterols, tocopherols, tocotrienols, carotenoids, and flavonoids. Due to this rich nutrient composition, their oil possesses antimicrobial, antioxidant, antidiabetic, anti-inflammatory, antitumor, and antihypertensive properties, making it a traditional medicine in many countries (Badr et al., 2011; Adnan et al., 2017; Syed et al., 2019). Additionally, pumpkin seeds have gained popularity in recent years for helping to prevent prostate enlargement due to their high levels of minerals like zinc and magnesium, which aid in the treatment of benign prostatic hyperplasia (Abdel-Rahman, 2006).

Recent findings suggest that the rich composition of pumpkin seed oil makes it an effective treatment for benign prostatic hyperplasia and for men experiencing persistent urinary problems. Pumpkin seed oil also exhibits other biological effects, including cardiovascular protective effects, wound healing properties, and antimicrobial and anti-inflammatory activity. Therefore, it can be effectively used as an alternative treatment for conditions such as urinary tract infections, cardiovascular diseases, and other inflammatory disorders (Ramak & Mahboubi, 2019). However, excessive consumption may lead to weight gain, allergic reactions in sensitive individuals (Figueredo et al., 2000). Additionally, since it naturally lowers blood pressure, and due to its blood sugar-lowering effect (Majid et al., 2020), athletes should take these sensitivities into account.

Asian ginseng (*Panax ginseng* C. A. Mey.)

This plant, which grows naturally in China, Japan, and Korea, is used to enhance physical capacity in cases of fatigue, exhaustion, and lack of concentration, as well as to restore strength and vitality during recovery periods. It has also been reported to help regulate blood sugar levels in diabetic patients, assist in the treatment of erectile dysfunction, and increase libido (Altun, 2022). As stated in the systematic review conducted by Vogler et al., several randomized clinical trials have been conducted to investigate the effects of *P. ginseng* on physical and psychomotor performance, cognitive function, immunomodulation, diabetes mellitus, and herpes simplex type II infections (Vogler et al., 1999).

Although it is claimed to be safe, excessive dosage and a low level of purity of the product can render this otherwise safe herbal product dangerous. Ginseng, the most studied herb for physical performance, is probably one of the most popular herbal dietary supplements (Bucci, 2000).

Panax ginseng preparations have been developed in human clinical trials for various purposes, including anti-inflammatory and antioxidant effects, stimulation of brain function, anabolic properties, and enhancement of endurance performance (Sellami et al., 2018).

Ginseng contains a variety of important compounds, including vitamins A, B, C, and E, minerals such as iron, magnesium, potassium, and phosphorus, as well as fibers, proteins, saponins, and ginsenosides. It has been shown that the various rich components of ginseng help to reduce mental stress, enhance immune function, and stabilize blood pressure (Popov & Goldwag, 1973. Furthermore, chronic use of ginseng has been shown to enhance cardiorespiratory function and lower blood lactate concentrations, as well as improve physical performance (Kim et al., 2005).

Ginseng, used as a stimulant among athletes, is considered relatively safe by various sources; however, it has been observed to have a high incidence of side effects. Long-term use of ginseng has been associated with central nervous system stimulation and excessive alertness (Siegel, 1979). Furthermore, some of the side effects of ginseng may be significant depending on the dosage and an individual's metabolism. The use of ginseng has been associated with diarrhea, insomnia, headaches, rapid heartbeat, fluctuations in blood pressure, and digestive disorders. Several of these side effects are serious enough to warrant stopping the use of ginseng, especially in breast cancer patients. Ginseng can also interact with various medications, including insulin, digoxin, anticoagulants, and monoamine oxidase inhibitors (Siegel, 1980; Sellami et al., 2018).

As a result, ginseng presents a significant limitation for the healthy population. It has been stated that individuals who are energetic, nervous, tense, hysterical, or schizophrenic should avoid ginseng (Nocerino et al., 2000). Additionally, it should not be taken in combination with other stimulants, medications, or during hormone treatments. Therefore, athletes using ginseng should be well-informed about the purity, dosage, and potential side effects of the products they are using, and they should be especially cautious about these factors during competitions.

Puncturevine (*Tribulus terrestris* L.)

Tribulus terrestris is one of the many exotic plants recommended for use and has been utilized in traditional and ancient medicine in Greece, China, and India. Extracts from this plant have been used to treat urinary tract infections, urolithiasis, dysmenorrhea, edema, hypertension, and hypercholesterolemia (Sellami et al., 2018). The pleiotropic effects of *Tribulus terrestris* are suggested to balance and modulate physiological biomarkers, such as hematological, lipid, kidney, and liver biomarkers, which deviate from normal values due to intense and stressful physical exercise. The key chemical compounds in this plant are steroids, including saponins such as dioscin, diosgenin,

and protodioscin. These compounds may have a positive effect on libido and physical fitness. Recent studies have shown that *Tribulus terrestris* extract enhances testosterone production in healthy men. Furthermore, a study revealed that well-trained athletes and weightlifters utilize *Tribulus terrestris* supplementation to enhance luteinizing hormone (LH) production and support muscle growth (Ivanova et al., 2016).

There are also studies with opposing results suggesting that the use of TT as a performance enhancer with ergogenic properties to increase training tolerance, muscle mass, physical strength, or endurance in athletes does not actually show sufficient effect (Neychev & Mitev, 2005; Pokrywka et al., 2014).

Studies conducted on animals have detected serious damage indicators in the cardiac muscle, liver, and kidneys from the use of *Tribulus terrestris* (Aslani et al., 2004). Additionally, a person who took a high dose of *Tribulus terrestris* for two days to prevent kidney stones developed hepatitis and kidney necrosis. Therefore, it is understood that the benefits and harms of *Tribulus terrestris* on human health still remain unclear (Talazas et al., 2010).

Although it has been stated that they have positive effects on physical exercise due to the saponins they contain, athletes should only use these plant products with the recommendation of a specialist physician due to the side effects they cause.

Stinging nettle (*Urtica dioica* L.)

The use of stinging nettle for its health benefits dates back to ancient times. Nettle provides iron and other minerals, vitamin C, carotenoids, as well as essential amino acids and fatty acids. The medicinal use of nettle, both internally and topically, has been documented for over 2,000 years. It has been used to treat bites, wounds, and poisonings, smoked for asthma relief, and prepared as teas or juices to support pregnancy, and encourage hair growth (https://naturalmedicines.therapeuticresearch.com/databases).

Previous studies have demonstrated that stinging nettle has potential effects for treating various inflammatory and other conditions, including osteoarthritis, benign prostatic hyperplasia, allergic rhinitis, asthma, bleeding disorders, and diabetes (Baumgardner, 2016). Additionally, research indicates that nettle extracts protect against liver toxicity in rats, decrease lipid peroxidation, lower liver enzyme levels, and enhance the antioxidant defence system (Kanter et al., 2005).

Earlier reviews suggested that nettle extracts may be useful in the treatment of symptoms of benign prostatic hyperplasia, (Lowe & Fagelman, 2002). Moreover, studies have demonstrated that this agent's effect in treating benign prostatic hyperplasia includes anti-inflammatory and antiproliferative actions, as well as other beneficial inhibitory effects, through the release of tumor necrosis factor-α and other inflammatory cytokines (Cheetham, 2013).

Physical contact with stinging nettle often leads to urticaria or irritant dermatitis due to a non-immunological reaction. There is an immediate sensation of burning, stinging, and itching in the affected area; this sensation is followed within minutes by a blanching urticarial rash. Although there is no reliable information regarding potential problems other than dermatitis that may arise from its use by athletes, seeking expert advice on its usage is advisable.

Golden root (*Rhodiola rosea* L.)

Rhodiola rosea is recognized for its ability to enhance both the body's physical and mental performance. Although this plant is cultivated in Europe, it grows mainly in the Himalayan region, China and Mongolia and is available on the market as dietary supplement. *Rhodiola* extracts are traditionally used in tonics and in adaptogenic, antidepressant, and anti-inflammatory medications (Chan, 2012). The pharmacological effects of *Rh. rosea* have been extensively studied, highlighting its role in enhancing longevity, stimulating the central nervous system, and improving work performance. Additionally, it exhibits cardioprotective, neuroprotective, and hepatoprotective properties, along with immunotropic, antiviral, anti-inflammatory, and antibacterial activities (Chan, 2012). Recently, *Rhodiola* has gained attention as a supplement because of its potential energy-replenishing effects, which can enhance physical performance (Tinsly et al., 2024). Although only a limited number of studies have assessed the effects of *Rhodiola* as a supplement for exercise and physical activity, its potential benefits are gaining attention. Elite athletes have been effectively using *Rh. rosea* as a safe nutritional supplement for years to increase endurance and aid rapid muscle recovery. The use of RR extract by professional athletes boosts physical performance and endurance while stimulating anabolic processes in skeletal muscles (Lu et al., 2022).

The main components that exhibit the phytochemical and pharmacological properties of *Rh. rosea* are *Rhodiola* glycosides, benzophenones, caffeic acid, protocatechuic acid, gallic acid, and epigallocatechin gallate, each of which has distinct biological properties (Coors et al., 2019). It has been clearly demonstrated that *Rhodiola* supplementation can enhance sports and exercise performance by reducing oxidative stress, muscle pain, and injuries. Additionally, it aids in improving skeletal muscle damage and recovery during training while increasing explosive power in athletes (Lu et al., 2022).

Exercise is a form of physical stress and stress has been linked to a higher incidence of various health disorders affecting the neuroendocrine-immune system. These range from milder physiological issues, such as decreased physical and mental capacity and feelings of weakness, to more serious health conditions, including anxiety, depression, fatigue, burnout, and dysfunctions in cardiovascular and reproductive systems (Ivanova Stojcheva & Quintela, 2022).

Due to its effects in preventing stress-induced cardiac damage, reducing myocardial catecholamine and cyclic adenosine monophosphate (cAMP) levels, and decreasing adrenal catecholamine release, *Rh. rosea* is considered beneficial for use as a cardioprotective agent, especially in athletes experiencing intense stress (Maslova et al., 1994; Lee et al., 2013).

Among the 183 individuals participating in the 10 clinical studies, it has been reported that none of the doses of *Rh. rosea* caused significant clinical side effects or had adverse effects on health (Lu et al., 2022). Due to the mild side effects of *Rhodiola*, it may seem harmless for athletes to use these herbal products to manage exercise-induced stress and enhance their performance; however, they should pay attention to expert recommendations.

Echinacea (*Echinacea purpurea* (L.) Moench)

Echinacea is one of the most significant and recognized medicinal plants globally, belonging to the Asteraceae family. It has been used for various conditions, such as the common cold and flu, but it can also cause nausea and vomiting and may impact coagulation. In addition, *Echinacea* has primarily been used in chemotherapy for infectious diseases affecting both the upper and lower respiratory systems. The important constituents of the plant are alkamides, caffeic acid derivatives, and polysaccharides (Erdem & Eren, 2009; Zaushintsena, 2019).

Several studies have shown that alkamides contribute to the immunomodulatory properties of *Echinacea* extracts both *in vitro* and *in vivo*. Its Immunomodulatory and antioxidant properties have also been attributed to caffeic acid derivatives and polysaccharides (Senchina et al., 2009). Additionally, polysaccharides also play a significant role in the anti-inflammatory effects of *Echinacea* preparations (Laasonen et al., 2002; Gertsch et al., 2004).

Furthermore, because of its immunomodulatory and anti inflammatory effects it may be effective for preventing and treating various infectious diseases, including infections of the upper and lower respiratory systems, wound infections, and chronic pelvic infections (Grimm & Muller, 1999). Like many other medical plants, the findings of clinical trials of the *Echinacea* preparation are controversial. A randomized blinded trial found no significant difference in the incidence or severity of colds and respiratory infections between the *Echinacea* and placebo groups (Barrett et al., 2010).

On the other hand, a study found that *E. purpurea* preparations had a beneficial effect on adults with cold symptoms in clinical trials, if treatment is started early (Brinkeborn et al., 1999). A study found

that *Echinacea* supplementation was associated with an increase in VO_{2max}, likely due to elevated hemoglobin and hematocrit levels linked to increases in serum erythropoietin (Whitehead et al., 2012). Conversely, the findings of several authors contradict these results, indicating that a concentrated dose of *Echinacea* is insufficient to enhance maximum aerobic capacity (Beller et al., 2014).

The side effects associated with the use of this plant have been linked to both allergic reactions and hepatic or gastrointestinal effects. It has been reported that allergic reactions primarily arise from IgE-mediated hypersensitivity, likely due to *Echinacea's* immune-stimulating effects (Mullins et al., 2002). *Echinacea* may lead to adverse outcomes in humans by increasing cytokine production (Barret, 2003). Other side effects associated with *Echinacea* use include hepatotoxicity, cholestatic autoimmune hepatitis, erythema nodosum, diarrhea, vomiting, headache, and drowsiness (Soon & Crawford, 2001; Taylor et al., 2003; Jacobsson et al., 2009).

Conclusion

It is well-known that herbal supplements, widely used around the world, are especially popular among athletes. The athlete's performance is just as vital to them as their health. Herbal products, while offering many benefits, also have side effects that should be taken seriously. For this reason, while athletes may benefit from the supplements they use, there can also be negative impacts on their health. It is therefore essential to thoroughly inform athletes about the indications, contraindications, food-drug interactions, proper usage methods, dosage forms, recommended minimum and maximum doses, and potential side effects associated with these supplements. Therefore, athletes utilizing herbal therapy should pay close attention to the advice of their experts and trainers.

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References

Abdel-Rahman, M. K. (2006). Effect of pumpkin seed (*Cucurbita pepo* L.) diets on benign prostatic hyperplasia (BHP): Chemical and morphometric evaluation in rats. World Journal of Chemistry, 1, 33–40.

Adnan, M., Gul, S., Batool, S., Fatıma, B., Rahman, A., Yaqoob, S., Shabir, H., Yousuf, T., Mussarat, S., Ali, N., Khan, S.N., Rahman, H., & Abdul Aziz, M. (2017). A review on the ethnobotany, phytochemistry, pharmacology and nutritional composition of *Cucurbita pepo* L. Journal of Phytopharmacology, 6(2), 133–139.

Ali, B. H., Blunden, G., Tanira, M. O., & Nemmar, A. (2008). Some phytochemical, pharmacological, and toxicological properties of ginger (*Zingiber officinale* Roscoe): A review of recent research. Food and Chemical Toxicology, 46(2), 409–420.

Ali, S. I., Gopalakrishnan, B., & Venkatesalu, V. (2017). Pharmacognosy, phytochemistry and pharmacological properties of *Achillea millefolium* L.: A review. Phytotherapy Research, 31(8), 1140–1161.

Altun, M. L. (2022). Fitoterapide yer alan bazi bitkisel kaynaklar ve gelecekte tibbi bitkiler [Some herbal resources in phytotherapy and medicinal plants in the future]. In: Tekin, A., Çankaya, İ. T., & Zeybek, A. U. (Eds.). Fitoterapi Uygulaması Kitabı [Phytotherapy Practice Book]. T. C. Sağlik Bakanliği, Sağlık Hizmetleri Genel Müdürlüğü. Republic of Turkey Ministry of Health, General Directorate of Health Services, Ankara. Pp: 88–95.

Amalraj, A., Divya, C., & Gopi, S. (2020). The effects of bioavailable curcumin (Cureit) on delayed onset muscle soreness induced by eccentric continuous exercise: A randomized, placebo-controlled, double-blind clinical study. Journal of Medicinal Food, 23(5), 545–553.

Appell, C. R., Jiwan, N. C., Wang, R., Shen, C. L., & Luk, H. Y. (2024). Ginger supplementation attenuated mitochondrial fusion and improved skeletal muscle size in type 2 diabetic rats. In vivo, 38(1), 73–81.

Aslani, M. R., Movassaghi, A. R., Mohri, M., Pedram, M., & Abavisani, A. (2004). Experimental *Tribulus terrestris* poisoning in goats. Small Ruminant Research, 51, 261–267.

Badr, S. E., Shaaban, M., Elkholy, Y. M., Helal, M. H., Hamza, A. S., Masoud, M. S., & El Safty, M. M. (2011). Chemical composition and biological activity of ripe pumpkin fruits (*Cucurbita pepo* L.) cultivated in Egyptian habitats. Natural Product Research, 25(16), 1524–1539.

Bakhshaei, S. (2017). Phyto-pharmacological effect of nine medicinal plants as a traditional treatment on depression. Journal of Applied Pharmacy, 9(3), 2–5.

Balaji, S., & Chempakam, B. (2010). Toxicity prediction of compounds from turmeric (*Curcuma longa* L). Food and Chemical Toxicology, 48(10), 2951–2959.

Barrett, B., Brown, R., Rakel, D., Mundt, M., Bone, K., Barlow, S., & Ewers, T. (2010). *Echinacea* for treating the common cold: a randomized trial. Annals of Internal Medicine, 153(12), 769–777.

Baumgardner, D. J. (2016). Stinging nettle: The bad, the good, the unknown. Journal of Patient-Centered Research and Reviews, 3(1), 48–53.

Bayir, E., Cebe, G. E., & Öztürk, B. (2023). Naturally sourced ergogenic supports used by athletes. Journal of the Faculty of Pharmacy of Ankara, 47(3), 1155–1169.

Bellar, D., Moody, K. M., Richard, N. S., & Judge, L. W. (2014). Efficacy of a botanical supplement with concentrated *Echinacea purpurea* for increasing aerobic capacity. International Scholarly Research Notices Nutrition, 2014, 49549.

Bent, S., & Ko, R. (2004). Commonly used herbal medicines in the United States: A review. The American Journal of Medicine, 116(7), 478–485.

Borchardt, J. K. (2002). "The beginnings of drug therapy": Ancient Mesopotamian medicine. Drug News and Perspectives, 5(3), 187–192.

Borrelli, F., & Izzo, A. A. (2009). Herb–drug interactions with St John's wort (*Hypericum perforatum*): An update on clinical observations. The American Association of Pharmaceutical Scientists Journal, 11(4), 710–727.

Brinkeborn, R. M., Shah, D. V., & Degenring, F. H. (1999). Echinaforce and other *Echinacea* fresh plant preparations in the treatment of the common cold: A randomized, placebo-controlled, double-blind clinical trial. Phytomedicine, 6(1), 1–6.

Bucci, L. R. (2000). Selected herbals and human exercise performance. American Journal of Clinical Nutrition, 72(S2), 624S–636S.

Burgos-Morón, E., Calderón-Montaño, J. M., Salvador, J., Robles, A., & López-Lázaro, M. (2010). The dark side of curcumin. International Journal of Cancer, 126(7), 1771–1775.

Çankaya, İ. T. (2022). Bitkiden ilaca tarihi yolculuk ve fitoterapide temel kavramlar [Historical journey from plants to medicine and basic concepts in phytotherapy]. In: Tekin, A., Çankaya, İ. T., & Zeybek, A. U. (Eds.). Fitoterapi Uygulaması Kitabı [Phytotherapy Practice Book]. Republic of Turkey Ministry of Health, General Directorate of Health Services, Ankara. Pp. 3–20.

Chan, S. W. (2012). *Panax ginseng*, *Rhodiola rosea*, and *Schisandra chinensis*. International Journal of Food Sciences and Nutrition, 63(S1), S75–S81.

Cheetham, P. J. (2013). Role of complementary therapy for male LUTS. Current Urology Reports, 14(6), 606–613.

Chen, X. W., Sneed, K. B., Pan, S. Y., Cao, C., Kanwar, J. R., Chew, H., & Zhou, S. F. (2012). Herb–drug interactions and mechanistic and clinical considerations. Current Drug Metabolism, 13(5), 640–651.

Clare, B. A., Conroy, R. S., & Spelman, K. (2009). The diuretic effect in human subjects of an extract of *Taraxacum officinale* folium over a single day. The Journal of Alternative and Complementary Medicine, 15(8), 929–934.

Clayton, D. J., Burbeary, R., Parker, C., James, R. M., Saward, C., Procter, E. L., Mode, W. J. A., Baker, C., Hough, J., Williams, N. C., Rossington, H., & Varley, I. (2024). Combined turmeric, vitamin C, and vitamin D ready-to-drink supplements reduce upper respiratory illness symptoms and gastrointestinal discomfort in elite male football players. Nutrients, 16(2), 243.

Coors, A., Brosch, M., Kahl, E., Khalil, R., Michels, B., Laub, A., Franke, K., Gerber, B., & Fendt, M. (2019). *Rhodiola rosea* root extract has antipsychotic-like effects in rodent models of sensorimotor gating. Journal of Ethnopharmacology, 235, 320–328.

Dias, K. A., da Conceição, A. R., Oliveira, L. A., Pereira, S. M. S., Paes, S. D. S., Monte, L. F., Sarandy, M. M., Novaes, R. D., Gonçalves, R. V., & Della Lucia, C. M. (2021). Effects of curcumin supplementation on inflammatory markers, muscle damage, and sports performance during acute physical exercise in sedentary individuals. Oxidative Medicine and Cellular Longevity, 2021, 9264639.

Dias, K. A., da Conceição, A. R., Pereira, S. M. S., Oliveira, L. A., da Silva Rodrigues, J. V., Dias, R. S., de Paula, S. O., Natali, A. J., da Matta, S. L. P., Gonçalves, R. V., Tako, E., Martino, H. S. D., & Lucia, C. M. D. (2022). Curcumin-added whey protein positively modulates skeletal muscle inflammation and oxidative damage after exhaustive exercise. Nutrients, 14(22), 4905.

Dias, M. I., Barros, L., Dueñas, M., Pereira, E., Carvalho, A. M., Alves, R. C., Oliveira, M. B. P. P., Santos-Buelga, C., & Ferreira, I. C. F. R. (2013). Chemical composition of wild and commercial *Achillea millefolium* L. and bioactivity of the methanolic extract, infusion and decoction. Food Chemistry, 141(4), 4152–4160.

Diker, N. Y., & Çankaya, İ. T. (2022). Gebelik, doğum sonrası ve emzirme döneminde fitoterapi ve homeopati uygulamalarında kullanılan bitkisel kaynaklar [Herbal resources used in phytotherapy and homeopathy practices during pregnancy, postpartum and breastfeeding]. In: Tekin, A., Çankaya, İ. T., & Zeybek, A. U. (Eds.). Fitoterapi uygulaması kitabı [Phytotherapy Practice Book]. Republic of Turkey Ministry of Health, General Directorate of Health Services, Ankara. Pp. 182–187.

Ding, A., & Wen, X. (2018). Dandelion root extract protects NCM460 colonic cells and relieves experimental mouse colitis. Journal of Natural Medicines, 72(4), 857–866.

Domínguez-Balmaseda, D., Bressa, C., Fernández-Romero, A., de Lucas, B., Pérez-Ruiz, M., San Juan, A. F., Roller, M., Issaly, N., & Larrosa, M. (2022). Evaluation of a *Zingiber officinale* and *Bixa orellana* supplement on the gut microbiota of male athletes: A randomized placebo-controlled trial. Planta Medica, 88(13), 1245–1255.

Elendu, C. (2024). The evolution of ancient healing practices: From shamanism to Hippocratic medicine. A review. Medicine, 103(28), e39005.

Erdem, S., & Eren, P. A. (2009). Tedavi amacıyla kullanılan bitkiler ve bitkisel ürünlerin yan etkileri [Adverse effects of herbal medicines and products]. Türk Hijyen ve Deneysel Biyoloji Dergisi, 66(3), 133–141.

Figueredo, E., Cuesta-Herranz, J., Minguez, A., Vidarte, L., Pastor, C., de las Heras, M., Vivanco, F., & Lahoz, C. (2000). Allergy to pumpkin and cross-reactivity to other Cucurbitaceae fruits. Journal of Allergy and Clinical Immunology, 106(2), 402–403.

Gertsch, J., Schoop, R., Kuenzle, U., & Suter, A. (2004). *Echinacea* alkylamides modulate TNF-α gene expression via cannabinoid receptor CB2 and multiple signal transduction pathways. FEBS Letters, 577(3), 563–569.

Göktaş, Ö., & Gıdık, B. (2019). Tıbbi ve aromatik bitkilerin kullanım alanları [Areas of use of medicinal and aromatic plants]. Bayburt Üniversitesi Fen Bilimleri Dergisi, 2(1), 145–151.

González-Gross, M., Quesada-González, C., Rueda, J., Sillero-Quintana, M., Issaly, N., Díaz, A. E., Gesteiro, E., Escobar-Toledo, D., Torres-Peralta, R., Roller, M., & Guadalupe-Grau, A. (2021). Analysis of effectiveness of a supplement combining *Harpagophytum procumbens*, *Zingiber officinale* and *Bixa orellana* in healthy recreational runners with self-reported knee pain: A pilot, randomized, triple-blind, placebo-controlled trial. International Journal of Environmental Research and Public Health, 18(11), 5538.

Greeson, J. M., Sanford, B., & Monti, D. A. (2001). St. John's wort (*Hypericum perforatum*): A review of the current pharmacological, toxicological, and clinical literature. Psychopharmacology, 153(4), 402–414.

Grimm, W., & Müller, H. H. (1999). A randomized controlled trial of the effect of fluid extract of *Echinacea purpurea* on the incidence and severity of colds and respiratory infections. American Journal of Medicine, 106(2), 138–143.

Gupta, S. K., & Sharma, A. (2014). Medicinal properties of *Zingiber officinale* Roscoe – A review. IOSR – Journal of Pharmacy and Biological Sciences, 9(5), 124–129.

Hammerness, P., Basch, E., Ulbricht, C., Barrette, E. P., Foppa, I., Basch, S., Bent, S., Boon, H., & Ernst, E. (2003). St John's wort: A systematic review of adverse effects and drug interactions for the consultation psychiatrist. Psychosomatics, 44(4), 271–282.

Iddrisu, I., Oduro, I. N., Tandoh, A. M., & Annan, R. A. (2015). Anti-diabetic effect of dandelion leaves and roots in type two diabetic patients: A systematic review. Nutrition and Food Science, 45(3), 479–492.

Ivanova, S., Ivanov, K., Mladenov, R., Papanov, S., Ivanova, S., Obreshkova, D., & Atanasov, P. P. (2016). Food supplements with anabolic and androgenic activity – UHPLC analysis of food additives containing *Tribulus terrestris* extract. World Journal of Pharmaceutical Research, 5(3), 6–13.

Ivanova Stojcheva, E., & Quintela, J. C. (2022). The effectiveness of *Rhodiola rosea* L. preparations in alleviating various aspects of life-stress symptoms and stress-induced conditions – Encouraging clinical evidence. Molecules, 27(12), 3902.

Izzo, A. A., Hoon-Kim, S., Radhakrishnan, R., & Williamson, E. M. (2016). A critical approach to evaluating clinical efficacy, adverse events, and drug interactions of herbal remedies. Phytotherapy Research, 30(5), 691–700.

Jacobsson, I., Jönsson, A. K., Gerdén, B., & Hägg, S. (2009). Spontaneously reported adverse reactions in association with complementary and alternative medicine substances in Sweden. Pharmacoepidemiology and Drug Safety, 18(11), 1039–1047.

Jakubczyk, K., Koprowska, K., Gottschling, A., & Janda-Milczarek, K. (2022). Edible flowers as a source of dietary fibre (total, insoluble and soluble) as a potential athlete's dietary supplement. Nutrients, 14(12), 2470.

Kanter, M., Coskun, O., & Budancamanak, M. (2005). Hepatoprotective effects of *Nigella sativa* L. and *Urtica dioica* L. on lipid peroxidation, antioxidant enzyme systems, and liver enzymes in carbon tetrachloride-treated rats. World Journal of Gastroenterology, 11(42), 6684–6688.

Karakus, A., Deger, Y., & Yildirim, S. (2017). Protective effect of *Silybum marianum* and *Taraxacum officinale* extracts against oxidative kidney injuries induced by carbon tetrachloride in rats. Renal Failure, 39(1), 1–6.

Kim, S. H., Park, K. S., Chang, M. J., & Sung, J. H. (2005). Effects of *Panax ginseng* extract on exercise-induced oxidative stress. Journal of Sports Medicine and Physical Fitness, 45, 178–182.

Klemow, K. M., Bartlow, A., Crawford, J., Kocher, N., Shah, J., & Ritsick, M. (2011). Medical attributes of St. John's Wort (*Hypericum perforatum*). In: Benzie, I. F. F., & Wachtel-Galor, S. (Eds.). Herbal medicine: Biomolecular and clinical aspects. 2nd ed. CRC Press/Taylor & Francis, Boca Raton.

Laasonen, M., Wennberg, T., Harmia-Pulkkinen, T., & Vuorela, H. (2002). Simultaneous analysis of alkamides and caffeic acid derivatives for the identification of *Echinacea purpurea*, *Echinacea angustifolia*, *Echinacea pallida*, and *Parthenium integrifolium* roots. Planta Medica, 68(6), 572–574.

Lee, W. J., Chung, H. H., Cheng, Y. Z., Lin, H. J., & Cheng, J. T. (2013). *Rhodiola* water extract induces β-endorphin secretion to lower blood pressure in spontaneously hypertensive rats. Phytotherapy Research, 27(7), 1543–1547.

Li, H., Liu, Y., Luo, D., Ma, Y., Zhang, J., Li, M., Yao, L., Shi, X., Liu, X., Yang, K. (2019). Ginger for health care: An overview of systematic reviews. Complementary Therapies in Medicine, 45, 114–123.

Lis, B., Jedrejek, D., Rywaniak, J., Soluch, A., Stochmal, A., & Olas, B. (2020). Flavonoid preparations from *Taraxacum officinale* L. fruits – A phytochemical, antioxidant and hemostasis studies. Molecules, 25(22), 5402.

Liu, Q., Zhao, H., Gao, Y., Meng, Y., Zhao, X. X., & Pan S. N. (2018). Effects of dandelion extract on the proliferation of rat skeletal muscle cells and the inhibition of a lipopolysaccharide-induced inflammatory reaction. Chinese Medical Journal, 131(14), 1651–1658.

Liu, S., Liu, J., He, L., Liu, L., Cheng, B., Zhou, F., Cao, D., & He, Y. (2022). A comprehensive review on the benefits and problems of curcumin with respect to human health. Molecules, 27(14), 4400.

Lovell, C. R., & Rowan, M. (1991). Dandelion dermatitis. Contact Dermatitis, 25(3), 185–188.

Lowe, F. C., & Fagelman, E. (2002). Phytotherapy in the treatment of benign prostatic hyperplasia. Current Opinion in Urology, 12, 15–18.

Lu, Y., Deng, B., Xu, L., Liu, H., Song, Y., & Lin, F. (2022). Effects of *Rhodiola rosea* supplementation on exercise and sport: A systematic review. Frontiers in Nutrition, 9, 856287.

Majid, A. K., Ahmed, Z., & Khan, R. (2020). Effect of pumpkin seed oil on cholesterol fractions and systolic/diastolic blood pressure. Food Science and Technology, 40(3), 769–777.

Mashhadi, N. S., Ghiasvand, R., Askari, G., Hariri, M., Darvishi, L., & Mofid, M. R. (2013). Anti-oxidative and anti-inflammatory effects of ginger in health and physical activity: Review of current evidence. International Journal of Preventive Medicine, 4(S1), S36–S42.

Maslova, L. V., Kondratev, B., Maslov, L. N., & Lishmanov, I. B. (1994). O kardioprotektornoĭ i antiadrenergicheskoĭ aktivnosti ékstrakta rodioly rozovoĭ pri stresse [The cardioprotective and antiadrenergic activity of an extract of *Rhodiola rosea* in stress]. Eksperimental'naya i Klinicheskaya Farmakologiya, 57, 61–63.

Mullins, R. J., & Heddle, R. (2002). Adverse reactions associated with *Echinacea*: The Australian experience. Annals of Allergy, Asthma and Immunology, 88(1), 42–51.

Nathan, P. J. (2001). *Hypericum perforatum* (St John's wort): A non-selective reuptake inhibitor? A review of the recent advances in its pharmacology. Journal of Psychopharmacology, 15(1), 47–54.

Nedzvetsky, V. S., Gasso, V. Y., Agca, C. A., & Sukharenko, E. V. (2021). Soluble curcumin ameliorates motility, adhesiveness and abrogate parthanatos in cadmium-exposed retinal pigment epithelial cells. Biosystems Diversity, 29(3), 235–243.

Neychev, V. K., & Mitev, V. I. (2005). The aphrodisiac herb *Tribulus terrestris* does not influence androgen production in young men. Journal of Ethnopharmacology, 101, 319–323.

Nishiyama, T., Mae, T., Kishida, H., Tsukagawa, M., Mimaki, Y., Kuroda, M., Sashida, Y., Takahashi, K., Kawada, T., Nakagawa, K., & Kitahara, M. (2005). Curcuminoids and sesquiterpenoids in turmeric (*Curcuma longa* L.) suppress an increase in blood glucose level in type 2 diabetic KK-Ay mice. Journal of Agricultural and Food Chemistry, 53(4), 959–963.

Nocerino, E., Amato, M., & Izzo, A. A. (2000). The aphrodisiac and adaptogenic properties of ginseng. Fitoterapia, 71(S1), S1–S5.

Ojulari, L. S., Olatubosun, O. T., Okesina, K. B., & Owoyele, B. V. (2014). The effect of *Zingiber officinale* (ginger) extract on blood pressure and heart rate in healthy humans. IOSR Journal of Dental and Medical Sciences, 13(10), 76–78. http://doi.org/10.9790/0853-131037678

Orhan, I. E. (2022). Plant/herbal medicine–drug/medicinal product interactions, abuse of medicinal plants, phytovigilance. In: Tekin, A., Çankaya, İ. T., & Zeybek, A. U. (Eds.). Phytotherapy practice book. Republic of Turkey Ministry of Health, General Directorate of Health Services, Ankara. Pp. 182–187.

Pareek, A., Purohit, S. G., Khatik, N., & Neha, N. (2020). Selected traditional Indian plants and sports performance: A review. Journal of Phytological Research, 33(1), 115–126.

Park, C. M., Youn, H. J., Chang, H. K., & Song, Y. S. (2010). TOP1 and 2, polysaccharides from *Taraxacum officinale*, attenuate CCl_4 -induced hepatic damage through the modulation of NF-κB and its regulatory mediators. Food and Chemical Toxicology, 48(5), 1255–1261.

Parlakpınar, H. (2022). Medicinal plants used in respiratory diseases. In: Tekin, A., Çankaya, İ. T., & Zeybek, A. U. (Eds.). Phytotherapy practice book. Republic of Turkey Ministry of Health, General Directorate of Health Services, Ankara. Pp. 138–145.

Pokrywka, A., Obmiński, Z., Malczewska-Lenczowska, J., Fijałek, Z., Turek-Lepa, E., & Grucza, R. (2014). Insights into supplements with *Tribulus terrestris* used by athletes. Journal of Human Kinetics, 41(8), 99–105.

Popov, I. M., & Goldwag, W. J. (1973). A review of the properties and clinical effects of ginseng. American Journal of Chinese Medicine, 1, 263–270.

Prasad, S., & Aggarwal, B. B. (2011). Turmeric, the golden spice: From traditional medicine to modern medicine. In: Benzie, I. F. F., & Wachtel-Galor, S. (Eds). Herbal medicine: Biomolecular and clinical aspects. 2nd ed. CRC Press. Pp. 263–288.

Ramak, R., & Mahboubi, M. (2019). The beneficial effects of pumpkin (*Cucurbita pepo* L.) seed oil for health condition of men. Food Reviews International, 35(2), 166–176.

Rubió, L., Motilva, M. J., & Romero, M. P. (2013). Recent advances in biologically active compounds in herbs and spices: A review of the most effective antioxidant and anti-inflammatory active principles. Critical Reviews in Food Science and Nutrition, 53(9), 943–953.

Saraç, H., Durukan, H., & Demirbaş, A. (2021). Önemli tıbbi bitkilerden biri olan *Achillea millefolium* L. (Civanperçemi) bitkisinin besin elementi konsantrasyonları ve antioksidan aktivitesi [Nutrient concentrations and antioxidant activity of *Achillea millefolium* L. (Yarrow), one of the important medicinal Plants]. Türk Tarım – Gıda Bilim ve Teknoloji Dergisi, 9(3), 590–594.

Şarışen, Ö., & Çalışkan, D. (2005). Fitothrapy: Herbal medicine, attetion of in primary health care. Journal of Continuing Medical Education, 8(14), 182–187.

Sciberras, J. N., Galloway, S. D., Fenech, A., Grech, G., Farrugia, C., Duca, D., & Mifsud, J. (2015). The effect of turmeric (curcumin) supplementation on cytokine and inflammatory marker responses following 2 hours of endurance cycling. Journal of the International Society of Sports Nutrition, 12(1), 5.

Sellami, M., Slimeni, O., Pokrywka, A., Kuvačić, G., Hayes, L. D., Milic, M., & Padulo, J. (2018). Herbal medicine for sports: A review. Journal of the International Society of Sports Nutrition, 15, 14.

Senchina, D. S., Shah, N. B., Doty, D. M., Sanderson, C. R., & Hallam, J. E. (2009). Herbal supplements and athlete immune function – What's proven, disproven, and unproven? Exercise Immunology Review, 15, 66–106.

Şengül, F., Çakır, M., Öztürk, B., Çakmak, A. N., & Vatansev, H. (2021). Sarı Kantaron'a dair (*Hypericum perforatum* L.): Morfoloji, etki mekanizmaları, aktivite, yan etkileri ve ilaç etkileşimlerinin incelenmesi. Doğal Yaşam Tıbbı Dergisi, 3(1), 1–37.

Shakya, S. R. (2015). Medicinal uses of ginger (*Zingiber officinale* Roscoe) improves growth and enhances immunity in aquaculture. International Journal of Chemical Studies, 3(2), 83–87.

Sharma, R. (2021). Bioactive food components for managing cellular senescence in aging and disease: A critical appraisal and perspectives. Pharma Nutrition, 18, 100281.

Sidhu, K., Kaur, J., Kaur, G., & Pannu K. (2007). Prevention and cure of digestive disorders through the use of medicinal plants. Journal of Human Ecology, 21(2), 113–116.

Siegel, R. K. (1979). Ginseng abuse syndrome: Problems with the panacea. Journal of the American Medical Association, 241, 1614–1615.

Siegel, R. K. (1980). Ginseng and high blood pressure. Journal of the American Medical Association, 243(1), 32.

Soon, S. L., & Crawford, R. I. (2001). Recurrent erythema nodosum associated with *Echinacea* herbal therapy. Journal of the American Academy of Dermatology, 44(2), 298–299.

Sulieman, A. M. E., Ibrahim, S. M., Alshammari, M., Abdulaziz, F., Idriss, H., Alanazi, N. A. H., Abdallah, E. M., Siddiqui, A. J., Shommo, S. A. M., Jamal, A., & Badraoui, R. (2024). *Zingiber officinale* uncovered: Integrating experimental and computational approaches to antibacterial and phytochemical profiling. Pharmaceuticals, 17(11), 1551.

Surh, Y. J., Park, K. K., Chun, K. S., Lee, E., & Lee, S. S. (1999). Antitumor-promoting activities of selected pungent phenolic substances present in ginger. Journal of Environmental Pathology, Toxicology and Oncology, 18(2), 131–139.

Syed, Q. A., Akram, M., & Shukat, R. (2019). Nutritional and therapeutic importance of the pumpkin seeds. Biomedical Journal of Scientific and Technical Research, 21(2), 15798–15803.

Taj Eldin, I. M., Elmutalib, M. A., Hiba, A., Hiba, F., Thowiba, S., & Hamedelniel, E. I. (2016). An *in vitro* anticoagulant effect of aqueous extract of ginger (*Zingiber officinale*) rhizomes in blood samples of normal individuals. American Journal of Research Communication, 4(1), 113–121.

Talazas, A. H., Abbasi, M. R., Abkhiz, S., & Dashti-Khavidaki, S. (2010). *Tribulus terrestris*-induced severe nephrotoxicity in a young healthy male. Nephrology Dialysis Transplantation, 25, 3792–3793.

Taylor, J. A., Weber, W., Standish, L., Quinn, H., Goesling, J., McGann, M., & Calabrese, C. (2003). Efficacy and safety of *Echinacea* in treating upper respiratory tract infections in children. Journal of the American Medical Association, 290(21), 2824–2830.

Tinsley, G. M., Jagim, A. R., Potter, G. D. M., Garner, D., & Galpin, A. J. (2024). *Rhodiola rosea* as an adaptogen to enhance exercise performance: A review of the literature. British Journal of Nutrition, 131(3), 461–473.

Vogler, B. K., Pittler, M. H., & Ernst, E. (1999). The efficacy of ginseng. A systematic review of randomized clinical trials. European Journal of Clinical Pharmacology, 55, 567–575.

Wang, L., Meng, Q., & Su, C. H. (2024). From food supplements to functional foods: Emerging perspectives on post-exercise recovery nutrition. Nutrients, 16(23), 4081.

Whitehead, M., Martin, T., Scheett, T., & Webster, M. (2012). Running economy and maximal oxygen consumption after 4 weeks of oral *Echinacea* supplementation. Journal of Strength and Conditioning Research, 26(7), 1928–1933.

Wilson, P. B. (2015). Ginger (*Zingiber officinale*) as an analgesic and ergogenic aid in sport: A systemic review. Journal Strength Conditions Research, 29(10), 2980–2995.

Wirngo, F. E., Lambert, M. N., & Jeppesen, P. B. (2016). The physiological effects of dandelion (*Taraxacum officinale*) in type 2 diabetes. The review of Diabetic Studies, 13(2–3), 113–131.

Woelk, H., Burkard, G., & Grünwald, J. (1994). Benefits and risks of the hypericum extract LI 160: Drug monitoring study with 3250 patients. Journal of Geriatric Psychiatry and Neurology, 7(S1), S34–S38.

Yousefi Ghale-Salimi, M., Eidi, M., Ghaemi, N., & Khavari-Nejad, R. A. (2018). Inhibitory effects of taraxasterol and aqueous extract of *Taraxacum officinale* on calcium oxalate crystallization: *In vitro* study. Renal Failure, 40(1), 298–305.

Zaushintsena, A. V., Milentyeva, I. S., Babich, O. O., Noskova, S. Y., Kiseleva, T. F., Popova, D. G., Bakin, I. A., & Lukin, A. A. (2019). Quantitative and qualitative profile of biologically active substances extracted from purple echinacea (*Echinacea purpurea* L.) growing in the Kemerovo Region: Functional foods application. Foods and Raw Materials, 7(1), 84–92.

Zhang, Y., Liu, K., Zhan, Y., Zhao, Y., Chai, Y., Ning, J., Pan, H., Kong, L., & Yuan, W. (2024). Impact of Chinese herbal medicine on sarcopenia in enhancing muscle mass, strength, and function: A systematic review and meta-analysis of randomized controlled trials. Phytotherapy Research, 38, 2303–2322.

Zhou, S., Chan, E., Pan, S. Q., Huang, M., & Lee, E. J. D. (2004). Pharmacokinetic interactions of drugs with St John's wort. Journal of Psychopharmacology, 18(2), 262–276.