

Review Article

Effects of Herbs and High-Intensity Exercise Training on Antioxidant Properties Regarding Weight Management and Exercise-Related Variables: A Review

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Abstract

It has been determined that high-intensity exercise training is associated with the production of oxidative stress factors leading to a reduction in the efficiency and physical functioning of rapid reaction forces. Conversely, high levels of physical activity and coping with oxidative stress factors (using supplements) are highly suggested for rapid reaction forces. Hence, the present study sought to examine the effects of plants and high-intensity exercise on antioxidant properties associated with weight management and some related factors. The literature on this research was collected from the PubMed archive on January 31, 2019, and included the keywords, high-intensity exercise training, herb and overweight. To date, 15,000 articles have been published on the PubMed archive with the keyword 'herb', 4473 articles have been published concerning high-intensity exercise training, and 94 articles related to the present review article are categorized into two categories of complete and abstract texts. All the articles were classified according to the novelty before being examined. Rapid reaction forces need to increase physical activity in order to have better functions. Likewise, they use plants and herbal supplements owing to maintaining physical fitness, and counteract the effects of oxidative stress caused by high-intensity exercise. Consequently, a comprehensive and efficient research that would adequately indicate the side effects and the effectiveness of these plants had to be carried out. The use of herbs and supplements will depend on the purpose of the individuals, particularly rapid reaction forces. If the goal of these forces is to increase their vigilance as well as their reaction and to postpone fatigue in missions, Ginseng and caffeine are the best plants, and if they seek to maintain physical fitness and reduce body fat, green tea is the best option. Nutritional interventions and the use of supplements (antioxidant, herbal and physical activity enhancers) are effective ways of protecting rapid reaction forces against the effects of oxidative stress caused by high-intensity exercise and maintaining fitness. Remarkably, despite the positive effects of plants, the excessive consumption of these supplements induces certain side effects on the kidneys and stomach. Likewise,

they should be used cautiously.

Keywords: Rapid Reaction Forces, Medicinal Plants, Antioxidants, Obesity

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Introduction

Military forces are involved in special training, and face high-intensity exercise in various missions. One of the main characteristics for these forces is having a high level of fitness and body function during the execution of assigned missions (1). Obesity disrupts fitness, and induces cardiovascular diseases that significantly raise the mortality rate. It is estimated that around 1.2 billion of the world's population are overweight (2). Various relations have been detected between overweight and several of the risks associated with health, such as cardiovascular diseases, hypertension, and diabetes mellitus (3). Nowadays, medical specialists recommend the utilization of non-pharmacological procedures, including exercise and physical activity, for weight loss and prevention of various diseases. Exercise is an efficacious method to prevent and treat cardiovascular risk factors (3). From another point of view, the use of supplements, foods, and medicinal plants has recently expanded in the treatment of diseases and metabolic disorders among the public. Chemical drugs have been supplied to the world for about 150 years. A comparison of the use of chemical and vegetable drugs shows that even though chemical drugs are efficient remedies, they have side effects and some of their complications last forever. Moreover, these complications could be transferred to next generations, whereas the side effects of herbal remedies are less common, and in many cases they are uncomplicated (4). Furthermore, a considerable number of studies have indicated that regular exercise has many benefits for the health of individuals in the community. Nevertheless, high-intensity exercise induces injuries and reduces the performance in athletes by producing free radicals and reactive oxygen species. Notwithstanding, it has been indicated that nutritional interventions, and the

use of antioxidant supplements can protect human beings against oxidative stress caused by exercise (5). High-intensity exercise among rapid reaction forces is associated with increased reactive oxygen species and decreased physical activity. Meanwhile, medicinal herbs are more effective than existing synthetic drugs in the improvement of physical fitness, the maintenance of fitness, and prevention of overweight in these forces. This paper shall sufficiently address the relationship between plants, antioxidants, high-intensity exercise and overweight.

The literature on this research was collected from the PubMed archive on January 31, 2019, and included the keywords, high-intensity exercise training, herb and overweight. To date, 15,000 articles have been published on the PubMed website with the keyword 'herb', 4473 articles have been published concerning high-intensity exercise training, and 94 articles related to the present review article are categorized and divided into two categories of complete and abstract texts. Subsequently, all the articles were classified according to the novelty before being examined.

The Effect of Medicinal Plants on the Treatment of Obesity and Overweight

Among the drugs with FDA-approved indication for obesity, the efficiency of orlistat and sibutramine for long-term use in the treatment of obesity and overweight has been confirmed. Nevertheless, apart from high costs and adverse side effects, these drugs do not significantly contribute to the treatment of obesity. Accordingly, other drugs and methods with fewer complications and more efficacy are required to treat obesity and overweight. Complementary and alternative medicine are being progressively used in healthcare. Examples of complementary and alternative therapies for weight loss include dietary supplements, such as medicinal plants and their active components, acupuncture, homeopathy and sleep therapy (6). Moreover, people in many cultures who

face epidemics of overweight and obesity are more likely to welcome plant drugs than psychosocial drugs. Plants are also a chief source of finding new drugs to prevent or treat obesity and overweight. In this spot, primarily clinical trials in which the efficiency and safety of medicinal plants and herbal substances as remedies for obesity or overweight are evaluated, and rarely only when needed or necessary, animal studies on the effects of anti-obesity are examined. Likewise, the weight of herbal medicines, are examined. In a non-control group, 70 humans aged 69-20 received daily 2 capsules of green tea extract containing 270 mg of epigallocatechin gallate and 475 mg of total catechins daily for three months, and lost an average of 4.6% of body weight (7). In another study, 102 obese people consumed 8 grams of Oolong tea daily for 6 weeks. Body weight was reduced by more than 1 kg in 70% of people who were overweight, and weight loss was 22% in more than 3 kg. Furthermore, 64% of obese and 66% of overweight people lost more than 1 kg during the weight loss test, and subcutaneous fat decreased by 12%. It is believed that catechins, which are polyphenolic tea components, can lead to tea thinning through the effects of norepinephrine destruction. These effects increase the oxidation in mitochondria and decrease the production of ATP simultaneously and lead to increased heat production (8). Even though there is no published study indicating the effect of black tea weight reduction, a study indicated that the rate of metabolism could increase after mixing black tea with other substances (9). Orange blossom is known for weight loss. Allegedly, these alkaloids act in the same way as the Epidural alkaloids, though they are weaker. However, this issue has not been meticulously investigated in a bioequivalence trial. It is not exactly known which of the various alkaloids of the plant contribute to weight loss (10, 11). Even though small trials indicated that these alkaloids could raise systolic blood pressure and heart rate (12, 13), other studies did not indicate any side effect. Orange blossom could increase heat production by raising systolic blood pressure and heart rate (14, 15).

Capsaicin

It has been shown that capsaicin derived from spicy and red peppers growing in Iran provokes fat

oxidation and heat production (16). The main mechanism of this effect is unclear, but the active ingredients of red pepper appear to activate the vasodilator and endorphin-releasing vascular signals. Moreover, there are certain studies confirming that the weight loss effects of pepper spices are low (17). Efforts began to examine the relationship between dietary fiber and body weight in the 1980s. Guar gum is a type of water-soluble dietary fiber that comes from the plant. The effectiveness of *Cyamopsis tetragonolobus* guar gum has been restrained by weight loss. Twenty placebo-controlled randomized trials, and 11 trials were analyzed in a meta-analysis. The results of this meta-analysis indicated that guar gum could not be efficient in weight loss. The consistency between the randomized control trials used confirms the overall meta-analysis. The side effects reported in the reviewed trials are mainly gastrointestinal, such as diarrhea and bloating (18).

Glucomannan

A type of water-soluble fiber is one of the compounds of the root of *Amorphophallus konjac* whose chemical structure is almost identical to the glucoma of the bread contained in guar gum, and includes a polysaccharide chain composed of glucose and mannose (19). The effects of glucosamine were studied in a randomized, double-blind randomized controlled trial including patients weighing 20% or more than the optimal weight. The study suggested a significantly lower weight loss in the treatment group compared with placebo. No adverse effect was observed in the treatment group (20).

Generally, most of the evidence confirm that fiber reduces hunger and the intake of food. Water-soluble fibers might be more sensitive to water-insoluble fibers. Fibers might increase gastrointestinal uptake by increasing gastrointestinal uptake. Moreover, the fibers cause swelling as they swell after swallowing, and their masses replace the high calorie foods.

Bean Seed Extract

This plant, which is grown in Iran, can prevent carbohydrate intake in the intestine through the inhibition of alpha-amylase enzyme activity. In a clinical trial, which was conducted on 20-45 aged participants, the group that consumed 445mg of bean seed extract underwent the reduction of body mass index, fat mass, fat tissue thickness, and lumbar and

hip area as well as groin mass after 30 days compared to the placebo group ($p < 0.001$), whereas the body weight without body fat remained unchanged compared to the placebo group (21). Bean seed extract can prevent the activity of alpha-amylase and the absorption of carbohydrates in the intestine.

Phytosterols

In animal studies, phytosterols inhibit lipid absorption and contribute to weight loss, even though there is currently no information on the effect of phytosterol reduction in humans (22).

Seeds of Fenugreek

This plant that grows in Iran has been used for long years as a herbal remedy for the treatment of metabolic and nutritional disorders. It has been shown that the fenugreek seed has affected eating habits in animals. Furthermore, hydroalcoholic extract of fenugreek seed with a daily dose of 1176 mg has resulted in weight loss in healthy volunteers with normal weight (23).

Anti-Overweight and Anti-Overweight Herbal Remedies in Iran

These medicines include 1- Carrillo Pills, which consists of celery, anise, cumin and salmon extracts, 2- Coco slime tablets with celery, tea and green tea, 3. Oral drops Lemon oil, 4. Oral drops Cumin essential oil - Apple cider vinegar – and Green tea teaspoon. All the plants used in these six herbal remedies are grown in Iran. Even though the first five drugs have been marketed for the treatment of obesity and overweight, no significant clinical study has been conducted to address their efficiency and safety in the treatment of obesity and overweight (23).

Licorice root is widely used as a drug. The roots and rhizomes of this plant have been used for about 4,000 years and have been registered in pharmacies in countries such as the United States, China, and other countries. Sweetness in traditional Asian and European medicine is used to treat gastritis, respiratory infections, and in traditional Chinese medicine in the treatment of hepatitis, peptic ulcers, tumor growth, and heart disease. In traditional Iranian medicine, licorice was used as a treatment for stomach and anxiety (24). Licorice root also affects the body's small intestine system and its consumption may reduce blood testosterone levels. It has also been

proven that licorice or diclofenac is effective in increasing the secretion of serotonin and prostaglandin in the stomach, and it affects the effects of stomach inflammation (25). Today, the Sweet Extract is one of the components of the cough syrup, and is also used as a medicine for skin inflammation and for the treatment of spasticity, swelling, and rheumatism. Anticancer properties have also been reported for this plant. The extract also inhibits the replication of HIV in people with AIDS (26, 27). The extensive consumption of licorice root or its other products is to be avoided due to the induction of hyperlipidemia and the over secretion of the aldosterone hormone. This condition causes complications such as an abnormality in metabolic activity and high blood pressure. Adverse side effects might occur in the daily consumption of licorice root or its other products provided that more than 20 grams of them is taken per day. The excessive use of sweetener for the spleen is also harmful. Excessive sweating can lead to high blood pressure and even heart attacks. Some people with high levels of muscle spasm suffer from muscle pain, while others are suffering from palpitations. The high levels of this substance also cause weight gain (28).

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The use of this plant has been confirmed in the treatment of upper respiratory tract, and gastric and duodenal ulcers (29).

Effects of Different Herbal Supplements on Exercise-Induced Oxidative Stress

It has been indicated that aerobic exercise activities with high intensity and high volume significantly increase metabolism, which could ultimately play a role in increasing the creation of reactive oxygen species (ROS), particularly superoxide anions in mitochondria. It will also increase oxidative stress. Moreover, it has been well documented that the production of oxidants increases with increasing metabolic activity due to skeletal muscle contractions (30). Furthermore, it has been reported that exercise-induced oxidative stress could lead to muscular injury and the development of over-training symptoms such as fatigue, and cause the loss of performance in athletes. Among the possible mechanisms and theories of action, that certain studies have suggested increasing the oxidative stress following intense aerobic activity is that during intense exercise,

metabolic rate in contractile muscles is up to 100 fold. It increases during the rest period, which is associated with an increase in oxygen consumption, and consequently an increase in the production of superoxide anions in the muscle contraction of mitochondria (30, 31).

Due to the important role that free radicals play in creating various fungal infections, cell death, aging process, and even the loss of exercise, various methods have been developed to reduce the production of free radicals and minimize their harmful effects. Researchers have addressed the harms that could be induced by free radicals. One of

the proper ways to protect the body against the unfavorable impacts of oxidative stress induced by intensive exercise is be the use of nutritional strategies and the use of antioxidant supplements, particularly natural herbal supplements, which are listed below with some of the supplements (30, 31). It is believed that supplements, along with sports activities, could be effective in human health due to their potent antioxidant capacities (32).

Results and Discussion

Medicinal plants and supplements have been

Table 1: Effect of Different Herbal Supplements on Exercise-Induced Oxidative Stress.

Authors	Medicinal plant type	Supplementation protocol	subjects	effects
Atashak S, et al. (2012)(32)	Ginger	(3 months ginger supplementation (4 capsules of 250 mg of zinc) + resistance training	Obese men	Ginger supplementation+ resistance training reduces malondialdehyde (MDA) and increases the total antioxidant capacity of plasma (FRAP) in obese men.
Kimoto. R et al (2005) (34)	Garlic	Extract of aged garlic extract for 2 weeks	Athlete students	Significant decrease in urinary 8-OHdG as an indicator of oxidative damage
Mirdar S et al. (2014)(35)	Caffeine	5 mg / kg of caffeine following a sedative exercise session	Active men	Caffeine supplementation can reduce the oxidative stress caused by exhausting exercise and play an effective role in enhancing the antioxidant system of athletes.
Prasad NK et al. (2009) (44)	Cinnamomum	10 grams of cinnamomum prior to an exhaustive exercise	Athletes	Decreased lipid peroxidation and increased antioxidant capacity.
Jówko E et al. (2011) (39)	Green tea	4 weeks of green tea extract/40 mg polyphenols per day	Healthy men	Strengthens the antioxidant defense system of the base state and thus prevents cellular and oxidative damage caused by exercise activities.
Lafay S et al. (2009) (40)	Grape extract	400 mg grape extract per day	Elite male athletes	Improved the antioxidant status of elite male athletes and, as a result, increased their athletic performance.
Atashak S et al. (2014)(41)	Blackberry Extract	Blackberry extract supplementation after acute resistance exercise	Obese Men	It prevented lipid peroxidation and consequently the destructive effects of free radicals after acute resistance exercise.
Kim SH. et al (2005)(42).	Panax Ginseng extract (PGE)	PGE ingestion 2 g before 2 exhaustive incremental exercise on the treadmill, 3 times a day	Sedentary humans	PGE increased catalase and superoxide dismutase as scavenger enzymes. Also these findings supported claims that PGE has ergogenic properties in facilitating recovery from exhaustive exercise
Lyall KL et al. (2009) (43)	blackcurrant extract	Short-term consumption of blackberry extract after 30 minutes of rowing with 80% of VO2max.	Adult men and women	Adjustment and prevention of increased oxidative stress indices

extensively used over the past decade. Many plants are used to improve the strength, and muscle mass as well as muscular endurance. Numerous evidences have shown that the health benefits of plants, such as terpenoids, alkaloids and polyphenols, have proved to be due to their bioactive compounds. Unfortunately, many supplements that are prescribed to improve the performance and increase the physical efficiency of athletes are illegal and have a high effectiveness. To date, no organ or company has guaranteed the safety of supplements, especially for athletes. Certain plants such as ginseng, alkaloids, and other herbs, including *Tribulus terrestris*, *Cordyceps sinensis* have been identified. It could be concluded that most of the impacts of herbal supplements on increasing the strength, endurance and power, and subsequently increasing their exercise performance are due to the activation of the CNS system as a result of the activation of catecholamines (epinephrine and norepinephrine) (33).

Certain herbs such as capecine, glucomon, white bean extract, and fenugreek seeds that reduce fat mass and improve the body composition are recommended to be consumed by athletes looking for fitness (15, 20, 21, 23). The imperative object about the liquorice is that it can reduce the amount of blood testosterone that reduces the strength of athletes. The excessive consumption of this plant also leads to weight gain and fitness disorders (28). Another category of plants that are considered as antioxidants reduces oxidative stressors in high-intensity exercises that cope with the harmful effects of these agents. Moreover, they improve the performance and efficiency in athletes and rapid reaction forces. Ginger consumption along with exercise results in a remarkable reduction in malondialdehyde (MDA) concentration and a noticeable increase in total antioxidant capacity of plasma (FRAP) in obese men (32). The consumption of garlic extract supplementation for 2 weeks led to a significant reduction of 8-hydroxy-deoxy-guanosin edema, as an indicator of oxidative damage to DNA in student athletes (34). Caffeine consumption could reduce the oxidative stress caused by exhaustive exercise and play an vital role in enhancing the antioxidant capacity of athletes (35). Cinnamon consumption

before a single bout of exhaustive exercise session will reduce lipid peroxidation and increase antioxidant capacity. Eugenol could inhibit more than 95% of free radicals(36). Green tea has a very robust antioxidant effect due to the presence of effective polyphenols, and can be very effective in oxidative stress and free radical depletion conditions (37, 38). Furthermore, green tea enhances the antioxidant defense system of the basal state, and thus prevents cellular and oxidative damage induced by sports activities in untrained men (39). The use of grapevine extract improves the antioxidant status of elite male athletes and, as a result, increases their exercise performance (40). The acute consumption of blackberry extract, although not significantly altering the total antioxidant capacity of the plasma, could prevent lipid peroxidation and consequently the adverse impacts of free radicals after intensive exercise (41). The use of ginseng intensifies the activity of antioxidant enzymes, including superoxide dismutase (SOD) and catalase (CAT), and therefore significantly reduces MDA after exhaustive exercise session. The effects of ginseng and facilitating in post-exercise recovery have been established (42). The short-term consumption of blackberry extract could modify and prevent the increase of oxidative stress indices in adult women and men after 30 minutes of boating with 80% VO₂max (43)

Conclusion

Rapid reaction forces are engaged in intense physical activity, and seek to maintain fitness. The study that addresses the impacts of plants and supplements on the exercise-induced oxidative stress is a comprehensive and useful guide concerning their side effects and efficacy. These plants require that we review the classification of herbs and herbal supplements whose effectiveness in weight loss and coping with oxidative stress has been proven in various studies. The use of herbs and supplements is dependent on athletes and their forces. If their goal is to increase their vigilance as well as their reaction, and delay the fatigue of the mission, ginseng and caffeine are the best plants. Moreover, green tea is the optimal choice for those who seek to maintain fitness and reduce body fat. Nevertheless, it has to be noted that despite the positive effects that plants have on improving the

performance and increasing the effectiveness of the forces, the excessive use of these plants induces adverse effects on the kidneys and the stomachs. Hence, they should be taken with caution.

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Conflict of Interest

The authors declare that they have no conflict of interest.

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