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Safety issues of herbal weight loss dietary supplements: hepatotoxicity and adulteration

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Abstract

Herbal weight loss supplements are widely used in the management of obesity, but consistent data to support long-term weight loss efficacy and safety are missing. Besides, legal framework for food supplements is less restrictive than regulation of medications. The objective of this review is to give weight to the fact that many weight loss supplements contain herbal compounds with unknown mechanism of action, increasing the risk for adverse effects, even toxicity, especially in co-administration with prescribed drugs. Hepatotoxicity ranging from elevated transaminases and autoimmune-like hepatitis to acute liver failure appears to be underrecognized, but is not uncommonly encountered. Another and even more serious concern is adulteration of weight loss supplements by illegal addition of unauthorized substances or medications to provide quick effects and to increase sales. Here are some significant data regarding the possible hepatotoxicity of frequently used herbal extracts, as well as the health risks related to some common adulterants. Towards safer use of supplements, a comprehensive and critical discussion of current regulatory principles is essential to address the existing gap between the increased use of food supplements and the lack of knowledge about their benefits, providing better protection for consumers.

Key words: herbal supplements, weight loss, hepatotoxicity, adulteration

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Introduction

Obesity manifests through an accumulation of adipose tissue, precipitating a spectrum of health complications, notably including type-2 diabetes mellitus, hypertension, coronary heart disease, dyslipidemia, obstructive sleep apnea, respiratory diseases and cancer (1, 2). Evidence-based obesity treatment includes behavioral modifications, dietary adjustments, physical activity regimens, pharmacological interventions and metabolic or bariatric surgical procedures (3). Weight loss requires considerable effort, and herbal weight loss supplements (HWLS) are therefore widely used as an additional approach in weight management. HWLS are extensively used because of their easy accessibility and widespread perception among the general populace as being natural, hence presumed efficacious and safe. However, the current legislation does not test these products for authenticity, efficiency and safety, which means that products with inadequate quality and safety can reach the market (4, 5). The objective of this review is to elucidate the safety concerns associated with herbal weight loss supplements: hepatotoxicity and adulteration.

Herbal weight loss supplements

A variety of food supplements are employed to address obesity, primarily aiming to reduce body weight. These supplements often regulate appetite, stimulate thermogenesis and lipid metabolism, limit pancreatic lipase activity, prevent adipogenesis and promote lipolysis (6). In general, food supplements encompass numerous products containing distinctive herbal compounds as main active ingredients. Constituents commonly found in herbal weight loss supplements include extracts from plants such as *Garcinia cambogia*, *Camellia sinensis*, *Coffea arabica*, *Cinnamomum* spp., *Pausinystalia yohimbe*, and *Citrus aurantium* (7). HWLS are incredibly popular among the many supplements for weight reduction available, since consumers believe they are safe and natural. However, there is a lack of scientific data proving the effectiveness and safety of herbal products. Moreover, the multitude of compounds that may have additive or synergistic effects are a continuing challenge. Pharmacokinetic evidence available for herbal compounds included in supplements is also limited, and thus their co-administration with prescribed medications may elevate the risk of unpredictable interactions and subsequently adverse events (6, 8). Co-administration of medications and herbal supplements can lead to qualitative or quantitative alterations in the effects of either or both substances, and even nullify the pharmacological effect of the medication. The consequences of such interactions can significantly impair the function of specific organs and organ systems (9). Pharmacokinetic interactions, particularly those occurring at the metabolic level, are of significant concern regarding liver function. Herbal ingredients can induce or inhibit the expression or activity of specific enzymes, significantly impacting the metabolism of pharmacologically active substances, i.e., medications (10). Of particular concern are herbal compounds that inhibit CYP450 enzymes, as these interactions can compromise the therapeutic efficacy of drugs and inhibit the

metabolism of toxic compounds, leading to potentially life-threatening outcomes (11, 12). The complex mechanisms of action of many herbal ingredients often render the assessment of potential interactions with other herbal products or medications challenging. Since the frequency of simultaneous use of HWLS and prescribed drugs is increased, greater awareness and caution among consumers is imperative. In fact, these concerns force them to make sure HWLS are taken as directed and in the prescribed amounts. Nonetheless, HWLS are extensively advertised and readily accessible without a prescription from pharmacies, health food stores, and internet sellers. Information on the internet regarding HWLS is widely available. This trend raises concerns about their efficacy for weight reduction, safety, and economic benefits. Consumers mainly rely on public information and media for information regarding HWLS, with few seeking expert advice (13, 14). This also suggests that, in view of globalization and commercial expansion, a comprehensive analysis and safety assessment of food supplements, particularly the herbal ones, is necessary.

Hepatotoxicity

Herbal food supplements do not typically contain substances considered immediately life-threatening; however, many include large amounts of caffeine and/or green tea extracts, which could be harmful (15). The adverse effects of herbal supplements are dominantly related to the pharmacologically active ingredients present, but may be caused by allergens, endogenous toxic compounds, and even heavy metals like mercury, lead, and arsenic (16). Notably, a substantial number of cases of hepatotoxic manifestations linked to HWLS have been documented, with acute hepatitis being the most common presentation (17, 18, 19). A liver transplant may be necessary in certain severe instances (20). It is not readily apparent what the underlying mechanisms are. Nonetheless, Figure 1 illustrates the potential hepatotoxicity pathways of green tea, garcinia, tarragon, acai berry, and aloe.

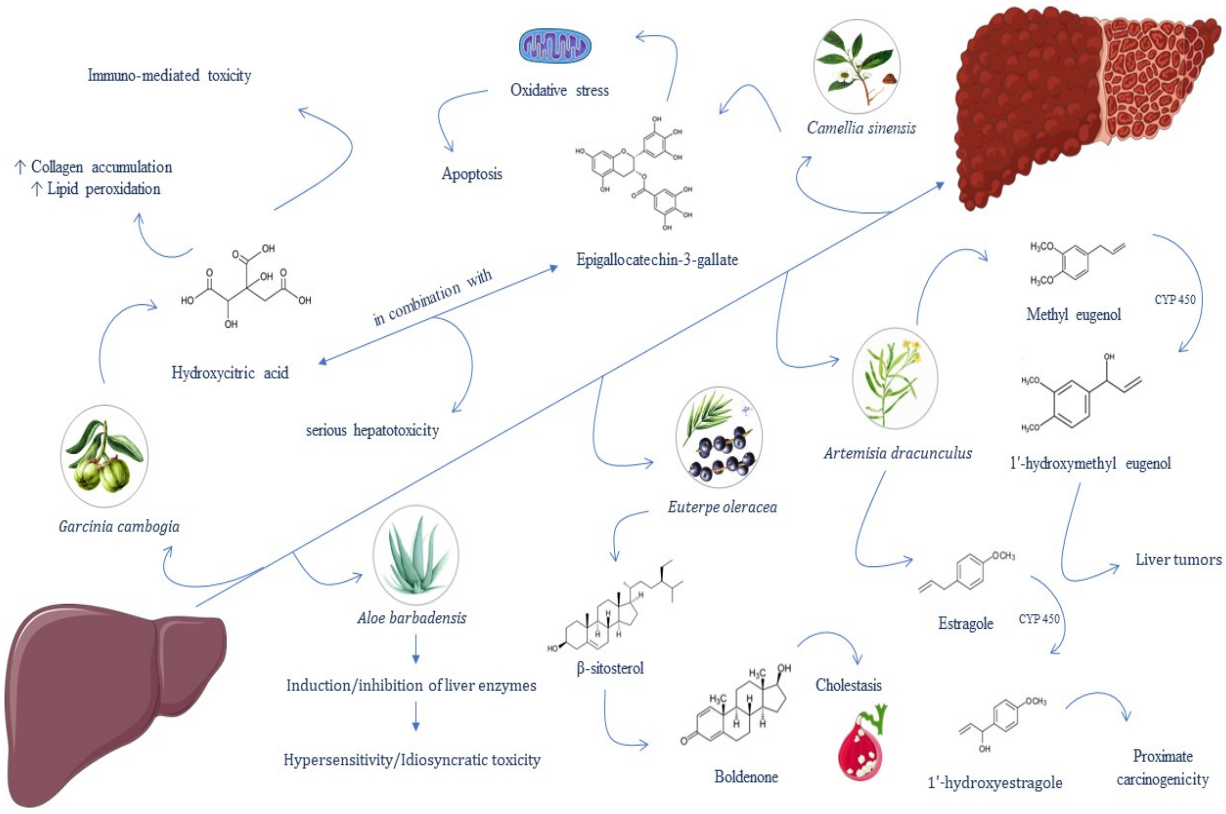

Figure 1. Putative mechanisms of green tea, garcinia, tarragon, acai berry and aloe-related hepatotoxicity.

Slika 1. Potencijalni mehanizmi hepatotoksičnosti povezane sa primenom zelenog čaja, garsinijom, estragonom, asai bobicama i alojom.

Green tea (Camellia sinensis)

Green tea extract (GTE) has attracted significant interest due to its contribution to weight reduction and it is found in many herbal formulations at varying concentrations. However, GTE use has been reported to be associated with hepatotoxicity risk (21, 22). Its primary bioactive constituents, the polyphenols catechin and epigallocatechin-3-gallate, are renowned for their capacity to induce oxidative stress, leading to damage to the liver under fasting conditions (23). The most commonly described mechanism underlying the hepatotoxic action of epigallocatechin and epigallocatechin-3-gallate, through the induction of oxidative stress, is attributed to the presence of phenolic groups in their structure, which can auto-oxidize under certain conditions and convert to quinones, generating superoxide radicals and hydrogen peroxide, thereby leading to hepatocyte damage (24). Animal studies indicate liver damage due to oxidative stress affecting hepatocellular lipids and DNA (25), as well as elevated serum lipid levels contributing to liver tissue damage (26). In PD-1 knockout mice, a presumed safe dose of 500 mg/kg of GTE led to delayed increases in liver alanine aminotransferase and CD8+ T-cell levels, suggesting an immune-mediated cause of liver damage (27). In the

case of diagnosed acute hepatitis in a sixteen-year-old girl, after autoimmune, viral, and metabolic causes potentially leading to the condition were ruled out, it was determined to be a consequence of several months of continuous consumption of Chinese green tea for weight reduction, purchased online (18). Adverse reactions associated with the use of GTE in food supplements most commonly pertain to hepatotoxicity in the form of acute hepatitis (17, 19). In general, catechin was imputed to cause hepatotoxicity; nevertheless, an immune-mediated mechanism as demonstrated by the association with the HLA-B* allele 35:01 in human subjects was observed (28).

Regarding the possible interactions of green tea, it has been found that its constituents affect the pharmacokinetics and pharmacodynamics of various medications, potentially reducing their therapeutic efficacy or increasing the risk of toxicity (29, 30). Notwithstanding, Teschke et al. (2014) reported that catechins of GTE do not increase the risk of drug induced liver injury by co-administered drugs, stipulating that they impair the *in vivo* metabolism only selectively and that careful use is necessary mainly for drugs that are substrates of CYP3A4 (31).

Garcinia cambogia

Garcinia continues to gain popularity as an over-the-counter (OTC) herbal supplement due to its potential for aiding weight loss (22). Hydroxycitric acid, the primary active ingredient in *G. cambogia* fruit, is known to inhibit the enzyme adenosine triphosphate-dependent citrate lyase, which is involved in the *de novo* biosynthesis of fatty acids and glycogen storage, while also reducing appetite (32). Garcinia extracts have long-standing recognition for beneficial effects against obesity, and they were initially considered to have no risk of adverse effects. However, since 2005, the literature has documented at least 25 cases of hepatotoxicity with varying clinical severity associated with its use (33). Other adverse effects linked to the use of *G. cambogia* include collagen accumulation in the liver, lipid peroxidation, and elevated levels of transaminases in the liver (34). Furthermore, acute damage to the liver has been associated with the use of multicomponent HWLS containing garcinia extracts (12). Smith et al. (2016) reported that hydroxycitric acid may induce serious hepatotoxicity, especially when combined with epigallocatechin-3-gallate (20). The clinical study of Vuppalanchi et al. (2022) included 1418 patients with liver injury, of which five cases from *G. cambogia* alone and sixteen cases from *G. cambogia* in combination with green tea revealed that the injury was indistinguishable. Moreover, HLA testing showed the presence of HLA-B*35:01 allele in 60% of the cases of liver injury in those who had been taking the supplement of *G. cambogia* only. ince an association with HLA-B*35:01 allele as a risk factor for herbal supplement-induced liver injury was speculated for both *G. cambogia* and green tea, which are often found together in HWLS, a synergism in their adverse effects is to be expected (21).

Regarding interactions with medications, it was reported that pharmacokinetics of drugs metabolized by the CYP2B6 enzyme, particularly antilipemic agents, increased the risk of adverse events (35). The toxicity of *G. cambogia*-based products was

assessed by Di Giacomo et al. (2023), who also discussed the underlying mechanisms. They concluded that concurrent use of *G. cambogia* supplements may exacerbate oxidative imbalance in obese patients with altered antioxidant status and excessive reactive oxygen species production, as well as in pharmacological therapy that heightens oxidative stress (36).

Tarragon (Artemisia dracunculus)

The main constituents of fresh tarragon leaf are essential oils, predominantly containing estragole and methyl eugenol (37). Obolsky et al. (2011) reported the anti-inflammatory, antioxidant, and anti-hyperglycemic effects of tarragon extract (38). In the study of Yu et al. (2018) involving wild mice fed with a high-fat diet and concurrently treated with tarragon extract over a three-month period, an improvement in glucose utilization through the stimulation of insulin signaling in skeletal muscles was observed. As a result, lipid accumulation in both the liver and skeletal muscles was significantly reduced, but without a reduction in body weight (39). A hepatoprotective effect of water-ethanol extract of tarragon was suggested following a single exposure of rats to carbon tetrachloride, confirmed with a reduction of liver damage at the histopathological level, as well as decreased levels of transaminases and alkaline phosphatase (ALP) (40). However, the potential toxicity of the two main constituents of tarragon essential oil, estragole and methyl eugenol, was highlighted (38). Methyl eugenol has been found to induce liver tumors in rats and mice, and it has been involved in the formation of neoplasms of the kidney, mammary glands and subcutaneous tissue in rats (41). Considering the evidence for carcinogenicity, the Committee on Herbal Medicinal Products recommended the amount of estragole in herbal medicinal products to be kept at the lowest possible level (42). Usually, the amounts of estragole are considerably lower in herbal food supplements compared to herbal medicinal products; however, caution is required.

Acai berry (Euterpe oleracea)

According to the published literature, the fruits of the acai plant have been primarily described as “superfoods” with antioxidant and anti-inflammatory properties due to their high content of polyphenols (43). In a recent review of Laurindo et al. (2023), acai berry was attributed with beneficial properties, only emphasizing its prospective use in helping the defensive mechanisms of the liver against oxidative stress and hepatic steatosis (44). However, there is a case report that indicates the possibility of developing cholestatic jaundice associated with the use of acai berry (45). Although the exact mechanism of toxicity is unclear, it was presumed that the causative agent is β-sitosterol, which is a precursor to boldenone (46), leading to elevated levels of steroids and the development of cholestasis as a liver response (45).

Aloe vera (Aloe barbadensis)

The plant *Aloe vera* is primarily known for its analgesic, anti-inflammatory, anti-aging, laxative, and hepatoprotective properties, but the dry leaf extract contains

alkaloids that can induce or block enzymatic systems in the liver such as cytochrome P450 (47). This property of aloe to interfere with detoxification processes can lead to dose-dependent damage to the liver, as confirmed by the published reports of toxic hepatitis caused (48, 49), or acute liver injury (50). In several cases of aloe-induced liver injury, eosinophilic infiltrates were found in the liver biopsies, suggesting that hypersensitivity could be the mechanism of toxicity (50, 51). Though the exact mechanism of aloe-induced hepatotoxicity is unknown, it is likely a result of the alkaloids' complex biochemical interplay with the liver enzymes.

Adulteration of herbal weight loss supplements

Adulteration refers to inclusion or mixing of undeclared and even substandard substances with the original active ingredients into a formulation for commercial purposes and to gain more economic benefit (52). Aside of the unethical dimension, adulteration unambiguously compromises product efficacy and safety, and may deteriorate human health (52) (Figure 2). Rocha et al. (2016) emphasized that food supplements intended for weight loss exemplify a typical case of adulteration to achieve rapid effects, as users tend to discontinue use in the absence of immediate weight loss. The authors pointed out that targeted adulteration with drugs is prevalent in HWLS due to the challenging detection of undeclared ingredients within their complex formulations (53). In the US market, weight loss food supplements were found to be among the most commonly detected adulterated products (41% of 776) between 2007 and 2016 (54). In the period from 1988 to 2019, the Rapid Alert System for Food and Feed (RASFF) registered 202 cases of adulterated weight loss dietary supplements within the EU member states (55).

HWLS were reported to be predominantly adulterated with anorexics (sibutramine, rimonabant, orlistat, phentermine) (56), followed by stimulants (ephedrine, synephrine, caffeine, theobromine), antidepressants (fluoxetine, sertraline), anxiolytics (diazepam, flurazepam), laxatives (phenolphthalein), and diuretics (hydrochlorothiazide, furosemide) or their analogues (53).

The health and wellbeing of those who use adulterated food supplements might be seriously compromised. With this in mind, the risks associated with five commonly used substances are discussed below.

Fluoxetine is known to influence body weight and it is sometimes used to adulterate food supplements purportedly used for weight loss (57). Although generally safe within recommended therapeutic doses (20-80 mg/day), fluoxetine exhibits dozens of side effects, including headache, sweating, nervousness, agitation, nausea, vomiting, diarrhea, weakness, fatigue, sexual dysfunction, suicidal ideation, seizures, insomnia, somnolence, and weight fluctuations (58). It is dangerous in uninformed patients, precipitating manic or hypomanic episodes, particularly in susceptible individuals who have a family history of suicide, bipolar disorder, and depression (59). A noteworthy health issue is related to the concurrent use of food supplements adulterated with fluoxetine and monoamine oxidase inhibitors, increasing the risk of serotonin syndrome. Patients suffering from liver

failure or hepatic impairments are at a far greater risk (60). Furthermore, in combination with anticoagulant or thrombolytic therapy, aspirin, or non-steroidal anti-inflammatory drugs, as well as other medications known to augment bleeding propensity, fluoxetine may significantly perturb hemostasis and exacerbate the risk of bleeding due to compromised platelet aggregation stemming from diminished platelet serotonin levels (61). Diuretics, as a common therapy in overweight patients, may result in clinically significant hyponatremia if administered concomitantly with fluoxetine, with hypovolemic patients being particularly susceptible (62). In addition, fluoxetine was linked to substantial ramifications for reproductive health (63). Experimental findings in mice demonstrate fluoxetine-induced hepatocellular membrane damage, leading to hepatocyte steatosis and hypertrophy (64). Herein, using an adulterated herbal supplement containing both fluoxetine and a potentially hepatotoxic compound can be extremely harmful to liver function.

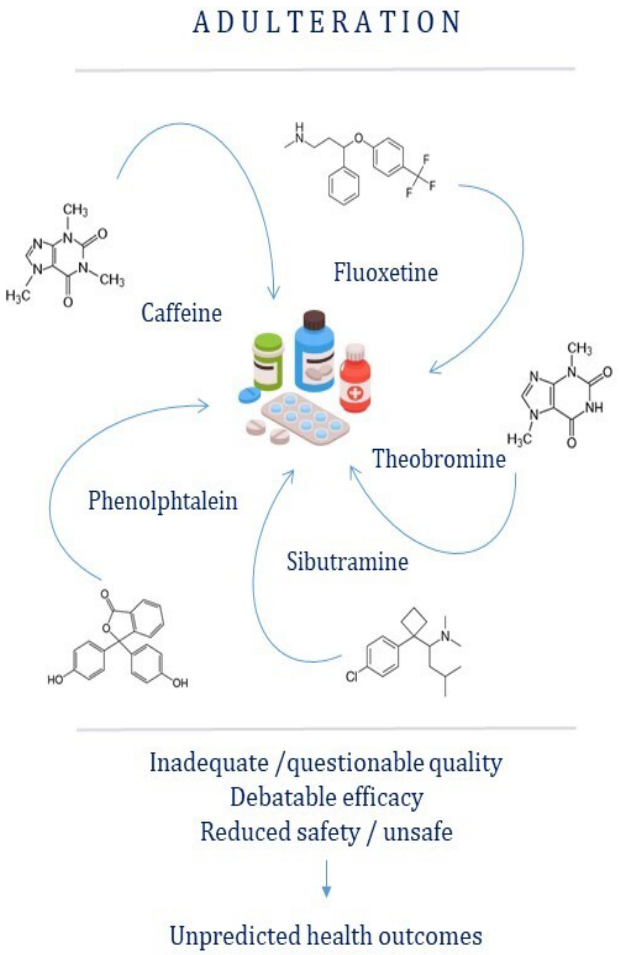

Figure 2. Adulteration of food supplements for weight loss contributes to their reduced quality and safety and may cause health disorders unexpectedly.

Slika 2. Falsifikovanje dodataka ishrani namenjenih redukciji telesne mase doprinosi smanjenju njihovog kvaliteta i bezbednosti i može neočekivano predstavljati zdravstveni rizik.

Sibutramine was found to cause rare, but serious adverse reactions, such as tachycardia, hypertension and, cardiac arrhythmia, as well as increases in the blood pressure and pulse rate (65, 66). As a consequence, the European Medicines Agency (EMA) decided to suspend the marketing authorization for sibutramine-containing products within the European market in 2010 (67). A plethora of other occurrences of serious adverse effects have been documented, including myocardial infarction cardiomyopathy, psychosis, manic episodes, palpitations, panic attacks, insomnia and suicidal tendencies (68, 69). However, sibutramine is still identified as a frequent adulterant in food supplements intended to help consumers in slimming (70, 71).

Both purine bases, derivatives of methylxanthine **caffeine** and **theobromine** have drawn increased attention as potential adulterants in weight loss supplements (4). Concerns over the undeclared presence of caffeine in weight loss products have intensified because its amount may be superimposed by the usually consumed foods such as coffee and coke, leading consumers to suffer a sudden adverse reaction. According to the European Food Safety Authority (72), the established recommended daily allowance for caffeine consumption in adults, excluding pregnant women, is set at 400 mg. However, exceeding doses of 600 mg is likely to induce notable adverse effects, such as tachycardia, tremors, insomnia, nervousness, chest pain, and arrhythmia (73, 74). Pure and high concentrated caffeine products are considered to have contributed to at least two deaths in the US (75), and thus caffeine represents a serious concern if it is present as an undeclared adulterant in weight loss supplements.

The variability in reactions to theobromine is contingent upon dosage, as noted by Baggott et al. (2013), who observed a dose-dependent increase in the heart rate. The concealed presence of theobromine may pose discernible health risks to the consumers of implicated products, especially those who enjoy drinking tea as a concentrated source of methylxanthines (76). Adeyina et al. (2008) observed elevated serum alkaline phosphatase (ALP) and AST activities in rabbits who had been administered theobromine, attributing such an increase to a theobromine-induced disruption of hepatocyte membrane integrity, leading to enzyme leakage into the bloodstream. This finding postulates a serious impairment of liver function in the case of consumption of a herbal supplement which includes other potentially hepatotoxic substance besides theobromine (77).

Phenolphthalein was recognized as a pharmaceutical agent for its laxative properties, but investigations have shown that it may be carcinogenic due to increased incidences of neoplasms of the ovary, adrenal gland, kidney and hematopoietic system in rodents (78). Hence, the FDA reclassified phenolphthalein as “not generally recognized as safe and effective” in 1997 (79) and subsequently phenolphthalein-containing laxatives were withdrawn from commercial circulation. Later studies noted that rodents had been treated with doses 10 to 1,000 times higher than were commonly used in humans (80). Although the data collected from 1975 to 1999 for patients aged 21-79 who were admitted to US hospitals revealed no association between phenolphthalein laxative use and risk of cancers, phenolphthalein was not reintroduced as a laxative. Since phenolphthalein is still

evidenced as a potential carcinogen, some studies have highlighted the danger of its presence as an adulterant in weight loss supplements (70, 81, 82).

Current regulations and future perspectives

Current regulations allow producers to create plant-based supplements that fit into the category of food supplements to evade the strict pre-marketing requirements for efficacy and safety necessary for medications (5). Actually, the conviction that HWLS are inherently safe and their "natural" label permit them to bypass strict regulatory restrictions, which in turn lead to substantial consumption, especially through online sales (4, 53). Because plant extracts contain pharmacologically active compounds constituting a small portion of their composition, some authors have suggested that herbal supplements should be controlled like medications (83).

European regulations on food supplements delineate the types of food supplements permissible for circulation within the European market and mandate safe ingredients in the correct proportions, correct labeling, and technical requirements concerning additives and contaminants (84). The goal of the Dietary Supplements Directive 2002/46/EC is to safeguard consumers by maintaining a high level of protection and guaranteeing that there is no disinformation. The requirements encompass mandatory designation of the product as a food supplement, delineation of substance categories characterizing the product, recommendations for daily supplement intake, caution against exceeding the recommended intake, instructions to keep the product out of reach of children, and a disclaimer stating that the supplement does not substitute a regular diet. European legislation on food supplements also encompasses producer responsibilities, traceability obligations, information provision, and the withdrawal of harmful products. These regulations further include adherence to hygiene principles during production, food labeling guidelines, as well as the usage of approved nutritional and health claims, adherence to established additive criteria, setting maximum contaminant and residue levels, and the approval of new food and nutritional ingredients on the European market since 1997. Botanicals used for the manufacture of herbal food supplements have to comply with the following requirements: identity and nature of the source material, manufacturing process, chemical composition, concentrations of main compounds present and maximum levels for possible contaminants, stability, proposed use, toxicological assessment, and data about exposure (85). Despite the aforementioned, the escalating usage of food supplements for weight loss, coupled with a lack of evidence regarding their efficacy, safety, and sustainability in weight reduction, presents a significant challenge to public health (86).

In the United States, food supplement manufacturers must adhere to good manufacturing practices to guarantee product identity, purity, quality, strength, and appropriate composition (87). Regulatory initiatives by the US Food and Drug Administration (FDA) aimed at requiring manufacturers and distributors to substantiate the efficacy and safety of food supplements before market placement are constrained by the existing Dietary Supplement Health and Education Act (DSHEA) of 1994 (88). From

2000 onwards, one such FDA initiative required producers to provide competent and trustworthy scientific data to support suggested roles for nutrients or dietary ingredients in body structure or function. However, subsequent FDA initiatives have not updated guidelines governing weight loss supplement claims. Efforts to strengthen regulation have included actions by the US Trade Commission against false advertising in 2003, a civil petition in 2008 seeking classification of weight loss product claims as disease claims, and actions by the US Office of Inspector General based on an inspection report finding inadequacies in evidence reliability among verified disease claims in 2013 (54). Velasquez et al. (2022) advocated for mandatory statements on product packaging to facilitate informed decision-making by users, emphasizing clear, conspicuous, large-font placement of weight loss claims (54).

In contrast, the European Commission has not initiated efforts to harmonize or improve the legislation on food supplements since the inception of Directive 2002/46/EC, despite variations among countries in interpreting substances as food supplements or medications (89). Some European nations mandate pre-market registration for food supplements, while others do not, leading to disparities in the banned compounds and approvals. The RASFF is an existing system for reporting food supplement safety, but the EU legislation has not provided a provision to establish a coordinated European nutrivigilance system able to detect and scrutinize the adverse effects of food supplements, as well as to help in decisions based on scientifically confirmed risk assessments. Unsafe supplements, while prohibited, remain accessible through online channels and free trade regulations in the EU (90). The only effort undertaken by the European Commission in 2015 was a formal assessment of food supplement regulations, with the aim of developing more useful guidelines for the implementation of regulations (91). However, this initiative was unable to address classification discrepancies or improve user safety. Given these deficiencies, novel strategies are imperative to promote the regulatory framework for food supplements on a global scale. Regulatory agencies should also mandate manufacturers to provide user instructions for reporting potential adverse effects. Implementing a system for preventing and monitoring adverse events associated with supplement use is essential (92). A global adverse event reporting system was proposed back in 2012 (93), heralding the emergence of nutrivigilance as a distinct domain (94).

The only current strategy for evaluating supplement quality is post-market surveillance. Information from this kind of surveillance can help with risk assessments, direct choices about product recalls or withdrawals, force changes to product labels, and motivate product reformulation plans (95). Introducing an excise tax on weight loss food supplements, as proposed by Velasquez et al. (2022), may reduce overall product use, but won't address safety or adulteration concerns (54). Cohen and Bass (2019) advocated regulatory reforms mandating pre-market supplement registration, accompanied by analytical methods for adulteration screening and safety testing (96).

Conclusion

The use of HWLS is burgeoning, yet further research is imperative to evaluate their efficacy, safety, appropriate dosage, mechanisms of action, and interactions with drugs. The potential for adverse and even toxic effects of herbal compounds and extracts, which are often used for the manufacture of HWLS, should not be overlooked. Moreover, HWLS are subjected to adulteration with undeclared substances, a fraudulent practice multiplying health risks for the consumers. Undeclared active substances pose risks not only due to their presence, but also due to potential interactions with other prescribed drugs in unaware consumers. These observations emphasize the need for thorough revision of regulations for food supplements at a global scale. Until a more adequate technology and/or methodology than post-marketing surveillance is introduced, providing safer use of herbal supplements, both health professionals and their patients should be very careful, opting for lifestyle changes that may help in the efficient management of overweight.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Author contributions

Zoran Zhivikj: Conceptualization, Visualization, Writing - original draft; **Tanja Petreska Ivanovska:** Methodology, Supervision, Writing - original draft; **Marija Karapandzova:** Writing - review & editing; **Svetlana Kulevanova:** Supervision, Writing - review & editing; **Tatjana Kadifkova Panovska:** Writing - review & editing, **Lidija Petrushevska-Tozi:** Supervision, Writing - review & editing.

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Bezbednosni aspekt i primene biljnih dodataka ishrani namenjenih redukciji telesne mase: hepatotoksičnost i falsifikovanje

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Kratak sadržaj

Upotreba biljnih dodataka ishrani namenjenih smanjenju telesne mase široko je rasprostranjena u terapiji gojaznosti, ali nedostaju dosledni podaci koji bi podržali dugoročnu efikasnost i bezbednost njihove primene. Osim toga, pravni okvir za dodatke ishrani manje je restriktivan od regulative za lekove. Cilj ovog pregleda je da ukaže na činjenicu da mnogi dodaci ishrani namenjeni redukciji telesne mase sadrže biljne sastojke sa nepoznatim mehanizmom delovanja, što povećava rizik od neželjenih efekata, pa čak i toksičnosti, posebno u kombinaciji sa prepisanim lekovima. Upravo je hepatotoksičnost, koja se kreće od povišenih transaminaza i autoimunog hepatitisa do akutne insuficijencije jetre, nedovoljno prepoznata kao neželjeni efekat usled primene ovih dodatak ishrani, iako nije retka pojava. Još ozbiljniji razlog za zabrinutost je falsifikovanje dodataka ishrani namenjenih redukciji telesne mase dodavanjem neodobrenih supstanci ili lekova kako bi se postigli brzi efekti i povećala prodaja. U ovo radu navodimo neke od značajnih literaturnih podataka o mogućoj hepatotoksičnosti biljnih ekstrakata često korišćenih u dodacima ishrani za redukciju telesne mase, kao i zdravstvenim rizicima povezanim sa nekim od najčešćih supstanci koje se koriste pri njihovom falsifikovanju. Za bezbedniju upotrebu dodataka ishrani, neophodna je sveobuhvatna i kritička rasprava o trenutnim regulatornim principima koji se primenjuju na dodatke ishrani kako bi se pružio odgovor na postojeći jaz između povećane upotrebe dodataka ishrani i nedostatka znanja o njihovim benefitima i rizicima upotrebe, te tako potrošačima omogućila bolja zaštita.

Ključne reči: biljni suplementi, smanjenje telesne težine, hepatotoksičnost, falsifikovanje