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The influence of selected plant stimulants and mushrooms on the human body

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ABSTRACT

INTRODUCTION

In recent years, there has been an increase in the use of herbal stimulants around the world. Many people cannot imagine life without coffee, a cup of this drink is often a mandatory part of the day. As the world moves faster and faster, people are looking for a way to keep up with it. Therefore, more and more plant and mushroom stimulants appear on the market, which help people replenish energy deficiencies and meet the challenge of constantly living on the run. Selected stimulants, the benefits associated with their use, and side effects are described in the work below.

THE AIM

The aim of this work is to discuss the properties that stimulate the human body. We have selected less and more known plants and mushrooms, describing their properties, benefits of their use, side effects, and contraindications to their use.

MATERIALS AND METHODS

In this work, we describe the impact of substances that stimulate the human body contained in selected plants and mushrooms. A review of the literature available in the National Library of Medicine database at https://pubmed.ncbi.nlm.nih.gov and Google Scholar was conducted. The articles were searched using keywords such as herbs stimulants, fungi, side effects, adaptogens, and advantages.

SUMMARY

There are many plants and fungi in nature containing substances that have a beneficial effect on the human body. They improve brain function, reduce stress, and increase concentration. We often reach for them because we really need an additional energy booster in today's world. However, it should be remembered that these agents in too high doses may also cause side effects. Therefore, these preparations should be selected individually, taking into account chronic diseases, conditions such as pregnancy and lactation, and medications taken.

Keywords: herbs stimulants, fungi, side effects, adaptogens, advantages

INTRODUCTION

In recent years, there has been an increase in the use of herbal stimulants around the world. Many people cannot imagine life without coffee, a cup of this drink is often a mandatory part of the day. As the world moves faster and faster, people are looking for a way to keep up with it. Therefore, more and more plant and mushroom stimulants appear on the market, which help people replenish energy deficiencies and meet the challenge of constantly living on the run. Apart from the coffee tree, which is the most popular plant from which caffeine is obtained, we also distinguish guarana and yerba mate. We can also mention many other plants

and mushrooms containing substances that have a stimulating effect on the human body. Selected stimulants, the benefits associated with their use, and side effects are described in the work below. [38]

The herbal products used are mainly derived from leaves, seed extracts, berries or roots.[39] Plant extracts are standardized - they contain a precisely defined amount of an ingredient that has a healing effect. Standardization allows you to determine the amount of active compounds that provide the expected effects or sometimes undesirable ingredients. It is made on the basis of pharmacopoeial standards or quality standards of a given raw material. The content is determined using analytical methods, and the purity of the raw material can also be assessed. Standardization is important in the case of extracts with strong medicinal properties, an overdose of which may be dangerous for the patient. [40]

THE AIM

This work aims to discuss the properties that stimulate the human body. We have selected less and more known plants and mushrooms, describing their properties, advantages of use, side effects, and contraindications to their use. In natural medicine, herbal preparations and mushrooms are often credited with very wide health-promoting properties. In this work, we included both properties that can be confirmed in research and those that require examination or deepening their credibility.

MATERIALS AND METHODS

This work describes the impact of substances that stimulate the human body contained in selected plants and mushrooms. A review of the literature available in the National Library of Medicine database at https://pubmed.ncbi.nlm.nih.gov and Google Scholar was conducted. The articles were searched using keywords such as herbs stimulants, fungi, side effects, adaptogens, and advantages. We mainly selected review articles collecting the most important information about selected plants and fungi, as well as meta-analyses confirming their properties.

COFFEE, YERBA MATE, GUARANA - SOURCES OF CAFFEINE

Caffeine is one of the main psychoactive substances. It belongs to the group of methylxanthines and is a natural stimulator of the central nervous system. We can find it in many popular products such as coffee, tea, and chocolate. It is also added to carbonated drinks such as Coca-Cola or Pepsi.[1,2] Caffeine is a natural component of many plants, it occurs in coffee seeds, tea leaves, kola seed germs, and Mate leaves (yerba mate). Depending on the plant from which it is obtained, it has different names - theine (if it comes from a tea tree), guaranine (if it comes from guarana), mateine (if it comes from yerba mate). [3,4,5]

The most popular species of coffee tree is *Coffea arabica* from Ethiopia. A coffee tree needs about 3 years to develop from germinating seeds to a mature plant. Beans are the basic raw material for the production of roasted and ground coffee, instant coffee, and coffee liqueur. Properly grown, a coffee tree can bear fruit for up to 80 years or more, but the economic life of a coffee plantation rarely exceeds 30 years [41]. The method of preparing the infusion affects the caffeine content. Coffee beans often contain more caffeine than ground coffee. This may be due to the degree or method of grinding the beans. Instant coffee often contains less caffeine than the previously mentioned types of coffee, due to the way it is produced - often using lower-quality beans.[42]

Guarana is a plant from the Brazilian Amazon. There are several species of guarana, the most researched and used in medicine is the guarana species *Paullinia cupana*. Guarana plant extract is one of the natural sources of caffeine. Its highest concentration occurs in seeds and depends on the maturity of the seeds. Guarana seeds are roasted and ground, and the resulting powder is used as a single-ingredient supplement in the form of tablets or as one of the components of a combination of herbal extracts, it is also added to teas, energy, and alcoholic drinks. [34.50]

Yerba Mate tea is an herbal tea drink widely consumed in southern Latin American countries (southern Brazil, Argentina, Paraguay, and Uruguay). It is made from an infusion of dried leaves of *Ilex paraguariensis*, a plant from the holly family. Yerba Mate is not consumed as a raw product but is processed before it reaches the consumer. This includes blanching, drying, and aging the tea. Mate tea is dried very slowly and often using wood smoke. The leaves are heated rapidly over an open flame.[43]

The mechanism of action of caffeine is its effect on adenosine receptors in the brain. Due to its solubility in fat and water, caffeine easily penetrates the blood-brain barrier. It antagonizes all 4 adenosine receptor subtypes. [6,7] Caffeine has a positive effect on the nervous system. Increases alertness, concentration, attention, and energy, improves cognitive abilities, shortens reaction time, increases efficiency at work, reduces fatigue, improves mood and well-being, and relieves headaches. It also reduces the risk of stroke. [5] Antagonism of the A1 receptor found in the myocardium causes a positive inotropic effect. Stimulation of the release of catecholamines has a positive chronotropic effect and also increases the inotropic effect. The effect on the receptors present in the vessels causes vasodilation and additionally stimulates the release of nitric oxide by the endothelium, which intensifies the vasodilator effect. Catecholamines antagonize the relaxation of vascular smooth muscles, therefore the effect of caffeine on the vessels is balanced. [1] Other effects of caffeine include increasing respiratory drive and improving diaphragm contractility. This substance also stimulates diuresis by increasing glomerular filtration and sodium excretion. Moreover, it is a strong stimulator of gastric acid secretion and stimulates peristalsis of the digestive tract. [1,7,9] Studies have shown that daily coffee consumption reduces the risk of many systemic diseases such as type 2 diabetes, Parkinson's disease, liver cirrhosis, leukemia, and liver cancer. [10]

Caffeine also plays a protective role in inflammation when it weakens the overexpression of hepcidin - one of the acute phase proteins. This happens by activating the IL-6/STAT3 pathway. Thanks to these properties, caffeine becomes an interesting therapeutic solution for anemia developing due to chronic inflammation. [11]

Another positive effect of using this substance is the normalization of cognitive functions and neuroprotective effects against dementia and probably Alzheimer's disease, but work on the mechanisms of action of caffeine in these diseases is still in the research phase. [12]

Caffeine also plays an important role in the therapy of premature infants, through its neuroprotective effect and reduction of impairment factors, especially in bronchopulmonary dysplasia. [13]

Despite the many positive effects of using caffeine, this substance also has a negative impact on the human body. By blocking adenosine receptors, bone formation and resorption are inhibited. Calcium and vitamin D metabolism is also disturbed. [14] Mild side effects include anxiety, restlessness, fidgeting, insomnia, facial flushing, frequent urination, irritability,

muscle spasms, agitation, tachycardia or irregular heartbeat, and gastrointestinal irritation. More serious side effects include confusion, hallucinations, psychosis, seizures, arrhythmias, ischemia and rhabdomyolysis. Moreover, as in the case of other psychoactive substances, stopping caffeine intake leads to withdrawal symptoms such as tachycardia, arrhythmia, thinking disorders or convulsions. The first symptoms appear after 12-24 hours and may last up to 7 days. The best solution to avoid withdrawal is to gradually reduce the dose. [1,15] Finally, the use of caffeine to treat apnea of prematurity increases the risk of necrotizing enterocolitis in the newborn. [16]

GINSENG (*Panax ginseng*)

Ginseng is a species of perennial plant originating from Asia and eastern Russia. The part of this plant used in herbal medicine is the rhizome. Its main active compound is Panaxosides (Ginsenosides). Standardization is determined based on its concentration, which usually ranges from 1.5 to 7 percent. The daily dose is 200 mg per day for a longer period. [34]. Ginseng extract has adaptogenic, antioxidant, and blood vessel-relaxing properties. Ginseng preparations should not be used in patients with asthma and hypertension. Too large doses may cause insomnia, increased blood pressure, problems with concentration, and nervousness. [34]

GINKGO BILOBA

Ginkgo is a species of tree native to China. The production uses leaves and ripe fruits collected from spring to early autumn, as well as seeds. Its main bioactive ingredient is ginkgolides. They have antioxidant and neuroprotective properties, dilate blood vessels, and reduce blood viscosity. [34] Clinical studies have shown that after treatment with ginkgo biloba extract, working memory improved significantly and the speed of information processing also increased. [8]

MACA (*Lepidium meyenii*)

Peruvian pepper is a plant from the Andes region, rich in fiber, a large number of essential amino acids, fatty acids, and other nutrients, including vitamin C, copper, iron, and calcium. [17] Maca is divided into an aboveground and underground part - the hypocotyl, which is the edible part.[18]

Table 1. Therapeutic effects of Peruvian pepper.[17]

THERAPEUTIC EFFECTS	
Neuroprotection	Improvement of cognitive functions in post-stroke and elderly patients, regulation of transcription, protein inhibition, anti-inflammatory effect
Skin	Protection and treatment of UV-damaged skin, improved wound healing at high altitudes
Carbohydrate metabolism	Decrease in glucose levels, inhibition of lipid oxidation, which reduces oxidative damage in the liver, significant increase in insulin levels and glutathione content
Learning	Improving spatial learning and reducing memory deficits
Fertility	Increased sexual drive, ejaculate volume, sperm concentration and total sperm count
Energizing properties	Improved physical condition in athletes, higher levels of the enzyme superoxide dismutase and lower concentrations of catalase, lactate dehydrogenase and lipid peroxidation
Anti-fatigue	Increased enzymatic activity of glutathione peroxidase and creatine kinase, which delays the onset symptoms of fatigue. Increasing antioxidant capacity and accelerating the conversion of energy into ATP. Reducing the level of urea nitrogen.

	Increase in glycogen levels depending on the dose.
Antioxidant	The presence of substances such as phenols, glucosinolates, alkamides, and polysaccharides inhibits oxidation. However, the effect depends on the concentration of the substance and the conditions of the microenvironment.

RHODIOLA ROSEA

Rhodiola rosea, also called golden root or rose root, is a botanical adaptogen containing many substances such as flavonoids, coumarins, volatile substances, anthraquinone, and organic acids.[19,20] Additionally, the water and alcohol extract from *Rhodiola rosea* rhizomes has antioxidant properties, thanks to which the presence of gallic acid, caffeic acid, epigallocatechin gallate, and other phenolic compounds.[21]

Scientists have shown that *Rhodiola rosea* L. preparations, extracts, and active compounds have many biological functions, including regulating immunity, having an antioxidant effect, and inhibiting the proliferation of cancer cells. [22]

Rhodiola rosea preparations are used in patients with circulatory system diseases. The effects are due to anti-inflammatory, antioxidant and anti-apoptotic effects. [23] This leads to an improvement in the ejection fraction of the heart and a reduction in the level of inflammatory mediators (IL-6, hs-CRP, NT-proBNP). A side effect of using this preparation is an increase in heart rate. [22]

Another group of diseases in which *Rhodiola rosea* preparations are useful are diseases of the nervous system. They improve concentration, memory and perceptiveness, increase resistance to stress and reduce fatigue. Thanks to this, after the stress factors subside, the body can quickly return to normal.[21]

In diabetic patients, *Rhodiola rosea* inhibits hepatic gluconeogenesis, represses adipogenesis and lipid peroxidation, and increases the survival of islet B cells. It also has a good therapeutic effect in diabetic complications - nephropathy and retinopathy.[22,24]

Rhodiola rosea is also used in oncology, mainly in adjuvant chemotherapy. On the one hand, it strengthens immunity through immunoregulation, killing cancer cells or inhibiting their proliferation. On the other hand, it increases sensitivity to chemotherapy.[22]

Rhodiola rosea tincture reduces fatigue, mainly in seniors, and is also effective in stomach and liver diseases. When using *Rhodiola rosea* preparations, we must remember not to take them in the evening, as they may cause insomnia.[25]

KRATOM (*Mitragyna speciosa*)

Kratom is a tropical tree found in Africa and Southeast Asia. Their leaves are used to make tea, which has many uses. [27]

This plant is a stimulant and calming agent. It has effects similar to opiates and cocaine. Native inhabitants of tropical areas of Asia use it to combat the symptoms of opioid withdrawal, treat muscle pain and fatigue. It is also used as an analgesic product in the treatment of diabetes, hypertension, leukemia and anorexia. It also gives good results in cases of persistent diarrhea. It is an immunostimulant. [27,28,29,30]

The effects of Kratom on the body depend on the dose. Small doses produce a stimulant effect, and large doses have an opioid-like effect.[27,31]

The negative effects of kratom include anxiety, irritability, aggression, lethargy, nausea, constipation, and itching. With long-term use, cheek hyperpigmentation, tremors, anorexia, weight loss and psychosis may occur. [32] In addicted patients, withdrawal symptoms such as irritability, dysphoria, nausea, hypertension, insomnia, yawning, rhinitis, muscle pain, diarrhea, and arthralgia may occur upon discontinuation of use. [33]

ASHWAGANDHA (*Withania somnifera*)

Ashwagandha is a subtropical, evergreen shrub. Its root extract has been used for centuries in Indian medicine - Ayurveda. The active substances responsible for the healing properties are

primarily withanoids. It is to them that the standardization of the plant extract is established. The content of active substances in ashwagandha root ranges from 0.13 -0.30%. The maximum daily dose is 3 mg of powdered root or 10 mg of withanoids. Ashwagandha is credited with a very wide range of properties, but not all of them are confirmed by scientific research. The most famous and documented properties of ashwagandha are stress reduction. It reduces stress-related anxiety [26,35] and lowers cortisol levels [26,36], animal studies confirm its positive effect on falling asleep and sleep quality, but in humans, the results are not clear. [37], Ashwagandha treatment may be beneficial in normalizing thyroid parameters in patients with subclinical hypothyroidism. [48]. A reduction in total cholesterol levels was also observed. [26] Ashwagandha is completely contraindicated during pregnancy due to its potential early abortive properties.

CORDYCEPS (*Cordyceps* Fr.)

Cordyceps is a type of hallucinogenic mushroom used in Chinese medicine. The main substance responsible for the therapeutic effect is cordycepin, other bioactive compounds are adenosine and polysaccharides. The main properties attributed to these substances are immunomodulation and anticancer activity. Cordycepin is believed to have anticancer, antidiabetic, anti-inflammatory, antimicrobial, platelet aggregation-inhibiting, hypolipemic, analgesic, and immunomodulatory properties. Tryptophan contained in the mushroom is responsible for the calming and hypnotic effect and is also a precursor of the synthesis of serotonin and tryptamine, a neurotransmitter. Cordyceps also contains B vitamins necessary for the proper functioning of the nervous system. [44,45]

Cordyceps is considered relatively safe and non-toxic for human consumption. Side effects you may encounter when using it include dry mouth, nausea, abdominal bloating, throat discomfort, headache, and diarrhea, as well as allergic reactions. Due to its immunomodulatory properties, cordyceps should be avoided in patients with systemic lupus erythematosus, multiple sclerosis, and rheumatoid arthritis. [44,45]

LION'S MANE (*Hericium erinaceus*)

Hericium erinaceus is an edible mushroom, traditionally used as a herbal medicine in East Asian countries. The typical dose is 1 to 3 mg daily. [47] The activities attributed to this mushroom include antioxidant, antimicrobial, and anticancer properties. The substances responsible for these properties include hericenones, erinacins, terpenoids, beta-

polysaccharides and phenolic acids, and many minerals and vitamins. [46] Research suggests that Hericium erinaceus may improve performance speed and reduce subjective stress in healthy young adults. Studies have shown that H. erinaceus has properties that alleviate depressive disorders, so it can serve as a complementary and alternative medicine in the treatment of depression. [49]. It is believed that the use of this mushroom is generally safe.

SUMMARY

The plants and mushrooms described above indicate that there is a large variety of substances of natural origin, the use of which brings benefits to the human body in the form of, among others, improving brain function, reducing stress, and increasing concentration. When deciding to introduce herbal or mushroom preparations into your diet, you should pay attention to the fact that while these substances have beneficial effects, they also have side effects and may interact with medications. The content of the active ingredient responsible for the therapeutic effect and the appropriate duration of treatment are also important. It is certainly worth using available natural plant stimulants and mushrooms, but preparations should be selected individually, taking into account chronic diseases, conditions such as pregnancy and lactation, and medications taken.

DISCLOSURE

Author's contribution

Conceptualization, Katarzyna Polańska, and Marta Wojaczek; methodology, Weronika Szafrańska; software, Marta Wojaczek; check, Dominika Poborowska and Weronika Kahan; formal analysis, Magdalena Kras and Marcin Łata; investigation, Katarzyna Lelek and Piotr Niedbał; resources, Agnieszka Kosińska; data curation, Weronika Szafrańska; writing - rough preparation, Weronika Kahan; writing - review and editing, Katarzyna Polańska; visualization, Dominika Poborowska; supervision, Katarzyna Polańska and Magdalena Kras; project administration, Katarzyna Lelek and Marta Wojaczek; receiving funding - no specific funding.

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The authors deny any conflict of interest

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