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Selected Natural Stimulants in Food and Their Effects on Human Health

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Abstract: The paper discusses the various stimulants found in foods and the prevalence and public knowledge of their effects on health. The study aimed to identify the impact of consuming selected natural stimulants on human health. A survey was conducted online in 2023, based on the authors' questionnaire, among people of different ages and education. Stimulants were found to be commonly used by the survey respondents. A significant number of the respondents consumed stimulants even several times a day (41.1%), however they were aware of the adverse effects of consuming these substances and many expressed a desire to reduce their consumption (46.1%). A total of 84.1% indicated the need for more education on the subject, noting that the information they gained from the Internet regarding both the effects and safe doses of a substance was insufficient.

Keywords: caffeine, health, food

1. Introduction

Stimulants are found in food on a daily basis (Babik, 2020; Wierzejska, 2012). Scientific articles describe the properties of active substances, e.g. those contained in coffee beans, with a particular focus on pharmacological effects and potential side effects of their main component – caffeine (Grodzka et al., 2021; Wierzejska, 2012). Some papers focus on the amount and frequency of consumption of coffee, tea, chocolate products, energy drinks, cola-type drinks, and some dietary supplements by different social groups such as university and high school students, adult women, etc. (Wanat and Woźniak-Holecka, 2011; Wierzbicka et al., 2010).

However, only few people know how these substances affect the human body and how stimulation occurs. Therefore, learning about their advantages and disadvantages is of great importance, as there are risks associated with the use of these stimulants, primarily if the permitted safe doses regulating their consumption are not known.

This study aimed to determine the respondents' knowledge about the effects of consuming stimulants on human health. It was intended to prove that regular consumption of natural stimulants in food in appropriate doses can positively affect human health.

2. Caffeine

Nearly 80% of the world's population consume caffeine daily as a stimulant. It is most often introduced into the body with coffee, tea, or cola drinks. The chemical name of caffeine is 1,3,7-Trimethylxanthine, an alkaloid found naturally in some plants, such as coffee beans, tea tree leaves, cocoa seeds, and cola seed sprouts. Caffeine has different names depending on the plant in which it is found, as taina is the caffeine found in tea leaves, guaranine is found in guarana fruit, and matein comes from yerba mate (Balawejder-Biśto and Pyka-Pająk, 2022). There are many ways to obtain caffeine from the above products. The most popular method is extraction, which involves collecting raw materials and extracting caffeine from them, removed with organic solvents or carbon dioxide. Finally, the extracted caffeine is purified by distillation or crystallisation.

Caffeine consists of four nitrogen atoms, two oxygen atoms, ten hydrogen atoms, and eight carbon atoms. It is an alkaloid of the purine group, and appears as a white powder with a bitter taste. It is a substance that dissolves easily in water, alcohol, and other organic solvents. The human body quickly breaks down caffeine after ingestion.

Since it is alkaline, it can react with acids to form salts, such as sodium caffeate or potassium caffeate. The average melting point of caffeine is 236.1°C, while the sublimation temperature is 90°C. It is thermally stable and does not degrade under regular coffee or tea steaming conditions. Caffeine can already be isolated from over sixty plants (Barczak, 2021).

Average doses of caffeine in individual products are as follows:

1. Coffee: about 100-200 mg of caffeine in a cup of coffee.
2. Tea: 50-100 mg of caffeine in a cup of tea.
3. Energy drinks about 50-200 mg of caffeine per can.
4. Cocoa and chocolate: about 2-60 mg of caffeine in 100 g of product.
5. Dietary supplements with caffeine: contain various doses of caffeine, usually from 50 to 300 mg per serving (Grodzka et al., 2021; Sadowski, 2024; *Scientific opinion*…, 2015; Wierzejska, 2012).

The caffeine content of tea and coffee differs depending on the variety or the way the beverage is prepared (Grodzka et al., 2021). Approximate recommended daily doses of caffeine vary by age:

1. Adults: the recommended safe daily dose of caffeine for adults is 400-450 mg, 200 mg at one time.
2. Pregnant and nursing mothers: the recommended safe daily dose of caffeine for pregnant and lactating women is 200 mg or less.
3. Children and adolescents: the recommended daily caffeine dose for children and adolescents is lower and depends on age and weight. It is usually recommended that children and adolescents under 18 consume less than 100 mg of caffeine daily (Evans et. al., 2023; Grodzka et al., 2021; Rosa, 2022; *Scientific opinion*…, 2015).

Caffeine works by blocking adenosine receptors in the brain – thus, it increases the secretion of neurotransmitters, namely norepinephrine, dopamine, serotonin, glutamate, acetylcholine, GABA (Matysek-Nawrocka and Cyrankiewicz, 2016). It stimulates the central nervous system and expands the blood vessels. It is wholly absorbed in the gastrointestinal tract after about 45 minutes and is

metabolised mainly in the liver. It reaches its highest concentration after 30-120 minutes. The half-life of this compound is approximately 4 hours (Detlaff i in., 2020). Changes in the concentration of caffeine in the body and the recommended daily intake depend on several factors, such as genetics, smoking, age, pregnancy, and medication consumption. Only 2% of caffeine in unchanged form is excreted in the urine.

Caffeine is a substance known worldwide and widely used as a stimulant. It owes its fame to its stimulating effect on the nervous and cardiovascular systems. After consuming it, one notices increased alertness and concentration. It improves performance and endurance, helping sports people achieve better results, however it was proved that trained individuals with good acid-base balance obtain more significant effects. It reduces feelings of fatigue, improving one's mood. Increasing the secretion of gastric juice accelerates total and resting metabolism. It enhances lipolysis (breakdown) of adipose tissue and the body's thermogenesis process, which aims to maintain a constant body temperature (Sikorska, 2020). Due to its diastolic properties, it dilates the airways, which reduces the frequency and intensity of coughing attacks and breathlessness in people with asthma and/or chronic bronchitis (Wierzejska, 2012). Caffeine has many pharmacological actions; coffee consumption has been linked with the incidence of diabetes. For this reason, caffeine increases insulin secretion and enhances sensitivity to this hormone. According to recommendations, drinking several cups of coffee a day regularly benefits glucose metabolism and reduces the likelihood of type 2 diabetes. It reduces the risk of liver damage, Alzheimer's, and Parkinson's disease and even improves psychomotor performance (Babik, 2020; Grodzka et al., 2021; Qi and Li, 2014; Surma et al., 2020; Zhou and Zhang, 2021).

In reasonable amounts, caffeine is safe, but its excessive consumption may have many adverse effects (Rodak et al., 2021). The safe daily dose of caffeine for an adult is 400 mg (Walczynski, 2019). The lethal dose of this substance is about 10 g. Increasing the dose of caffeine beyond the established norm can cause side effects such as insomnia, anxiety, and headaches. Symptoms of acute intoxication can include headache, nausea, insomnia, agitation, photophobia, anxiety, and visual disturbances. In addition, the risks of ischemia, osteoporosis, gastritis, and coronary artery disease should be considered (Kumar et al., 2018). Caution should be taken with caffeine consumption by pregnant and nursing women. According to the European Food Safety Authority (EFSA), breastfeeding and pregnant women should not take more than 200 mg daily. In this case, the half-life of caffeine is three times longer, and caffeine quickly passes through the placenta to the fetus. As a result, the caffeine level in the fetus's blood is the same as in the mother. Caffeine permeates the breast milk and the baby, causing irritability and sleep problems (Baran and Kubit, 2021; Wierzejska, 2020).

By meeting four conditions out of the seven set by the American Psychiatric Association (APA), i.e. increasing the body's tolerance to the substance taken, experiencing adverse effects associated with withdrawal from stimulants, problems controlling the amount of the intake, and using the substance knowing the adverse effects of its use - caffeine is considered an addictive substance (Siwek et al., 2013).

Caffeine used together with medications significantly changes its activity. Most often, the half-life of the substance in the body is prolonged. Women taking oral contraceptives and people being treated for depression are at risk (Balawejder-Biśto and Pyka-Pająk, 2022). A reduction in the effectiveness of medications with concurrent caffeine consumption occurs most often when taking antiepileptic and antihistamine drugs. It is worth noting, however, that caffeine can sometimes support the effects of drugs. A standard treatment is to add caffeine to painkillers so that the impact of the drug is enhanced, which was confirmed by a study of 10,000 people in 1984 (Lipton et al., 2017).

Today, caffeine is used in the food industry and has found applications in medicine and cosmetology (Balawejder-Biśto and Pyka-Pająk, 2022; Baran and Kubit, 2021).

2.1. Comparison of Stimulants in Foods

Stimulants are widely present in many foods and beverages, offering a quick energy source and a temporary enhancement in mental and physical activity. However, their effects on human health are controversial. Below is a brief comparison of the substances by their indication or contraindication in supplementation.

Caffeine is one of the most well-known stimulants in coffee, tea, energy drinks, and some carbonated beverages (Balawejder-Biśto and Pyka-Pajak, 2022). Its action is to block adenosine receptors, leading to feelings of arousal and increased alertness (Matysek-Nawrocka and Cyrankiewicz, 2016). It is recommended when concentration, focus, or physical performance needs to be improved. However, excessive caffeine consumption can lead to insomnia, hand tremors, and heart rhythm disturbances.

Guarana is a plant native to South America whose seeds contain a high amount of caffeine. It is often used in dietary supplements and energy drinks (Schimpl et al., 2013). Its effects are similar to caffeine, but caution should be exercised when consuming it due to its concentrated source. Guarana supplementation may be indicated in short-term increases in physical performance, but long-term consumption may lead to side effects similar to excessive caffeine consumption.

Taurine is an amino acid that occurs naturally in animal bodies. It is found in energy drinks and dietary supplements; its effects are complex, including an impact on the nervous system and cellular functions. It may be recommended in situations requiring improved brain function and focus (Dziewiecka et al., 2010). However, there is currently not enough research focusing on the long-term effects of its supplementation, so it is recommended to use taurine in moderation.

Tyramine is an organic chemical compound in many food products, such as ripened cheeses, cured meats, and some fermented foods. According to Burns and Kidron (2020), tyramine can affect the cardiovascular system. It acts as a sympathomimetic substance, meaning that it can increase the activity of the sympathetic nervous system, which regulates the functioning of the heart and blood vessels. In some people this can lead to increased blood pressure and an increased risk of vasospasms, migraines, or other ailments (Grudzińska, 2023).

Theobromine is a compound found mainly in chocolate and cocoa drinks. It has a mild stimulant effect, but its concentration is much lower than caffeine's. It can be used as a mild stimulant, but excessive consumption of chocolate can lead to theobromine-related health problems, such as stomach irritability and heart problems.

Ginseng is a plant used in natural medicine, often advertised to be able to improve physical and mental strength. Recommendations for ginseng supplementation include periods of intense exertion or stress. However, there is only sometimes sufficient research to support its effectiveness, and long-term use can lead to complicated interactions with the medications taken (Stańczak and Lewgowd, 2021).

Yerba mate is a beverage popular in South America, containing caffeine and other compounds such as theobromine and theophylline (Gambero and Ribeiro, 2015; Lutomski et al., 2020). It can be used as an alternative to coffee due to its content of various stimulants. It can help improve concentration and physical performance, but excessive consumption can lead to heart and nervous system problems.

Kola nut is traditionally used in carbonated beverages containing caffeine and other stimulant compounds. Its effects are similar to caffeine's, and supplementation may be advisable for short-term periods requiring greater alertness and stimulation. However, as with other sources of caffeine, overuse can lead to adverse effects (Adelusi et al., 2020).

Acai is a fruit grown in South America and is promoted for its antioxidant properties and health benefits. It is not directly a stimulant in the traditional sense but contains components that can affect overall energy and health (Piekarska-Radzik and Klewicka, 2020). It can be used as part of a balanced diet but is not a substitute for other energy sources.

Nicotine is a substance found mainly in tobacco products, such as cigarettes and tobacco smoke. It is highly addictive, and its consumption is hazardous to health. There are no recommendations for nicotine supplementation, and its use has been linked to many diseases, including cancer.

When considering the use of stimulants in daily life, there are several vital aspects to address. First and foremost, scientific studies have shown that moderate consumption of stimulants, such as caffeine or taurine, can increase alertness and improve concentration and, thus, efficiency in daily tasks (Wierzejska, 2012). However, many factors influence whether supplementation is advisable; individual tolerance and the body's unique reactions to these substances are essential. Individuals who are sensitive to stimulants may experience side effects, such as insomnia, nervousness, or heart rhythm irregularities. Evans et al. (2023) divide side effects into mild (anxiety, restlessness, fidgeting, insomnia, facial flushing, increased urination, muscle twitches or tremors, irritability, agitation, elevated or irregular heart rate, GI (gastrointestinal) upset)) and severe (disorientation, hallucinations, psychosis, seizure, arrhythmias, ischemia, rhabdomyolysis). Hence, it is necessary to start with low doses and gradually increase them, watching how the body reacts. In addition, the source of the stimulants is essential. Natural products such as coffee or tea, which contain caffeine, are often preferred due to their milder effects on the body compared to artificial energy drinks. However, it is essential to remember that additives in these drinks, such as sugars and artificial flavours, can negatively affect health (Wierzejska, 2012).

Research on supplements with stimulants, such as guarana or ginseng, is still ongoing and does not always provide conclusive evidence of their effectiveness and safety. Therefore, if one is considering using them, it is advisable to consult a doctor or nutritionist.

In conclusion, the use of stimulants in daily life is possible and can be beneficial, but it should be undertaken with caution and in full awareness of individual needs and body reactions. Scientific studies are still analysing the effects of these substances, therefore it is worth being aware of their possible changes.

3. Survey Research

Based on the authors' questionnaire, an online survey was conducted on selected natural stimulants and their effects on human health. The survey was designed to investigate what most commonly natural stimulants the respondents consume and how they affect them. The respondents were also asked questions about their eating habits and attitudes towards, and the knowledge of stimulants. Since the survey was scientific and educational, it was accompanied by information on what stimulants are, why they are used, and the factors (intake, frequency, individual body sensitivity) that affect the absorption of nutrients from food, such as iron, calcium, magnesium, zinc, and copper.

The survey was disseminated through several well-known communication channels. Online platforms such as Facebook, Instagram, and some instant messengers were used. People of varying ages and educational backgrounds were invited to participate in the survey. Throughout the research process, priority was given to ensuring the full anonymity of the participants. The survey was conducted with deep respect for ethical principles, guaranteeing the respondents' right to confidentiality and privacy. Each person was aware of their contribution to the study and could withdraw from participation without giving a reason.

Data analysis was performed using the $\chi 2$ statistical test for selected questions. The relationship between responses and gender was tested, assuming a significance level of $\alpha \leq 0.05$ (Słowińska, 2019). The collected information was analysed using Microsoft Excel, and the results were presented in the form of graphs and tables. When the number of persons is given in brackets, the question was multiple--choice.

The survey comprised 17 questions; the sheets were filled in over four months, i.e. from May 2023 to August 2023. One hundred and seven respondents took part in the survey, of which 86 sheets were

completed by women (80.4%) and 21 by men (19.6%). All the questionnaires were filled in correctly, so none of the responses were rejected. The age of the respondents ranged from 17 to 57, with the majority falling into the 20-25 age group (60.7%). Most of the respondents had a higher education (57%) and fewer secondary education (39.3%).

The vast majority of participants resided in cities with more than 100,000 residents (52.3%), suggesting that the sample focused on people from urban areas. A small number of the respondents came from rural areas and cities with less than 100,000 residents (Table 1).

Table 1. Profile of the respondents
Tabela 1. Charakterystyka respondentów

Number of respondents		Number of respondents	Share %
Gender	Female	86	80.4
	Male	21	19.6
Age (years)	15 – 25	65	60.7
	26 – 35	20	18.7
	36 – 45	9	8.4
	over 45	13	12.2
Education	Elementary	4	3.7
	Secondary	42	39.3
	Higher	61	57.0
Place of residence	A city up to 10 thousand residents.	4	3.7
	A city of more than 10 thousand residents but less than 100 thousand residents	10	9.3
	A city with more than 50 thousand residents but less than 100 thousand residents	18	16.8
	A city with more than 100 thousand residents	56	52.3
	Rural area	19	17.8

Source: own study.

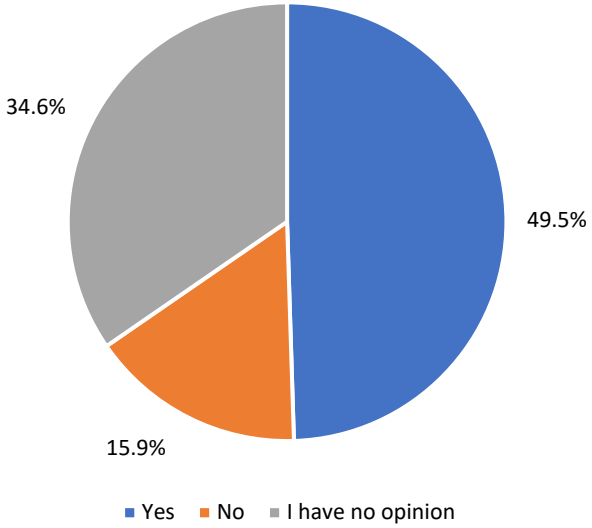
4. Results and Discussion

The survey asked the respondents about their familiarity with various stimulants. The most familiar substances were caffeine (106 persons, 99%), nicotine (100 persons, 93%), and Yerba mate (98 persons, 92%). The least familiar was theobromine (14 persons, 13%). The respondents were most likely to use caffeine (104 persons, 97.2%), tyramine (79 persons, 73.8%), and theobromine (66 persons, 61.7%). When asked about their consumption of other stimulants, they additionally mentioned pre-workout drugs and illegal substances. As many as 41.1% consumed stimulants, even several times a day, most often consumed before or during work (51 persons, 27.7%) and in the morning (38 persons, 20.7%).

The survey results on stimulant consumption, and the respondents' beliefs and habits offer an insight into how people make decisions about their health and daily habits. The educational level of the respondents is worth noting – the majority (57%) have a college degree, suggesting that this is a well--educated group and potentially more aware of the health effects of stimulants.

Caffeine, a widely available substance, is one of the most recognisable. As such, it is not surprising that declarations of daily caffeine consumption are at a high level. Other substances, such as tyramine and theobromine, are also popular, but their recognition among respondents appeared to be significantly lower. Evidence of the prevalence of stimulant consumption, especially among adolescents and students, was provided by a 2011 study conducted among 200 people in the Silesia and Malopolska provinces, which found that these substances are frequently consumed due to their unlimited availability and mode of action (Wanat and Woźniak-Holecka, 2011). Subsequently, a 2013 study among schoolchildren

(110 students aged 15.4±1.6 living in the Warsaw area) found that all the respondents consumed stimulants, and adverse effects were experienced by more than half of them (Wierzbicka et al., 2013).



The respondents' opinions on the harmfulness of stimulants in this study varied. More than half (53.5%) believed that stimulants were harmful to health and that they should limit the number of stimulants in their diet (Figure 1). It may be worrying that a significant proportion of the respondents (34.6%) had no opinion on the subject, suggesting that they lacked specific knowledge in this area.

Fig. 1. The respondents' answers about whether stimulants are harmful to health
Rys. 1. Odpowiedzi na pytania, czy substancje pobudzające są szkodliwe dla zdrowia

Source: own study.

Confirmation of the lack of basic information in this area was the response of most of the respondents (84.1%) about the need to spread knowledge about stimulants (Figure 2). They agreed on banning the sale of energisers to people under the age of 18 (66.3%) (Figure 3).

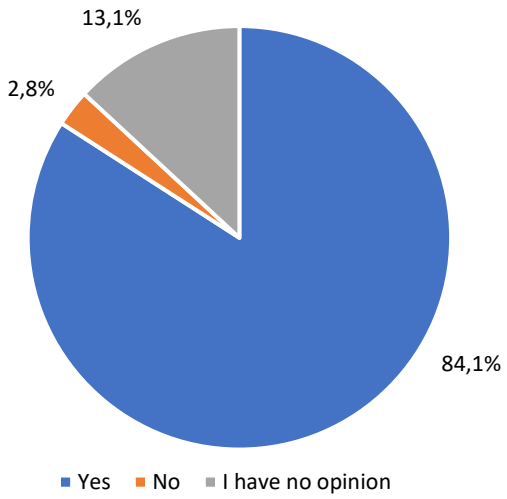


Fig. 2. The respondents' answers to whether they think education about stimulants should be more widespread in society
Rys. 2. Odpowiedzina pytanie, czy według nich edukacja na temat substancji pobudzających powinna być bardziej rozpowszechniona w społeczeństwie?

Source: own study.

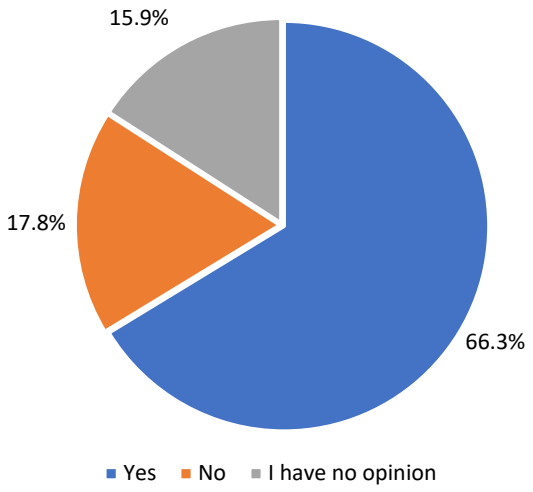


Fig. 3. Responses whether in their opinion, the sale of energisers to people under 18 should be banned in Poland
Rys. 3. Odpowiedzi respondentów, czy według nich w Polsce powinien zostać wprowadzony zakaz sprzedaży energetyków osobom poniżej 18. roku życia

Source: own study.

According to the respondents, the most frequently cited adverse effects brought about by stimulant consumption were anxiety and insomnia (93 votes, 19.3%), addiction (84 votes, 17.4%), hand/leg shaking (78 votes, 16.1%), concentration problems (68 votes, 14.1%) and increased a risk of

cardiovascular diseases – according to the respondents, there is a potential risk of such a disease (67 votes, 13.9%) (Figure 4).

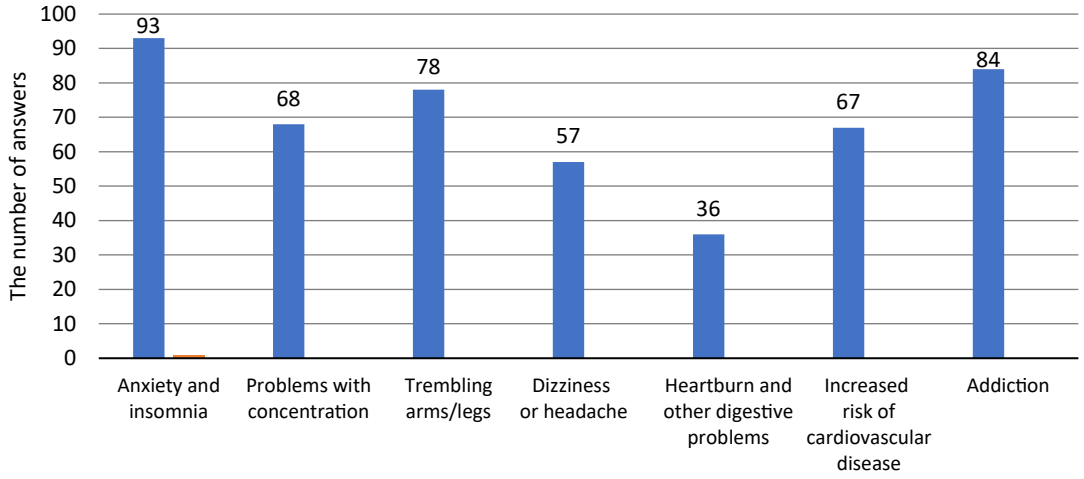


Fig. 4. Responses regarding the adverse effects experienced after consuming stimulants experienced by the respondents
Rys. 4. Odpowiedzi dotyczące znanych przez respondentów negatywnych skutków doświadczanych po spożyciu substancji pobudzających

Source: own study.

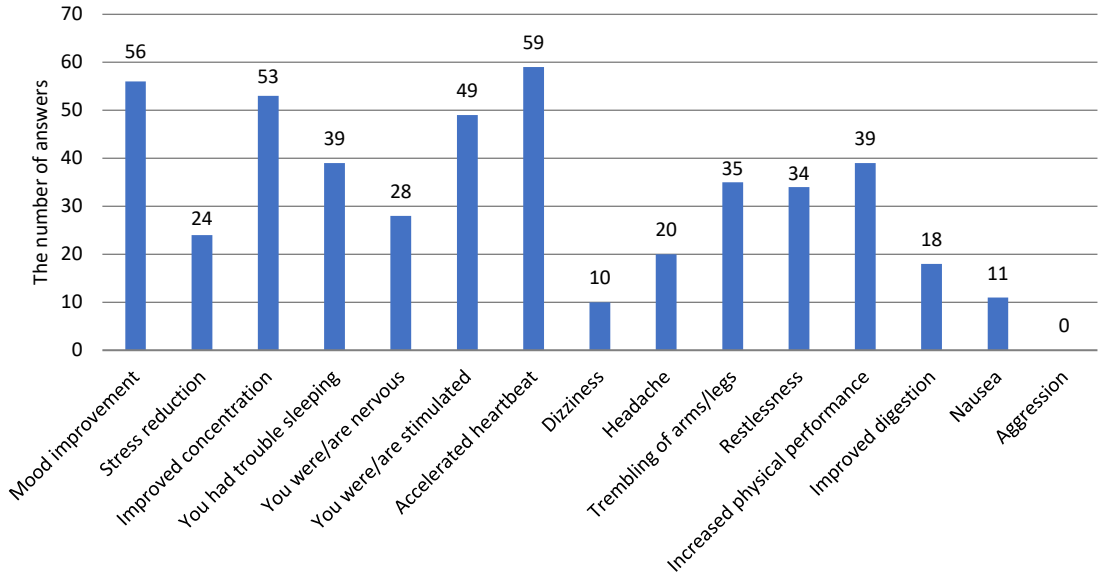


Fig. 5. Responses to the question: did you experience any of the following symptoms after consuming stimulants? (regarding the adverse effects experienced after consuming stimulants known by respondents)
Rys. 5. Odpowiedzi respondentów na pytanie: czy doświadczyłeś któregoś z poniższych objawów po spożyciu używek? (dotyczące znanych respondentom działań niepożądanych po spożyciu używek)

Source: own study.

The analysis of the data presented in Figures 4 and 5 on the effects of stimulants on health confirms that a significant number of the respondents have experienced adverse effects after consuming them. Typical responses were sleep problems, feelings of agitation, nervousness, accelerated heartbeat, anxiety, and aggression (Figure 5). These results indicate the need for careful consumption of these

substances and point out that there are real consequences associated with their excessive use. Similarly, a study conducted by Pawlas, Hołojda, and Brust (2017) found a high prevalence (54.7%) of adverse side effects after consuming stimulants among students at Wroclaw universities (1263 aged 18-28). In another study conducted in 2010 on a group of 138 adult women from Warsaw and the surrounding area, Wierzbicka, Gałkowska, and Brzozowska (2010) found that 14.5% of the respondents exceeded the safe intake of stimulants, i.e. caffeine taken mainly from coffee and tea, which increases the risk of adverse health effects.

It is also worth noting that in this study, almost half of the respondents (46.1%) considered the option of reducing the amount of stimulants consumed for health reasons. The opposite view was held by 40.4% of the respondents, and the possibility of this was indicated by 13.5%. Such an opinion may result from growing knowledge of these substances' effects on their health and suggests a desire to make more informed dietary choices.

According to the respondents, the main reason for limiting the consumption of stimulants was primarily "for health reasons" (85%), and to a small extent "for financial reasons" (11%), as well as "for social reasons" (1%), or other (1%), i.e. that one can become addicted.

A significant proportion of respondents turned to the Internet for information on stimulants (94 persons), followed by information from friends/parents (37), books/scientific publications (34), and doctors and specialists (27 people). Only nine indicated that they obtained this information from school, and six did not reach for it. Searching for information nowadays has become quick and easy, yet one has to wonder if everyone who searches for information on a given topic in the Internet uses verified sites, journals, or publications. This question becomes especially important when it comes to one's health.

The survey shows that most of the respondents used the Internet just to obtain information on a particular stimulant, which may involve incomplete and unreliable knowledge.

The cited studies showed that over several years, stimulants were consumed in large quantities, and adverse effects were often felt after their consumption. These findings can help with creating educational and regulatory actions that support healthy eating habits and promote a conscious approach to the consumption of stimulants. In addition, it is necessary to continuously monitor information on stimulant consumption and people's beliefs and habits.

From verification of several hypotheses made using the chi-square correlation test regarding the influence of age and gender on assessing the harmfulness of stimulants, the results indicated that no significant relations were found. Below are presented some results proving such hypothesis regarding:

- women's and men's age and place of residence, and the effect on the assessment of the harmfulness of stimulants (chi-square statistic value: 3.872341, the critical value read from the chi-square table at the 0.05 significance level: 12.5916; 6.076923 versus 12.5916, and 9.04853 versus 15.5073),
- women's and men's age and place of residence regarding the assessment of whether education about stimulants should be more widespread in society (3.882352941 versus 12.5916; 3.882352941 versus 12.5916, and 6.925338 versus 15.5073).

5. Conclusion

The hypothesis was proved that the regular consumption of natural stimulants in appropriate doses can positively affect human health. Its validity is supported by the mechanism of action of caffeine, which stimulates the central nervous system, improving concentration and mood and increasing energy. Caffeine speeds up metabolism and reduces the risk of chronic diseases such as diabetes and heart disease.

The survey conducted for this study showed that a significant proportion of the respondents consumed stimulants up to several times a day (41.1%) and that they experienced adverse effects after consuming them. The frequent consumption of these substances is due to the high availability and variety of products on the market. It should be noted that respondents who felt that they should reduce the amount of stimulants consumed (46.1%) were directed by health reasons (85%) rather than financial reasons (11%). Thus, the price was not entirely crucial for the respondents, but rather how much the products they consumed were affordable.

The majority of the respondents (84.1%) pointed to the need for more education regarding stimulants, indicating that the information they gained from the Internet regarding both the effects and safe doses of consumption of a given substance was far from sufficient. Therefore, it is essential to promote the dissemination of knowledge regarding both the effects and safe doses of consumption of a given substance.

The ingestion of stimulants used to be reserved for the upper strata of society, but over time it has become commonplace and, despite their high prices, is an everyday companion for many people. However, one is constantly following the latest information about them, paying particular attention to the health issues. Scientists are divided as to whether consuming four cups of coffee a day is still acceptable in terms of good health. The values remain a contentious issue that will surely provide a point for discussion for generations to come.

References

Adelusi, A. A., Ogunwolu, Q. A., Ugwu, C. A., Alli, M. A., Adesanya, K. A., Agboola-Adedoja, M. O., and Akinpelu, M. O. (2020). Kolanut Consumption, Its Benefits and Side Effects. *World Journal of Advanced Research and Reviews*, *8*(3), 356-362. https://doi.org/10.30574/wjarr.2020.8.3.0483

Babik, K. (2020). Kofeina – pomaga czy szkodzi? *Journal of NutriLife*, (4). Retrieved February 1, 2024 from http://www.NutriLife.pl/index.php?art=342

Balawejder-Biśto, A., and Pyka-Pająk, A. (2022). Kofeina – substancja znana czy poznawana? *Farmakognozja*, Polska Platforma Medyczna, Repozytorium Śląskiego Uniwersytetu Medycznego w Katowicach.

Baran, J., and Kubit, P. (2023). Kawa i jej prozdrowotne właściwości. *Herbalism*, *1*(7), 19-30. https://doi.org/10.12775/HERB.2021.002

Barczak, A. (2021). Rola kawy w zapobieganiu otępieniu. *Psychiatria i Psychologia Kliniczna* (*Journal of Psychiatry & Clinical Psychology*), *21*(2), 10-15.

Burns, C., and Kidron, A. (2020). *Biochemistry, tyramine*. Retrieved February 1, 2024 from https://europepmc.org/article/NBK/nbk563197

Detlaff, G., Samaszko-Fiertek, J., Madaj, J., and Dmochowska, B. (2020). Kofeina: właściwości i przykłady wykorzystania. *Wiadomości Chemiczne*, *74*(7-8), 527-543.

Dziewiecka, H., Kasperska, A., and Zembroń-Łacny, A. (2010). Zastosowanie związków siarkowych w sporcie, biotyna, tyramina i tauryna. *Medycyna Sportowa*, *26*, *1*(6), 11-18.

Evans, J., Richards, J. R., Amanda, S., and Battisti, A. S. (2023). Caffeine. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, 2024 Jan. https://www.ncbi.nlm.nih.gov/books/NBK519490/

Gambero, A., and Ribeiro, M. L. (2015). The Positive Effects of Yerba Maté (Ilex paraguariensis) in Obesity. *Nutrients*, *7*(2), 730-750.

Grodzka, A., Kużaj, W., Zielińska-Pisklak, M., Szeleszczuk, Ł., and Sobczak, M. (2021). Kofeina i inne substancje aktywne farmakologicznie zawarte w ziarnach kawowca. *Prospects in Pharmaceutical Sciences*, *19*(1), 1-8. https://doi.org/10.56782/pps.11.

Grudzińska, M. (2023). *Tyramina – gdzie się znajduje, jak działa i kiedy szkodzi?* Retrieved February 1, 2024 from https://portal.abczdrowie.pl/tyramina-gdzie-sie-znajduje-jak-dziala-i-kiedy-szkodzi

Kumar, V., Kaur, J., Panghal, A., Kaur, S., and Handa, V. (2018). Caffeine: a Boon or Bane. *Nutrition & Food Science*, *48*(1), 61-75. https://doi.org/10.1108/NFS-05-2017-0100

Lipton, R. B., Diener, H. C., Robbins, M. S., Garas, S. Y., and Patel, K. (2017). Caffeine in the Management of Patients with Headaches. *The Journal of Headache and Pain*, *18*(1), 1-11.

Lutomski, P., Goździewska, M., and Florek-Łuszczki, M. (2020). Health Properties of Yerba Mate. *Annals of Agricultural and Environmental Medicine*, *19*, *27*(2), 310-313. https://doi.org/10.26444/aaem/119994

Matysek-Nawrocka, M., and Cyrankiewicz, P. (2016). Substancje biologicznie aktywne pozyskiwane z herbaty, kawy i kakao oraz ich zastosowanie w kosmetykach. *Postępy Fitoterapii*, *17*(2), 139-144.

Pawlas, K., Hołojda, P., and Brust, K. (2017). Ocena spożycia napojów energetycznych oraz ich wpływu na zdrowie człowieka na podstawie badania wśród studentów wrocławskich uczelni. *Medycyna Środowiskowa-Environmental Medicine*, *2*(20), 39-45.

Piekarska-Radzik, L., and Klewicka, E. (2020). Wpływ preparatu z jagód acai (Euterpe oleracea) na właściwości powierzchniowe, autoagregację i tworzenie biofilmu przez bakterie z rodzaju Lactobacillus. *Żywność Nauka Technologia Jakość*, *27*(1), 96-110. https://doi.org/10.15193/zntj/2020/122/325

Qi, H., and Li, S. (2014). Dose-response Meta-analysis on Coffee, Tea and Caffeine Consumption with Risk of Parkinson's Disease. *Geriatr Gerontol Int.*, *14*(2), 430-439. https://doi.org/10.1111/ggi.12123

Rodak, K., Kokot, I., and Kratz, E. M. (2021). Caffeine as a Factor Influencing the Functioning of the Human Body-Friend or Foe? *Nutrients*, *13*(9), 3088. https://doi.org/10.3390/nu13093088.

Rosa, N. (2022). Kofeina w ciąży. Czy jest bezpieczna i w jakich ilościach? Retrieved April 1, 2024 from https://dietetycy.org.pl/kofeina-w-ciazy/

Sadowski, M. (2024). *Kofeina – wszystko, co powinniście o niej wiedzieć*. https://dietetycy.org.pl/kofeina/

Schimpl, F. C., da Silva, J. F., de Carvalho Gonçalves, J. F., and Mazzafera, P. (2013). Guarana: Revisiting a Highly Caffeinated Plant from the Amazon. *Journal of Ethnopharmacology*, *150*(1), 14-31.

Scientific Opinion on the Safety of Caffeine. (2015). *EFSA Journal*, *13*(5), 4102. https://doi.org/10.2903/j.efsa.2015.4102

Sikorska, J. (2020). *Kofeina a metabolizm*. Retrieved February 1, 2024 fromhttps://www.herreria.pl/pl/n/15

Siwek, R., Witkowska-Banaszczak, E., and Szamański, M. (2013). Kofeina w lekach i suplementach diety – znaczenie w lecznictwie. *Farmacja Polska*, *69*(7), 541-549.

Słowińska, M. (2019). Wykorzystanie testu chi-kwadrat w badaniach preferencji żywieniowych konsumentów. *Nauki Inżynierskie i Technologie (Engineering Sciences and Technologies)*, *1*(32), 24-38. https://doi.org/10.15611/nit.2019.1.02

Stańczak, A., and Lewgowd, W. (2021). Środki wspierające poprawę funkcji poznawczych–co powinniśmy o nich wiedzieć. *Uniwersytet Medyczny w Łodzi*, *77*(4), 201-219.

Surma, S., Romańczyk, M., Fojcik, J., and Krzystanek, M. (2020). Kawa – lekarstwo, używka i narkotyk. *Psychiatria*, *17*(4), 237-246. https://doi.org/10.5603/PSYCH.a2020.0031

Walczyński, P. (2019). *Kawa – wpływ na zdrowie i funkcje mentalne.* Retrieved February 1, 2024 from https://www.solvelabs.eu/blog/31_kawa-wplyw-na-zdrowie-i-funkcje-mentalne.html

Wanat, G., and Woźniak-Holecka, J. (2011). Ocena konsumpcji produktów zawierających kofeinę wśród młodzieży akademickiej i licealnej. *Problemy Higieny i Epidemiologii*, *92*(3), 695-699.

Wierzbicka, E., Brzozowska, A., and Dróżdż, K. (2013). Ocena ryzyka nadmiernego pobrania kofeiny z dietą w wybranej grupie młodzieży szkolnej. *Problemy Higieny i Epidemiologii*, *94*(4), 820-824.

Wierzbicka, E., Gałkowska, K., and Brzozowska, A. (2010). Ocena spożycia kofeiny z całodzienną racją pokarmową w wybranej grupie dorosłych kobiet. *Problemy Higieny Epidemiol*ogii, *91*(4), 564-571.

Wierzejska, R. (2012). Kofeina – powszechny składnik diety i jej wpływ na zdrowie. *Roczniki Państwowego Zakładu Higieny*, *63*(2), 141-147.

Wierzejska, R. (2020). *Kawa i zielona herbata a karmienie piersią*. Retrieved February 1, 2024 from https://ncez.pzh.gov.pl/ciaza-i-macierzynstwo/kawa-i-zielona-herbata-a-karmienie-piersia/

Xiangyu Zhou, X., and Zhang, L. (2021). The Neuroprotective Effects of Moderate and Regular Caffeine Consumption in Alzheimer's Disease. *Oxid Med Cell Longev*.: 5568011. https://doi.org/10.1155/2021/5568011.

Wybrane naturalne substancje pobudzające w żywności i ich wpływ na zdrowie człowieka

Streszczenie: W pracy omówiono poszczególne substancje pobudzające występujące w żywności oraz powszechność i wiedzę społeczeństwa na temat ich wpływu na zdrowie. Celem pracy było zidentyfikowanie wpływu spożywania wybranych naturalnych substancji pobudzających na zdrowie człowieka. Badania ankietowe przeprowadzono *online* w 2023 roku, w oparciu o autorki kwestionariusz, wśród osób o różnym wieku i wykształceniu. Stwierdzono, że substancje pobudzające są powszechnie stosowane przez respondentów ankiety. Znaczna część ankietowanych spożywała substancje pobudzające nawet kilka razy dziennie (41,1%). Ankietowani zdawali sobie jednak sprawę z negatywnych skutków spożycia tych substancji i wyrazili chęć ograniczenia ich spożycia (46,1%). Aż 84.1% respondentów wskazało na konieczność większej edukacji na ten temat, zaznaczając, że informacje, które pozyskiwali z Internetu, dotyczące zarówno działania, jak i bezpiecznych dawek spożycia danej substancji, były daleko niewystarczające.

Słowa kluczowe: kofeina, zdrowie, żywność