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Use of energy drinks and their impact on the body based on the view of student population

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Abstract

In recent years, studies have often been devoted to the frequent on frequency, motives and consequences of consuming energy drinks by the student population at universities. These studies have been common in many countries. The aim of this study was to identify the patterns of energy drink consumption among college students of the Serbian University of Belgrade and to understand the attitudes, motives and consequences of consuming these beverages. The result of this study indicates that energy drink consumption is a common practice among Serbian university students (72.0% use energy drinks and 1.1% consume them regularly). Out of the total number of surveyed students 12.9% consumed energy drinks with alcohol. The most frequent negative effects in students who had used energy drinks were: weight gain (24.2%), headaches (2.6%), thirst (18.9%) and hunger (11.6%). Many of the students surveyed (62.0%) cited that their main motive for using energy drinks was improving their academic capabilities, commonly used as a way to study longer and improve mental focus. But, 10.5% of the surveyed students felt the effect of increased concentration after using energy drinks. This indicated the students' confusion and disagreement between their motives for using energy drinks and the effects achieved. A large number of surveyed students (85.3%) did not

check the composition of energy drinks before consumption. The results show that students need education in this regard. This research is part of a study called "Attitudes and Behavior of Students in relation to Food and Nutrition" and is a form of preventive action to combat the widespread use of energy drinks in the student population.

Key words: energy drinks; college students; motivation; effects; nutrition; anonymous survey.

INTRODUCTION

There is no agreed definition in the regulatory framework for the products referred to as "stimulant" or "energy" drinks. These drinks are usually defined as "beverages, which typically contain caffeine, taurine and vitamin(s), and may contain an energy source (e.g. carbohydrate), and/or other substance(s), marketed for the specific purpose of providing real or perceived enhanced physiological and/or performance effects" [1]. Energy drinks are one of the most commonly used functional beverages among commercially available non-alcoholic beverages [2]. High concentrations of caffeine with a distinctive taste and color, as well as attractive packaging and advanced marketing, have contributed to making energy drinks a mass-produced

product across the globe. These drinks often provide a sense of refreshment, good taste and high energy. Energy drinks are often consumed by athletes, adolescents and college students in large quantities [2]. In most countries, minors are not prohibited from consuming them [3], and there are no specific prohibitions in this regard in Serbia either.

The content of energy drinks varies by brand and type, and it may include: water, caffeine, taurine, glucuronolactone, B-group vitamins, glucose, sucrose, inositol, guarana essence, ginseng, ginkgo biloba and carnitine [1,4-6]. Research indicates that the synergistic effect on the body of all energy drink constituents is greater than the effect of each one individually [7,8]. There are conflicting opinions as to whether the

effect of the constituents of energy drinks is desirable to the body or not. Namely, some studies point out that, thanks to these ingredients, energy drinks improve physical and mental stamina, concentration, ability to perceive, as well as the level of caution and vigilance, and contribute to a faster recovery from demanding physical activities [8,9]. On the other hand, it highlights possible toxicity and concern for potentially serious adverse effects associated with the use of energy drinks, such as insomnia, gastrointestinal disorders, chest pain, palpitations, seizures, headaches, sexual dysfunctions and feelings of "distress" [10,11]. In the last decade, many publications have addressed the study of caffeine and sugar intake as the two biggest risks when consuming energy drinks. Energy drinks typically contain large amounts of caffeine [1]. Caffeine is found in almost all commercially available energy drinks at a concentration of about 11-90 µg/ml [12]. Caffeine is a methylxanthine class alkaloid and is naturally present in many plants (leaves, seeds, fruits) [13], and can be found in chocolate and dietary supplements [1]. The daily intake of caffeine, which is of no concern as for the occurrence of adverse effects, varies from individual to individual, but for most people it is up to 200 mg/day [14]. Caffeine is a stimulant and in large quantities it can cause palpitations (strong throbbing) of the heart, as well as nervousness, irritability and insomnia [14]. Heckman *et al* [15] point out that caffeine intake can be harmful in pregnancy (it can increase the risk of fetal damage and decrease fertility). In addition, it can lead to liver and kidney problems [2]. However, there are conflicting opinions as to whether caffeine increases the risk of cardiovascular disease, as well as the risk of diabetes type 2 [15]. On the other hand, it has been proven that caffeine increases resting energy consumption (by promoting fat lipolysis), increases endurance and improves performance, increases "mental energy" and directly supports the central nervous system [16], increases cognitive brain functioning [17], delays fatigue [18], increases energy efficiency, and reduces the level of effort during training [19]. In addition, it has been proven that caffeine plays a role in the prevention of sunlight-induced skin cancer [20], as well as in helping people lose weight [21].

Many studies highlight the sugar content of energy drinks, where obesity and the risk of type 2 diabetes are the biggest problems [22]. On average, energy drinks contain 10 g of sugar/100 ml [2].

The combination of energy drinks with alcohol is a new "trend" that has been spreading rapidly among adolescents and college students in recent years [23-26]. Studies with American (26%) [27] and Italian (48.4%) [28] students show a high prevalence of consuming energy drinks with alcohol. This drink combi-

nation reduces the feeling of drowsiness and increases the feeling of pleasure. But, this combination of drinking can also cause serious problems, such as body dehydration that is caused by alcohol consumption and is enhanced by the effects of caffeine [23]. Then, the dehydrating effect of caffeine prevents the body's ability to metabolize ethanol. It increases alcohol toxicity as well as adrenaline release [29].

Considering both the frequency of the consumption of energy drinks in the student population (for example, 54% of US students) [27] and the large number of disorders resulting from such behavior (in terms of metabolic and health problems, as well as unacceptable social behavior and psychiatric problems), in recent years research has often been done on the frequency and consequences of consuming energy drinks in the student population [6,23-30]. In the literature available to us, there is no data on the frequency, motives and consequences of consumption of energy drinks at the faculties of the Serbian University of Belgrade. The aim of this study was (1) to identify patterns of energy drink consumption among college students of the Institute of Food Technology and Biochemistry, on Faculty of Agriculture, University of Belgrade and (2) to understand the attitudes, motives and consequences of consuming these beverages.

PARTICIPANTS AND METHODS

The study was conducted using anonymous questionnaires. The survey was voluntarily done by 264 students of the bachelor studies at the Institute of Food Technology and Biochemistry, Faculty of Agriculture, University of Belgrade (174 female and 90 male subjects). The surveyed students were selected randomly; all students had an equal chance of being selected for the sample. This study was conducted according to the guidelines laid in the General Regulation on Data Protection of the European Union. This research is a part of a broader study titled "Attitudes and behavior of students in relation to food and nutrition" conducted among students of the Faculty of Agriculture, University of Belgrade, on the subject of "Food Biochemistry".

Descriptive statistics methods were used to process and analyze the data. Version 8.0 software (StatSoft Co., Tulsa, Oklahoma, USA) was used for statistical processing of the results.

RESULTS

The study sample included 264 students of the second year of bachelor studies, between the ages of 20 and 23 (the average age was 21.78 ± 1.3) and all were of Serbian nationality. The sample was composed of 174 females (65.9%) and 90 males (34.1%). Most students are housed in a dorm (86.8%) and most respondents usually study by day (81.8%). 20.5% of the respondents are athletes and actively involved in sports. 11.4% of the students used cigarettes and 18.9% alcohol, 72.0% of the surveyed students consumed energy drinks (**Table 1**).

Table 1. Participants' socio-demographic characteristics and individual habits of energy drink users (N = 264).

Characteristics	n	%
Gender		
Male	90	34.1
Female	174	65.9
Age groups (average age - 21.78 ± 1.3)		
21-23	264	100
Physical activity status		
athlete	54	20.5
not athlete	210	79.5
Class status		
2 nd year	264	100
Usual study time		
Day	216	81.8
Night	48	18.2
Nationality		
Serbian	264	100
Consuming energy drinks		
No	74	28.0
Yes	190	72.0
Accommodation		
Dorm	229	86.8
At home with family	32	12.1
Living with a friend	3	1.1
Cigarette use		
No	202	76.5
Yes	30	11.4
Quit	32	12.1
Alcohol use		
No	205	77.7
Yes	50	18.9
Quit	9	3.4

A large number of students (89.0%) responded that they most often drink water when they are thirsty (**Figure 1**). While 28.0% of students have not consumed

Figure 1. Results of the interviewed students' answers to questions related to their energy drink habits.

energy drinks, 62.9% consume them occasionally, 8.0% 2-3 times a week, and only 1.1% consume energy drinks every day. Their motives for consuming energy drinks were different. Most of the respondents linked consuming energy drinks with obligations at the faculty. So, their basic motives for consuming energy drinks were to improve their concentration in class (35.8%) and spend a longer period of time learning (15.1%) (**Table 2**). A significant number of students responded that their motive for consuming energy drinks was to improve their mental focus (11.1%) and athletic performance (10.6%), as well as endurance with longer periods of exercise (10.6%). Few students cited a reason for using energy drinks for better sleep (2.1%), to have less need for sleep (1.1%), a good feeling overall (1.6%), feeling less restless (1.6%), or long-term driving (3.2%) (**Table 2**). The students surveyed most often consume Guarana (31.1%) from the array of energy drinks offered in the Serbian market (**Figure 2**).

Figure 2. Results of the interviewed students' answers to questions related to the consumption of certain energy drink brands and their views on the consumption of energy drinks.

Table 2. The most common reasons/motivations for consuming/not consuming energy drinks.

Offered reasons	Consuming energy drinks (N=190)*	
	n	%
Concentrate in class	68	35.8
Study longer	30	15.1
Improve mental focus	21	11.1
Feel good	3	1.6
Feeling less restless	3	1.6
Less need for sleep	2	1.1
Better sleep	4	2.1
Needed more energy	6	3.2
Exercise longer	22	11.6
Improve athletic performance	22	11.6
Drive for a long period of time	6	3.2
Prolong the effects of alcohol	-	-
Lose weight	-	-
Being more involved in circle of friends	3	1.6
Addicted	-	-
Curiosity	-	-
Motivation	Not consuming energy drinks (N=74)**	
	n	%
Can be harmful to health	40	54.1
Can create dependency	9	12.1
Can lead to obesity	7	9.5
Can lead to poor sleep	6	8.1
Expensive	10	13.5
No interest	2	2.7

*Only responses from students consuming energy drinks were considered.

**Only responses from students who do not consume energy drinks were considered.

The desired effects felt by students after consuming energy drinks are feeling more energetic (34.2%) and happier (20.5%), as well as less sleepy (13.1%) and having increased concentration (10.5%). In addition, fewer students responded that after using energy drinks, they felt more endurance in training (4.7%) and over a longer driving period (5.8%). Desired effects were not felt by 11.1% of students (**Table 3**).

Table 3. The most common effects among students who use energy drinks (N=190)*.

Effects	Consuming energy drinks	
	n	%
Desired effects		
More energetic	65	34.2
Less sleepy	25	13.1
More happy	39	20.5
Increased concentration	20	10.5
Higher endurance in training	9	4.7
Longer driving period	11	5.8
Not felt desired effect	21	11.1
Unwanted effects		
Palpitations	9	4.7
Sleeplessness	7	3.7
Headache	5	2.6
Thirst	36	18.9
Hunger	22	11.6
Vertigo	11	5.8
Weight gain	46	24.2
Not felt unwanted effect	54	28.4

*Only responses from students consuming energy drinks were considered.

A large number of respondents (84.9%) believe that energy drinks mixed with alcohol are popular among adolescents (very often – 41.0% and sometimes – 43.9%). The level of students using energy drinks and mixing these with alcohol was 12.9%, while 61.0% of respondents replied that they consumed either one or the other (**Figure 1**). Students find it very difficult to quit cigarettes (67.1%), then alcohol (25.0%), and then fizzy (4.9%) and energy (3.0%) drinks (**Figure 2**).

Among the reasons cited by those not using energy drinks were: fears they may be harmful to health (54.1%), can create dependency (12.1%), can lead to obesity (9.5%), can lead to poor sleep (8.1%), they considered the drinks expensive (13.5%), or they just weren't interested (2.7%) (**Table 2**).

A significant number of students (14.7%) do not feel satiated after consuming an energy drink, while 21.1% think that an energy drink can replace their meal (**Figure 1**). Most of the students surveyed responded that energy drinks (83.0%) have the most sugar compared to the other two answers offered: fruit juice (14.0%) and alcohol drink (3.0%). Almost all students (98.1%) are aware that caffeine is contained in energy drinks,

and 33.0% said that 11-100 µg of caffeine is in 1 ml of energy drinks (**Figure 3**).

Figure 3. Results of the interviewed students' answers to questions related to their basic knowledge of the content of individual components in energy drinks.

The students answered to a group of questions that were related to possible side effects and the occurrence of metabolic problems. They considered that the overuse of energy drinks can lead to sterility (28.0%), irregular heartbeat (64.0%), hypertension (20.1%), diabetes (6.8%), obesity (3.0%), tachycardia (2.3%), insomnia (2.3%) and disorders of the cardiovascular and nervous system (89.0%). The students pointed out that the occurrence of most of these problems depends on the amount of energy drinks consumed, except for obesity, which a large number of students (73.1%) thought appears regardless of the amount of energy drinks consumed (**Figure 4**). Students surveyed would not, in the vast majority (66.0%), support the ban on the use of energy drinks, since they believe that they are not harmful to health in small quantities (58.0%) (**Figure 2**).

Figure 4. Results of the interviewed students' answers to questions related to their knowledge about the harmful effects of energy drinks on the body.

The most frequent negative effects found in students who had used energy drinks were: weight gain (24.2%), thirst (18.9%), hunger (11.6%), vertigo (5.8%), palpitations (4.7%), sleeplessness (3.7%) and headache

(2.6%). Unwanted effects were not felt by 28.4% of students (**Table 3**).

DISCUSSION

Our study revealed that 72.0% of the Serbian surveyed students used energy drinks, while 1.1% used them regularly (every day). The results of this study indicate that energy drink consumption is a common practice among Serbian university students. Studies in other countries show less use of energy drinks by students. Namely, in a study of university students in Turkey, 46.5% used energy drinks at least once [30]. In another study of university students in the United States, 54% were reported as having used energy drinks [27], or 56.9% college students in Italy [28]. However, Serbian students are less likely to drink energy drinks mixed with alcohol (13%) than college students in other countries. Studies with American (26%) [27] and Italian (48.4%) [28] students show a greater consumption of energy drinks with alcohol.

For Serbian college students the motivations for their use of energy drinks were similar to that documented in studies from other countries. In the survey, the most commonly cited reason for using energy drinks was their desire to concentrate better in class, study longer, exercise longer and improve athletic performance and mental focus (**Table 2**). For example, Oglesby *et al.* [29] pointed out the reasons for using energy drinks by students from a private university in the southwestern United States. These reasons were: studying longer (34%), concentrating when studying (32%), concentrating in class (11.5%) and improving mental focus (19.8%). In his study, Bulut *et al.* [30] noted that most students at a university in Turkey cited an increase in physical performance (34.5%) as a reason for using energy drinks. For most American students, the main reason for using energy drinks is feeling more energetic (57.0%) [29]. This was not the most common reason for Serbian students (**Table 2**). But, most of the students surveyed just cited the feeling of having more energy as one of the effects of using energy drinks (**Table 3**). Nonetheless, the results of this study showed that for most students, the main reason for using energy drinks was to increase their learning ability. But, in fact, only 20 students of the 190 students felt the effects of increased concentration after using energy drinks (**Table 3**). Such results indicated the students' confusion and disagreement between their motives for using energy drinks and the effects achieved. This may explain the high level of experimentation with energy drinks and college students in recent years.

Although a large number of students thought that consuming energy drinks mixed with alcohol was a very common occurrence among university students, (**Figure 1**) in fact, this was done only by 12.9% of the

total surveyed students. If this result is compared with research at universities in other countries, this is not a worrying percentage. Namely, studies with American (26%) [27] and Italian (48.4%) [28] students show a much high prevalence of consuming energy drinks mixed with alcohol. It is very important to be aware of the frequency of consumption of energy drinks and alcohol since literature data suggest that consumption of energy drinks mixed with alcohol is associated with smoking, illicit prescription use, and stimulant drug use (e.g. amphetamine) [2,22,27,30].

A worrying result of this study may be the low level of student interest in the composition and content of individual components in energy drinks. Namely, less than 30 students from 190 students became interested in the composition of energy drinks. A large number of students knew that caffeine was present in energy drinks, but only a third of respondents knew the exact range of the usual caffeine content (11-90 µg/ml; [12]) in energy drinks (**Figure 3**). This result indicates that students need education in this regard.

Students have shown knowledge of the unwanted metabolic effects that can occur as a result of using energy drinks. That is what can be worrying for a lot of students who use energy drinks despite being aware of the possible occurrence of numerous health problems. Some of these unwanted effects were felt, such as: palpitations, sleeplessness, headaches, thirst, hunger, vertigo and weight gain. Most of these side effects have also been reported by students from other countries [30]. In this study, the majority of students reported weight gain as a side effect of consuming energy drinks. This is in line with the feeling of hunger after using energy drinks. Given the high sugar content of energy drinks [2,22], such results were expected.

CONCLUSIONS

Energy drink consumption is a common practice among Serbian students. Many college students claimed to use energy drinks as a way of improving their academic capabilities, commonly as a way to study longer and improve athletic performance, but a small number of surveyed students achieved these effects. Such results indicated the students' confusion and disagreement between their motives for using energy drinks and the effects achieved. The level of student interest in the composition and content of individual components in energy drinks is low. A large number of students thought that consuming energy drinks mixed with alcohol was a trend among university students. This kind of thinking should suggest caution, because it can lead to a significant increase in the number of students consuming energy drinks with alcohol. After consuming energy drinks, students felt the usual unwanted effects, and particularly empha-

sized weight gain. The results of this study show that students need education in this regard. Generally, this research may help us better understand patterns of energy drinks consumption in college students' population.

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Stavovi studentske populacije o upotrebi energetske napitake i njihovom uticaju na organizam

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Kratak sadržaj

Poslednjih godina studije su često posvećene učestalosti, motivima i posledicama konzumiranja energetske pića od strane studentske populacije. Ove studije su uobičajene u mnogim zemljama. Cilj ove studije bio je da identifikuje obrasce potrošnje energetske pića među studentima Univerziteta u Beogradu i da objasni stavove, motive i posledice konzumiranja ovih pića. Rezultat ove studije ukazuje na to da je potrošnja energetske pića

uobičajena praksa među srpskim studentima (72.0% koristi energetska pića, a 1.1% ih redovno konzumira). Od ukupnog broja anketiranih studenata 12.9% je konzumiralo energetska pića sa alkoholom. Najčešći negativni efekti kod studenata koji su koristili energetska pića bili su: debljanje (24.2%), glavobolja (2.6%), žeđ (18.9%) i glad (11.6%). Mnogi anketirani studenti (62.0%) naveli su da je glavni motiv za korišćenje energetske pića poboljšanje njihovih akademskih sposobnosti, odnosno, kao podstrek za duže učenje i poboljšanje mentalnog fokusa. Ali, samo 10.5% anketiranih studenata osetilo je efekat povećane koncentracije nakon upotrebe energetske pića. Ovo je ukazalo na zbunjenost i neslaganje između motiva studenata za korišćenje energetske pića i postignutih efekata. Veliki broj anketiranih učenika (85.3%), nije proveo sastav energetske pića pre konzumiranja. Rezultati pokazuju da je učenicima potrebna edukacija u ovom pogledu. Ovo istraživanje je deo studije pod nazivom „Stavovi i ponašanje učenika u odnosu na hranu i ishranu“ i predstavlja oblik preventivne akcije u borbi protiv široke upotrebe energetske pića u studentskoj populaciji.

Ključne reči: energetska pića; studenti; motivacija; efekti; ishrana; anonimna anketa.