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Review Article

Effect of Energy Drinks Consumption on Physical Performance Beneficial and Adverse Impact on Health

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Abstract: Consumption of energy drinks has been increasing dramatically in the last two decades, particularly amongst adolescents and young adults. Energy drinks are aggressively marketed with the claim that these products give an energy boost to improve physical and cognitive performance. Energy drinks have several adverse health effects. The prevalence of Energy Drinks usage in this group ranges from 52% to 68%, whilst in adults is estimated at 32%. The compositions of energy drinks vary widely. Caffeine content can range from 75 to 240 mg, whereas the average taurine quantity is 342.28 mg/100 mL. Caffeine and taurine in doses 3–6 mg/kg and 1–6 g, respectively, appear to be the main ergogenic elements. It is concluded that although energy drink may have beneficial and adverse effects on physical performance, these products also have possible detrimental health consequences. Energy-drink usage is higher among males and those with higher monthly expenditure. A high proportion of students are ignorant to the main constituents and side effect of energy drinks.

Keywords: Energy drinks (EDs), Consumption pattern, Composition, Health effects, prevalence.

INTRODUCTION

Energy drinks belong to a class of products, in liquid form, that typically contain caffeine, with or without other added dietary supplements. The term “energy drinks” refers to beverages that contain caffeine in combination with other ingredients such as Taurine, guarana, and B vitamins, The first energy drink appeared in the U.S. in 1949 and was marketed as "Dr. Enuf" [1]. The energy drink market has grown dramatically, with various brands released worldwide. The annual consumption of energy drinks in 2013 exceeded 5.8 billion liters in around 160 countries [2]. These drinks have been popularized as health drinks among many population groups such as athletes and college going students. EDs, the non-alcoholic functional beverages comprise caffeine, guarana, glucuronolactone, taurine, ginseng, inositol, carnitine, B-complex vitamins (riboflavin, niacin, B5, B6, and B12), etc. as chief components and mainly act as stimulants [3]. These sweetened drinks are generally served cold and generally contain high levels of caffeine, which based on dosage has been known to be beneficial as well as harmful [4].

Energy drinks have become available everywhere, their manufacturers say that, in addition to providing a boost in energy, the drinks promote wellness through medicinal properties (they usually contain vitamins and/or ingredients like ginseng, guarana, and Taurine). Whatever their intended use and purported benefits, consumers today consume energy drinks for a variety of reasons: to boost energy, keep awake at night, relief stress and other causes [5].

Energy drinks drive their properties chiefly from sugar and caffeine. Caffeine in energy drinks will provide the consumer the desirable effects of increased alertness, improved memory, and enhanced mood [6]. Caffeine can have harmful physical consequences, including central nervous system, cardiovascular, gastrointestinal, and renal dysfunction [7]. Energy drinks contain between 14 and 31 mg of caffeine per 100 ml. Although their caffeine concentration (in milligrams per milliliter) may be similar to coffee, energy drinks are often packaged in significantly higher volumes, resulting in increased caffeine intake [8].

In 2013, a study conducted in 16 European countries (n = 52,016) recorded a 68% lifetime prevalence of Energy Drinks use among adolescents (aged 10–18 years old). Among the declared users, 12% were "high chronic" consumers with an average consumption of 7 liters per month. In adults, the prevalence of consumption was 30%, and it 18% in children (aged 6–10 years old) [9]. In 2014, similar results were observed in Canada (n = 8210), where 62% of adolescents reported consuming Energy Drinks at least once in the previous year Likewise, in 2019, Galimov and colleagues [10] (n = 6902) reported that 61.7% of German adolescents between 9–19 years of age had used Energy Drinks at least once [11] noted that 52.3% of Norwegian adolescents (aged 12–19 years old) drank at least one ED per month (n = 31,081). Presented data show that a young population, mainly between 9–19 years old, constitutes the biggest pool of ED consumers, with the prevalence of lifetime use ranged from 52% to 68% [12].

Ingredient of energy drinks

Caffeine	The caffeine content of sodas to (18 mg/100 ml). Energy drinks contain between 14 and 31 mg of caffeine per 100 ml [13]. Caffeine has differing CNS, cardiovascular, and metabolic effects based on the quantity ingested. A dose of caffeine (85-250 mg) may result in feelings of alertness, decreased fatigue, and eased flow of thought. But high doses (250-500 mg) can result in restlessness, nervousness, insomnia, tremors, seizures and cardiovascular instability [14].
Guarana	It is one of the richest sources of caffeine, containing up to three times the amount of caffeine as coffee. [15] It reputed to be a stimulant and increase mental alertness, fight fatigue, and increase physical endurance. People with heart conditions, diabetes, high blood pressure, epilepsy, overactive thyroid, anxiety, insomnia, and kidney disease. It may increase the risk of stroke, hemorrhage, myocardial infarction, and sudden death and has been associated with increases in heart rate, blood pressure, and potentially harmful changes in glucose and potassium levels [16].
Sugar	To reduce body weight, a person must decrease the amount of calories he or she consumes. People to reduce their intake of added sugars and help manage their weight is to reduce the amount of sugar-sweetened beverages they drink [17].
Taurine	Taurine is involved in several metabolic processes and may also have antioxidant properties. [18]Taurine is about 60 mg per day, but a single serving of Red Bull (and of most other energy drinks) contains about 1,000 mg of Taurine. Long-term effects of consuming Taurine in the amounts present in energy drinks [19].
Vitamins	The presence of B vitamins (B2, riboflavin; B3, niacin; B6; and B12) is a common ingredient in energy drinks. While these vitamins' importance to healthy living is undeniable, it may be more appropriate to ingest them in the form of a balanced diet than in the form of an energy drink supplement [20]

Composition of energy drinks

The composition of Energy Drinks varies according to the base material used for their preparation. The two main types of Energy Drinks available in the market are fruit-based (Energy Drinks) and non-fruit based (Red Bull, Rockstar, Monster, Full Throttle ED, NOS, etc.). The data pertaining to their composition are given and reviewed in Table I.

Table 1: Composition of energy drinks [21-24]

Nutrient	Non-fruit-based ED	Fruit-based ED
Calories	105-144 kcal.	110 kcal.
Caffeine	70-86 mg	71 mg
Sugar	27-31 mg	29 mg
Taurine	1,000 mg	ND
Glucuronolactone	600 mg	-
Vitamin B2	1.7-3.4 mg	-
Vitamin B3	10-20 mg	-
Vitamin B5	5-10 mg	-
Vitamin B6	2-5 mg	100% DV*
Vitamin B12	5-6 mg	100% DV*
Ginseng extract	may or may not be present	Present
Guarana extract	may or may not be present	Present

Potential adverse effects of energy drinks in relation to their ingredients

Cardiovascular effects

Increase in heart rate and arterial blood pressure after energy drink consumption. The effects of the caffeine content of the energy drink. Significant cardiac manifestations such as ventricular arrhythmias, ST segment elevation and QT prolongation have been documented following energy drink overconsumption [25]. Energy drink consumption has

been related to myocardial infarction in healthy 17-and 19-year old boys and girls [26] consuming energy drinks reduces endothelial function and stimulates platelet activity through arachidonic acid-induced platelet aggregation in healthy young adults [27].

Table 2: Adverse health effects of energy drinks

Component of Energy Drinks	Adverse health effects	References
Guarana	Causes birth defects as well as mutagenic effects Causes insomnia, nervousness, restlessness, angina, anxiety, tremors, tachycardia, dysrrhythmia and stomach upset Inhibit platelet aggregation	[28, 29, 30]
Ginseng	Overconsumption may lead to elevated BP, nervousness, insomnia, skin eruptions, headache, vomiting, oedema and diarrhoea Other adverse effects are mastalgia, cerebral arteritis, vaginal bleeding and Stevens-Johnson syndrome	[31, 32, 33]
Carnitine	Overconsumption of carnitine may cause gastrointestinal (GI) problems such as nausea, vomiting, abdominal pain and diarrhoea	[33]
Sugar Excessive	consumption of sugar may lead to hypercholesterolemia, weakened immunity, hyperactivity, anxiety, hypoglycaemia, hypertension, difficulty concentrating and impaired DNA structure	[34, 35, 36]
B-vitamins	Overconsumption of B3 may lead to stomach upset, dizziness, pain in mouth, irregular heartbeat, increased blood glucose levels, hypotension or allergy	[35, 36]
Taurine	Taurine has been shown to worsen hypoglycaemia	[37, 38]
Caffeine	As a diuretic and leads to dehydration Can cause high BP, anxiety attacks, heart palpitations, insomnia, vomiting, abdominal pain, agitation, muscle rigidity, calcium imbalance, seizures, infertility, late miscarriages, stillbirths, cancer and even death	[39, 40, 41, 42]

Table 3: Beneficial effects of energy drinks

Component of Energy Drinks	Positive health effects	References
Guarana	Its pharmacological actions include antifatigue, anti-depressant, ergogenic and fat burning effects as well as antioxidant activity	[29, 33, 34, 39]
Glucoronolactone	It helps to eliminate toxic metabolites including carcinogens from the body and enhances body's natural defense mechanism	[33, 34]
Ginseng	It helps to increase physical, mental and sexual performance, improves stamina, concentration, vigilance, stress resistance and overall work efficiency It also controls blood glucose level as well as BP It protects against neurodegenerative diseases It facilitates antioxidant effect, antithrombotic effect, and also possesses anti-hyperlipidemic activity	[31, 32, 33, 45, 46]
Carnitine	It acts as a co-factor, provide energy for sperm motility and respiration It prevents myocyte death, treat Alzheimer's disease, end stage renal failure, peripheral vascular disease and chronic fatigue syndrome It prevents apoptosis and thus strengthens immunity	[43, 44, 33, 34]
Sugar	Glucose postpones fatigue and conserve muscle glycogen when administered prior to or during exercise	[34]
B-vitamins	Vitamin B1 and B2 serves as a coenzyme in carbohydrate metabolism Vitamin B3 converts fats, carbohydrates and starches into energy. Vitamin B5 and B7 have their role in fatty acid oxidation and gluconeogenesis Vitamin B6 is required for DNA synthesis and production of amino acids Vitamin B12 prevents anaemia by forming red blood cells	[35, 36]
Inositol	It helps to reduce cholesterol levels, combat depression, panic disorder as well as obsessive compulsive disorder	[36, 53]
Taurine	The positive effects of taurine include inotropy, chronotropy and antidysrhythmia It helps to lower BP, increase physical performance, assists osmoregulation and detoxification	[33, 34, 36, 44, 47]
Caffeine	Caffeine consumption has been linked to a decreased risk of diabetes, improves immune response and lowers the risk of neurodegenerative diseases like Parkinson's and Alzheimer's Caffeine improves mood, alertness, memory and psychomotor performance	[48,49,50,51,52,53]

CONCLUSION

The rising popularity of Energy Drinks particularly among young adults and adolescents necessitates the need of further research in this field. Energy Drinks might pose a huge threat to the safety of individual and public health. A scientifically justified utmost permissible amount of caffeine in Energy Drinks must be set by the governing agencies. The manufacturers should willingly state a warning on the product labels and their advertising materials against the risks associated with caffeine consumption among the vulnerable groups. Therefore, the need of the present era is to develop nutritious and economical Energy Drinks which would prove to be safe for human consumption as well. Public health and policy action must be taken to mitigate the negative health effects and public health challenges associated with Energy Drinks. A high proportion of students are ignorant to the main constituents and side effect of energy drinks. Campaigns should be encouraged in order to spread awareness about the contents and possible side effects of energy drinks. Such campaigns should focus to a greater extent on adolescents and young adults, males, and people of high economic classes.

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