

# Energy drinks and human body physiology

## Editorial

Human survival depends on three main factors, which are: genetics, environment and nutrition. While the genetic makeup of individuals cannot be changed, the influencing environmental factors can be controlled and improved to some extent. In contrast, the nutrition factor is considered the most modifiable among these three factors. A variety of nutrients are required for normal bodily functions. Obtaining adequate amounts of these nutrients is essential for a healthy survival. Introduction of foreign substances into the body would most likely result in disturbances to the body physiology. Many brands of what are known as energy drinks and shots have been introduced in the market during the last two decades. These drinks contain many substances that deviate from the normal human dietary patterns. Thus, it is of interest to explore the contents of such drinks and learn about their effects on the functions of the human body.

Energy drinks are beverages that contain varying amounts of caffeine (77-110mg/240ml) and a variety of other additives. While the actual caffeine content for many energy drinks is not identified on product packaging or via other sources, the total amount of caffeine contained in some of these drinks can exceed 500mg and can cause caffeine toxicity.<sup>1</sup> A lethal dose of caffeine is considered to be between 200 to 400mg/kg body weight.<sup>2</sup> Energy drinks contain other ingredients, such as: vitamins, taurine, theanine, carnitine, herbal supplements, creatine, sugars (3-31g/240ml), and guarana - a plant product that contains high amounts of caffeine. Some of these drinks may also contain glucuronolactone, B vitamins, antioxidants, sodium (40-340mg/240ml), potassium (0-240mg/240ml), calcium (0-180mg/240ml), and trace minerals.<sup>3</sup> Furthermore, there are other ingredients in some energy drinks that are without known specific function or purpose; such as: white tea extract, inositol, aloe Vera leaf extract, resveratrol, and coconut water. Herbal extracts, such as ginseng and gingko biloba, are added to provide a certain flavor and to give the notion that such drinks are good for health. Some products are known as "energy shots", which have higher contents of caffeine than regular energy drinks. These, drinks and shots, are available in cans or bottles that are sold at grocery stores and through vending machines. The so called energy drinks, or shots, are not to be mistaken with what are known as "sports drinks" and should not be viewed interchangeably. Sports drinks are flavored beverages that most often contain carbohydrates, minerals, electrolytes, and sometimes vitamins or other nutrients. They are formulated for the purpose of replenishing certain nutrients for athletes and regularly-exercising individuals - rather than being stimulants. However, it has been reported that energy drinks and sports drinks are commonly used interchangeably.<sup>3</sup>

Energy drinks surfaced in the 1990's and they are currently available worldwide. A certain brand of these drinks was introduced to the United States in 1997. Ever since, these drinks are marketed as being sources of energy and that they are energizing. The "energizing" term being used is basically because of the caffeine content, but for them being dependable sources of energy is questionable. Advertising and marketing strategies for these drinks by their manufacturers target teenagers, young adults, and those who exercise. Advertisements by energy drinks manufacturers stimulate the thoughts of consumers

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about increased concentration, alertness, and help in improving mental and physical performance. Such advertisements use catchy phrases such as: "help pump up the beast", "vitalize body and mind", "fuel your brain", "provide focus, energy, and determination", and "get animated". In their vigorous publicity campaigns, manufacturers of energy drinks also promote their products by sponsoring a variety of sport events that require power and stamina; such as: rally car jumps, motorcycle races – among many others that attract the young and physically active individuals. With such publicity campaigns, it was reported that the market size for energy drinks in the US was nearly 12.5billion dollars in 2012 and it is projected to reach about 21.5billion in 2017.<sup>4</sup> An early study showed that consumption of sports and energy drinks by children and adolescents was widespread-56 and 42% for sports drinks and energy drinks, respectively. This study also showed that adolescents consumed these products for various reasons; such as: good taste, quenched thirst, and extra needed energy to improve sports performance. These adolescents did not differentiate between sports and energy drinks and cited the same benefits for both types of beverages, without any mention of potential problems referable to their consumption.<sup>5</sup> A rough estimate could be that between 30 to 50% of adolescents consume energy drinks.<sup>4</sup>

As it is always the issue with available products for human consumption, the safety of such is of most concern. With the increased popularity of these energy drinks and shots, there must be a serious interest in assessing their safety. Unfortunately, the long-term safety of the unique combinations of ingredients found in these drinks has not been sufficiently addressed. However, the most logical approach towards this concern would be to examine the ingredients that these drinks contain and study the related documented health problems. One major interest would be directed towards the adverse effects of excessive consumption of caffeine and the benefits and/or adverse effects of the other ingredients. Caffeine can enhance physical performance in adults by increasing aerobic endurance improving reaction time, and delaying fatigue. However, such effects are variable and dose-dependent, which have not been studied in children and adolescents. Ergogenic effects have been reported with doses of 3 to 6mg/kg body weight – but, some athletes may voluntarily have

daily caffeine intakes up to 13mg/kg.<sup>6</sup> Caffeine can increase anxiety in those with anxiety disorders<sup>7</sup> and is known to play a role in triggering cardiac arrhythmias.<sup>8</sup>

In addition, excessive consumption of caffeine acutely causes caffeine intoxication, resulting in tachycardia, vomiting, seizures, and death. Caffeine raises blood pressure, disrupts adolescent sleep patterns, exacerbates psychiatric disease, causes physiologic dependence, and increases the risk of subsequent addiction.<sup>9</sup> Research has shown that energy drinks cause more forceful heart contractions, which can be harmful to some with certain heart conditions.<sup>10</sup> Another study showed a link between energy drinks and cardiac events among teens and recommended they should not consume more than one 250ml energy drink/d.<sup>11</sup> Because of danger to health, the Food and Drug Administration (FDA) announced in 2010, that caffeine is an unsafe food additive to alcoholic beverages.<sup>12</sup> While there is a good volume of literature on the effects of caffeine, such effects of chronic high-dose caffeine intake in children and adolescents are unknown. Also, the toxicity of ingredients often present in energy drinks, such as taurine, niacin, and pyridoxine, is not well defined.<sup>4,9</sup> Taurine has similar physiological effects on the intracellular calcium concentration in smooth muscles that may cause coronary vasospasm.<sup>13</sup>

Adverse health conditions as consequences of energy drinks consumption are many and involve both genders and, especially, teens and young adults. Such problems, other than cardiovascular-related can be briefly reported as follows: addiction to caffeine, headaches/migraines, increased anxiety, insomnia, jitters and nervousness, vomiting, allergic reactions, and increased stress hormone release. Some of these conditions, especially those that involve the heart, can be severe enough to require emergency care. Recent statistics showed that visits to emergency departments in hospitals doubled from 2007 to 2011 for female and male energy drinks consumers – with adolescents and young adults being the most vulnerable.<sup>14</sup> Additionally, depression may result from interactions with medications and teens who over consume energy drinks are likely to exhibit risky behavior.<sup>15</sup> On a different front, concern about dental erosion caused by sports and energy drinks in children and adolescents has been raised.<sup>16</sup> Most sports and energy drinks contain citric acid and have a pH range of 3-4, which is associated with enamel demineralization.<sup>17,18</sup>

It would be helpful to have a critical appraisal of such energy drinks that discusses their would-be benefits as well as their adverse effects. While energy drinks provide calories because they contain amounts of sugar, such energy can be described as “empty calories” and do not come from nutrient-dense food items. Also, these drinks provide some other nutrients in very small amounts and contain substances that are of questionable value.

Therefore, from a nutritional stand point, these drinks are of little or no value. Then, it would be recommended that there is no need for these drinks for the purpose of providing nutrients-as healthy nutrition implies obtaining required nutrients from their natural animal and plant sources. If the main purpose is to obtain caffeine in the body, other types of beverages, that are less risky, can be better alternatives. With the exploration of the adverse effects of energy drinks and the caffeine that they contain on body physiological processes, it seems that the dangers are serious enough to the extent that they may lead to death. Considering the health problems that result from consuming, over consuming, and misusing energy drinks, the current advice would be to adopt the practice of moderation. Attention should be directed towards educating the public in general, and particularly children and young adults, about the contents of energy drinks and about the possible consequences of their excessive consumption. Caution about

the extreme danger of mixing caffeine and alcohol ought to be stressed in any awareness campaign. Currently, there seems to be an urgent need for legislations that relate to the manufacturing, advertising and sales to minors in many countries—similar to those enforced on alcohol and tobacco. Until such legislations become available and implemented, effective awareness campaigns to all sectors of society ought to be carried out. Since the children and adolescents are the most vulnerable segment of society, school teachers and administrators should play a prominent role in such awareness efforts. In short, a concerted societal effort has to be expended to regulate aspects of manufacturing and marketing to contain the adverse effects of energy drinks consumption on bodily functions and for the general well-being of all.

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## Conflict of interest

Author declares that there is no conflict of interest.

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