

# BEYOND THE BASICS

## Energy Drinks

### **What are energy drinks?**

Energy drinks are popular beverages that, according to manufacturers' claims, provide benefits such as increased mental alertness, wakefulness, attention, physical endurance, performance and stamina.<sup>1,2,3</sup> Popular brands include Red Bull, Rockstar, Full Throttle, Amp Energy and Monster, to name a few.

Caffeine, a CNS stimulant, is the main ingredient of energy drinks.<sup>4</sup> Depending on the brand and size of container, caffeine content in energy drinks can range from 50 mg to 505 mg. In comparison, the caffeine content is 76 to 179 mg in one cup of coffee, 36 to 46 mg in a 355 mL can of cola and 19 to 58 mg in 20 grams of dark chocolate.<sup>5</sup> Some high caffeine potency energy drinks can have the equivalent caffeine content of seven to 12 cans of cola or four to five cups of coffee.

Energy drinks may also contain other ingredients that are natural sources of caffeine (guarana and yerba maté), boosting the caffeine content of the drink even further. As well, other additives, such as taurine, glucuronolactone, ginseng, *Ginkgo biloba*, B vitamins and carnitine, may be ingredients in some of the energy drink brands.<sup>3,6</sup> (See page 2 for descriptions of these ingredients and additives.)

Energy drinks were introduced to the United States in 1997 when the product, Red Bull, was imported from Austria. Since then, consumption and sales have increased exponentially.<sup>2</sup> About 500 new brands of energy drinks were introduced worldwide in 2006 in response to the rise in popularity of these beverages.<sup>1</sup>

**Note:** Studies so far have been unable to conclude that the combined influences of the ingredients in energy drinks contribute to the potential effects touted by the manufacturers. Rather, it is likely that these effects are due to the main ingredient, caffeine,<sup>7,8,9,10</sup> which will be discussed on this information sheet.

### **Medical Use**

There is no medical use for energy drinks, but several ingredients in some of these drinks have been found to be helpful from a medical point of view (although they would not be prescribed through energy drink use). For example, ginseng (*Panax ginseng*), an East Indian herb, is known to be useful in treating type 2 diabetes and some cardiovascular conditions and in immune system enhancement.<sup>11</sup> *Ginkgo biloba*, another herb, has scientific evidence proving its effectiveness in treating claudication (limping/pain and leg weakness) and dementia.<sup>12</sup>

### **Prevalence of Use**

The target market for energy drinks are young consumers, and manufacturers are succeeding in reaching them: teenagers and young adults aged 12 to 24 represent the core consumer group.<sup>2,13</sup> Specifically, market surveys indicate that 31% of those aged 12 to 17 are regular consumers of energy drinks, as are 34% of 18- to 24-year-olds. The rates of regular consumption rapidly decrease with increasing age, and only 3% of seniors aged 65 and older report any consumption.<sup>2</sup>

Data shows that energy drink use tends to begin at a very young age, with 28% of 12- to 14-year-olds drinking them regularly. As well, from 2002 to 2006, consumption rates increased from 18% to 31% in 12- to 18-year-olds.<sup>2</sup> Energy drink consumption is prevalent in college students also: in two studies, the proportion of those students surveyed who had consumed energy drinks more than once in an average month was 39% and 51%.<sup>13,14</sup>

As well as claiming that their products provide instant energy and performance aptitude, the makers of these drinks use aggressive marketing strategies such as the use of edgy names (i.e. Daredevil, Rip It, SoBe Adrenaline Rush) and vivid graphics on the packaging.<sup>1,2</sup> They also employ non-traditional promotional methods to attract young consumers, including promoting their products in such youth-oriented settings as extreme sports events and concerts or by using student brand managers on campuses to advertize the beverage.<sup>2,15</sup> There is concern that using young themes and strategies to promote and sell energy drinks links these products to teenage attributes such as the desire to take risks, be rebellious and be adventurous.<sup>2</sup>

Alarmingly, some manufacturers link their products to illegal drug use by giving them names such as Cocaine and Blow.<sup>1</sup>

## Natural Sources of Caffeine in Energy Drinks

Energy drinks contain pure caffeine, and the amount must be on the label. However, the amount of caffeine in the drink could be higher than indicated as the caffeine content of the following natural ingredients is not required to be listed separately:

- Guarana comes from the seeds of the plant *Paullinia cupana* found in Brazil.<sup>3,5</sup> It has between two to three times the caffeine content found in regular coffee beans.<sup>16</sup>
- Yerba maté is a natural caffeine-containing herb from South America. It has a lower caffeine content than the coffee bean.<sup>5</sup>
- Other caffeine-containing natural ingredients that may be found in energy drinks are kola nut, tea and cocoa.<sup>3</sup>

## Pharmacokinetics

Caffeine is rapidly and completely absorbed through the gastrointestinal tract and reaches peak plasma concentrations in 40 to 60 minutes.<sup>3,17</sup> It has a half-life of three to five hours and readily crosses the blood brain barrier and the placenta.<sup>17</sup>

## Pharmacodynamics

Caffeine is part of the methylxanthine family and exerts its effects by nonselectively blocking central nervous system (CNS) adenosine receptors, thus inhibiting adenosine's actions.<sup>3,17</sup> Adenosine is known to modulate CNS neurotransmission. As well, it has vasodilatory effects, it decreases the release of catecholamines (which function in mediating the sympathetic response) and it inhibits the breakdown of lipids.

Potentially, caffeine also inhibits phosphodiesterase activity, leading to increased cyclic AMP and adrenergic tone.<sup>3</sup>

## Short-term Effects

Caffeine increases heart rate and blood pressure. It also causes respiratory effects, such as bronchodilation, pulmonary smooth muscle relaxation and increased respiratory rate.<sup>3</sup>

Small doses (for example, one to two cups of coffee) cause mild mood elevation, reduced fatigue and drowsiness, heightened arousal, increased concentration and alertness in adults and improved ability to do physical work. Some studies indicate that caffeine may enhance memory and reaction time.<sup>2,3,18,19,20</sup>

Studies show that in sleep deprived individuals, caffeine can improve performance in endurance activities such as running and cycling, but not in those doing acute, high-intensity activities. These effects are more evident in non-caffeine users compared to those who use it regularly.<sup>1,17</sup> Other

## Other Additives in Energy Drinks

Energy drinks contain additives alleged by the manufacturers to have positive but unproven effects. For the most part, these ingredients have not been shown to be safety concerns.<sup>21,22</sup>

- Taurine is an amino acid known to modulate muscle contraction.<sup>3,23,24</sup> However, it is unlikely that ingestion of taurine would greatly increase levels in muscle cells.<sup>23</sup> Another claim suggests that ingesting taurine may have cognitive enhancing effects, but this remains unproven.<sup>23</sup>
- Glucuronolactone is a carbohydrate and a metabolic byproduct of glucose.<sup>24,25</sup> It is promoted by energy drink makers for its detoxification capabilities, for eliminating wastes in the body and for providing extra energy.<sup>26,27</sup> No scientific evidence proves these claims.
- The B vitamins are known to play an important role in cell metabolism, proper cell functioning and in the maintenance of the nervous system.<sup>24</sup> Claims by manufacturers that B vitamins added to energy drinks provide users with extra energy are unfounded.<sup>27</sup>
- Carnitine, an amino acid derivative, is promoted in energy drinks for its stamina, performance enhancing and fat burning effects. However, these effects have not been proven.<sup>3</sup>
- Ginseng (*Panax ginseng*) is an East Indian herb taken by some to improve memory and stamina, but little evidence exists to support this claim.<sup>3</sup> Ginseng may alter blood clotting; people on medication for blood conditions should be cautious.<sup>11</sup>
- There is some evidence the herb *Ginkgo biloba*, known as Gingko, is helpful for people with dementia and for limping. Its effects at enhancing memory in healthy people remain unclear.<sup>12</sup> There is no evidence that it improves performance or energy. *Ginkgo* is well tolerated, but may cause bleeding and thus should be avoided by people with blood conditions.<sup>12</sup>

short term effects, most often found in non-tolerant individuals as well as in those who consume high doses and/or are habitual users, include: diuresis, decreased appetite, hand-tremor, impairment of fine motor coordination, increased body temperature and insomnia.<sup>1,18</sup>

Large doses of caffeine can cause caffeine intoxication. This is characterized by nausea, nervousness, restlessness, irritability, agitation, headache, rapid heart rate and even delirium.<sup>3,18</sup>

## Long-term Effects

Health Canada has confirmed that moderate consumption of caffeine (400 mg per day, or two to four cups of coffee) will not cause adverse affects for most people. However, there needs to be adequate calcium in the daily diet to make up for one of the long term effects of regular caffeine consumption: accelerated bone loss.<sup>28</sup>

Regular use of caffeine in doses of more than 600 mg daily may cause persistent anxiety and depression, chronic insomnia and stomach upset.<sup>18</sup>

## **Toxic Effects**

The fatal dose of pure caffeine in adults is 5 to 10 grams when taken orally and 3.5 grams by injection.<sup>18</sup> In children, the fatal dose is much lower. It is also lower in people with seizure or cardiac conditions because of caffeine's stimulant effects on the CNS and on the heart.<sup>3,18</sup>

## **Tolerance and Dependence**

Tolerance to caffeine can develop in individuals who regularly consume this drug. Tolerance develops because, in regular users, the upregulation of adenosine receptors occurs as a natural phenomenon.<sup>17</sup>

Caffeine has the potential to cause physical dependence in those consuming daily amounts of 350 mg or more.<sup>3,18</sup>

## **Withdrawal Symptoms**

Abrupt cessation of regular caffeine consumption of about 350 mg or more daily will likely result in caffeine withdrawal and include symptoms such as severe headache, fatigue, irritability and, in children, decreased attention.<sup>3,18</sup> These symptoms usually occur within 12 to 24 hours after stopping use and will peak at 20 to 48 hours. They may last up to one week in some people.<sup>3</sup>

## **Energy Drinks and Alcohol**

Numerous studies have found consumption of energy drinks with alcohol, such as Red Bull with vodka, to be an increasingly popular practice, mainly among young people.<sup>1,13,29,15,14</sup> There is a myth that caffeine from energy drinks will offset the effects of the alcohol, giving people the energy to stay up longer without feeling inebriated.<sup>30</sup> However, while users may feel more alert, research shows that there is no difference in blood alcohol levels when alcohol is taken with energy drinks.<sup>31,32</sup>

It has been found young people who combine alcohol with energy drinks are at higher risk for drinking more alcohol in a typical drinking episode and drinking heavily more often than those who drink alcohol not mixed with energy drinks.<sup>15</sup>

As well, those who mix alcohol with energy drinks are at higher risk for experiencing more alcohol-related consequences, including high risk sexual activity, driving or riding with an intoxicated driver and physical injuries.<sup>15,33</sup>

## **Risks & Other Harms**

Children who ingest too much caffeine are at higher risk for behavioural effects, such as anxiety, mood changes and loss of attentiveness.<sup>28</sup> Depending on the size of the child, Health Canada recommends a daily intake of no more than 45 to 85 mg (the equivalent of one or two regular cans of cola).<sup>5</sup> Many energy drinks contain much more caffeine than this.

People who habitually consume caffeine through coffee and soft drinks are at an increased risk of experiencing the adverse effects of this drug if they also have an energy drink.

Non-caffeine users and caffeine sensitive people are vulnerable to overdosing on caffeine if they drink energy drinks.

The high caffeine content of energy drinks could pose a health risk for people with high blood pressure or heart disease.<sup>34</sup>

A 2008 study showed energy drink consumption to be associated with risky behaviours, smoking, drinking, alcohol problems and illicit prescription drug use.<sup>14</sup> Another study revealed that energy drink consumption was a predictor for future non-medical prescription stimulant use.<sup>35</sup>

As is the case in any abuse of licit or illicit drugs, there are potential adverse consequences related to the law, a person's financial situation, family relationships, and generally putting oneself at risk by participating in unsafe behaviours while under the influence of energy drinks.

## **Legal Issues**

Caffeine is a legal CNS stimulant and is classified as a drug as it does not have any nutritional benefits.<sup>5,17</sup> Pure caffeine, a main ingredient in energy drinks, is regulated as a food additive by Health Canada. While it cannot be added to foods, it can be added to cola type beverages, and must be declared in the ingredient list on the product label.<sup>5</sup> Caffeine from natural food ingredients, natural flavours and crude extracts (i.e. guarana, yerba maté, kola nut, tea<sup>3</sup>) is not regulated when added to food or beverages and does not require listing as a separate ingredient.<sup>5,28</sup> Therefore, the actual amount of caffeine in an energy drink may be more than the amount declared on the label.

In Canada, Red Bull is the only energy drink that has been regulated as a Natural Health Product (NHP). It is required to have recommended conditions for use and cautions listed on its label. No other energy drink brands in Canada have been regulated as a NHP, which is a concern as they contain similar ingredients and most have higher levels of caffeine compared to Red Bull.<sup>36</sup>

In Canada, energy drinks are readily available in convenience and grocery stores, making them easily assessable to all age groups, including young people.<sup>3</sup>

Due to the concern of excessive caffeine consumption from energy drinks, some countries have set restrictions and even bans on their use. In Denmark, the sale of these beverages is forbidden, while in Norway, sales are restricted to pharmacies. In Sweden, energy drinks cannot be sold to children under age 15. In Argentina, an energy drink ban has been proposed for nightclubs.<sup>37</sup>

Alcoholic beverages pre-mixed with energy drinks have been banned in the United States.

## Pregnancy & Lactation

Caffeine consumption in women of childbearing age is associated with a greater risk of potential reproductive effects, such as loss in fertility.<sup>28</sup> Therefore, Health Canada recommends a maximum daily caffeine intake of 300 mg, or about two to three cups of coffee.<sup>5</sup>

Caffeine does cross the placenta,<sup>3</sup> but moderate consumption of caffeine by a pregnant woman does not appear to cause problems in the fetus. However, there is some data indicating that low birth weight babies and spontaneous abortion are associated with consumption of more than 150 mg of caffeine per day by pregnant women.<sup>38,39,40</sup>

Although caffeine appears in breast milk, it is not a concern for infants of nursing mothers as the amount is very low. However, if caffeine accumulation occurs after repeated exposure in babies, irritability and problems with sleep may occur.<sup>4</sup>

## Substance Use & Mental Health

- Substance use and mental health problems can often occur together. This is commonly referred to as a co-occurring disorder.
- Substance use may increase the risk of mental health problems.
- People with mental health problems are at higher risk of developing substance abuse problems:
  - Sometimes they use alcohol and other drugs in an attempt to relieve themselves from mental health symptoms.
  - For most people alcohol and other substance use only covers up the symptoms and may make them worse.

**Remember:** A person's experience with any drug can vary. Here are a few of the many things that may affect the experience: the amount and strength of the drug taken, the setting, a person's mood and expectations before taking the drug, gender, overall health, past experience with that drug and whether more than one drug is being used at the same time. Using alcohol and other drugs at the same time can also be dangerous.

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