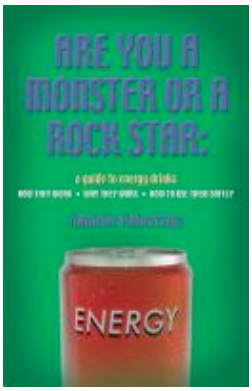
ARE YOU A MONSTER OR A ROCK STAR:

a guide to energy drinks

HOW THEY WORK • WHY THEY WORK • HOW TO USE THEM SAFELY

Danielle Robertson



This guide to so-called "energy drinks" tackles the three most common questions surrounding these controversial products: Are they safe? Do they work? How do they work? Discover the key factors that make energy drinks safe or unsafe. Meet the 20 most common ingredients found in energy drinks and learn the basic science to how they work. With this guide and the "Levels of Fatigue" outlined within, anyone can maximize energy while minimizing health risks.

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Consumption Specifics

Whether an energy drink is safe for you, specifically, depends on who you are. It also depends on how you consume the product.

Without Water

Caffeine has a mild dehydrating effect so someone on the verge of dehydration may become even more dehydrated if they have caffeine. Minimal dehydration (1-2 percent of body weight in fluids) can slow down metabolism and make you feel thirsty and slightly fatigued. The solution to this fatigue is not an energy drink, it's plain old-fashioned water (or water with cucumber slices in it if that's more your style). Consuming an energy drink won't quench your thirst and it could worsen your degree of dehydration. If dehydration reaches 4 percent (meaning a 135 pound woman now weighs about 130 pounds), symptoms include lagging pace, weariness, sleepiness and apathy. Again, these symptoms of sleepiness and weariness are not to be used as reasons to consume an energy drink – doing so is neither a good idea nor safe.

Without Food

Consuming an energy drink on an empty stomach is never a good idea. Some of the common ingredients can irritate the stomach lining and trigger dizziness, or nausea. Sure, you might know someone that has coffee or tea for breakfast every day with no problems. Coffee and certain types of tea can irritate an empty stomach,

but those unwanted symptoms are less likely if the coffee is consumed with cream, milk, sugar or whip cream. Caffeine in general can irritate the stomach but that's not the only reason energy drinks make a poor breakfast.

Have you ever taken a multivitamin *before* eating breakfast? If so, you might've felt queasy soon after. Some vitamins and minerals irritate the lining of an empty stomach, leading to inflammation and nausea. On top of that, bonking is another consequence of having an energy drink on an empty stomach. In the sports world, "bonking" or "hitting the wall" means to reach the point where the body has depleted its glycogen stores in the liver and muscles. The body is literally running on empty. The body uses up some of these glycogen energy stores while you sleep, which is why getting a quality breakfast is so important. Energy drinks with fruit juice don't count as a quality breakfast. If you need caffeine in the morning (join the club) just give some real food a head start to your stomach before you reach for caffeine.

Without Fail

The safety of a supplement depends on many different factors, including how often a person consumes the supplement. Vitamins are the perfect example of the importance of frequency. Multi-vitamins have specific instructions on the label indicating how many vitamins to take at one time and how many to take in one day. It's common knowledge that ignoring these instructions can make someone ill, and that's one of the concerns with vitamins that look like candy. Frequency is just as important for energy drinks as it is for vitamins and aspirin. There are four different frequencies that affect

caffeine safety, but to truly understand them, you must first understand half-life.

Half-life

The true meaning of the term "half-life" does not involve marriage, video games or unicorns. *Half-Life*, the video game, was released in 1998 as a science fiction first-person shooter game about a theoretical physicist in a post-apocalyptic world. In *Harry Potter and the Sorcerer's Stone*, a half-life is a cursed life, punishment for drinking the blood of a unicorn. In chemistry, the half-life of a compound or molecule is how long it takes to reach the half-way point in the process of breaking down.

Caffeine molecules are broken down and metabolized by the liver, and for some people it may take up to six hours to break down half the amount of caffeine ingested. Every person metabolizes caffeine differently because every person has different lifestyle factors that make their metabolism unique. Multiple servings of any caffeinated beverage in a short time span can be hazardous just because it takes the body so long to process the caffeine. Knowing how long it takes you, personally, to metabolize caffeine will help you avoid caffeine toxicity. In other words, how long after the first sip of a caffeinated beverage do you feel alert? How long after that do you feel like the caffeine has worn off? The more you pay attention to your body and mind, and also to how your surroundings affect your level of fatigue, the easier it'll be to answer these questions.

Frequency

Knowing how long it takes your body to process caffeine will help you avoid overdosing, but the following four frequencies will also help you stay safe.

Milligrams per Day

Consuming up to 400 milligrams of caffeine per day is considered safe for the healthy adult population. This limit was determined by the Bureau of Chemical Safety, Food Directorate of Health Canada. The FDA uses this limit because it's based on a comprehensive review of published studies on the effects of caffeine on human health (Nawrot 2003). Essentially, the authors of this review searched all published studies on human health and caffeine, then determined the overall consensus among the studies. The consensus was consuming 400 milligrams of caffeine per day doesn't pose a threat to the heart, the bones or male fertility, and doesn't cause general toxicity or increased incidence of cancer. Consuming caffeine safely means not exceeding this 400 milligrams per day limit.

Milligrams per Serving

If a caffeinated product has 400 milligrams of caffeine per serving, that amount is safe for one day, but it could be way more than your body can handle in one shot (pun intended). Before consuming an energy drink, look at the number of milligrams of caffeine per serving AND the number of servings per container. Not all caffeinated beverages list the milligrams of caffeine per serving so, to ensure your safety, choose the ones that do. The

alternative is to take only one sip every 20 minutes to see how the product affects you. Consuming caffeine safely means paying attention to milligrams per serving.

Milligrams per Hour

The best way to ease into a new caffeinated beverage is one sip at a time. This sounds quite simplistic, because unless you have the mouth of a pelican or the thirst of a Frat Boy, you probably already drink liquids one sip at a time, right? In this case I mean take one sip of that caffeinated beverage, and then wait 20 minutes to see how you feel. That one sip could be all you need to feel refreshed or to satisfy a craving. Remember, the placebo effect is real. Also remember the boy from the energy shot adverse event report – he had a history of drinking energy drinks, but it was the multiple servings of an energy shot he'd never tried before that caused the seizure. Limiting your milligrams of caffeine per hour is a good way to limit the risk of consuming too much.

Milligrams per Week – caffeine tolerance

The "caffeine headache" is a real condition, and caffeine withdrawals are not a myth. It's true that drinking coffee all the time can lead to a tolerance. A coffee newbie might be fine with a short non-fat mocha, but a veteran coffee drinker demands nothing short of a Venti Americano. Drink an energy drink or a cup of coffee every single day and you may find your body getting used to it. When you start needing more caffeine to feel that same energy boost, you're heading toward the upper intake levels of safe consumption. Consuming caffeine

safely means keeping track of how many milligrams of caffeine you consume throughout the week.

Key Concept Review

Safety of a caffeinated product depends on how it's used. Consuming caffeine safely means:

Not consuming it while dehydrated;

Not consuming it on an empty stomach;

Calculating your own personal caffeine half-life; and

Keeping track of the four frequencies of caffeine consumed (milligrams per day, per serving, per hour and per week).

Vitamin B3 aka Niacin

In many ways riboflavin and niacin are similar but, if they were related, niacin would be riboflavin's cooler older sibling. The body loves niacin. The body needs niacin. The body has made it extremely easy to get enough niacin from both external and internal sources. First of all, we can make niacin from the amino acid tryptophan. Second of all, almost all niacin consumed is absorbed. Most vitamins aren't absorbed until they get to the small intestine, but niacin is absorbed from both the stomach and the small intestine, which means it's absorbed faster and more efficiently than other vitamins.

Unlike riboflavin, niacin doesn't need to be consumed with food – it doesn't need stomach acids to liberate it from a protein before it can be absorbed. In fact, niacin is like that superhero that can walk through walls. Riboflavin needs to be carried and delivered into the bloodstream like the passenger of an elevator being delivered to a different floor. Niacin just passes through the walls of the stomach and small intestine, diffusing into the bloodstream as effortlessly as the aroma of a strong perfume diffusing through the air of a small room.

Speaking of aromas and odors, niacin exists as nicotinamide and nicotinic acid. Niacin is similar in chemical structure to nicotine in cigarettes but the difference between the two is like the difference between laughter and slaughter.

Niacin is so prized and popular that the niacin molecules in corn are under lockdown. Corn's content of niacin is considerably higher than that of most other vegetables but a protein in corn binds the vitamin and severely limits absorption. Soaking corn in alkaline solution such as lime water releases the bound niacin, making it available for absorption. Rich sources of niacin include mushrooms, wheat bran, tuna, chicken, turkey, asparagus, peanuts and animal proteins (which are rich in tryptophan).

What does it do?

Niacin is everywhere in the body. Niacin is like that person everyone wants at their party. Riboflavin coenzymes and niacin coenzymes participate in redox reactions, but niacin coenzymes are undeniably more ubiquitous. Niacin coenzymes participate in at least 200 reactions, most of those used to produce ATP (the chemical form of energy). Like riboflavin, niacin's role is to collect hydrogens to "feed the dragon", the electron transport chain (ETC), which ultimately results in a big release of energy (*see* riboflavin chapter for dragon metaphor explanation).

Another reason adults should appreciate niacin is its role in alcohol metabolism. Niacin helps with the first step of alcohol metabolism, helping the enzyme alcohol dehydrogenase convert ethanol to acetaldehyde. The body still has to break down acetaldehyde and get rid of it because it's acetaldehyde, not ethanol, which causes the slurring and poor coordination. Still, one step at a time, right?

Niacin and riboflavin have very similar roles but the consequences of not getting enough niacin are severe. The history and gravity of niacin deficiency are part of why niacin is so special.

Too Little, Too Much

One reason niacin is special is the body can make it to help meet demand. A vitamin is defined as an organic compound that is essential, meaning the body needs it but can't make it. If the body can make niacin from the amino acid tryptophan, is it still considered a vitamin? Yes, because we can't make tryptophan and because it takes 60 milligrams of tryptophan to make one milligram of niacin. Not to be overlooked, this reaction requires riboflavin.

Approximately 90 grams of protein provides about 60 milligrams of tryptophan, which gives up to 15 milligrams of niacin. The RDA is 16 milligrams per day for male adults; 14 milligrams per day for female adults. The Daily Value is 20 milligrams. Most energy drinks provide 100 percent DV.

Niacin Deficiency – mal de la rosa

A deficiency in niacin affects the whole body because niacin is used in so many metabolic reactions. Niacin deficiency leads to pellagra, which comes from the Italian words *pelle* (skin) and *agra* (rough). When this deficiency was first discovered in 1735 by Spanish physician Casal, it was named *mal de la rosa* or "Red Sickness". Signs of the deficiency include a red rash on the skin exposed to the sun, especially the neckline (hence the phrase

"Casal's necklace"). Pellagra is often referred to as the three d's: dementia, diarrhea and dermatitis. You could also call it a dietary deficiency disaster.

In 1915, more than 10,000 Americans died of pellagra and an estimated 200,000 more suffered from the disease between the end of World War I and the end of World War II. Some people had dementia so severe they were put into mental institutions. Niacin is the only vitamin associated with a deficiency that reached epidemic proportions in the US, and it all started with corn.

King Corn

Niacin deficiencies became wide-spread through Europe during the 1700s as corn became more of a dietary staple. Spanish settlers in Latin American learned the ways of the native populations that soaked the corn in lime water before cooking it, thereby releasing niacin from its protein lockdown. During the early 1900s, consumption of corn rose dramatically in the United States but the value of this soaking treatment was misunderstood. The cause of pellagra was also misunderstood, and it affected so many lives for so many years because it was thought to be contagious.

Cue the hero. Dr. Goldberger, a public health specialist, proved that Pellagra was not contagious by exposing himself and his colleagues to biological samples from patients with pellagra. One can only imagine the confidence and bravery it took to carry this out. Suffice to say, Dr. Goldberger helped resolve the dietary deficiency disaster by finding the true cause and

identifying the cure. With the introduction of niacin-enriched grains in 1941 and post-wartime increases in protein consumption, pellagra eventually disappeared in the United States.

Niacin Toxicity

The upper intake level of niacin intake is set to 35 milligrams, based on an effect called the Niacin Flush. At a daily dose as low as 35 milligrams, some people experience a red flush of the skin and itching. At amounts around 1.5 grams, other, more serious side effects like GI distress and liver damage have been reported. This flushing does not occur with niacin consumed from food, only supplemental niacin.

An exception to the upper intake level is when niacin is used to combat atherosclerosis (hardening of the arteries). When under supervision of a qualified physician and when combined with appropriate diet and exercise, doses 75-100 times the RDA ("mega-doses") of nicotinic acid may help lower "bad cholesterol" LDL levels and increase "good cholesterol" HDL levels. Prescriptions are normally provided in 1.5 – 2.0 grams nicotinic acid per day. One cannot and should not self-medicate and attempt to mega-dose without the help of a physician because this amount of niacin can cause serious side effects. Mega-doses of niacin are provided with a time-release coating that should minimize flushing of the skin, itching, gastrointestinal distress with nausea and vomiting, and liver damage.

Bottom Line

The sheer number of energy-related reactions niacin participates in makes it an excellent ingredient for an energy drink…to a point.

Don't exceed 35 milligrams of supplemental niacin. At that level some people feel warm and itchy – symptoms of niacin flush. Amounts around 1.5 grams could damage the liver.

PLEASE ALWAYS READ THE LABEL FOR AMOUNT OF NIACIN, SERVING SIZE AND SERVINGS PER CONTAINER.

Even if you're playing poker, a niacin flush is something to be avoided.

Read a Label in 10 Seconds or Less

The more you practice, the faster this exercise will go. What to look for:

10 – Amount of caffeine: Many products (supplements and beverages alike) are now listing the amount of caffeine and whether that's from all sources, meaning from added caffeine and the caffeine that's naturally part of a plant like guarana or tea. First check the Facts Panel that lists ingredients line by line. If you can't find it there, check below that box or on the sides. Don't consume more than 400 milligrams of caffeine per day. That's the maximum dosage recommended by Health Canada and the FDA, prompted by a huge review of scientific studies on caffeine safety. Consuming 3 – 10 grams of caffeine can be lethal (Sepkowitz 2012).

9 – Serving Size AND Servings per container: Don't assume one can is one serving, and even if it *is*, that doesn't mean your body needs the entire serving to feel more awake—no one will arrest you if you don't finish the whole can. If you always feel obligated to drink the entire can or you feel guilty about wasting your money on a drink you won't finish, buy a drink that contains only one serving.

8 – Nutrition Facts Panel or a Supplements Facts Panel: A Nutrition Facts panel means the product has to follow food/beverage regulations, meaning it contains only

approved food additives and ingredients Generally Recognized As Safe (GRAS).

7 – Recommended Use (for supplements and *some* beverages): Most energy products will say how many servings are recommended per hour and/or per day. These instructions are typically near the warnings for children, pregnant women and those sensitive to caffeine.

6 – First ingredient in Ingredients List (for beverages and *some* supplements) or "Other Ingredients" list (for supplements): Is the first ingredient carbonated water or just purified water? Carbonation will speed up absorption of caffeine through the stomach lining.

5 – Where's the sweet stuff: Sugar might be listed in the ingredients line as glucose, sucrose, trehalose or cane syrup. Look for natural alternative sweeteners like luo han/monk fruit and stevia. Sugar will make the product sweet and raise your blood sugar so try to go sugar-free. If you don't like alternative sweeteners, pick trehalose over glucose or sucrose because it gives the body more energy per gram and less of an insulin spike.

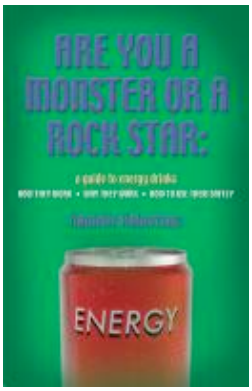
4 – B-12: Some people don't fully metabolize B-12 but this is a new discovery in genetics. Until your doctor can test you for this, don't assume you're one of those people and that you need 45,000 percent of B-12. Put it down, walk away.

3 – B-6: The Daily Value is 2 milligrams and the upper intake level is 100 milligrams (5,000 percent DV), based on development of nerve damage. Intakes of 2 – 6 grams

of B6 per day for two or more months can lead to irreversible nerve damage.

2 – Folic Acid: The Daily Value is 400 micrograms per day. For adults, the upper intake level is 1000 micrograms (250 percent DV) because more than that could mask a B-12 deficiency. The FDA limits the amount of folic acid in nonprescription vitamin supplements to 400 micrograms (100 percent DV) so it's rare to see more than that in an energy drink.

1 – Niacin (B3): The Daily Value is 20 milligrams. At 35 milligrams (175 percent DV), some people experience a red flush of the skin and itching. At amounts around 1.5 grams, more serious side effects like GI distress and liver damage have been reported. This flushing does not occur with niacin consumed from food, only from supplemental niacin.



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