German Federal Institute for Risk Assessment

FAQ

DD August 2025

Coffee, energy drinks and caffeine powder: Energizers with health risks?

Traditionally, foods containing caffeine are consumed primarily for their vitalising effect. Caffeine stimulates the cardiovascular and central nervous systems and can increase concentration and physical performance. The occurrence of possible undesirable effects such as nervousness or cardiac arrhythmia from consuming foods containing caffeine depends on individual sensitivity to caffeine and the extent to which such foods are consumed.

The following section answers key questions about foods containing caffeine – especially energy drinks as well as about caffeine powder marketed as a food supplement.

What is caffeine?

Caffeine is a natural alkaloid that occurs naturally in, for instance, coffee beans, tea leaves and cocoa beans. It can be isolated from these sources or produced industrially through chemical synthesis.

Caffeine is consumed through foods that naturally contain caffeine, such as coffee, tea and cocoa, as well as through the consumption of numerous foods to which caffeine is added, e.g. baked goods, ice cream, sweets, cola drinks and energy drinks. In addition, certain products containing caffeine in isolated form are also marketed, such as food supplements. Traditionally, caffeinated products have been used primarily for their stimulating effects.

What are the desirable and undesirable effects of caffeine?

Caffeine stimulates the cardiovascular system and the central nervous system, which, in moderate doses, leads to heightened concentration and alertness as well as improved physical performance.

However, high doses of caffeine can also have undesirable effects, such as increased nervousness and irritability, insomnia, sweating and palpitations. The occurrence of

undesirable effects depends largely on individual sensitivity to caffeine and the dose consumed. Over a longer period of time, excessive caffeine consumption can lead to cardiovascular problems, such as high blood pressure. In pregnant women, prolonged high caffeine intake can lead to reduced foetal growth.

Consuming several grams (5 to 10 g) of caffeine – amounts that generally cannot be obtained from common foods containing caffeine – can lead to acute, life-threatening circulatory failure.

How quickly does the body absorb caffeine? How quickly does it leave the system?

Caffeine is quickly and completely absorbed after oral ingestion. The stimulating effects can occur 15 to 30 minutes after consumption and may last for several hours. In the liver, caffeine is converted, broken down and finally excreted via the kidneys. The duration of the effect and the speed of breakdown can vary from person to person.

How much caffeine is harmless to health?

According to a risk assessment by the European Food Safety Authority (EFSA) from 2015, caffeine is not expected to pose a health risk to healthy adults when consumed in amounts of up to 200 milligrams (mg) in a single dose or within a short period of time (equivalent to 3 mg per kilogram (kg) of body weight). For habitual consumption, an intake of up to 400 mg of caffeine spread out over the day is considered harmless to the health of healthy adults.

However, for pregnant or breastfeeding women, a daily intake of up to 200 mg of caffeine is considered harmless to the health of the foetus and breastfed infants. For children and adolescents, EFSA has set harmless amounts based on body weight. According to this, 3 mg of caffeine per kg of body weight as a single dose or spread out over the day is not associated with negative effects in healthy children and adolescents.

Do the harmless intake levels for caffeine derived by EFSA apply to everyone?

The harmless intake amounts for caffeine derived by EFSA apply to the healthy general population, including specific subgroups such as children, adolescents, adults, the elderly, pregnant or breastfeeding women, and athletes.

The EFSA report did not assess the possible harmful effects of caffeine on people suffering from diseases or disorders and/or people who take drugs or medication in combination with caffeine or consume large amounts of alcohol. Therefore, the caffeine amounts deemed harmless do not apply to these groups of people.

Is there a labelling requirement for caffeine in food?

Beverages containing more than 150 mg of caffeine per litre must bear the label "*High caffeine content. Not recommended for children and pregnant or breastfeeding women*." This statement must be placed in the same region as the name of the food, followed by an indication of the caffeine content. This regulation does not apply to coffee or tea or

beverages based on coffee or tea extract where the term "coffee" or "tea" appears in the name.

A similar labelling requirement also applies to solid foods to which caffeine has been added.

For food supplements, the caffeine content must be indicated in reference to the recommended daily intake amount.

How much caffeine is contained in caffeinated beverages and foods?

Caffeine occurs naturally in some foods and beverages, such as coffee or chocolate. In other cases, it is added artificially, as is the case in energy drinks. The following table outlines how much caffeine is consumed through caffeinated beverages and foods.

Table 1: Caffeine content of various foods[a]

Beverage	Serving Size	Caffeine per serving
Filter coffee[b]	One cup (200 ml)	90 mg
Energy drink	One can (250 ml)	80 mg
Espresso	One cup (60 ml)	80 mg
Black tea	One cup (200 ml)	45 mg
Cola-drink	One can (330 ml)	35 mg
Cocoa drink	One cup (200 ml)	8 to 35 mg
Green tea	One cup (200 ml)	30 mg
Dark chocolate	Half a bar (50 g)	25 mg
Milk chocolate	Half a bar (50 g)	10 mg

[a] Source: Modified from EFSA (2015)
[b] All values are approximations; caffeine content may vary.

What are the main sources of caffeine intake?

According to the German National Nutrition Survey II (survey period 2005 to 2007) caffeine intake among adults in Germany is mainly via coffee (85 %) and according to the nutrition study as a KiGGS module (EsKiMo) wave II (survey period 2015 to 2017) among children (6 to 11 years) mainly via tea drinks (approx. 20%), caffeinated soft drinks (17%) and chocolate (12%) as well as pastries (11%). According to the EsKiMo II study, adolescents (aged 12 to 17) consume caffeine mainly through coffee (32 %), tea (30 %) and caffeinated soft drinks (20 %).

According to the EsKiMo II study, the relative contribution of energy drinks to overall caffeine intake is rather low, coming in at 1.1 % for children and 3.9 % for adolescents. However, it should be noted that the EsKiMo II study aims to determine the general eating habits of children and adolescents, meaning that the questions on energy drink consumption were meal-related. The acute consumption of energy drinks in other contexts was not surveyed. Thus, the study is likely to underestimate energy drink consumption.

In a 2012 study commissioned by EFSA which specifically surveyed the consumption of energy drinks in 16 EU Member States, it was calculated that around 10 % of the total caffeine intake of adolescents (aged 10 to 18) in Germany comes from energy drinks.

Caffeine powder sold as a food supplement: what is it?

Caffeine is a white, odourless, bitter-tasting powder. It can be isolated from natural foods such as coffee beans or tea leaves and it can also be produced synthetically (artificially). Caffeine powder, which is sold as a food supplement, is freely available in stores and online. Products containing only caffeine are available, as well as those that include additional nutrients or other substances. The products are used by athletes, for example, as so-called "pre-workout" products to enhance performance. However, caffeine powder sold as food supplement is also consumed in other situations with the aim of boosting energy and performance.

Is the consumption of food supplements containing caffeine harmless to health?

According to the risk assessment conducted by the European Food Safety Authority (EFSA), no health risk is expected for healthy adults when consuming up to 200 milligrams (mg) of caffeine in a single dose or 400 mg spread out over the day. This also applies to caffeine of food supplements.

However, according to the German Federal Institute for Risk Assessment (BfR), loose, highly concentrated or pure caffeine powder offered as food supplements—where consumers are expected to measure or weigh the recommended serving themselves—pose a high risk of accidental overdose. For example, in pure caffeine powder, the amount of powder corresponds to the amount of caffeine. This means that 0.2 grams (g) of powder (equivalent to 200 milligrams; roughly a pinch of powder) corresponds to 0.2 g of caffeine, which is already the maximum single dose considered harmless for human health.

Although the recommended amount is usually indicated on the products offered (usually 200 mg), such a small amount cannot be measured accurately with a conventional kitchen scale. These usually weigh in 1-gram increments. Even with measuring spoons provided, such a small amount can only be measured very inaccurately. In addition, pure caffeine powder is also sold as food supplements in larger packs of 200 grams or more. This can contribute to consumers underestimating the potency of the powder.

And while it is generally known that very high coffee consumption can cause severe restlessness, nausea, increased blood pressure, palpitations and cardiac arrhythmia, many consumers are unaware that consuming 5 to 10 grams of pure caffeine (roughly one to two teaspoons) is potentially life-threatening. Individual cases of severe or even fatal poisoning from such high amounts have been described in scientific literature.

What are energy drinks?

Energy drinks are caffeinated soft drinks that contain caffeine as well as at least one additional substance such as taurine, glucuronolactone or inositol.

The drinks are available in various serving sizes and are advertised as products for increasing concentration and physical performance.

Energy drinks should not be confused with hypo- or isotonic carbohydrate-containing sports drinks, which are designed to compensate for energy, water and electrolyte loss during physical exertion.

What are energy shots?

Energy shots are similar in composition to energy drinks, but contain significantly less water and are sold in smaller portions (25 to 75 millilitres (ml)). The concentration of caffeine in energy shots is usually significantly higher than in energy drinks. This means that a much higher amount of caffeine can be consumed in a very short time. Energy shots are often marketed as food supplements and, in such cases, may only be sold if accompanied by a recommended intake amount.

What ingredients do energy drinks contain?

The recipe of energy drinks can vary depending on the manufacturer, but usually contains the same basic ingredients. As a rule, energy drinks contain caffeine, glucuronolactone, taurine, inositol and sugar or sweeteners. In Germany, maximum levels apply to the amount of caffeine, glucuronolactone, taurine and inositol in energy drinks.

Are there legal limits for ingredients in energy drinks?

Since June 2013, legally binding maximum levels for the following four ingredients in energy drinks have applied in Germany, in accordance with the Fruit Juice and Soft Drinks Ordinance:

- Caffeine: 320 mg per litre
- Taurine: 4,000 mg per litre
- Inositol: 200 mg per litre
- Glucuronolactone: 2,400 mg per litre

The amount of caffeine contained in the drink must be stated by the manufacturer on the packaging of the energy drink.

What is taurine?

Taurine is obtained from food, particularly from fish, seafood and meat. The amount consumed through normal nutrition varies between 10 and 400 mg per day.

In animal studies, intake levels of up to 1,000 mg of taurine per kg of body weight per day showed no harmful effects.

Taurine also occurs naturally in the human body and is formed as a metabolic end product mainly from the amino acid cysteine. In the body, taurine is found particularly in the skeletal and heart muscles and in the brain. Laboratory studies on individual muscle fibres have

shown that taurine regulates calcium balance in the muscles. There is also evidence that taurine may increase heart muscle contractility.

According to a scientific opinion issued by EFSA in 2015, taurine in commercially available energy drink concentrations (4,000 mg taurine per litre) does not affect the safety of single doses of caffeine up to 200 mg (still a safe dose for healthy adults). However, consuming three conventional doses of energy drinks (250 ml each) already provides 240 mg of caffeine.

Previous studies on whether additional taurine intake increases physical and mental performance are contradictory and often of poor scientific quality. There is therefore no clear evidence of this to date.

What is glucuronolactone?

Glucuronolactone is an ester of glucuronic acid, which is also produced naturally in the body as a metabolite of glucose. Glucuronic acid plays a role in certain detoxification reactions in the body and is also an important component of connective tissue. Glucuronolactone is only absorbed in small amounts through food (1 to 2 mg per day). In animal studies, intake levels of up to 1,000 mg of glucuronolactone per kg of body weight per day showed no harmful effects.

According to a scientific opinion issued by EFSA in 2015, glucuronolactone in commercially available energy drink concentrations (2,400 mg glucuronolactone per litre) does not affect the safety of single doses of caffeine up to 200 mg (still a safe dose for healthy adults). However, consuming three conventional doses of energy drinks (250 ml each) already provides 240 mg of caffeine.

The data available to date does not indicate that the usual doses of glucuronolactone in energy drinks enhance physical or mental performance.

What is inositol?

Chemically speaking, inositol (cyclohexanehexol) is an alcohol that occurs in both plants and animals. Inositol is not an essential nutrient, as it can be produced in sufficient amounts in the body from glucose. Derivatives of inositol are important for cell function and play an important role in signal transduction within the cell, for example.

Most energy drinks contain 200 milligrams (mg) of inositol per litre, meaning that consuming a 250 ml can provides 50 mg of inositol. Overall, the toxicity of inositol is low, and only mild symptoms, such as discomfort, have been observed in studies involving intakes of several grams.

How much sugar do energy drinks contain?

On average, energy drinks contain approximately 100 grams (g) of sugar per litre in the form of glucose or sucrose. A single energy drink can (250 ml) can therefore contain a relatively high number of calories: 25 g of sugar corresponds to approximately 100 kilocalories or about eight sugar cubes. Glucose and sucrose are easily digestible and provide quick energy,

but they are only short-term energy sources. Sugar-free energy drinks with sweeteners are now also available.

How often and in what amounts do children and adolescents consume energy drinks?

The consumption of energy drinks by children and adolescents has been investigated, including by the DAK health insurance company. A survey conducted in schools in 13 German federal states ("Laender") in the 2021/22 school year in grades 5 to 10 (ages 11 to 15; N = 17,877) also asked about the consumption of energy drinks. A total of 9 % of pupils said they consumed such drinks at least once a week. Around 4 % drank them every day. Broken down by school year, the results were as follows:

- In years 5/6 (average age 11), 4 % of pupils said they drank energy drinks at least once a week, and around 2 % drank them daily.
- In years 7/8 (average age 13), 9 % of children said they drank energy drinks at least once a week, and around 4 % drank them daily.
- In years 9/10 (average age 14.9), 14 % of children said they drank energy drinks at least once a week, and around 6 % drank them daily.

According to the nutrition study conducted as part of the KiGGS module (EsKiMo) Wave II (survey period 2015 to 2017), the relative contribution of caffeine intake from energy drinks is relatively low—1.1% among children and 3.9% among adolescents. However, since the EsKiMo II study aims to assess the general dietary habits of children and adolescents, questions regarding energy drink consumption were asked in relation to meals. Acute consumption of energy drinks on specific occasions was not surveyed, which means the study likely underestimates actual energy drink consumption.

What are the effects of moderate consumption of energy drinks?

Due to their caffeine content, energy drinks have a stimulating and invigorating effect. In addition to caffeine, the large amounts of sugar contained in these products also leads to a short-term increase in performance. Sugar-free products, on the other hand, do not provide any additional energy.

Moderate consumption of energy drinks in accordance with consumer information is not expected to cause any health impairments in healthy adults. Consuming a standard 250 ml energy drink with a caffeine concentration of 320 mg per litre provides 80 mg of caffeine. This amount of caffeine is harmless to healthy adults and is roughly equivalent to one cup of coffee.

What are the effects of excessive consumption of energy drinks?

It is likely that the undesirable effects of energy drinks are mainly caused by caffeine. When consumed in large quantities within a short period of time, energy drinks can cause acute effects such as increased nervousness and excitability, insomnia, sweating and palpitations. Consuming just three energy drink cans (equivalent to 240 mg of caffeine) within a short period of time exceeds the single dose of 200 mg of caffeine that is considered safe for healthy adults. The occurrence of possible adverse effects depends on the extent of consumption, but also on individual sensitivity to caffeine.

In particular, the simultaneous consumption of large amounts of alcohol and/or extensive physical activity can have an additional negative effect on the cardiovascular system, as the effects may reinforce each other.

Case reports have described serious health impairments such as cardiac arrhythmia, fatal in some cases, following high consumption of energy drinks and simultaneous consumption of large amounts of alcohol or other drugs or concurrent intensive exercise. What is causally responsible for these consequences or whether it is the interaction of all parameters cannot be deduced from case reports. Pre-existing medical conditions may also have played a role in these cases.

The possible health consequences of chronic high consumption of energy drinks in adolescents, including for the cardiovascular system, are also being discussed within the scientific community. As there are no studies on this topic to date, it was investigated in the EDKAR study (Energy Drinks and Cardiological Risk), which was conducted under the direction of the BfR in cooperation with the Charité medical centre (see question: What was investigated in the EDKAR study and what do the results show?)

What was investigated in the EDKAR study and what do the results show?

For the EDKAR study (Energy Drinks and Cardiological Risk), more than 5,000 adolescents between the ages of 15 and 18 were initially surveyed at Berlin schools (including vocational schools) about their consumption of energy drinks using an online questionnaire. Adolescents who had been consuming energy drinks on at least four days a week for at least one year and who had consumed more than 3 milligrams (mg) of caffeine per kilogram of body weight through these drinks were defined as chronic heavy consumers. The identified heavy consumers and a control group of adolescents who did not consume energy drinks and only very few other caffeinated beverages underwent a comprehensive cardiological examination. Blood pressure and heart rate were measured, heart rate and heart rhythm were determined using an ECG (electrocardiogram), and the heart structures were analysed in detail using echocardiography.

The evaluation of the data showed that the heart parameters of the adolescents with high consumption (97 persons) did not differ from those of the control group (160 persons).

However, surveys of adolescents showed that almost half of those who consumed large quantities had experienced undesirable effects after consuming an energy drink. The most common symptoms reported were heart palpitations or rapid heartbeat, poor sleep, headaches and a feeling of pressure or tightness in the chest. Given that the adolescents who took part in the study reported acute effects but no discernible differences on their heart health, the researchers concluded that the cardiovascular system of adolescents is adaptable. However, the study does not provide any information on whether continued high consumption of energy drinks could potentially lead to impairments in heart at a later stage.

In this context, another result of the study is significant: adolescents who drank a lot of energy drinks smoked tobacco and marijuana more frequently than the control group. They also drank more alcohol and slept less. In total, they exhibited more behaviours that could endanger heart health in the long term.

Who should avoid energy drinks?

For some groups of people, increased caffeine intake is associated with a particularly pronounced health risk. These include children, pregnant or breastfeeding women and people who are sensitive to caffeine (e.g. people with cardiovascular disease). These groups of people should avoid consuming energy drinks.

Can energy drinks be consumed together with alcohol?

According to EFSA, moderate alcohol consumption (blood alcohol level up to 0.8 per mille) does not affect the safety of single doses of caffeine up to 200 mg (still a safe dose for healthy adults). However, consuming three conventional 250 ml energy drink cans already provides 240 mg of caffeine.

From the BfR's point of view, health risks may arise if energy drinks are consumed in large amounts in combination with large amounts of alcohol, as the effects on the cardiovascular system could be mutually reinforcing.

Are energy drinks suitable for optimising athletic performance?

Energy drinks should not be confused with isotonic beverages. Sport drinks mainly provide fluids and energy in the form of water and carbohydrates. They are hypotonic or isotonic, i.e. they have a lower or identical concentration of dissolved particles compared to blood, which means that the fluid is quickly absorbed by the body. Many sports drinks also contain caffeine, as it can increase endurance performance during exercise.

Energy drinks generally contain a relatively high amount of sugar. They therefore provide a lot of energy in the short term, but the high sugar content can delay fluid absorption through the digestive tract. As physical exertion increases the feeling of thirst, there is also a risk that energy drinks may be consumed in large amounts, resulting in high caffeine intake. The effects of exercise on the cardiovascular system can then be potentially exacerbated by high caffeine intake.

Moderate caffeine intake in connection with sport is harmless to health. The EFSA states that healthy adults are not expected to experience any health risks from single doses of up to 200 mg of caffeine, even if consumed less than two hours before intense physical exercise.

Further information on caffeine and energy drinks on the BfR website

Health assessment of caffeine
https://www.bfr.bund.de/en/food-safety/health-assessment-of-special-food-groups/selected-foods/health-assessment-of-caffeine/

Health assessment of energy drinks

https://www.bfr.bund.de/en/food-safety/health-assessment-of-special-food-groups/selected-foods/health-assessment-of-energy-drinks/

About the BfR

The German Federal Institute for Risk Assessment (BfR) is a scientifically independent public health institution within the portfolio of the German Federal Ministry of Agriculture, Food and Regional Identity (BMLEH). The BfR advises the Federal Government and the States ('Laender') on questions of food, feed, chemical and product safety. The BfR conducts independent research on topics that are closely linked to its assessment tasks.

This text version is a translation of the original German text which is the only legally binding version.

Legal notice

Publisher:
German Federal Institute for Risk Assessment
Max-Dohrn-Straße 8-10
10589 Berlin, Germany
T +49 30 18412-0
F +49 30 18412-99099
bfr@bfr.bund.de
bfr.bund.de/en

Institution under public law
Represented by the President Professor Dr Dr Dr h. c. Andreas Hensel
Supervisory Authority: Federal Ministry of Agriculture, Food and Regional Identity
VAT ID No. DE 165 893 448
Responsible according to the German Press Law: Dr Suzan Fiack

BfR | Identifying Risks –
Protecting Health