



# Scientific Facts on Aspartame

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## Level 2 - Details on Aspartame

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This Digest is a faithful summary of the leading scientific consensus report produced in 2002 by the European Commission Scientific Committee on Food (EC-SCF): *"Update on the Safety of Aspartame"*

The full Digest is available at: <https://www.greenfacts.org/en/aspartame/>

**i** This PDF Document is the Level 2 of a GreenFacts Digest. GreenFacts Digests are published in several languages as questions and answers, in a copyrighted user-friendly Three-Level Structure of increasing detail:

- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

*All GreenFacts Digests are available at: <http://www.greenfacts.org/>*

## 1. What is aspartame?

### 1.1 What is the history of aspartame?

Aspartame was discovered as a novel sweetener in 1965. It was first authorized to enter the market in the United States in 1974. This authorization was suspended a few months later on the grounds that the first studies had not properly evaluated if aspartame could be toxic to the brain or cause brain cancer. A new assessment of those studies and the examination of new data, led to a marketing authorization for solid food in 1981 and for soft drinks in 1983. Aspartame was finally authorized as general sweetener in 1996. Up to now, the safety of aspartame has been assessed by a number of national and international organisations. An Acceptable Daily Intake (ADI) of aspartame for humans has been set at 40 mg/kg body weight per day by an international committee of experts.

A debate on the risks to human health posed by the consumption of aspartame was relaunched, notably on the Internet, following an article published in 1996 which suggested there was a link between brain tumours and aspartame. Allegations claim that aspartame is responsible for a large number of adverse health effects such as multiple sclerosis, lupus erythematosus, Gulf War Syndrome, brain tumours, epileptic seizures, complications of diabetes, etc.

### 1.2 What are the uses and properties of aspartame?

Aspartame is marketed as table sweetener (for example, Canderel [see Annex 1, p. 6] <sup>®</sup>, NutraSweet [see Annex 3, p. 7] <sup>®</sup>). It is also incorporated in a number of foodstuffs throughout the world, including drinks, desserts and sweets (European code E951). It is a white, odourless powder, approximately 200 times sweeter than sugar, manufactured by combining phenylalanine and aspartic acid. Its main impurity is diketopiperazine that has no sweetening properties.

Aspartame is stable in the dry state and in frozen products. However, when stored in liquids at more than 30°C, it progressively converts into diketopiperazine, which is partially degraded into methanol, aspartic acid and phenylalanine. These transformations result in the loss of sweetness. Therefore, aspartame can not be used in cooked or sterilized foods.

### 1.3 Why is there concern about aspartame?

Some concerns have been raised about aspartame and its breakdown products (methanol, phenylalanine and aspartic acid). These concerns include epilepsy, brain tumours and effects on the nervous system.

Another concern is related to possible effect of aspartame breakdown products on specific people, including healthy infants, children, adolescents, adults, obese individuals, diabetics, lactating women, and people suffering from phenylketonuria (PKU) disease.

## 2. How much aspartame do people consume?

The Acceptable Daily Intake (ADI) of 40 mg/kg body weight per day set by the committee of experts of the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) is not likely to be exceeded, even by children and diabetics.

A European Commission (EC) report gives a theoretical maximum estimate for adults' consumption of 21.3 mg/kg body weight per day of aspartame. However, the actual consumption is likely to be lower, even for high consumers of aspartame. The report also gives refined estimates for children which show that they consume 1 to 40% of the Acceptable Daily Intake.

Other reports in Europe use actual food consumption data and actual sweetener levels in foods to estimate that high level intakes for the general population vary between 2.8 and 7.5 mg/kg body weight per day. People with diabetes are high consumers of foods containing aspartame; their highest reported intake varies between 7.8 and 10.1 mg/kg body weight per day.

## 3. What happens to aspartame once it is ingested?

Following ingestion, aspartame is broken down in the digestive tract to form aspartic acid, phenylalanine and methanol. Therefore, hardly any aspartame gets in the blood.

The body rapidly metabolises both aspartic acid and methanol, without significantly increasing their concentration in the bloodstream, even for aspartame taken as a single dose equivalent to the entire Acceptable Daily Intake (ADI).

At high doses usually surpassing the ADI, the level of phenylalanine in blood may increase with the dose of aspartame given. However, high doses generally do not increase the blood level more than a normal meal - except for individuals affected by phenylketonuria disease (homozygous PKU).

## 4. Can aspartame affect human health?

### 4.1 Can aspartame cause cancer or induce genetic damage?

#### 4.1.1 In laboratory studies:

- Aspartame did not induce genetic mutations.
- A study on mice showed no cancer effects. A first study on rats fed with very high doses of aspartame (1000 to 6000 mg/kg body weight per day) found a higher incidence of brain tumours. This study was contradicted by two subsequent ones. Therefore, it was concluded that aspartame does not cause brain cancer in laboratory animals.
- Diketopiperazine does not cause cancer or genetic mutation in rats or mice.

4.1.2 In 1996, Olney published an article linking the consumption of aspartame and the occurrence of brain tumours in the United States, which has been criticized by a number of scientists. Subsequent studies did not find such a link. In France, the sale of aspartame did not increase the frequency of brain tumours.

## 4.2 Can aspartame affect reproduction and development?

In laboratory animal tests, no effects on reproduction and development was observed below 4.000 mg/kg body weight per day. At higher doses, some pups grew marginally slower and weighed slightly less than normal because they ate less. No other effects of aspartame and its breakdown products were observed on reproduction and development (including neurodevelopment).

## 4.3 Can aspartame produce neurological disorders?

Following the marketing of aspartame, some consumers complained of neurological or behavioural effects. These complaints received special consideration because some experiments in rats had shown that very high doses of aspartame (1000 mg/kg body weight per day) could alter the concentrations of some important substances (neurotransmitters) in the central nervous system. However, it appears that these effects on neurotransmitters are not consistent and could not be reproduced in later studies.

About 10% of aspartame breaks down into methanol, which is known to be toxic. However, toxic effects on vision and the central nervous system only occur at doses of methanol 100 times higher than could be produced from the amount of aspartame in one litre of "diet" soft drink.

## 4.4 Can aspartame affect behaviour, cognition or mood?

Some years ago, it was suggested that aspartame could have effects on human behaviour and cognition. However, studies on laboratory animals showed no adverse effects on behaviour and cognition, even at very high doses (up to 2000 mg/kg body weight per day).

Also, studies in healthy adults and children and in people heterozygous for phenylketonuria (PKU) disease failed to show effects of aspartame on behaviour, mood or learning. But a study suggested that aspartame increased the frequency and severity of adverse effects in depressed individuals; this study must however be taken with caution as there were criticisms regarding the authors' interpretation and because too few subjects were evaluated.

## 4.5 Does aspartame cause headaches?

Headaches are one of the most commonly reported symptoms. Three studies on humans indicate a possible association between aspartame intake and headaches. However, it is not possible to draw conclusions. A more recent study in a controlled environment on individuals complaining of aspartame-related headaches concluded that aspartame was no more likely to trigger headaches than placebo.

## 4.6 Does aspartame trigger epileptic seizures?

Some websites report testimonies of people who identify aspartame as the cause of their health problems and epileptic seizures. A few studies have linked the consumption of large amounts of aspartame and the triggering of epileptic seizures. They suggest that aspartame could cause seizures by affecting the synthesis of neurotransmitters in the brain. Also, some animal studies indicate that aspartame reduces the threshold of sensitivity to chemically induced seizures.

Another study reported that aspartame could increase the duration of certain types of epileptic seizure in children. Effects of phenylalanine, aspartic acid and methanol on seizures have been reported, but under unusual conditions, such as high doses, particular sensitivities or rare types of seizures. This relationship has been refuted by a large number of scientists, who base their opinions on many animals and humans studies.

The Epilepsy Institute in the USA has also concluded that aspartame is not the cause of epileptic seizures.

#### **4.7 Can aspartame cause other health effects?**

Some individuals have attributed their allergic reactions to aspartame. However, two studies on such individuals indicated that their allergies were no more likely to be caused by aspartame than by placebo.

Other studies focusing on the effects of aspartame on hunger and food intake, reported that aspartame did not cause an increase in calorie consumption or body weight.

### **5. Conclusion**

Several national and international scientific committees have reviewed the health risks of aspartame consumption. They conclude:

- Compared to normal consumption of natural foods, aspartame consumption is only a minor source of aspartic acid, phenylalanine and methanol. Furthermore, aspartame intakes in adults, children and diabetics of all ages are unlikely to exceed the current Acceptable Daily Intake (ADI) (see question 2).
- Aspartame and its main impurity, diketopiperazine (DKP), do not cause cancer. Neither the tests on rodents nor the human epidemiological studies demonstrate that the consumption of aspartame causes brain tumours (see question 4.1).
- Overall, current studies do not bring evidence that aspartame induces changes in behaviour, cognition, mood or learning, even in individuals claiming to be sensitive and individuals heterozygous for phenylketonuria disease (PKU) (see question 4.3 & 4.4).
- Studies do not show that aspartame causes headaches (see question 4.5).
- There is no conclusive evidence that aspartame causes epileptic seizures (see question 4.6).
- Studies on individuals claiming to be allergic to aspartame do not confirm the claims (see question 4.7).

In its most recent evaluation (EEA 2002) the European Commission Scientific Committee on Food concluded that there is no need to revise the Acceptable Daily Intake (ADI) of 40 mg/kg body weight per day previously established for aspartame.

## Annex

### Annex 1:

#### What is Canderel ®?

Canderel ® is a low calorie artificial sweetener [see Annex 2, p. 7] , available in tablets and in a granular powder form. It uses a blend of ingredients, but its main sweetening ingredient is aspartame [see <https://www.greenfacts.org/en/aspartame/index.htm>].

One level teaspoon of granular Canderel is equivalent in sweetness to one level teaspoon of sugar, but it is much less caloric: 1 Teaspoon of Canderel (0.5g) = 2 Calories compared to 1 Teaspoon of Sugar (5g) = 16 Calories

Canderel tablets are available in dispensers in several sizes. One tablet is equivalent to one teaspoonful of sugar, but it contains about 50 times less calorie: one tablet of Canderel = 1/3 of a Calorie, compared to 1 teaspoon of sugar = 16 Calories.

Canderel® is just one of the brand names under which aspartame [see <https://www.greenfacts.org/en/aspartame/index.htm>] is marketed. This sweetener is used in many diet soft drinks and food preparations. Scientists have verified its safety and established an Acceptable Daily Intake for aspartame (ADI). *More* [see <https://www.greenfacts.org/en/aspartame/1-2/aspartame-99.htm#0>]

However, some allegations of aspartame side effects have launched debates on artificial sweeteners [see Annex 2, p. 7] such as Canderel. *More* [see <https://www.greenfacts.org/en/aspartame/1-2/aspartame-1.htm#3>]



One Canderel tablet is equivalent to one teaspoonful of sugar.

Canderel ® is a registered trade mark of Merisant.

#### Read the GreenFacts summary on aspartame and find out about the safety of Canderel.

1. What is aspartame? [see <https://www.greenfacts.org/en/aspartame/index.htm#1>]
2. How much aspartame do people consume? [see <https://www.greenfacts.org/en/aspartame/index.htm#2>]
3. What happens to aspartame once it is ingested? [see <https://www.greenfacts.org/en/aspartame/index.htm#3>]
4. Can aspartame affect human health? [see <https://www.greenfacts.org/en/aspartame/index.htm#4>]
5. Conclusion [see <https://www.greenfacts.org/en/aspartame/index.htm#5>]

## Annex 2:

### Can I use an artificial sweetener?

An artificial sweetener is a low calorie substance used as sweetener to replace sugars.

Carbohydrates, including sugars, are our body's main source of energy. We eat sugars occurring in fruits (fructose) and dairy products (lactose) and added sugars (sucrose).

We may want to replace sugars by an artificial sweetener such as aspartame when we want to loose weight. Also, diabetics need to limit their consumption of sugars; they can replace them by an artificial sweetener.

Aspartame [see <https://www.greenfacts.org/en/aspartame/index.htm>] is widely used as a low calorie sweetener in many diet soft drinks, food preparations and as table sweetener. *More* [see <https://www.greenfacts.org/en/aspartame/l-2/aspartame-1.htm#0>]

Food safety organizations have checked the safety of this artificial sweetener and of many others. However, some allegations of side effects still fuel debates. *More on the aspartame sweetener debate...* [see <https://www.greenfacts.org/en/aspartame/l-2/aspartame-1.htm#3>]

**Read the GreenFacts summary on aspartame and find out about the safety of Canderel.**

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Artificial sweeteners such as Aspartame (Canderel® [see Annex 1, p. 6] , NutraSweet® [see Annex 3, p. 7] ...) can be used in hot drinks in place of sugar.

## Annex 3:

### What is NutraSweet®?

NutraSweet® is the NutraSweet Company's brand name for the low-calorie artificial sweetener [see Annex 2, p. 7] aspartame [see <https://www.greenfacts.org/en/aspartame/index.htm>]. It is used to sweeten a variety of foods and beverages and is about 200 times sweeter than sugar.

Since aspartame is intensely sweet, very little is required to sweeten foods and beverages. Therefore products sweetened with aspartame are usually lower in calories.

NutraSweet® brand sweeteners have been widely used for diet carbonated soft drinks since their introduction in the early 1980

NutraSweet® is a registered trade mark of NutraSweet Property Holdings, Inc.

NutraSweet® is one of the brand names under which aspartame [see <https://www.greenfacts.org/en/aspartame/index.htm>] is marketed. More than 200 scientific studies have been conducted on aspartame over the last 30 years, verifying its safety and establishing an Acceptable Daily Intake (ADI).

However, alleged side effects of aspartame [see Annex 4, p. 8] fuel debates on artificial sweeteners [see Annex 2, p. 7] such as NutraSweet. *More* [see <https://www.greenfacts.org/en/aspartame/l-2/aspartame-1.htm#3>]

**Read the GreenFacts summary on aspartame and find out about the safety of Canderel.**

1. What is aspartame? [see <https://www.greenfacts.org/en/aspartame/index.htm#1>]
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5. Conclusion [see <https://www.greenfacts.org/en/aspartame/index.htm#5>]



NutraSweet® is used in a variety of foods and beverages and is about 200 times sweeter than sugar.

## Annex 4:

### What are the aspartame side effects?

Aspartame [see <https://www.greenfacts.org/en/aspartame/index.htm>] is an artificial sweetener [see Annex 1, p. 6] used in many diet soft drinks and food preparations. It was discovered in 1965 and entered the market in the 80's. Aspartame is marketed under several brand names, including Canderel [see Annex 1, p. 6] and NutraSweet [see Annex 3, p. 7]. More [see <https://www.greenfacts.org/en/aspartame/index.htm#1>]

A number of scientific organizations have analyzed aspartame for possible side effects. An Acceptable Daily Intake of 40 mg/kg body weight per day was established, while the consumption of aspartame in Europe is between 2.8 and 10.1 mg/kg body weight per day. More [see <https://www.greenfacts.org/en/aspartame/l-2/aspartame-2.htm#0>]

However, some allegations of side effects have launched a debate on the safety of artificial sweeteners [see Annex 2, p. 7] and aspartame.

*Does aspartame cause side effects on human health? [see <https://www.greenfacts.org/en/aspartame/l-2/aspartame-4.htm#0>]*

The scientific committees that reviewed the side effects of aspartame and its breakdown products concluded that:

- People get far less breakdown products from aspartame than from normal consumption of natural foods.
- Aspartame consumption is not likely to exceed the current Acceptable Daily Intake ((ADI)), even for children and diabetics.
- While some minor health effects may occur at very high doses, no effects are expected below the ADI. More [see <https://www.greenfacts.org/en/aspartame/l-2/aspartame-99.htm#0>]



The consumption of aspartame in Europe is well below the Acceptable Daily Intake.

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4. Can aspartame affect human health? [see <https://www.greenfacts.org/en/aspartame/index.htm#4>]
5. Conclusion [see <https://www.greenfacts.org/en/aspartame/index.htm#5>]