# Difference Between Ascorbic Acid and Citric Acid

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## **Difference Between Ascorbic Acid and Citric Acid**

Citric acid and ascorbic acid (vitamin C) have both similarities and differences.

They have completely different molecular structures.The similarities between citric acid and vitamin C come down to the fact that they are both acids commonly found in citrus fruits.

They also both have antioxidant properties and antimicrobial properties, per the *"Journal of Functional Foods".* As a result, they both have various health benefits.

#### Ascorbic acid | HC6H7O6



Ascorbic Acid (Vitamin C) Molecular Structure

Citric acid | C6H8O7



Citric Acid Molecular Structure

### Definition

Ascorbic acid: Ascorbic acid is a naturally occurring weak organic acid.

*Citric acid:* Citric acid is a weak organic tribasic acid.



Natural Synthesis from Lemons

### Represent a vitamin

**Ascorbic acid**: Ascorbic acid, also known as vitamin C, is an essential vitamin to the human body.

*Citric acid:* Citric acid is not a vitamin.

## **IUPAC Name**

**Ascorbic acid:** Its IUPAC name is (5R)-[(1S)-1,2-Dihydroxyethyl]-3,4-

dihydroxyfuran-2(5H)-one.

*Citric acid:* Its IUPAC name is 3-carboxy-3-hydroxypentane-1,5-dioic acid.

### **Other Names**

Ascorbic acid: It's also known as Vitamin C.

*Citric acid:* It's also known as 3-carboxy-3-hydroxypentanedioic acid, 2-hydroxy-1,2,3-propanetricarboxylic acid

### **Chemical Formula**

Ascorbic acid: Its chemical formula is C6H8O6.

Citric acid: Its chemical formula is C6H8O7.

### **Molar Mass**

Ascorbic acid: Its molar mass is 176.12 g·mol-1

Citric acid: Its molar mass is 192.12 g·mol-1

### Appearance

Ascorbic acid: It is white or light yellow solid.

*Citric acid:* It is crystalline white solid.

### Density

Ascorbic acid: Its density is 1.65 g/cm3 Citric acid: Its density is 1.665 g/cm3

### **E-numbers**

#### Ascorbic acid: Its E-numbers include

- 1. E300 ascorbic acid
- 2. E301 sodium ascorbate
- 3. E302 calcium ascorbate
- 4. E303 potassium ascorbate
- 5. E304 fatty acid esters of ascorbic acid (i) ascorbyl palmitate (ii) ascorbyl stearate

### Citric acid:

1. E-number is E330

## **Natural Food Sources**

**Ascorbic acid:**\_Green leafy vegetables, yellow and green color fruits and vegetables such as Indian gooseberry, guava, banana, etc. contain ascorbic acid.

**Citric Acid:** Lemon, lime, grapefruit, lemonade, oranges and orange juice contain citric acid.

### **Uses and Functions**

- 1. Act as a powerful antioxidant
- 2. Use as a food preservative agent
- 3. Enhance the bioavailability of dietary iron
- 1. Use as a food preservative agent
- 2. Use as Cleaning and chelating agentDifference Between Ascorbic Acid and
- 3. It's certainly possible for foods to contain both substances. Lemons, for example, have both citric acid and vitamin C.

# That being said, citric acid and ascorbic acid should not be confused with one another

Unlike vitamin C, citric acid is not one of the recommended vitamins and minerals you need each day. *Citric acid also has not been linked to the prevention of diseases or connective tissue repair, unlike ascorbic acid*.

Citric acid also does not have the same effects on the immune system and levels of cholesterol as vitamin C.

These important differences mean citric acid has many more commercial uses — unlike nutrient vitamin C, citric acid is also used in cleaning products, cosmetics and pharmaceuticals



### **Citrus Fruit**

## ASCORBIC ACID VERSUS

# CITRIC ACID

Naturally occurring weak organic acid	Weak organic tribasic acid
Essential vitamin to the human body	Not a vitamin
(5R)-[(1S)-1,2- Dihydroxyethyl]-3, 4-dihydroxyfuran- 2(5H)-one	3-carboxy-3- hydroxypentane-1, 5-dioic acid
С6Н8О6	C6H8O7
176.12 g·mol-1	192.12 g·mol-1
White or light yellow solid	Crystalline white solid
Contained in green leafy vegetables, yellow and green color fruits and vegetables like, guava & banana	Contained in lemon, lime, grapefruit, lemonade, oranges and orange juice Pediaa.com

## What Is Citric Acid?

Citric acid is found in your favorite citrus fruits, processed foods, medicines and even cleaning agents. Natural citric acid in lemons is different from manufactured citric acid found



Synthetic Citric Acid Crystals

in other products, however.

When it was first discovered in the 18th century, citric acid was derived from lemon juice. Now, it's obtained by sugar fermentation. It's common practice to use a fungus or black mold called Aspergillus niger in this process. The main source of 'synthetic' citrus acide is Grain (mainly GMO corn)

Since commercially made citric acid is sourced from Aspergillus niger, which is a known allergen, its safety is cause for concern.

In a 2018 study published in Toxicology Reports, researchers found that citric acid may be linked to inflammatory symptoms, such as swelling, stiffness and abdominal pain. There have been several case reports of patients exhibiting symptoms within two to 12 hours of ingesting foods containing manufactured citric acid. However, no reports exist stemming from ingestion of natural forms of citric acid, such as with too much citrus.

Despite the findings, the researchers conclude that evidence is limited and more research is needed to determine the safety of manufactured citric acid.

According to the U.S. Food and Drug Administration, citric acid falls within its "Generally Recognized as Safe" (GRAS) designation.

## **Citric Acid Side Effects**

Like many substances, citric **acid has its pros and cons**. It's considered a safe food preservative, and it may even have some health benefits. *According to Cleveland Clinic, citric acid may be taken orally to balance the pH of urine*, to prevent kidney stones and to treat symptoms related to kidney problems.

However, *there are concerns about citric acid poisoning*. In food and beverages, manufactured citric acid is present in trace amounts. Most of the citric acid side effects are associated with oral usage.

Side effects associated with citric acid medicines or supplements:

- Upset stomach
- Feeling weak or tired
- Lightheadedness
- Diarrhea
- Nausea or vomiting
- Numbness in the hands or feet

Symptoms, allergic reactions and side effects from citric acid are very rare. Few reported cases exist, though researchers press for more studies to be done on the long-term effects of manufactured citric acid.

## Citric Acid vs. Ascorbic Acid: Which Is Healthier?

## **Avoiding Citric Acid Poisoning**

Citric acid poisoning from consuming too much citrus is highly unlikely. Naturally occurring citric acid has many health benefits and very few risks, but manufactured citric acid is much different.

Though it's FDA-approved, some researchers question the safety of citric acid. It's wise to be aware of the potential side effects, **especially if you're allergic or sensitive to the fungi used in the manufacturing process**.

## Do Humans Make Citric Acid?

**The citric acid cycle**, which is also known as the *Krebs cycle* or tricarboxylic acid (TCA) cycle, is a biochemical process that takes place inside the body's mitochondria, which are known as the powerhouse of the cell.

In this process, fuel molecules — like amino acids, carbohydrates and fatty acids — are oxidized. This process helps produce most of the energy the cells in your body use. The **citric acid cycle does produce citrate**, but it's not the same as the citric acid you consume in citrus fruits or other food products.



**Citric acid and Ascorbic Acid** are two weak natural organic acids that occur naturally in fresh leaves, fruits and vegetables, particularly citrus fruits such as oranges, lemons and limes.

Both acids have nutritional benefits, and they're commonly used in food manufacturing and as a preservative, but there are few differences between the two compounds, including a difference in flavor.

However, there seems to be a lot of confusion over *the difference between ascorbic acid and citric acid*.

### Can you possibly die from too much citric acid?

This acid is generally considered non-toxic. Most people would need to consume a very high dose of it to suffer serious side effects — much more than is found in most foods. However, **there's more concern regarding citric acid supplements and citrate medications**.

### Serious side effects of taking too much citrate:

numbness or tingly feeling	swelling or rapid weight gain
muscle twitching or cramps	fast or slow heart rate
bloody or tarry stools	severe stomach pain
ongoing diarrhea	seizures

The main difference between ascorbic acid and citric acid is that ascorbic acid is a watersoluble vitamin and has a chemical make-up of C6H8O6 whereas citric acid has one more oxygen atom than ascorbic acid formula, making its chemical formula C6H8O7. This article, highlights the difference between ascorbic acid and citric acid in terms of their intended uses and other

### Heartburn or acid reflux symptoms?

Acid reflux/heartburn is caused by acidic digestive juices creeping up from the stomach and entering back into the esophagus and can be due to low stomach acid, poor digestion, inflammation and other causes. To help manage acid reflux, you'll want to cut back on oily, meaty foods, fast foods, processed cheeses, chocolate, alcohol and caffeine.

Spicy foods and acidic foods, like tomatoes, tomato products, onions, citrus fruits and citrus juice, may also make heartburn symptoms worse. While acidic foods aren't usually the cause of heartburn, it might be best to avoid them until you've addressed other underlying issues. People who have peptic ulcers or other GI sensitivities may also experience irritation from citric acid, so they will want to limit their intake.

### In some cases, is citric acid bad for you or harmful?

It is mostly harmless, but when found in packaged foods it's often made from GMO ingredients and may be linked to mold and allergies. It can be irritating to the skin or digestive system and can interact with medications when taken in supplement form.

## Mold or Corn Allergy

**Citric acid** can be synthetically produced using a type of mold called Aspergillus niger, a safe strain of black mold. It's much cheaper to produce it this way than to use the natural version.

In the manufacturing process, the mold culture is fed sugar solutions, which are often derived from corn. This is often the source of citric acid used as a food additive in many processed foods.

There's a high demand for citric acid production because it's used as a flavoring agent, preservative, cleansing agent and in many other ways. Since it's added to many prepackaged foods and is made from fungus, there are, however, concerns about citric acid side effects.



The side effects of citric acid are associated with medicines and supplements containing this ingredient. They include inflammatory symptoms and allergies, though a reaction of any kind is rare.

It's not unusual to have an allergy or a sensitivity to mold or corn, and in fact, many people who react to foods containing citric acid may actually be allergic to the mold or the corn used to produce the acid.

If you have an allergy or sensitivity to airborne mold or mold found in the environment, you may also react to mold in or on the foods you eat.If you're allergic to corn, you may be sensitive to the

tiny amount of corn that's left in citric acid during the manufacturing processIn conclusion, ascorbic acid and citric acid are different weak organic acids and they have different chemical and sensory properties.

## References

- Lotfy, Walid A.; Ghanem, Khaled M.; El-Helow, Ehab R. (2007). Citric acid production by a novel Aspergillus niger isolate: II. Optimization of process parameters through statistical experimental designs. Bioresource Technology 98 (18): 3470–3477.
- Zheng, F. Xiao, L.M. Qian, Z.R. Zhou; Xiao; Qian; Zhou (December 2009). Erosion behavior of human tooth enamel in citric acid solution. Tribology International 42 (11– 12): 1558–1564.
- 3. Davies, Michael B.; Austin, John; Partridge, David A. (1991). Vitamin C: Its Chemistry and Biochemistry. The Royal Society of Chemistry. p. 48. ISBN 0-85186-333-7.

National Institutes of Health: "Vitamin C"

https://ods.od.nih.gov/factsheets/VitaminC-HealthProfessional/

Journal of Endourology: "Quantitative Assessment of Citric Acid in Lemon Juice, Lime Juice, and Commercially-AvailableFruituiceProducts"

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2637791/

Food Science and Technology: "Effect of Ascorbic Acid in Comparison to Citric and Lactic Acid onListeria monocytogenes Inhibition at Refrigeration Temperatures"

https://www.sciencedirect.com/science/article/abs/pii/S0023643896900419

Nutritional Management of Renal Disease (Third Edition): Chapter 24 - Vitamin Metabolism and Requirements in Renal Disease and Renal Failure

https://www.sciencedirect.com/science/article/pii/B9780123919342000242

FDA: "Overview of Food Ingredients, Additives & Colors"

https://www.fda.gov/food/food-ingredients-packaging/overview-food-ingredients-additivescolors

Utah State University Extension: "Pretreatments to Prevent Darkening of Fruits Prior to Canning or Dehydrating" PDF

https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=2781&context=extension\_curall