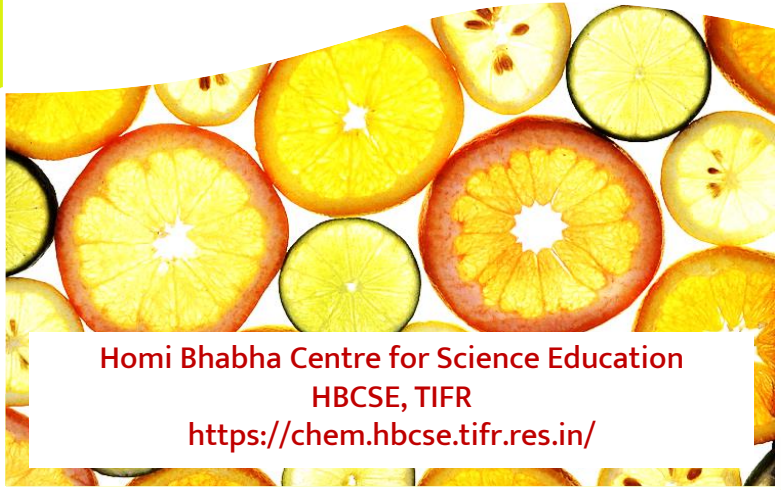
CITRIC ACID



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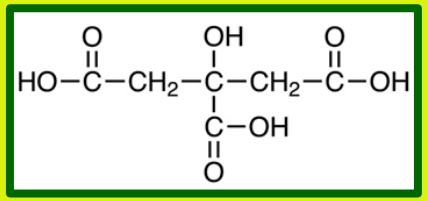
Molar mass : 192.1 g mol^{-1}
Melting point : 153 °C – 159 °C
Boiling point : 310 °C



Citric acid is a well-known naturally occurring edible acid. It is an odorless, crystalline colorless, crystalline, water soluble, solid. It is present in fruits like oranges, lemons, grapefruits which occur worldwide. The sour taste of these fruits is due to citric acid.

Chemical properties

- Citric acid is a weak tribasic acid with pK_a values 3.1, 4.7 and 6.4.
- It can be esterified at one or more of the three carboxyl groups using alcohols depending on the use. For example fully esterified triethyl citrate is used in pharmaceutical coatings and plastics.
- Citric acid can form complexes with metallic cations, eg. ammonium ferric citrate, which is used as a food additive

History

Citric acid was first isolated in 1784 by chemist, Carl Wilhelm Scheele, who crystallized it from lemon juice.

Carl Wilhelm Scheele

Industrial-scale citric acid production first began in 1890 in Italian citrus fruit industry. During World War I, citrus fruit export from Italy was disrupted. Hence, after World War I, the production of citric acid from sugar started, based on a process discovered by Carl Friedrich Wilhelm Wehmer in 1893 using *Penicillium* mold.

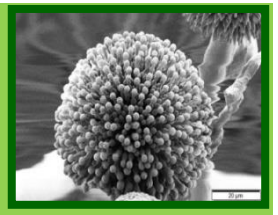
Did you know???

Major components of cow milk are water, lactose and protein but it also contains about 0.2% by mass of citric acid.

Sources

Lemons have about ~4-8% of citric acid of the total dry weight of the fruits whereas, oranges and grapefruits have about ~0.6-1%

Aspergillus niger is superior to other microorganisms for the commercial production of citric acid from sugar.



Aspergillus niger

Sugar cane and beet molasses are common raw materials which are used as sources of citric acid. Due to its high sugar content (40–55%) and comparatively low cost, molasses is also used as the source of sugar for microbial production of citric acid.

Blackstrap molasses, by product of sugar cane refining

Do you know???

Citric acid is the essential component of cellular respiratory Krebs cycle in animals and plants, where it is consumed and regenerated in a series of redox reactions with the corresponding release of stored energy from carbohydrates, fats and proteins into (adenosine triphosphate) ATP and CO_2.

Production

In 1919, Pfizer, a multinational pharmaceutical company began industrial scale production of citric acid using the microbial method employing *Aspergillus niger*. Citric acid production through this method is still the major industrial route.

Pfizer headquarters 2016, Manhattan, New York City

In 1977, the Lever Brothers patented the industrial synthesis of citric acid from isocitrate calcium salts.

More than 50% of the acid is used in beverages, 20% in food applications, 20% for detergent applications, and 10% in cosmetics, pharmaceutical and chemical industries. Global production of citric acid was about 20 million tons in 2018.

Applications

Citric acid is added to ice creams as an emulsifying agent to keep fats from separating out

Used as a flavoring agent and preservative in soft drinks and foods like candies.

Used in cosmetic products as it removes dead skin cells, improves skin tone and helps in skin growth by reducing wrinkles.

Reference and further reading

Soccol, C.R et al. (2006) Citric Acid Production. *Food Technol Biotechnol*, 44 (2), 141–149.

Apelblat, A. (2014). *Citric Acid*. New York, United States: Springer Publishing.

Photos :

Citrus. In *Wikipedia*. Retrieved July 24, 2020, from https://en.wikipedia.org/wiki/Citrus

Aspergillus niger prepared using the freeze drying method, SEM image (2016) Mogana Das Murtey and Patchamuthu Ramasamy. CC BY-SA 3.0.

Can you answer this?

Which country is the largest producer of citric acid?

Identify the items in your house that contain citric acid.

What is the IUPAC name of citric acid?