Stearic acid

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Stearic acid (***STAIR**-ik* or ***STEER**-ik*) is the saturated fatty acid with an 18-carbon chain and has the IUPAC name **octadecanoic acid**. It is a waxy solid, and its chemical formula is $CH_3(CH_2)_{16}CO_2H$. Its name comes from the Greek word στέαρ *"stéar"*, which means tallow. The salts and esters of stearic acid are called **stearates**. Stearic acid is one of the most common saturated fatty acids found in nature following palmitic acid.[2]

Contents

Production

It occurs in many animal and vegetable fats and oils, but it is more abundant in animal fat (up to 30%) than vegetable fat (typically <5%). The important exceptions are cocoa butter and shea butter, where the stearic acid content (as a triglyceride) is 28–45%.[3]

Stearic acid is prepared by treating these fats and oils with water at a high pressure and temperature (above 200 °C), leading to the hydrolysis of triglycerides. The resulting mixture is then distilled.[4] Commercial stearic acid is often a mixture of stearic and palmitic acids, although purified stearic acid is available.

In terms of its biosynthesis, stearic acid is produced from carbohydrates via the fatty acid synthesis machinery via acetyl-CoA.

Uses

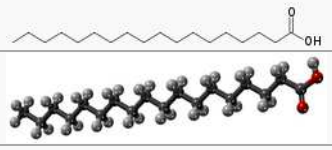
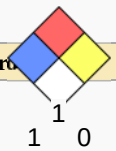
In general, applications of stearic acid exploit its bifunctional character, with a polar head group that can be attached to metal cations and a nonpolar chain that confers solubility in organic solvents. The combination leads to uses as a surfactant and softening agent. Stearic acid undergoes the typical reactions of saturated carboxylic acids, a notable one being reduction to stearyl alcohol, and esterification with a range of alcohols.

Soaps, cosmetics, detergents

Stearic acid is mainly used in the production of detergents, soaps, and cosmetics such as shampoos and shaving cream products. Soaps are not made directly from stearic acid, but indirectly by saponification of triglycerides consisting of stearic acid esters. Esters of stearic acid with ethylene glycol; glycol stearate and glycol distearate, are used to produce a pearly effect in shampoos, soaps, and other cosmetic products. They are added to the product in molten form and allowed to crystallize under controlled conditions. Detergents are obtained from amides and quaternary alkylammonium derivatives of stearic acid.

Lubricants, softening and release agents

In view of the soft texture of the sodium salt, which is the main component of soap, other salts are also useful for their lubricating properties. Lithium stearate is an important component of grease. The stearate salts of zinc, calcium, cadmium, and lead are used to soften PVC. Stearic acid is used along with castor oil for preparing softeners in textile sizing. They are heated and mixed with caustic potash or caustic soda. Related salts are also commonly used as release agents, e.g. in the production of automobile tires.

Stearic acid[1]	
	
IUPAC name	
Octadecanoic acid	
Other names	
C18:0 (Lipid numbers)	
Identifiers	
CAS number	57-11-4 ✓
PubChem	5281
ChemSpider	5091 ✗
DrugBank	DB03193
ChEMBL	CHEMBL46403 ✗
Jmol-3D images	Image 1 (http://chemapps.stolaf.edu/jmol/jmol.php?model=CCCCCCCCCCCCCCCCCC%28%3DO%29O)
SMILES	
Properties	
Molecular formula	$C_{18}H_{36}O_2$
Molar mass	284.48 g mol^{-1}
Appearance	white solid
Density	0.847 g/cm^3 at 70 °C
Melting point	69.8 °C (157.6 °F; 342.9 K)
Boiling point	382 °C (720 °F; 655 K)
Solubility in water	3 mg/L (20 °C)
Refractive index (n_D)	1.4299
Thermochemistry	
Specific heat capacity *C*	501.5 J mol^{-1} K^{-1}
Hazard	
NFPA 704	
Flash point	110 °C (230 °F; 383 K)
Except where noted otherwise, data are given for materials in their standard state (at 25 °C (77 °F), 100 kPa)	
✗ (verify) (what is: ✓/✗?)	
Infobox references	

Niche uses


Stearic acid

Being inexpensively available and chemically benign, stearic acid finds many niche applications, for example, in making plaster castings from a plaster *piece mold* or *waste mold* and in making the mold from a shellacked clay original. In this use, powdered stearic acid is mixed in water and the suspension is brushed onto the surface to be parted after casting. This reacts with the calcium in the plaster to form a thin layer of calcium stearate, which functions as a release agent. When reacted with zinc it forms zinc stearate, which is used a lubricant for playing cards (fanning powder) to ensure a smooth motion when fanning. In compressed confections, it is used as a lubricant to keep the tablet from sticking to the die.

Stearic acid is also used as a negative plate additive in the manufacture of lead-acid batteries. It is added at the rate of 0.6 g per kg of the oxide while preparing the paste.[5] It is believed to enhance the hydrophobicity of the negative plate, particularly during dry-charging process. It also reduces the extension of oxidation of the freshly formed lead (negative active material) when the plates are kept for drying in the open atmosphere after the process of tank formation. As a consequence, the charging time of a dry uncharged battery during initial filling and charging (IFC) is comparatively lower, as compared to a battery assembled with plates which do not contain stearic acid additive.

Fatty acids are classic components of candle-making. Stearic acid is used along with simple sugar or corn syrup as a hardener in candies.

Stearic acid is used to produce dietary supplements.

In fireworks, stearic acid is often used to coat metal powders such as aluminium and iron. This prevents oxidation, allowing compositions to be stored for a longer period of time.

Stearic acid is a common lubricant during injection molding and pressing of ceramic powders.[6] It is also used as a mold release for foam latex that is baked in stone molds.

Metabolism

An isotope labeling study in humans[7] concluded that the fraction of dietary stearic acid that oxidatively desaturates to oleic acid is 2.4 times higher than the fraction of palmitic acid analogously converted to palmitoleic acid. Also, stearic acid is less likely to be incorporated into cholesterol esters. In epidemiologic and clinical studies, stearic acid was found to be associated with lowered LDL cholesterol in comparison with other saturated fatty acids.[8] These findings may indicate that stearic acid is healthier than other saturated fatty acids.

See also

- Magnesium stearate
- Sodium stearate

References

1. ^ Susan Budavari, ed. (1989). *Merck Index* (11th ed.). Rahway, New Jersey: Merck & Co., Inc. p. 8761. ISBN 978-0-911910-28-5.
2. ^ Gunstone, F. D., John L. Harwood, and Albert J. Dijkstra. The Lipid Handbook with Cd-Rom. 3rd ed. Boca Raton: CRC Press, 2007. ISBN 0849396883 | ISBN 978-0849396885
3. ^ Beare-Rogers, J.; Dieffenbacher, A.; Holm, J.V. (2001). "Lexicon of lipid nutrition (IUPAC Technical Report)" (http://iupac.org/publications/pac/73/4/0685/). *Pure and Applied Chemistry* **73** (4): 685–744. doi:10.1351/pac200173040685 (http://dx.doi.org/10.1351%2Fpac200173040685).
4. ^ David J. Anneken, Sabine Both, Ralf Christoph, Georg Fieg, Udo Steinberner, Alfred Westfechtel "Fatty Acids" in Ullmann's Encyclopedia of Industrial Chemistry 2006, Wiley-VCH, Weinheim. doi:10.1002/14356007.a10_245.pub2 (http://dx.doi.org/10.1002%2F14356007.a10_245.pub2)
5. ^ L.T. Lam et al. Journal of Power Sources 73 (1998) 36–46
6. ^ Tsenga, Wenjea J.; Mo Liua, Dean; Hsub, Chung-King (1999). "Influence of stearic acid on suspension structure and green microstructure of injection-molded zirconia ceramics". *Ceramics International* **25** (2): 191–195. doi:10.1016/S0272-8842(98)00024-8 (http://dx.doi.org/10.1016%2FS0272-8842%2898%2900024-8).
7. ^ Emken, Edward A. (1994). "Metabolism of dietary stearic acid relative to other fatty acids in human subjects". *American Journal of Clinical Nutrition* **60** (6): 1023S–1028S. PMID 7977144 (//www.ncbi.nlm.nih.gov/pubmed/7977144).
8. ^ Hunter, J. Edward; Zhang, Jun; Kris-Etherton, Penny M. (January 2010). "Cardiovascular disease risk of dietary stearic acid compared with trans, other saturated, and unsaturated fatty acids: a systematic review". *Am. J. Clinical Nutrition* (American Society for Nutrition) **91** (1): 46–63. doi:10.3945/ajcn.2009.27661 (http://dx.doi.org/10.3945%2Fajcn.2009.27661). ISSN 0002-9165 (//www.worldcat.org/issn/0002-9165). PMID 19939984 (//www.ncbi.nlm.nih.gov/pubmed/19939984).

External links

- NIST Chemistry WebBook Entry (http://webbook.nist.gov/cgi/cbook.cgi?Name=stearic+acid&Units=SI)

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