

# Malic, Maleic and Malonic Acid

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## Question

What is the origin of the names malic, maleic and malonic acid?

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## Answer

Malic acid [(HOOC)CH<sub>2</sub>-CH(OH)(COOH)] was first isolated from apple juice by the Swedish chemist, Carl Wilhelm Scheele (figure 1), in 1785 (1). Scheele simply referred to it as “acid of apples” or as *acide de pommes* in French. Two years later, in 1787, Lavoisier and his collaborators, in their famous memoir on chemical nomenclature, suggested the alternative name *acide malique*, from the Latin *malum* or apple, and this was eventually Anglicized as malic acid (2).

In 1834 the French chemist, Théophile Jules Pelouze (1807-1867), distilled malic acid and identified among the resulting dehydration products two new acids having the same composition [(HOOC)CH=CH(COOH)], but very different properties (3). Following the suggestion of Ampère, Pelouze proposed the names *acide maléique* and *acide para-maléique* for his new compounds - names which were eventually Anglicized as maleic and para-maleic acid. Later the same year, the French chemist, Horace Demarçay, published a short note (4) pointing out that both the composition and the properties of Pelouze’s para-maleic acid were identical to those of an acid isolated two years earlier by the German chemist, F. L. Winckler, from the pharmaceutical preparation *Extractum fumariae*, which was, in turn, prepared from the herb *Fumaria officinalis* (5, 6). In recognition of this fact, Winckler had named his new compound *fumarsäure* or fumaric acid. We now know that the maleic acid of Pelouze and the fumaric acid of Winckler are an example of cis and trans isomerism and that they would, via the work of van’t Hoff and Wislicenus, play an important role in the development of modern stereochemistry in the last quarter of the 19th-century (7).



Figure 1. Carl Wilhelm Scheele (1742-1786).

In 1858 the French chemist, Victor Dessaignes (1800-1885), prepared yet a third acid [(HOOC)-CH<sub>2</sub>(COOH)] from malic acid via its oxidation with chromic acid, which he identified as a possible isomer of “l’acide nicotique de M. Barral.” In order to emphasize both this relationship and its preparation from malic acid, Dessaignes proposed the name *acide malonique*, which was eventually Anglicized as malonic acid (8). Thus the names of all three acids are ultimately derived from the Latin word for apples.

## Literature Cited

1. C. W. Scheele, “On the Acid of Fruits and Berries,” *Kongl. Vetenskaps Academiens Nya Handlingar.*, **1785**, 6, 17-27 (In Swedish). An English translation may be found in L. Dobbins, Ed., *The Collected Papers of Carl Wilhelm Scheele*, Bell and Sons: London, 1931, pp. 267-275.
2. L. Guyton de Morveau, A. Lavoisier, C. Berthollet, A. Fourcroy, *Méthode de nomenclature chimique*, Cuchet: Paris, 1787, p. 150.
3. T. J. Pelouze, “Mémoire sur les produits de la distil-

lation de l'acide malique," *Ann. chim. phys.*, **1834**, 56, 72-87.

4. H. Demarçay, "Identité de l'acide fumarique de M. Winckler avec l'acide para-maléique de M. Pelouze," *Ann. chim. phys.*, **1834**, 56, 429-433.

5. F. L. Winckler, "Ueber eine neue Säure (Fumarsäure) in *Extractum Fumariae*," *Buchners Repertorium*, **1832**, 34, 48-76.

6. The name *fumaria* or *fumatory* supposedly comes from the Latin words *fume* (smoke) and *terra* (earth) and thus means "smoke of the earth." A variety of contradictory explanations have been offered for this rather imaginative name, none of which are worth repeating here.

7. See the translations in G. M. Richardson, Ed., *The Foundations of Stereo Chemistry; Memoirs by Pasteur, van't Hoff, Le Bel, and Wislicenus*, American Book Co: New York, NY, 1901.

8. V. Dessaignes, "Note sur un acide obtenu par l'oxydation de l'acide malique," *Comptes rendus*, **1858**, 47, 76-79.

*Do you have a question about the historical origins of a symbol, name, concept or experimental procedure*

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### 2009 Update

Since writing the column I have come upon the following rather curious anecdote concerning the Latin word *malum* or apple. It seems that the original manuscripts to the Old Testament do not specify that Eve ate an apple (which in any case is not indigenous to Palestine) while in the Garden, but rather merely that she partook of the "fruit" of the Tree of Knowledge. It is speculated that, when translating the Old Testament into Latin, the Monks translated "fruit" as "apple" because *malum* was a play on the Latin word *malus* for evil - thus providing both a pun and a metaphor for the Fall of Man.