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Organic Compounds: Insights into Their Structure, Properties, and Applications

Pourya Zarshenas *

Department of Chemistry Giacomo Ciamician, University of Bologna, Bologna, Italy

Short Communication

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***For Correspondence:** Pourya Zarshenas, Department of Chemistry Giacomo Ciamician, University of Bologna, Bologna, Italy

Email: dr.pouryazarshenas@yahoo.com

DESCRIPTION

In chemistry, many authors consider an organic compound to be any chemical compound that contains carbon-hydrogen or carbon-carbon bonds, although the definition of "organic" versus "inorganic" varies from author to author, and is a topic of debate. For example, methane (CH_4) is considered organic, but whether halides of carbon without hydrogen (e.g. carbon tetrachloride CCl_4) are organic or inorganic varies from author to author.

Due to carbon's ability to catenate (form chains with other carbon atoms), millions of organic compounds are known. The study of the properties, reactions, and syntheses of organic compounds comprise the discipline known as organic chemistry. For historical reasons, a few classes of carbon-containing compounds (e.g., carbonate salts and cyanide salts), along with a few other exceptions (e.g., carbon dioxide, hydrogen cyanide), are not classified as organic compounds and are considered inorganic. Other than those just named, little consensus exists among chemists on precisely which carbon-containing compounds are excluded, making any rigorous definition of an organic compound elusive.

Although organic compounds make up only a small percentage of Earth's crust, they are of central importance because all known life is based on organic compounds. Living things incorporate inorganic carbon compounds into organic compounds through a network of processes (the carbon cycle) that begins with the conversion of carbon dioxide and a hydrogen source like water into simple sugars and other organic molecules by autotrophic organisms using light (photosynthesis) or other sources of energy. Most synthetically-produced organic compounds are ultimately derived from petrochemicals consisting mainly of hydrocarbons, which are themselves formed from the high pressure and temperature degradation of organic matter underground over geological timescales. This ultimate derivation notwithstanding, organic compounds are no longer defined as compounds originating in living things, as they were historically. In chemical nomenclature, an organyl group, frequently represented by the letter R, refers to any monovalent substituent whose open valence is on a carbon atom.

For historical reasons discussed below, a few types of carbon-containing compounds, such as carbides, carbonates (excluding carbonate esters), simple oxides of carbon (for example, CO and CO2), and cyanides are considered inorganic. Different forms (allotropes) of pure carbon, such as diamond, graphite, fullerenes, and carbon nanotubes are also excluded because they are simple substances composed of only a single element and therefore are not generally considered to be chemical compounds. The relatively narrow definition of organic compounds as those containing C-H bonds excludes compounds that are (historically and practically) considered organic. Neither urea nor oxalic acid are organic by this definition, yet they were two key compounds in the vitalism debate. The IUPAC Blue Book on organic nomenclature specifically mentions urea and oxalic acid. Other compounds lacking C-H bonds but traditionally considered organic include benzenehexol, mesoxalic acid, and carbon tetrachloride. Mellitic acid, which contains no C-H bonds, is considered a possible organic substance in Martian soil. Terrestrially, it, and its anhydride, mellitic anhydride, are associated with the mineral mellite.

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