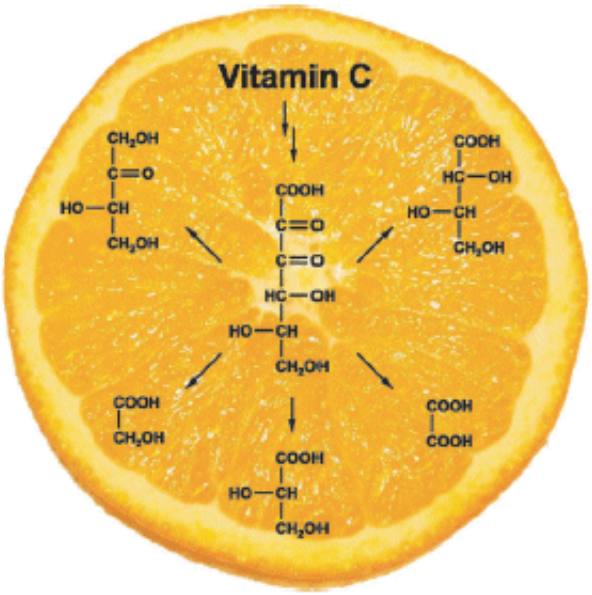
Reaction pathways for Maillard degradation of vitamin C

April 2 2013



(Phys.org) —Vitamin C is found in many foods, and, among other things, is used to prolong shelf life. However, it is not stable in air or at room temperature. Cut fruits turn brown and the tastes of foods change. In the journal *Angewandte Chemie*, German researchers have now presented a systematic study of the processes that occur during the degradation of vitamin C.

Vitamin C, ascorbic acid, is a reducing carbohydrate and can react with amino acids, peptides, and proteins. These types of reactions between carbohydrates (sugars) and proteins belong to a class of reactions known as Maillard reactions, which are named after the man who discovered them, Louis Camille Maillard. Maillard reactions are ubiquitous: They make our toast crispy, are responsible for the smell of browning meat, and give roast potatoes their aroma.

However, the Maillard reactions of vitamin C are less pleasant. They are involved in the browning of cut fruit and can cause changes in the flavor of foods. In addition, the Maillard degradation of vitamin C in the body may be involved in clouding the lenses of the eyes and in the age-related loss of elasticity in the skin and sinews.

The process of vitamin C degradation has previously not been truly understood. Marcus A. Glomb and Mareen Smuda at the Martin Luther University of Halle-Wittenberg have now comprehensively studied the amine-catalyzed degradation of vitamin C in a model system. By using vitamin C molecules marked in various places with 13C isotopes, they were able to trace the products of the Maillard reaction back to their original positions in the vitamin C structure. They also carried out experiments under an atmosphere of 18O2 isotopes and quantified all of the primary fragmentation products. This allowed them to clarify about 75 % of the Maillard-induced degradation reactions of vitamin C: the end products are carbonyl and dicarbonyl compounds, carboxylic acids, and amides.

Among other compounds, the researchers identified N6-xylonyl lysine, N6-lyxonyl lysine, and N6-threonyl lysine as unique characteristic end-products of vitamin C Maillard systems. In the future, identification of these compounds will make it possible to differentiate between vitamin C related Maillard reaction products and those stemming from other reducing carbohydrates like glucose.

The insights gained from this model system help to clarify the changes that occur in vitamin C containing foods during storage and preparation, even though the reaction pathways in real systems are naturally far more complex. These experiments also lay the groundwork for a better understanding of the negative effects of vitamin C degradation in the body.

More information: Glomb, M. Maillard Degradation Pathways of Vitamin C, *Angewandte Chemie International Edition*: dx.doi.org/10.1002/anie.201300399

Provided by Angewandte Chemie