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Symposium Introduction

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100 Years of the Maillard Reaction: Why Our Food Turns Brown

About a hundred years ago, Louis Camille Maillard, a French scientist who was admitted to the Faculty of Science in the University of Nancy, France, at the age of 16, studied the reaction between amino acids and sugars during heating.[1] From his results, the scientist suspected that there was a specific reaction yielding a class of chemical compounds responsible for the way raw ingredients changed their color to dark brown and produced carbon dioxide when heated (Figure 1). Louis Camille Maillard named the class of brown compounds formed "melanoidins" and continued his work to elucidate the formation pathways because he thought the reaction products would be important for health. Despite intensive research, it took another 40 years to identify the early stages of the Maillard reaction, the "non-enzymatic browning of foods". The American chemist John Hodge of the U.S. Department of Agriculture (USDA) sorted out the chemistry of the early stages of the reaction between reducing carbohydrates and amino acids, as published in the *Journal of Agricultural and Food Chemistry* back in 1953, the first comprehensive scheme of the reaction.[2] However, the entire mechanisms of reactions in the presence of amino acids, sugars, and high heat are still not fully understood. When a food containing amino acids and sugars is exposed to heat, a multitude of compounds are rearranged and molecules are created, resulting not only in the formation of colored structures but also in the formation of aroma and flavor compounds. A comprehensive compilation of the chemistry and biochemistry behind the Maillard reaction has been published by H. Nursten.[3]

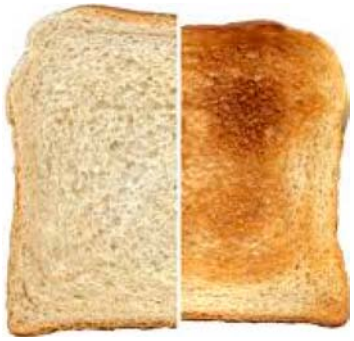

Figure 1.

Today, we know that Maillard reaction products are major determinants of food quality: Many of these compounds are responsible for a food's, texture, smell, taste, shelf life, and health value. The health impact of diets containing high amounts of Maillard reaction products has become a recent focus of research because not only harmful compounds, such as heterocyclic amines and acrylamide, but also beneficial structures, such as melanoidins that exert antibacterial and antioxidative effects in the gastrointestinal tract, have been identified. However, the search for structure-specific health effects of Maillard reaction products still starts with the elucidation of reaction mechanisms.

The centennial of the Maillard reaction was celebrated by members of the International Maillard Reaction Society (www.imars.org) on the occasion of the 11th International Symposium on the Maillard Reaction (ISMR11) held in Nancy, France, September 16−20, 2012. In this special volume, nine papers presented at this conference provide insights into novel reaction pathways (contributions by T. Davidek and I. Blank et al.; M. Smuda and M. Glomb; M. Kaufmann and W. Kroh et al.; C. Smarrito-Menozzi et al.; and R. Zamora et al.) and analytical techniques (contributions by S. Gensberger and M. Pischetsrieder et al.; and F. L. Chu and V. Yaylayan et al.) of and for Maillard reaction products formed in foods during heat treatment. Another paper provides an overview of strategies to mitigate acrylamide formation in foods (M. Anese et al.). The absorption of methylglyoxal, formed not only during heat treatment of foods but also in organisms by numerous enzymatic and nonenzymatic reactions, from honey was studied by the group of T. Henle (J. Degen et al.). This work demonstrated rapid intestinal degradation for methylglyoxal as a low molecular weight Maillard reaction compound.

Future studies will be aimed at integrating the knowledge on the chemical structure of Maillard reaction products and their biological effects after dietary intake. Hence, the development of innovative technologies that will mitigate harmful compounds while enhancing the contents of health beneficial compounds will be enabled, thereby maintaining or even improving the nutritional and sensorial properties of processed foods.

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Notes

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REFERENCES

(1) Maillard, L. C. Action des acides amines sur les sucres: formation des melanoidines par voie methodique. *C. R. Acad. Sci.* **1912**, *154*, 66−68.

(2) Hodge, J. Chemistry of browning reactions in model system. *J. Agric. Food Chem.* **1953**, *1*, 928−943.

(3) Nursten, H. *The Maillard Reaction Chemistry, Biochemistry and Implications*; Royal Society of Chemistry: London, UK, 2005.

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