SYMPOSIUM: METAL-CATALYZED LIPID OXIDATION

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Introduction to the 2nd Symposium on Metal-Catalyzed Lipid Oxidation

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The second symposium on Metal-Catalyzed Lipid Oxidation was organized as part of the Joint ISF and AOCS World Congress. The first symposium of this type took place in October 1967 at the Swedish Institute for Food Preservation Research (SIK) in Göteborg, Sweden. On that occasion 29 papers were read. These papers as well as the discussions were subsequently published. Both symposia were organized by the author of this introduction. A third symposium is planned for 1973.

In the years between the first and the second symposia numerous relevant investigations have been performed and published in this field. The reason for arranging this second symposium was, however, not so much this new material as the geographic difference of the audience, mainly European at the first symposium and American at the second. There could, therefore, occur some overlapping of the problems discussed in Göteborg and Chicago, but there was no real repetition of the papers of the first symposium.

The overall structures of the two symposia were the same: one section on analytical methods and procedures, one on matters of basic research type and a third on problems of practical interest, especially of interest to the edible oils industry and to food processing.

The area covered by the symposium includes numerous fields, which makes the subject both attractive and difficult. Many branches of basic and applied science-type are involved: fat chemistry, food chemistry, biochemistry, physico-chemistry, medicine, enzymology, analysis, technology and others.

Knowledge about metal-catalyzed lipid oxidation is still rather limited and research in this sector has been less extensive owing to the lack of suitable methods for quantitative analysis and qualitative determination of the physico-chemical state of metal traces in the lipid material. In this respect, however, our possibilities have increased considerably in recent years, which has resulted in rapid development in research and, consequently, widening of the scope of our knowledge in this field.

Another factor contributing to this development is the increased importance of metal-catalyzed lipid oxidation due to increasing risks of metal contamination and metal catalysis. Our requirements on the quality of food products and the damage caused by lipid oxidation are also much more rigorous than formerly.

Earlier the analytical determination of metal traces was time-consuming and often unreliable. Development of atomic absorption, activation analysis and electron spin resonance has, however, effected quite a change. Application of such new techniques may not only facilitate a correct quantitative analysis but also yield important information about physico-chemical conditions.

Determination of lipid oxidation itself is a more general problem not confined to metal-catalyzed lipid oxidation. Research on lipid oxidation is, however, still handicapped by the lack of suitable methods for the grading of lipid oxidation. The difficulty is mainly due to the diversity of lipid composition and, consequently, of the products of oxidation formed. It is now understood that the quantifica-

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tion of lipid oxidation requires consideration of qualitative aspects as well.

About one half of the contributions, the second group, is connected with aspects of more or less basic research, such as kinetics and mechanisms, often studied in model systems, while the rest is devoted to problems encountered in food and other biological material.

As in many other fields of research the complexity of the situation prevailing in systems like food products often places the researcher in a dilemma. This complexity requires simplification by studies in model systems. On the other hand, results in model systems may occasionally be without any real bearing on the true situation. However, in a simple model system, such studies are often the only way to approach the complex problem.

Research on the theory of metal-catalyzed lipid oxidation is intimately connected with research on catalyzed oxidation of hydrocarbons. In fact, most of the research has been done with hydrocarbons. An outstanding investigator in this field, Keith Ingold, Ottawa, gave a review of this subject at the first meeting in Göteborg. Another outstanding scientist in this area is W.A. Waters from Oxford, U.K., who accepted to present the introductory review at the second symposium.

An important question is, what makes a substance a more or less strong catalyst. Much information is given in the literature, based either on theoretical considerations or empirical experiments. Nevertheless, it is still difficult to answer this question as the catalytic effect is dependent on many circumstances. Catalytic effects can be expected mainly in the case of certain heavy metals, especially those with several valency states and with a suitable redox potential, e.g., cobalt, copper, iron and manganese.

An aspect of great importance for the catalytic effect and its elimination is the physico-chemical state of the metals. Metal traces in general occur as more or less dissociated metal salts or are bound in coordination compounds such as chelates. The formation of coordination compounds and their behavior as catalysts is of particularly great interest. Hemoglobin and other hemoproteins, chlorophyll and metal-containing enzymes play an important role as catalysts of lipid oxidation. On the other hand chelating agents are used for stabilizing oils and fats. The role of metallic chelates in the promotion and prevention of metal-catalyzed oxidation is, consequently, an important subject.

In the third group of contributions, certain problems related to metal-catalyzed lipid oxidation in food and other biological material are discussed. The items treated are concerned mainly with problems bearing on vegetable and animal oils and fats, margarine, dairy products, meat and fish.

Other branches of science and technology may be involved, as shown by problems of medical interest which were dwelt on, as well as problems due to metal catalysis in the field of packaging.

The discussions were chaired by R. Marcuse, Göteborg; W.A. Waters, Oxford, U.K.; H.S. Olcott, Davis, Calif.; L.R. Dugan, Jr., East Lansing, Mich.; E.G. Hammond, Ames, Iowa; and A.L. Tappel, Davis, Calif.

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