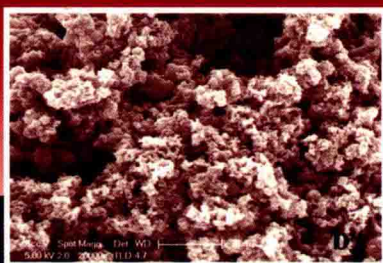
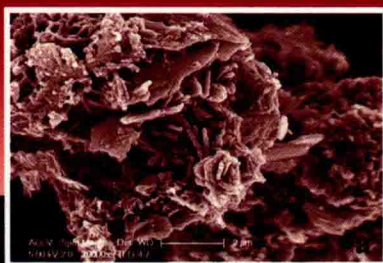


Synthesis, Properties, and Applications



Edited by

Giuseppe Cirillo
and Francesca Iemma

Antioxidant Polymers

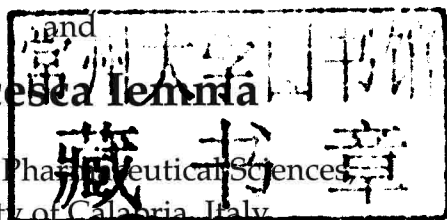
Synthesis, Properties,
and Applications

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Preface

This book is a complete and detailed overview on the recent development in the field of polymeric materials showing antioxidant properties. The research area has grown rapidly in the last decade because antioxidant polymers combine the advantageous properties of both polymeric materials and antioxidants components.

The importance of antioxidant materials in biomedicine, bio-pharmaceutics, cosmetic and nutrition has been highlighted by various scientific reports including research articles, review articles, as well as book chapters, proving the link between oxidative stress and the development of several human pathologies such as cancer, cardiovascular and neurodegenerative diseases, atherosclerosis, and so on. On the other hand, advancements in synthesis techniques and processing technologies have transformed both natural and synthetic polymers into an integral part of everyday life, with importance from both production and application points of view in innovative technological and engineering processes.

Antioxidant polymers are a topic of great interest for researchers in many industrial fields: a large number of research groups have helped to develop various industrial divisions such as pharmaceutical, cosmetic and food industry, plastic materials industries and nano-engineering technology. Furthermore, the strong interest in these materials has stimulated the activity of botanic and marine researchers that have broadened the expertise in this context.

In materials science, antioxidant polymers are studied in terms of innovative and unique physical-chemical properties with particular emphasis to the stability behaviour as well as to the mechanical strength and long-time stability. Recent years have, indeed, witnessed significant progress in the development of efficient and tailor-made stabilizer compounds for various plastics, rubbers, elastomers and coatings to meet the needs of the multiple industrial sectors.

In the biomedical area, antioxidant conjugates of various polymers were synthesized in consideration of extension and amplification of the physiological properties. In particular, novel drugs (e.g. anticancer, synthetic enzymes) or pro-drugs, in which the active ingredient is a molecule showing antioxidant ability, were proposed; furthermore, new polymeric drug delivery systems and tissue scaffolds have been prepared by covalent and/or non-covalent incorporation of antioxidant molecules with the aim to increase the bio-compatibility and to reduce the living tissue side-effects. In the last cases, the antioxidant is required to overcome the side-effects recorded after the topic or systemic administration of the device.

Regarding the pharmaceutical and cosmetic industry, the interest in antioxidant polymers is related not only to their biological activity, but also to their ability to protect the whole formulation and its components from degradation. A considerable limitation in the use of some promising pharmaceutical and cosmetic formulation is often ascribed to the short-term stability of their components which leads to the reduction of their efficiency and, even worse, to the development of toxic side-effects.

Last but not least, it should also be mentioned that food science and technology show this to be an important breakthrough area. Antioxidant polymers are studied from both a nutritional and an industrial points of view with respect to new functional foods or materials for food packaging. The growing evidence about specific health benefits of natural polymeric products, coupled with the recent popularity of functional foods, has led to an increased interest among food scientists to characterize and incorporate them in food products. The presence of antioxidant compounds in food has a strong impact on human health and nutritional value, contributing to the preservation quality of foods while in storage conditions. During storage, the nutritional behaviour of a food could be altered as a consequence of the interaction with atmospheric agents or packaging materials. To overcome these problems, an emerging field is the so-called "intelligent packaging", in which the materials employed for the production of the package are based on antioxidant polymers.

The whole of the above-mentioned application fields of antioxidant polymers are highlighted in this book. The contributors are researchers from top universities and research and development laboratories (from Europe, USA, Asia and Oceania) and their chapters give an exhaustive overview of the synthesis, characterization, and

practical applicability of these materials. In the choice of the chapter contributions and related authors, particular attention has been devoted to cover all the aspects of polymeric antioxidant materials.

After the first chapter which deals with a complete overview of the antioxidant compounds, the book goes in detail with the description of the natural and synthetic polymeric antioxidants, with particular attention to both their chemical and biological properties. The naturally occurring polymeric antioxidant (e.g. polyphenols and flavonoids) are subsequently treated, and the principal synthetic approach based on enzymatic catalysis for their synthesis explored. After this introductory section, polysaccharide biopolymers produced by different organisms are analyzed in terms of antioxidant properties and the most significant chemical approaches for their modification with the aim to improve their antioxidant activity are highlighted. The overview on natural polymers concludes with the treatment of particular kinds of antioxidant polymers (polysaccharides and proteins) from marine origin and to their extraction methodologies.

The section about synthetic antioxidant polymers starts with the description of enzyme mimics and follows with an overview on conducting polymers. Subsequently, a more chemical approach is present in the description of functionalized side-chain polymer with polyphenol moieties.

The final chapters of the book are mainly focused on applications. After an overview of the possible industrial application of the antioxidants in which particular attention is devoted to the differences between the applicability of low- and high-molecular weight antioxidants, as well as to some synthetic approaches for their preparation, the book elucidates the applicability of polymers and antioxidants in pharmaceutical and biomedical fields for the preparation of innovative drug delivery devices and tissue scaffolds.

Finally, the editors would like to thank all the contributing authors for their high quality cooperation which is the primary intent of this edited volume.

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March 23, 2012

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Contents

Preface	xv
List of Contributors	xix
1. Antioxidants: Introduction	1
<i>Chunhuan He, Yingming Pan, Xiaowen Ji and Hengshan Wang</i>	
1.1 The Meaning of Antioxidant	1
1.2 The Category of Antioxidants and Introduction of often Used Antioxidants	2
1.2.1 BHT	4
1.2.2 Quercetin	5
1.2.3 BHA	5
1.2.4 2- <i>tert</i> -Butylhydroquinone (TBHQ)	6
1.2.5 Gallic Acid	6
1.2.6 Resveratrol	6
1.2.7 Luteolin	7
1.2.8 Caffeic Acid	7
1.2.9 Catechin	7
1.3 Antioxidant Evaluation Methods	8
1.3.1 DPPH Radical Scavenging Assay	8
1.3.2 ABTS Radical Scavenging Activity	8
1.3.3 Phosphomolybdenum Assay	9
1.3.4 Reducing Power Assay	9
1.3.5 Total Phenols Assay by Folin-Ciocalteu Reagent	10
1.3.6 Hydroxyl Radical Scavenging Assay	10
1.3.7 β -carotene-linoleic Acid Assay	11
1.3.8 Superoxide Radical Scavenging Assay	11
1.3.9 Metal Ion Chelating Assay	12
1.3.10 Determination of Total Flavonoid Content	12

1.4	Antioxidant and its Mechanisms	13
1.4.1	Mechanism of Scavenging Free Radicals	13
1.4.2	Mechanism of Metal Chelating Properties	14
1.5	Adverse Effects of Antioxidants	15
	References	16
2.	Natural Polyphenol and Flavonoid Polymers	23
	<i>Kelly C. Heim</i>	
2.1	Introduction	23
2.2	Structural Classification of Polyphenols	24
2.2.1	Simple Phenolics	24
2.2.2	Stilbenes	26
2.2.3	Lignin	27
2.2.4	Flavonoids	28
2.2.5	Tannins	29
2.3	Polyphenol Biosynthesis and Function in Plants	34
2.3.1	Biosynthesis	34
2.3.2	Protective Roles	36
2.4	Tannins in Human Nutrition	36
2.4.1	Dietary Sources and Intake	36
2.4.2	Absorption and Metabolism	37
2.5	Antioxidant Activity of Tannins	41
2.5.1	Mechanisms	41
2.5.2	Structure-activity Relationships	44
2.6	Protective Effects of Proanthocyanidins in Human Health	45
2.7	Conclusion	46
	Acknowledgements	46
	References	47
3.	Synthesis and Applications of Polymeric Flavonoids	55
	<i>Hiroshi Uyama and Young-Jin Kim</i>	
3.1	Introduction	55
3.2	Polycondensates of Catechin with Aldehydes	57
3.3	Enzymatically Polymerized Flavonoids	69
3.4	Biopolymer-flavonoid Conjugates	76
3.5	Conclusion	84
	References	84

4. Antioxidant Polymers: Metal Chelating Agents	87
<i>Hiba M. Zalloum and Mohammad S. Mubarak</i>	
4.1 Introduction	87
4.1.1 Antioxidants	87
4.1.2 Natural Polymers as Antioxidants	88
4.1.3 Chelating Polymers and Heavy Metal Ions	90
4.2 Chitin and Chitosan	91
4.2.1 Chitin and Chitosan Derivatives	94
4.2.2 Chitin and Chitosan as Chelating Agents	95
4.3 Alginates	96
4.4 Chelation Studies	97
4.4.1 Chitosan Derivatives as Chelating Agents	101
4.4.2 Alginates as Chelating Agents	103
4.5 Conclusions	106
References	107
5. Antioxidant Polymers by Chitosan Modification	115
<i>Jarmila Vinšová and Eva Vavříková</i>	
5.1 Introduction	115
5.2 Chitosan Characteristics	117
5.3 Reactive Oxygen Species and Chitosan as Antioxidant	117
5.4 Structure Modifications	120
5.4.1 N-Carboxymethyl Chitosan Derivatives	120
5.4.2 Quaternary Salts	121
5.4.3 Sulphur Derivatives	122
5.4.4 Chitosan Containing Phenolic Compounds	124
5.4.5 Schiff Bases of Chitosan	127
5.5 Conclusion	129
References	129
6. Cellulose and Dextran Antioxidant Polymers for Biomedical Applications	133
<i>Sonia Trombino, Roberta Cassano and Teresa Ferrarelli</i>	
6.1 Introduction	133
6.2 Antioxidant Polymers Cellulose-based	134
6.2.1 Cellulose	134
6.2.2 Antioxidant Biomaterials	
Carboxymethylcellulose-based	135
6.2.3 Ferulate Lipoate and Tocopherulate Cellulose	136