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Review

Determination of antiradical and antioxidant activity: basic principles and new insights

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Although the term "antioxidant" is used very frequently, there are problems with the definition of antioxidants and estimation of antioxidant activity. The distinction between antioxidant and antiradical activities is not always obvious. This minireview discusses critically the principles, advantages and limitations of the most frequently used methods of estimation of antiradical and antioxidant activities.

Keywords: antioxidant, antiradical, DPPH, ABTS, hydroxyl radical

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CURRENT STATE OF THE ART

"It is difficult these days to open a popular science magazine or medical journal without seeing an article about the role of free radicals in human diseases" (Gutteridge & Halliwell, 1994). This sentence written in 1994 by the leading scientists in the field of free radicals and antioxidants, John Gutteridge and Barry Halliwell, is true today as well. Another statement of those authors that "antioxidant is a term widely used but rarely defined" (Halliwell & Gutteridge, 1999), has also remained true. A *Google* search for "antioxidants definition" brings more than 600 000 entries! Halliwell and Gutteridge propose to define an antioxidant as "*any* substance that, when present at low concentration compared with those of an oxidizable substrate, significantly delays or prevents oxidation of that substrate" (Halliwell & Gutteridge, 1999). This definition covers all oxidation processes, both radical and non-radical ones. But, as noted elsewhere, "a generic definition of an antioxidant is not experimentally constructive unless it is associated with the notion of the oxidant that has to be neutralized" (Azzi *et al.*, 2004). Moreover, the validity of the term "antioxidant" depends on the environment of its action, viz. whether we consider an *in vitro* or *in vivo* reaction. In this context a precise definition of conditions and processes in which antioxidant action is studied becomes crucial. Outside this context, a statement that some compound is an antioxidant may not bring any biologically meaningful information.

The literature of the last decade concerning free radical reactions *in vivo* shows that our understanding of these processes in the organism, both under normal conditions and in pathological situations, has changed considerably. Free radicals and reactive oxygen species in general are no longer seen only as destructive factors but also (and perhaps first of all) as messengers involved in intracellular and intercellular signalling (Bartosz, 2005; 2009; Halliwell, 2006). The revision of the ideas on the role of free radical reactions in the functioning of cells and organisms has led to a new concept of redox equilibrium. According to this hypothesis, oxidative stress is a modulation of thiol redox reactions, involved mainly in signalling pathways. Therefore, non-radical oxidants (enzymatically generated hydrogen peroxide, other peroxides, quinones, etc.) play a basic role in the oxidation of thiols for the sake of signalling, without the necessity of formation of free radical intermediates (Ghezzi *et al.*, 2005; Jones, 2006; 2008).

Similar changes are taking place with respect to our understanding of the role of vitamin E (α-tocopherol) in living processes. For a long time it was believed that the main function of vitamin E is its antioxidant action in biomembranes. Within the last few years it has become clear that the antioxidant activity of vitamin E is not the only one (and perhaps not the most important) of its biological functions (Atkinson *et al.*, 2008; Ezgin, 2008; Jones, 2008; Ricciarelli *et al.*, 2001). The common belief of the beneficial health-improving action of plant phenolics has also been revised (Halliwell, 2007).

In view of the substantial changes in the understanding of the role of reactive oxygen species and antioxidants in living systems, a critical re-evaluation of the methods of determination of the antioxidant activity is also necessary.

ANTIOXIDANT AND ANTIRADICAL ACTIVITY

The general methods of determination of antioxidant activity are summarized in many reviews, including (Frankel & Finley, 2008; Huang *et al.*, 2005; Sanchez-Moreno, 2002). Due to their practical significance much attention is paid to studies of natural products and food supplements (Davalos *et al.*, 2003; Moon & Shimamoto, 2009). Numerous studies have demonstrated that the antioxidant activity measured depends substantially on the test system used (Bauzaize *et al.*, 2003; Janaszewska & Bartosz, 2002) and recommended to base any conclusions on at least two different test systems (Moon & Shimamoto, 2009).

Most of the methods of determination of total antioxidant activity characterize the ability of the tested compound or product to scavenge free radicals and/or to complex metal ions driving the oxidation process.

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Determination Of Antiradical And Antioxidant Activity

Gennady E. Zaikov,A. K. Haghi

Determination Of Antiradical And Antioxidant Activity:

Chemical Analysis of Antioxidant Capacity Li Niu,Dongxue Han,2020-06-08 The book discusses the present strategies towards antioxidant capacity evaluation including optical chromatography electrochemical methods as well as photoelectrochemical technique where the advantages limitations and different applications are analyzed and compared Subsequently the corresponding analysis instruments are introduced and interpreted combining with their technical characteristics scope and performance indicators **Measurement of Antioxidant Activity and Capacity** Resat Apak,Esra Capanoglu,Fereidoon Shahidi,2018-02-20 A comprehensive reference for assessing the antioxidant potential of foods and essential techniques for developing healthy food products Measurement of Antioxidant Activity and Capacity offers a much needed resource for assessing the antioxidant potential of food and includes proven approaches for creating healthy food products With contributions from world class experts in the field the text presents the general mechanisms underlying the various assessments the types of molecules detected and the key advantages and disadvantages of each method Both thermodynamic i e efficiency of scavenging reactive species and kinetic i e rates of hydrogen atom or electron transfer reactions aspects of available methods are discussed in detail A thorough description of all available methods provides a basis and rationale for developing standardized antioxidant capacity activity methods for food and nutraceutical sciences and industries This text also contains data on new antioxidant measurement techniques including nanotechnological methods in spectroscopy and electrochemistry as well as on innovative assays combining several principles Therefore the comparison of conventional methods versus novel approaches is made possible This important resource Offers suggestions for assessing the antioxidant potential of foods and their components Includes strategies for the development of healthy functional food products Contains information for identifying antioxidant activity in the body Presents the pros and cons of the available antioxidant determination methods and helps in the selection of the most appropriate method Written for researchers and professionals in the nutraceutical and functional food industries academia and government laboratories this text includes the most current knowledge in order to form a common language between research groups and to contribute to the solution of critical problems existing for all researchers working in this field **Flow Injection Analysis of Food Additives** Claudia Ruiz-Capillas,Leo M.L. Nollet,2015-12-01 Flow Injection Analysis of Food Additives gives you the tools you need to analyze food and beverage additives using FIA This sets it apart from other books that simply focus on the theoretical basis and principles of FIA or on the design of equipment instrumentation manifold and setting mechanism Truly unprecedented in its scope this book rep Proceedings of the 4th International Conference on Biomass Utilization and Sustainable Energy; ICoBiomasSE 2024; 2–3 September; Penang, Malaysia Hui Lin Ong,Siti Jamilah Hanim Mohd Yusof,Noor Hasyierah Mohd Salleh,Khairul Farihan Kasim,Noor Shazliana Aizee Abidin,2025-07-23 This book includes peer reviewed articles from the 4th International Conference on Biomass Utilization and Sustainable Energy 2024 ICoBiomasSE 2024 organized by the Centre of

Excellence for Biomass Utilization COEBU Universiti Malaysia Perlis UniMAP held at Penang in MalaysiaThis book includes peer reviewed articles from the 4th International Conference on Biomass Utilization and Sustainable Energy 2024 ICoBiomasSE 2024 organized by the Centre of Excellence for Biomass Utilization COEBU Universiti Malaysia Perlis UniMAP held at Penang in Malaysia from 2nd to 3rd of Sept The theme of the conference Nurturing Sustainability through Net Zero Emissions Circular Economy and Academia Industry Collaboration has been selected to address the escalating environmental concerns through initiatives such as achieving net zero emission embracing circular economy principles and strengthening the academia industry partnership for a sustainable future The contents are broadly divided into seven parts 1 sustainable biomass resources for decarbonising the economy 2 biomass conversion technologies for bioenergy 3 biomass conversion to intermediates and products 4 bioeconomy sustainability impacts and policies 5 bioenergy integration and 6 techno economic in biomass energy It provides a platform to college or graduate students professionals researchers academicians policy makers and industries working in the areas of biomass utilization and sustainable energy to solve long standing environmental issues for healthier planet It may also be of interests for environmentalist and materialists who work on planning engineering and management fields **Handbook of Food Preservation** Mohammad Shafiur Rahman,2020-06-10 The processing of food is no longer simple or straightforward but is now a highly inter disciplinary science A number of new techniques have developed to extend shelf life minimize risk protect the environment and improve functional sensory and nutritional properties Since 1999 when the first edition of this book was published it has facilitated readers understanding of the methods technology and science involved in the manipulation of conventional and newer sophisticated food preservation methods The Third Edition of the Handbook of Food Preservation provides a basic background in postharvest technology for foods of plant and animal origin presenting preservation technology of minimally processed foods and hurdle technology or combined methods of preservation Each chapter compiles the mode of food preservation basic terminologies and sequential steps of treatments including types of equipment required In addition chapters present how preservation method affects the products reaction kinetics and selected prediction models related to food stability what conditions need be applied for best quality and safety and applications of these preservation methods in different food products This book emphasizes practical cost effective and safe strategies for implementing preservation techniques for wide varieties of food products Features Includes extensive overview on the postharvest handling and treatments for foods of plants and animal origin Describes comprehensive preservation methods using chemicals and microbes such as fermentation antimicrobials antioxidants pH lowering and nitrite Explains comprehensive preservation by controlling of water structure and atmosphere such as water activity glass transition state diagram drying smoking edible coating encapsulation and controlled release Describes preservation methods using conventional heat and other forms of energy such as microwave ultrasound ohmic heating light irradiation pulsed electric field high pressure and magnetic field Revised updated and expanded with 18 new chapters the

Handbook of Food Preservation Third Edition remains the definitive resource on food preservation and is useful for practicing industrial and academic food scientists technologists and engineers **Recent Advances in Natural Products Analysis** Seyed Mohammad Nabavi,Mina Saeedi,Seyed Fazel Nabavi,Ana Teresa Sanches Silva,2020-03-07 Recent Advances in Natural Products Analysis is a thorough guide to the latest analytical methods used for identifying and studying bioactive phytochemicals and other natural products Chemical compounds such as flavonoids alkaloids carotenoids and saponins are examined highlighting the many techniques for studying their properties Each chapter is devoted to a compound category beginning with the underlying chemical properties of the main components followed by techniques of extraction purification and fractionation and then techniques of identification and quantification Biological activities possible interactions levels found in plants the effects of processing and current and potential industrial applications are also included Focuses on the latest analytical techniques used for studying phytochemical and other biological compounds Authored and edited by the top worldwide experts in their field Discusses the current and potential applications and predicts future trends of each compound group **Plants as a Source of Natural Antioxidants** Nawal Kishore Dubey,2014-12-18 A comprehensive overview of both traditional and current knowledge on the health effects of plant based antioxidants this book reviews medicinal and aromatic plants from around the world It covers the different sources of antioxidants including essential oils algae and marine microorganisms as well as the role of abiotic and biotic stresses endophytes transgenic approaches in scavenging ROS and antioxidant plants used in different therapeutic systems *Biodiversity and Biomedicine* Munir Ozturk,Dilfuza Egamberdieva,Milica Pešić,2020-07-15 Biodiversity and Biomedicine Our Future provides a new outlook on Earth s animal plant and fungi species as vital sources for human health treatments While there are over 10 million various species on the planet only 2 million have been discovered and named This book identifies modern ways to incorporate Earth s species into biomedical practices and emphasizes the need for biodiversity conservation Written by leading biodiversity and biomedical experts the book begins with new insights on the benefits of biologically active compounds found in fungi and plants including a chapter on the use of wild fruits as a treatment option The book goes on to discuss the roles of animals such as amphibians and reptiles and how the threatened presence of these species must be reversed to conserve biodiversity It also discusses marine organisms including plants animals and microbes as essential in contributing to human health Biodiversity and Biomedicine Our Future is a vital source for researchers and practitioners specializing in biodiversity and conservation studies Students in natural medicine and biological conservation will also find this useful to learn of the world s most bio rich communities and the molecular diversity of various species Presents new developments in documenting and identifying species for biodiversity conservation and ethical considerations for biodiversity research Examines biodiversity as an irreplaceable resource for biomedical breakthroughs using available species for medical research Discusses challenges and opportunities for biodiversity protection and research in biosphere reserves *Analysis and Performance of Engineering*

Materials Gennady E. Zaikov,2015-08-28 This new book facilitates the study of problematic chemicals in such applications as chemical fate modeling chemical process design and experimental design It provides a valuable overview of current chemical processes products and practices and analyzes theories to formulate and prove physicochemical principles It addresses the production and **Multiple Biological Activities of Unconventional Seed Oils** Abdalbasit Adam Mariod,2022-01-26 Multiple Biological Activities of Unconventional Seed Oils brings detailed knowledge concerning the biological properties of oils antioxidant antimicrobial antidiabetic antitumor anti inflammatory etc the content of individual substances with health promoting properties methods for biological properties assay the influence of raw material quality and technological processes on the quality of oils and possible raw materials and oil contaminants with adverse health effects The book s chapters also highlight the unique properties of new oils along with their biological activities Less than a decade ago the vegetable oils on grocery store shelves were derived from conventional oil seeds e g cotton groundnut sesame corn sunflower and soybean However as consumers began to understand how fat intake affects overall health researchers plant growers and food manufacturers started to produce oils from unconventional sources This book highlights what we ve learned in the process Explores unconventional oils their different sources and where they grow worldwide Explains the medicinal uses of unconventional oils Details the biological activities antioxidant and physico chemical composition of unconventional oils

Biological Kinetics Elena Burlakova,Sergey Dmitrievich Varfolomeev,2005-10-28 This volume discusses questions of free radical biology and new modern directions in molecular cytobiology proteomics and genomics The book presents articles and reviews on bioantioxidants synthesis of new compounds mechanisms of their action and areas of application Studies on free radical states using ESR technique biochemistry of regulato **Fruit and Vegetable Phytochemicals** Laura A. de la Rosa,Emilio Alvarez-Parrilla,Gustavo A. Gonzalez-Aguilar,2009-10-13 Fruit and Vegetable Phytochemicals Chemistry Nutritional Value and Stability provides scientists in the areas of food technology and nutrition with accessible and up to date information about the chemical nature classification and analysis of the main phytochemicals present in fruits and vegetables polyphenols and carotenoids Special care is taken to analyze the health benefits of these compounds their interaction with fiber antioxidant and other biological activities as well as the degradation processes that occur after harvest and minimal processing **Chemical and Biochemical Physics, Kinetics and Thermodynamics** Gennadiĭ Efremovich Zaikov,2007 This book includes new and important research on antioxidants for chemistry and biology kinetics and mechanisms of molecular radical and ion reactions in chemistry and biochemistry chemistry of ozone reactions of ozone with organic and inorganic compounds action of antiozonants application of electron magnetic resonance and nuclear magnetic resonance in chemistry and biology investigations of the structure and properties of nanocomposites nanotubes particularly investigations on the structure and properties of nanocomposites nanotubes particularly investigations of heterogeneous heterophases mechanisms of reaction in polymer matrix preparation and using of organic papanagnets for investigation of radical reactions

in chemistry and biology investigation of kinetic parameters in biochemical reactions new designs for processing mechanisms of oxidation and stabilisation of organic compounds including polymers polymer blends composites and filled polymers preparation properties and application and information about genetic construction reactions with participants of enzymes

Evidence-Based Proactive Nutrition to Slow Cellular Aging Robert Fried,Lynn Nezin,2017-09-18 Recent research findings on the impact of nutrition on telomere length is unlocking the potential to combat premature aging at the cellular level We have learned that while aging is a natural cellular process premature aging is not and it can be positively impacted by an Evidence Based Proactive Nutrition to Slow Cellular Aging diet plan This book examines key elements of the biology of cell aging and focuses on enhancing mitochondrial function and preventing abnormal cell turnover thus preserving telomere length It details the cellular damage caused by free radicals and ROS explains the salutary effects of antioxidants and the body s need for adequate nitrates and other nutrient substrates from which the body derives nitric oxide NO to support cardiovascular health This book is the first to feature a simple do it yourself test of the effects of the diet on the availability of NO for heart health The book guides the reader through the rationale for a modified Mediterranean style diet that supplies the body with an adequate daily intake of essential nutrients simple high antioxidants and other functional foods It includes simple easy to prepare appealing recipes promoting a seamless transition to a healthy age defying lifestyle Legumes Research Jose C. Jimenez-Lopez,Alfonso Clemente,2022-10-12 Legumes have nutraceutical qualities that impart beneficial effects on human health They are an alternative protein source with great potential for use in producing novel foods with improved nutritional properties This book presents a comprehensive overview of legume proteins including information on their nutritional and nutraceutical profiles the health benefits of their compounds and their underlying bioactivities such as anti diabetic hepatoprotective anti inflammatory antioxidant and anti cancer properties Analytical Chemistry from Laboratory to Process Line Gennady E. Zaikov,A. K. Haghi,2018-08-06 This book highlights many of the latest developments and trends in engineering chemistry research and describes the respective tools to characterize and predict properties and behavior of materials The book provides original theoretical and important experimental results which use non routine methodologies and presents chapters on novel applications of more familiar experimental techniques and analyses of composite problems which indicate the need for new experimental approaches presented Technical and technological development demands the creation of new materials that are stronger more reliable and more durable i e materials with new properties This volume presents new research that will help lead to new and better materials Each chapter describes the principle of the respective method as well as the detailed procedures of experiments with examples of actual applications presented Thus readers will be able to apply the concepts as described in the book to their own experiments Experts in each of the areas covered have reviewed the state of the art thus creating a book that will be useful to readers at all levels in academic industry and research institutions Engineers polymer scientists and technicians will find this volume useful in

selecting approaches and techniques applicable to characterizing molecular compositional rheological and thermodynamic properties of elastomers and plastics Frontiers in Natural Product Chemistry: Volume 9 Atta-ur-Rahman,2022-03-11 Frontiers in Natural Product Chemistry is a book series devoted to publishing monographs that highlight important advances in natural product chemistry The series covers all aspects of research in the chemistry and biochemistry of naturally occurring compounds including research on natural substances derived from plants microbes and animals Reviews of structure elucidation biological activity organic and experimental synthesis of natural products as well as developments of new methods are also included in the series Volume nine of the series brings together 7 reviews on a variety of natural products and sources along with a chapter on the basics of investigating antioxidant activity Propolis and its key chemical constituents a promising natural product in therapeutic applications Investigation of the effects of using omega 3 fatty acids on egg quality in functional egg production Quercetin a flavonoid with remarkable anticancer activity Swertiamarin for the treatment of metabolic syndrome Overview of traditional uses phytochemistry and pharmacology of Peganum harmala l Investigation of measurement methods of antioxidant activity and involved mechanisms Recent progress on natural and synthetic flavanone and its derivatives Role of virgin coconut oil as a multiple health promoting function oil Oxidants, Antioxidants And Free Radicals Steven Baskin,Harry Salem,2017-11-01 This volume collates articles investigating antioxidant oxidant and free radical research It examines the role of such research in health and disease particulary with respect to developing greater understanding about the many interactions between oxidants and antioxidants and how such substances may act as natural protectants and or natural toxicants *Sorghum Biochemistry* CV Ratnavathi,Jagannath Vishnu Patil,UD Chavan,2016-06-01 Sorghum Biochemistry An Industrial Perspective explores the many uses for sorghum in industry and biofuels Not only does it offer a detailed understanding of the physical and biochemical qualities of the grain it also takes an in depth look at the role sorghum plays in such industries as brewing and ethanol production and the mechanics of post harvest processing and value addition Sorghum has long been an important staple in Africa and Asia but its value goes far beyond its uses in human and animal consumption Sorghum is also used in many industries including waxes packing material wall board ethanol beverages and brewing and one variety called sweet sorghum has also been used as a bioenergy crop Sorghum Biochemistry An Industrial Perspective offers a closer look at how the grain is used in such a variety of ways and how we can continue to optimize its potential Provides detailed biochemical studies on grain sorghum to inform researchers grappling with similar issues Offers foundational information on the quality and composition of sorghum as a grain Covers a variety of uses for sorghum in many industries including food and beverage energy and brewing Includes photos and illustrations to enhance the understanding of processes and sorghum biochemistry **Australian Native Plants** Yasmina Sultanbawa,Fazal Sultanbawa,2017-12-19 Australian Native Plants Cultivation and Uses in the Health and Food Industries provides a comprehensive overview of native food crops commercially grown in Australia that possess nutritional and health

properties largely unknown on a global basis These native foods have been consumed traditionally have a unique flavor diversity offer significant health promoting effects and contain useful functional properties Australian native plant foods have also been identified for their promising antioxidant and antimicrobial properties that have considerable commercial potential This book is divided into three parts The first part reviews the cultivation and production of many Australian native plants ANP including Anise Myrtle Bush Tomato Desert Raisin Davidson s Plum Desert Limes Australian Finger Lime Kakadu Plum Lemon Aspen Lemon Myrtle Muntries Native Pepper Quandong Riberry and Wattle Seed It then examines the food and health applications of ANP and discusses alternative medicines based on aboriginal traditional knowledge and culture nutritional characteristics and bioactive compounds in ANP In addition it reviews the anti obesity and anti inflammatory properties of ANP and discusses food preservation antimicrobial activity of ANP and unique flavors from Australian native plants The third section covers the commercial applications of ANP It focuses on native Australian plant extracts and cosmetic applications processing of native plant foods and ingredients quality changes during packaging and storage of Australian native herbs The final few chapters look into the importance of value chains that connect producers and consumers of native plant foods new market opportunities for Australian indigenous food plants and the safety of using native foods as ingredients in the health and food sectors

The Enigmatic Realm of **Determination Of Antiradical And Antioxidant Activity**: Unleashing the Language is Inner Magic

In a fast-paced digital era where connections and knowledge intertwine, the enigmatic realm of language reveals its inherent magic. Its capacity to stir emotions, ignite contemplation, and catalyze profound transformations is nothing lacking extraordinary. Within the captivating pages of **Determination Of Antiradical And Antioxidant Activity** a literary masterpiece penned with a renowned author, readers attempt a transformative journey, unlocking the secrets and untapped potential embedded within each word. In this evaluation, we shall explore the book is core themes, assess its distinct writing style, and delve into its lasting impact on the hearts and minds of those who partake in its reading experience.

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Determination Of Antiradical And Antioxidant Activity Introduction

In this digital age, the convenience of accessing information at our fingertips has become a necessity. Whether its research papers, eBooks, or user manuals, PDF files have become the preferred format for sharing and reading documents. However, the cost associated with purchasing PDF files can sometimes be a barrier for many individuals and organizations. Thankfully, there are numerous websites and platforms that allow users to download free PDF files legally. In this article, we will explore some of the best platforms to download free PDFs. One of the most popular platforms to download free PDF files is Project Gutenberg. This online library offers over 60,000 free eBooks that are in the public domain. From classic literature to historical documents, Project Gutenberg provides a wide range of PDF files that can be downloaded and enjoyed on various devices. The website is user-friendly and allows users to search for specific titles or browse through different categories. Another reliable platform for downloading Determination Of Antiradical And Antioxidant Activity free PDF files is Open Library. With its vast collection of over 1 million eBooks, Open Library has something for every reader. The website offers a seamless experience by providing options to borrow or download PDF files. Users simply need to create a free account to access this treasure trove of knowledge. Open Library also allows users to contribute by uploading and sharing their own PDF files, making it a collaborative platform for book enthusiasts. For those interested in academic resources, there are websites dedicated to providing free PDFs of research papers and scientific articles. One such website is Academia.edu, which allows researchers and scholars to share their work with a global audience. Users can download PDF files of research papers, theses, and dissertations covering a wide range of subjects. Academia.edu also provides a platform for discussions and networking within the academic community. When it comes to downloading Determination Of Antiradical And Antioxidant Activity free PDF files of magazines, brochures, and catalogs, Issuu is a popular choice. This digital publishing platform hosts a vast collection of publications from around the world. Users can search for specific titles or explore various categories and genres. Issuu offers a seamless reading experience with its user-friendly interface and allows users to download PDF files for offline reading. Apart from dedicated platforms, search engines also play a crucial role in finding free

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