

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 oxidisable 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 vivo* or *in vitro* action. 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 physiological functions (Rocciarelli *et al.*, 2001; Adamson *et al.*, 2008; Jones, 2008; Engin, 2009). 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 (Sanchez-Moreno, 2002; Huang *et al.*, 2005; Frukkel & Finley, 2008). 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 (Janaszewska & Bartosz, 2002; Baumann *et al.*, 2003) 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

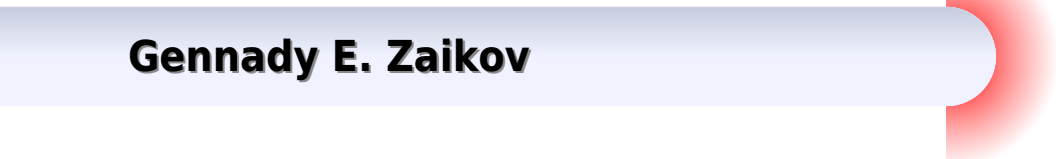
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Abbreviations: ABTS, 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulphonic acid); BHT, butylhydroxytoluene; DPPH, 1,1-diphenyl-2-picrylhydrazyl; TAS, total antioxidant status.

Determination Of Antiradical And Antioxidant Activity

Gennady E. Zaikov



Determination Of Antiradical And Antioxidant Activity:

Proceedings of the 4th International Conference on Biomass Utilization and Sustainable Energy;

ICoBiomassSE 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 ICoBiomassSE 2024 organized by the Centre of Excellence for Biomass Utilization COEBU Universiti Malaysia Perlis UniMAP held at Penang in Malaysia This book includes peer reviewed articles from the 4th International Conference on Biomass Utilization and Sustainable Energy 2024 ICoBiomassSE 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 Flow Injection Analysis of Food Additives Claudia Ruiz-Capillas, Leo M.L. Nolle, 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

Handbook of Food Preservation M. 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

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

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

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

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

Materials Science and Applied Chemistry Valdis Kokars,2018-02-05 58th International Conference of Materials Science and Applied Chemistry MSAC 2017 Selected peer reviewed papers from the 58th International Conference of Materials Science and Applied Chemistry MSAC 2017 October 20 2017 Riga Latvia *Magnetic Resonance in Food Science* G A Webb,Peter S Belton,A M Gil,I Delgadillo,2007-10-31 Magnetic resonance has long demonstrated its tremendous versatility in many areas of science Nowhere has this been more apparent than in food science where problems encountered in a variety of situations can be resolved using one of the many techniques available to the magnetic resonance practitioner From structural studies and investigations of molecules in frozen sugar solutions to identifying the origins of salmon and detecting free radicals in irradiated food magnetic resonance techniques can provide useful information Divided into four sections entitled A View Towards the Next Century Food Safety and Health Structure and Dynamics and Analysis Monitoring and Authentication the book consists of top quality contributions from renowned international scientists and looks at what magnetic resonance techniques can offer both now and in the future Offering state of the art material Magnetic Resonance in Food Science A View to the Future is essential reading for both academics and industrialists in food science

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 **Handbook of Antioxidant Methodology** Paul D Prenzler,Danielle Ryan,Kevin Robards,2021-10-12 The field of antioxidant research has grown rapidly over the last 30 years and shows no sign of slowing down In order to understand how antioxidants work it is

essential to understand how their activity is measured However antioxidant activity measurements are controversial and their value has been challenged This book addresses a number of the controversies on antioxidant testing methods Specifically the book highlights the importance of context helping the reader to decide what methods are most appropriate for different situations how the results can be interpreted and what information may be inferred from the data There are a multiplicity of methods for measuring activity with no standardized method approved for in vitro or in vivo testing In order to select an appropriate method a thorough knowledge of the processes associated with reduction oxidation is essential leading to an improved understanding and use of activity measurements and the associated data The book presents background information in a unique style which is designed to assist readers to grasp the fundamentals of redox processes as well as thermodynamics and kinetics which are essential to later chapters Recovery and extraction of antioxidants from diverse matrices are presented in a clear and logical fashion along with methods used to determine antioxidant activity from a mechanistic perspective Other chapters present current methodologies used for activity testing in different sample types ranging from foods and plants to body fluids and even to packaging but always with a strong emphasis on the nature of the sample and the underlying chemistry of the method A number of emerging techniques for assessing antioxidant behaviour namely electrochemical methods chip technology exploiting microfluidic devices metabolomics plus studies of gene and protein expression are examined Ultimately these techniques will be involved in generation of big data for which an understanding of chemometrics will be essential in drawing valid conclusions The book is written to appeal to a wide audience but will be particularly helpful for any researchers who are attempting to make sense of the vast literature and often conflicting messages on antioxidant activity

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 regulation

Handbook of Processed Meats and Poultry Analysis Leo M.L. Nollet, Fidel Toldra, 2008-11-12 Muscle foods include a wide range of processed meats and poultry and therefore represent an important percentage of total worldwide food consumption The sheer volume of products and the variety of processes available makes analyzing them problematic Co Edited by Fidel Toldra Recipient of the 2010 Distinguished Research Award from the American

Antioxidants, 2019-11-06 Antioxidants are substances that can prevent or slow damage to living cells caused by free radicals which are unstable molecules the body produces as a reaction to environmental and other pressures Sometimes called free radical scavengers free radicals can cause mutation in different biological compounds such as protein nucleic acids and lipids which lead to various diseases cancer cardiovascular disease aging etc Healthy foods are considered a main source of antioxidant compounds and from the beginning of a person's life a strong relationship is seen between antioxidant compounds and the

prevention of certain diseases such as types of inflammations cardiovascular diseases and different kinds of cancers It is thus of great importance that new data relating to antioxidants and their biological activity be collected and that antioxidant modes of action be illustrated Experts from around the world contributed to the current book discussing antioxidant sources modes of action and their relation to human diseases Twenty five chapters are presented in two sections Antioxidants Sources and Modes of Action and Antioxidants Compounds and Diseases

In Search of Honey Authentication Ioannis Karabagias, 2021-04-06 This book highlights the use of specific physicochemical parameters such as sugar content moisture content electrical conductivity acidity colour and attributes in the production of honey It also discusses the use of honey micro constituents including volatile compounds polyphenols minerals organic acids free amino acids and isotopic data in the determination of the botanical and geographical origins of honey in combination with chemometrics It represents the ultimate research guide and reference manual for the determination of honey uniqueness and will appeal to both academics and practitioners in the honey industry

Extraction, Characterization, and Functional Assessment of Bioactive Compounds María Figueiredo González, Patricia Reboredo Rodríguez, Elena Martínez Carballo, 2024-07-13 This volume details methods and procedures on extraction characterization and functional assessment of bioactive compounds Chapters guide readers through bioactive compounds development testing and characterization of phenolic compounds and other compounds Written in the format of the Methods and Protocols in Food Science series the chapters include an introduction to the respective topic list necessary materials and reagents detail well established and validated methods for readily reproducible laboratory protocols and contain notes on how to avoid or solve typical problems Authoritative and cutting edge Extraction Characterization and Functional Assessment of Bioactive Compounds aims to ensure successful results in the further study of this vital field

Biotechnological Advances, Phytochemical Analysis and Ethnomedical Implications of Sapindus species Reetika Singh, Bechan Sharma, 2019-11-13 Plants have always occupied a prominent position in the life of every living being Plants are the primary source of food shelter and medicines The global inclination toward herbal medicine has advanced the expansion of plant based pharmaceutical industries to a vast extent The production of traditional medicine at global market has been estimated to touch US 5 trillion by 2050 Some of the useful plant based drugs include vinblastine vincristine taxol podophyllotoxin camptothecin digoxigenin morphine codeine aspirin atropine capscicine allicin curcumin artemesinin and ephedrine Genus Sapindus is an important economical and medicinal trees distributed over the world Soap nuts contain higher amount of saponin a natural detergent which can be used to clean clothes and hairs Sapindus species possesses various pharmacological properties including antimicrobial antioxidant anti inflammatory anticancer hepatoprotective anti trichomonas activity Extracts of this plant are rich in various phytochemicals and polyphenolic compounds All the pharmacological properties are due to presence of saponins Biotechnological techniques can improve the saponin content thus this chemical content can be produced at large scale and can be used as phytomedicine We hope that

this book would be of great use to under graduates postgraduates scientists researchers and faculty members who are studying teaching or working in the field of Biotechnology Phytochemistry and Ethnopharmacology The techniques explained in this book could be of immense use for the researchers working in this area We shall deeply appreciate receiving any critical comments and suggestions from the readers from the different parts of globe which would help us improve the first edition of this publication

Proceedings of the 1st International Conference for Health Research - BRIN (ICHR 2022) Ika Nurlaila,Yunefit Ulfa,Hayani Anastasia,Gurendro Putro,Rika Rachmalina,Rozana Ika Agustiya,Novaria Sari Dewi Panjaitan,Rosantia Sarassari,Anna Lystia Poetranto,Sela Septima Mariya,2023-10-23 This is an open access book The National Research and Innovation Agency Acronymized in Bahasa as BRIN Badan Riset and Inovasi Nasional the Republic of Indonesia was launched in 2021 and has been the only one of Indonesia authorized research institution since The Agency embodies throughout department and non department research bodies in Indonesia and answers and thus responsible directly to the President of Indonesia Despite its juvenile age BRIN is in a tight competition with urgencies of untangling unresolved issues in various aspects in collective life as a nation and a state spanning socioeconomic and culture to medicine and its translational derivatives To function as effectively as expected BRIN has launched 12 research organizations with each is accountable for a specific research field as reflected by the expertise of the pertinent researchers Among those Research Organization for Health was established as an answer to the major challenge of overcoming national burdens which are holistically captured as the roadmaps of SDG s Indonesia where Health stands specially as the top three priority and regarded as Good Health Wellbeing It is clear that what have been produced through long chain of processes in the research chambers must be driven forward and translated accordingly to reach downstream utilizations in such a way that the good health and well being are reachable in any levels As to manifesting these goals into realization knowledge sharing is deemed to be a plausible vehicle This enables disseminations of most current research projects related to health across research institution regionally or globally Therefore we see the need to organize our very first international conference that is further set as one of our annual events with contemporary umbrella themes We welcome researchers scholars and practitioners in health and health related fields to share their insightful research results in our conference The general objective of BRIN s 1st International Conference for Health ICHR is to facilitate dissemination and exchange of most recent progresses made across research institutions and to promote prospectus multi nationals and or multi institutional collaborations to achieve the good health and well being

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