

Review

Protein-Based Packaging Films in Food: Developments, Applications, and Challenges

Rui Zhang ^{1,†}, Rongyu Liu ^{1,†}, Jianchun Han ^{1,2,3,*}, Lili Ren ⁴ and Longwei Jiang ^{4,*}

¹ College of Food Science, Northeast Agricultural University, Harbin 150030, China; 1325395396@163.com

² Heilongjiang Institute of Green Food Science, Harbin 150028, China; rongyuliu163.com

³ Key Laboratory of Biomic Engineering (Ministry of Education), College of Biological and Agricultural Engineering, Jilin University, Changchun 130022, China; jhan@jlu.edu.cn

⁴ College of Tea & Food Science and Technology, Anhui Agricultural University, Key Laboratory of Jianghuai, Agricultural Product Fine Processing and Resource Utilization, Ministry of Agriculture and Rural Affairs, Anhui Engineering Research Center for High Value Utilization of Characteristic Agricultural Products, Hefei 230036, China

* Correspondence: hanjanchun@hotmail.com (J.H.); jianglw58@163.com (L.J.)

† These authors contributed equally to this work.

Abstract: With the emphasis placed by society on environmental resources, current petroleum-based packaging in the food industry can no longer meet people's needs. However, new active packaging technologies have emerged, such as proteins, polysaccharides, and lipids, in which proteins are widely used for their outstanding gel film-forming properties. Most of the current literature focuses on research applications of single protein-based films. In this paper, we review the novel protein-based packaging technologies that have been used in recent years to categorize different proteins, including plant proteins (soybean protein isolate, zein, gluten protein) and animal proteins (whey protein isolate, casein, collagen, gelatin). The advances that have recently been made in protein-based active packaging technology can be understood by describing protein sources, gel properties, molding principles, and applied research. This paper presents the current problems and prospects of active packaging technology, provides new ideas for the development of new types of packaging and the expansion of gel applications in the future, and promotes the development and innovation of environmentally friendly food packaging.

Keywords: active packaging; protein-based film; gel film; performance characteristics; applied research

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1. Introduction

Product packaging is important in the food industry to extend the shelf life of perishable food such as vegetables, fruits, and meat, as well as to ensure their nutritional value and safety. Product packaging is particularly important. At present, packaging materials are still dominated by synthetic plastic films made from petroleum. Polymeric materials consisting of polyethylene, polypropylene, and polyethylene terephthalate are widely used for food packaging. These films have the advantages of low cost, good gas, and liquid barrier properties, and high durability. However, since petroleum is a non-renewable resource, long-term use exacerbates the consumption of resources, the carbon-carbon bonds in the petroleum base make this packaging non-degradable, and overuse cannot be mitigated in a short period of time, causing a serious burden on the natural environment. It is estimated that approximately 8 MMt of plastic packaging is discharged into the ocean each year because it cannot be disposed [1]. As it is discarded anywhere and is primarily white in color, it is also known as “white pollution”. At present, the main methods to deal with waste packaging are still incineration and landfill. However the former produces a large amount of carbon dioxide and other harmful substances,

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Developments in Food Packaging S. J. Palling,1980 Metal containers and closures rigid plastics packaging flexible plastics packaging glass paper and board developments food technology to the year 2000 international legislation *Smart Food Packaging Systems* Avik Mukherjee,Santosh Kumar,Manjusri Misra,Amar K. Mohanty,2024-12-16 Understand the future of food packaging with this timely guide Food packaging is a vital part of the food industry It contributes to food safety and quality throughout the supply chain reduced product loss allows high quality goods to be shipped safely to underserved regions and more Smart food packaging systems which can sense or detect changes in the product or packaging are at the forefront of this field and show potentially revolutionary promise Smart Food Packaging Systems offer a comprehensive overview of the fundamental principles and practical applications of Active food packaging and Intelligent food packaging systems The book incorporates the latest research developments and technologies in active and intelligent packaging systems that supplement food supply lines worldwide It is a must own for researchers and industry professionals looking to understand this key new tool in the fight against world hunger Smart Food Packaging Systems readers will also find Case studies on life cycle assessments of specific smart packaging systems Detailed discussion of topics including additives antimicrobial and other functional agents and biopolymers in active food packaging Use of sensors and indicators to monitor quality temperature and freshness of the packaged food Smart Food Packaging Systems is ideal for professionals researchers and academics in food science food technology and food packaging as well as manufacturers developers government officials and regulators working on supply chain and food distribution aspects Food Packaging Sanjay Mavinkere Rangappa,Jyotishkumar Parameswaranpillai,Senthil Muthu Kumar Thiagamani,Senthilkumar Krishnasamy,Suchart Siengchin,2020-10-20 Food Packaging Advanced Materials Technologies and Innovations is a one stop reference for packaging materials researchers working across various industries With chapters written by leading international researchers from industry academia government and private research institutions this book offers a broad view of important developments in food packaging Presents an extensive survey of food packaging materials and modern technologies Demonstrates the potential of various materials for use in demanding applications Discusses the use of polymers composites nanotechnology hybrid materials coatings wood based and other materials in packaging Describes biodegradable packaging antimicrobial studies and environmental issues related to packaging materials Offers current status trends opportunities and future directions Aimed at advanced students research scholars and professionals in food packaging development this application oriented book will help expand the reader s knowledge of advanced materials and their use of innovation in food packaging **Emerging Food Packaging Technologies** Kit L Yam,Dong Sun Lee,2012-03-15 The successful employment of food packaging can greatly improve product safety and quality making the area a key concern to the food processing industry Emerging food packaging technologies reviews advances in packaging materials the design and implementation of

smart packaging techniques and developments in response to growing concerns about packaging sustainability Part one of Emerging food packaging technologies focuses on developments in active packaging reviewing controlled release packaging active antimicrobials and nanocomposites in packaging and edible chitosan coatings Part two goes on to consider intelligent packaging and how advances in the consumer packaging interface can improve food safety and quality Developments in packaging material are analysed in part three with nanocomposites emerging coating technologies light protective and non thermal process packaging discussed alongside a consideration of the safety of plastics as food packaging materials Finally part four explores the use of eco design life cycle assessment and the utilisation of bio based polymers in the production of smarter environmentally compatible packaging With its distinguished editors and international team of expert contributors Emerging food packaging technologies is an indispensable reference work for all those responsible for the design production and use of food and beverage packaging as well as a key source for researchers in this area Reviews advances in packaging materials the design and implementation of smart packaging techniques and developments in response to growing concerns about packaging sustainability Considers intelligent packaging and how advances in the consumer packaging interface can improve food safety and quality Examines developments in packaging materials nanocomposites emerging coating technologies light protective and non thermal process packaging and the safety of plastics as food packaging materials

Recent Developments in Food Packaging Association of Food Scientists & Technologists (India),1986 *Food Packaging* Taylor & Francis Group,2021-06-30 FOOD PACKAGING Innovations and Shelf Life covers recently developments on food packaging and their influence in food quality preservation and shelf life extension The book also reviews sustainable and environmentally friendly packaging solutions The book includes the following main topics Active and Intelligent Packaging Bio based Materials Micro and Nano Materials Packaging Design Packaging Production and Characterization Interaction between Packaging and Food Regulatory Aspects It is an ideal reference source for government industry and academia professionals working in the areas of food science and technology

Trends in Packaging of Food, Beverages and Other Fast-Moving Consumer Goods (FMCG) Neil Farmer,2013-02-26 Packaging plays an essential role in protecting and extending the shelf life of a wide range of foods beverages and other fast moving consumer goods There have been many key developments in packaging materials and technologies in recent years and Trends in packaging of food beverages and other fast moving consumer goods FMCG provides a concise review of these developments and international market trends Beginning with a concise introduction to the present status and trends in innovations in packaging for food beverages and other fast moving consumer goods the book goes on to consider modified atmosphere packaging and other active packaging systems including smart and intelligent packaging and the role these play in augmenting and securing the consumer brand experience Developments in plastic and bioplastic materials and recycling systems are then discussed followed by innovations and trends in metal paper and paperboard packaging Further chapters review international

environmental and sustainability regulatory and legislative frameworks before the use of nanotechnology smart and interactive packaging developments for enhanced communication at the packaging user interface are explored Finally the book concludes by considering potential future trends in materials and technologies across the international packaging market With its distinguished editor and international team of expert contributors Trends in packaging of food beverages and other fast moving consumer goods FMCG is an important reference tool providing a practical overview of emerging packaging technologies and market trends for research and design professionals in the food and packaging industry and academics working in this area Introduces the present status current trends and new innovations in the field whilst considering future trends in materials and technologies Considers modified atmosphere packaging and other active packaging systems including smart and intelligent packaging Discusses developments in plastic and bioplastic materials and recycling systems

Food and Beverage Packaging Technology Richard Coles, Mark J. Kirwan, 2011-04-25 Now in a fully revised and updated second edition this volume provides a contemporary overview of food processing packaging technologies It acquaints the reader with food preservation processes shelf life and logistical considerations as well as packaging materials machines and processes necessary for a wide range of packaging presentations The new edition addresses environmental and sustainability concerns and also examines applications of emerging technologies such as RFID and nanotechnology It is directed at packaging technologists those involved in the design and development of packaging users of packaging in food companies and those who specify or purchase packaging Key Features An up to date and comprehensive handbook on the most important sector of packaging technology Links methods of food preservation to the packaging requirements of the common types of food and the available food packages Covers all the key packaging materials glass plastics and paperboard Fully revised second edition now covers sustainability nanotechnology and RFID

Innovations in Food Packaging Jung H. Han, 2005-07-20 Innovations in Food Packaging addresses selective topics of functions of food packaging to modify the traditional notion of this process This book is organized into five parts Part I focuses on the fundamental theories covering physical chemistry background and quality preservation of foods Parts II and III discuss active packaging research and development and modified atmosphere packaging of fresh produce meats and ready to eat products respectively Part IV talks about edible and biodegradable coatings and films whereas Part V discusses commercialization aspects of packaging technologies Each part is divided into chapters of subject review and detailed technical information This text will benefit those who are interested in innovative technology of food packaging in general and experienced field packaging specialists and graduate level food scientists in particular This book will be useful as a textbook not only for extension programs of food packaging development in food industry but also for advanced graduate level food packaging courses Covers four major food packaging topics Theories in food packaging Active packaging Modified atmosphere packaging Edible films and coatings

Recent Developments in Materials for Food Packaging R. A. Roberts, 1989

Development of Packaging and Products for Use in Microwave Ovens Ulrich Erle, Peter Pesheck, Matthew Lorence, 2020-05-28 Development of Packaging and Products for Use in Microwave Ovens Second Edition supports the efficient design of microwaveable food products and packaging materials explaining all essential aspects in a detailed and systematic way This new edition reviews recent developments and the latest cutting edge technology including new materials and package formats new ideas for product development and new information on developments in microwave technology Sections cover the effect of food dielectric properties and heating uniformity microwave packaging materials product development food packaging oven safety and the computer modelling of microwave products and active packaging Written by a distinguished team of international contributors this book is not only a valuable resource for engineers manufacturers and product developers in the food and packaging industries but also a great research tool for industrial R D and academia Enables the reader to understand product and packaging materials for microwave ovens down to a highly technical and detailed level Offers systematic coverage on all aspects involved including principles materials design product development and modelling Includes the very latest developments in products and packaging including smart packaging and solid state technology

Food Storage, Spoilage and Shelf Life: Recent Developments and Insights Shalini Gaur Rudra, Santanu Basu, Anindya Chanda, 2022-08-29

Food Packaging Technology Richard Coles, Derek McDowell, Mark J. Kirwan, 2003-08-15 The protection and preservation of a product the launch of new products or re launch of existing products perception of added value to products or services and cost reduction in the supply chain are all objectives of food packaging Taking into consideration the requirements specific to different products how can one package successfully meet all of these goals Food Packaging Technology provides a contemporary overview of food processing and packaging technologies Covering the wide range of issues you face when developing innovative food packaging the book includes Food packaging strategy design and development Food biodeterioration and methods of preservation Packaged product quality and shelf life Logistical packaging for food marketing systems Packaging materials and processes The battle rages over which type of container should be used for which application It is therefore necessary to consider which materials or combination of materials and processes will best serve the market and enhance brand value Food Packaging Technology gives you the tools to determine which form of packaging will meet your business goals without compromising the safety of your product

Concepts of Food Packaging Kirtiraj K. Gaikwad, Suman Singh, 2025-11-25 This book explores the historical roots of food packaging tracing its evolution through time and delves into the innovations shaping its future It covers the fundamental principles emerging trends sustainability challenges and regulatory considerations that define the landscape of food packaging today By seamlessly integrating insights from diverse domains including food science materials engineering microbiology marketing and environmental science the book provides a holistic understanding of the subject Each chapter offers a balance between theory and practical application ensuring that readers can grasp the core concepts while gaining

real world insights Chapters include case studies practical examples and thought provoking questions to engage readers actively in the learning process

Recent Advances in Ready-to-Eat Food Technology Hari Niwas Mishra, Pradyuman Kumar, Ajay Singh, 2024-11-28 Ready to Eat RTE describes foods that need not be cooked reheated or otherwise prepared before consuming them Recent Advances in Ready to Eat Food Technology covers all the aspects of RTE from statistics method of production mechanization thermal and non thermal processing gluten free consumer behavior control of foodborne illness and hygiene packaging requirements and improved functionalization to application of nanotechnology Key Features Covers the development of ready to eat products from meat cereal fruits vegetables dairy and pulses Provides a global review of labeling and packaging for ready to eat products Discusses hygienic design and safety in the production and consumption with an emphasis on pathogenicity issues Written by a team of well recognized researchers who present the latest advances in RTE food product development this book is of interest to industry professionals and academicians as well as to undergraduate students and postgraduate researchers

Biopolymer-Based Food Packaging Santosh Kumar, Avik Mukherjee, Joydeep Dutta, 2022-04-12 Biopolymer Based Food Packaging Explore the latest developments and advancements in biopolymer based food packaging In Biopolymer Based Food Packaging Innovations and Technology Applications a team of accomplished researchers delivers a complete systematic and sequential account of the contemporary developments in the application of biopolymers for sustainable food packaging This book introduces the fabrication characterization as well as benefits arising from the enhanced functionalities of biopolymer based food packaging materials The authors introduce various polysaccharide protein and microbial polymer based food packaging films and coatings as well as biopolymer based blends and nanocomposites Importance of these materials as active and intelligent food packaging systems is also introduced Finally the book explores biopolymer based edible food packaging and its efficacy in extending the shelf life of perishable food items using sustainable materials and processes suitable for the future of circular economies around the world Readers will also find A thorough introduction to the incorporation of nanomaterials as fillers to improve the physico chemical mechanical thermal barrier optical and antimicrobial properties of food packaging nanocomposites Comprehensive discussions of the use of plant based bioactive compounds including essential oils in biopolymer based food packaging Practical examinations of silver and zinc oxide nanoparticles in food packaging In depth treatments of polylactic acid based composites for food packaging applications Biopolymer Based Food Packaging Innovations and Technology Applications is an invaluable resource for academic researchers and professionals in food packaging and related industries as well as research scholars graduate students and entrepreneurs working and studying in the field of food preservation environmental safety and human health with a focus on the sustainable future

Advances in Sustainable Food Packaging Technology Megh R. Goyal, Preeti Birwal, Anand Kumar Pandey, Ritesh B. Watharkar, 2024 Food packaging plays a vital role in providing protection to food at every stage of production while maintaining its nutritive value While conventional plastic packaging technology

effectively protects food quality the massive accumulation of plastic waste drastically contributes to environmental pollution causing death of marine as well as terrestrial life forms The use of biodegradable plastic or edible packaging has transformed the food packaging industry with increased hope for a better green tomorrow This volume Advances in Sustainable Food Packaging Technology investigates the recent innovations in active intelligent and smart packaging systems that embrace packaging potential to not only provide protection to food but can also improve nutritive value reduce contamination by releasing antimicrobials and provide real time status of food quality This volume discusses the leading features of food storage management and food packaging The sections of the book address emerging and advanced approaches in packaging of foods which discusses novel food packaging and related innovations and trends nanotechnology based improvements in food packaging which illustrates the novel nanotechnology based application to extemporize food packaging techniques and biodegradation and bio based approaches for management of plastic waste which deals with management disposal and degradation of food waste and its packaging

Future Trends in Modern Plastics Johannes Karl Fink,2024-04-02 Future Trends in MODERN PLASTICS The prolific author and polymer scientist discusses the current topics in the plastics industry and recommends future research in sustainable polymers and the recycling routes of plastic waste The book opens with a chapter discussing newly developed monomers such as alkylene based monomers epoxide monomers diol based monomers bio based monomers and several other types Modern polymerization methods are then explained such as ionic polymerization plasma polymerization and ring opening polymerization The book moves on to special issues and some future trends in the plastics industry with recommendations for future research Plastics have given society enormous benefits because of their versatility light weight durability and low costs However these properties have come with negative impacts because these persistent materials are leaked into the environment during their entire life cycle Therefore critical chapters report on the future directions for sustainable polymers the valorization of plastic waste and the recovery treatment and recycling routes of plastic waste The book concludes with chapters on the usage of plastics in medical devices as well as the use of plastics in restoration food applications additive classes and manufacturing Audience The book will be used by plastics engineers chemists polymer and materials scientists in both academia and the plastics industry

Food Processing and Packaging Technologies Jaya Shankar Tumuluru,2023-04-05 Food processing preservation and packaging is a highly interdisciplinary science Various techniques and technologies have been developed to extend food shelf life minimize the risk of contamination protect the environment and improve foods functional sensory and nutritional properties Some of the many benefits of food processing preservation and packaging include increased food safety improved nutrition longer shelf life and increased economic opportunities In addition food processing and preservation help to reduce post harvest losses Developing novel food processing preservation and packaging technologies is critical to preserving food quality improving sensory characteristics and reducing losses At present there is a great emphasis on developing novel biobased and intelligent

packaging technologies that are safe for food and reduce environmental pollution This book provides a comprehensive overview of food processing and preservation packaging to tackle the challenges of food safety nutritional security and sustainability Chapters address such topics as edible packaging materials intelligent packaging materials nanotechnology for enhancing the shelf life of food products advanced food packaging systems green materials for food packaging antimicrobial packaging materials food drying technologies methods of food processing food analysis using acoustic and thermal methods food formulations and functional foods This volume is a useful resource for students researchers and food processing preservation professionals It highlights advances in food processing and packaging systems to increase food quality and preserve food longer without generating waste

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

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