# Effect Of Pulsed Electric Field On Lycopene Extraction

*Recently, the electrotechnologies based on the effects of pulsed electric fields (PEF), such as ohmic heating (OH) and DC electric field, have gained real interest in the field of food processing. These techniques efficiently enhance methods of extraction from food plants and dehydration of biosolids. The PEF and pulsed OH techniques preserve the nutritional, functional, structural and sensory properties of products better than conventional extraction technologies. The electrofiltration and electro-osmotic dewatering can be very effective for the separation of bioproducts and dehydration of food wastes. The first source book in the field, this book gives an overview the fundamental principles of electrical techniques, electrophysical properties of foods and agricultural products, application of various emerging electrotechnologies for enhancing the solid-liquid separation and drying processes, extraction techniques of pigments, processing methods of different in-plant tissues and biosolids, electro-osmotic dewatering and electrofiltration of biomaterials, recent industrial- scale gains, and other aspects. Each chapter is complementary to other chapters and addresses the latest efforts in the field.*

*Pulsed Electric Fields to Obtain Healthier and Sustainable Food for Tomorrow illustrates innovative applications derived from the use of pulsed electric fields beyond microbial inactivation. The book begins with an introduction on how pulsed electric fields work and then addresses the impact of pulsed electric fields on bioaccessability/bioavailability and the development of nutraceuticals and food additives. Other sections explore the reduction of contaminants and assess the improvement of industrial process efficiency. A final section explores patents and commercial applications. This book will be a welcomed resource for anyone interested in the technological, physiochemical and nutritional perspectives of product development and the reduction of food toxins and contaminants. The concepts explored in this book could have a profound impact on addressing the concept of "food on demand," a concept that is a top priority in industry. Explores how pulsed electric field treatment affects nutrients and the retention of bioactive compounds Identifies PEF approaches and optimized, targeted processing conditions to improve food quality, bioavailability and bioaccessibility of nutrients and bioactive compounds Highlights the mechanisms influencing the reduction of toxins and contaminants during pulsed electric fields processing Explains how pulsed electric fields design can enhance sustainability throughout the food chain*

*"Written by four experts actively researching alternatives to conventional thermal methods in food preservation. Presents information on traditional and emerging nonthermal food processing technologies in a convenient, single-source volume--offering an incisive view of the latest experimental results, state-of-the-art applications, and new developments in food preservation technology. Furnishes a thorough review of nonthermal techniques such as high hydrostatic pressure, pulsed electric fields, oscillating magnetic fields, light pulses, ionizing irradiation, the use of chemicals and bacteriocins as preservation aids, and combined methods/hurdle technology."*

*Pulsed Electric Fields Technology for the Food Industry*

*Emerging Technologies for Food Processing*

*Novel Food Processing Technologies*

*Advanced Electroporation Techniques in Biology and Medicine*

*Electromanipulation of Cells*

*Pulsed Electric Fields (PEF) is a method used in non-thermal food preservation. Chapter One of this book provides inactivation kinetic models for PEF treatment. Chapter Two discusses PEF in the winemaking process. Chapter Three reviews fruit juice preservation. Chapter Four investigates the effect of amplitude and treatment time of PEF on E. coli in carrot juice. Chapter Five analyzes the contribution of major electrical parameters on PEF treatment of Salmonella typhimurium in grape juice. Chapter Six reviews the effect of PEF on the quality of fresh apple fruits. Chapter Seven examines further potential of PEF treatments for the food industry. Chapter Eight discusses network simulation of the electrical response to PEF of ion-exchange membranes in electrodialysis.*

*Food Safety Engineering is the first reference work to provide up-to-date coverage of the advanced technologies and strategies for the engineering of safe foods. Researchers, laboratory staff and food industry professionals with an interest in food engineering safety will find a singular source containing all of the needed information required to understand this rapidly advancing topic. The text lays a solid foundation for solving microbial food safety problems, developing advanced thermal and non-thermal technologies, designing food safety preventive control processes and sustainable operation of the food safety preventive control processes. The first section of chapters presents a comprehensive overview of food microbiology from foodborne pathogens to detection methods. The next section focuses on preventative practices, detailing all of the major manufacturing processes assuring the safety of foods including Good Manufacturing Practices (GMP), Hazard Analysis and Critical Control Points (HACCP), Hazard Analysis and Risk-Based Preventive Controls (HARPC), food traceability, and recalls. Further sections provide insights into plant layout and equipment design, and maintenance. Modeling and process design are covered in depth. Conventional and novel preventive controls for food safety include the current and emerging food processing technologies. Further sections focus on such important aspects as aseptic packaging and post-packaging technologies. With its comprehensive scope of up-to-date technologies and manufacturing processes, this is a useful and first-of-its kind text for the next generation food safety engineering professionals.*

*For the potatoes, the plant skin or periderm was shown to have a protective effect against the electric fields applied. Peeled potato tubers showed a decrease in the proportion of viable cells compared to unpeeled potato tubers with this effect increasing as the treatment intensity increased. It appeared that when the skin was removed the current had more points of entry to the tissue and therefore the effect of PEF treatment was more pronounced compared to the unpeeled potato tubers. Hence the presence or absence of skin highly influenced the subsequent degree of cell membrane permeabilization, cell viability and rupture. Protein oxidation measured as protein carbonyls content increased significantly in peeled potato tubers treated at 0.5kV/cm compared to unpeeled potato tubers treated with the same conditions. This study revealed that the complex impacts of the PEF treatments are more pronounced in living cells of plant tissues compared to post rigor animal tissues indicating that living cells are capable of changing their metabolism in response to PEF induced stress. Moreover, the effectiveness of PEF treatment could be modified by applying different pre-treatments. Different combinations of traditional physical pre-treatments and PEF can result in supplementary synergetic effects useful for food processing. From the practical point of view, development of such combined technologies as well as understanding the complex structure of solid food materials is very important for improvement of industrial applications.*

*Food Preservation by Pulsed Electric Fields*

*A Thesis Submitted for the Degree of Doctor of Philosophy at the University of Otago, Dunedin, New Zealand*

*Pulsed Electric Fields (PEF)*

*Innovative Technologies in Seafood Processing*

*Electrotransformation of Bacteria*

**This book presents the latest developments in the area of non-thermal preservation of foods and covers various topics such as high-pressure processing, pulsed electric field processing, pulsed light processing, ozone processing, electron beam processing, pulsed magnetic field, ultrasonics, and plasma processing. Non-thermal Processing of Foods discusses the use of non-thermal processing on commodities such as fruits and vegetables, cereal products, meat, fish and poultry, and milk and milk products. Features: Provides latest information regarding the use of non-thermal processing of food products Provides information about most of the non-thermal technologies available for food processing Covers food products such as fruits and vegetables, cereal products, meat, fish and poultry, and milk and milk products Discusses the packaging requirements for foods processed with non-thermal techniques The effects of non-thermal processing on vital food components, enzymes and microorganisms is also discussed. Safety aspects and packaging requirements for non-thermal processed foods are also presented. Rounding out coverage of this technology are chapters that cover commercialization, regulatory issues and consumer acceptance of foods processed with non-thermal techniques. The future trends of non-thermal processing are also investigated. Food scientists and food engineers, food regulatory agencies, food industry personnel and academia (including graduate students) will find valuable information in this book. Food product developers and food processors will also benefit from this book.**

**Pulsed electric field (PEF) food processing is a novel, non-thermal preservation method that has the potential to produce foods with excellent sensory and nutritional quality and shelf-life. This important book reviews the current status of the technology, from research into product safety and technology development to issues associated with its commercial implementation. Introductory chapters provide an overview of the process and its history. Part one then discusses the technology of PEF food preservation, with chapters on circuitry and pulse shapes, chamber design and technical and safety requirements. The second part of the book focuses on important product safety and quality issues such as probable mechanisms of microbial inactivation by PEF, adaptation potential of microorganisms treated by this method, toxicological aspects, the impact on food enzymes and shelf life. Chapters in the final part of the book cover topics relating to the commercialisation of the technology, including current and future applications, pitfalls, economic issues and scaling up, and public and regulatory acceptance. Food preservation by pulsed electric fields is a standard reference for all those involved in research into PEF food processing and its commercialisation. Reviews the current status of PEF technology with an overview of the process and its history Discusses the technology involved in PEF food preservation Focuses on important product safety and quality issues such as the impact on food enzymes and shelf life**

**This major reference work is a one-shot knowledge base on electroporation and the use of pulsed electric fields of high intensity and their use in biology, medicine, biotechnology, and food and environmental technologies. The Handbook offers a widespread and well-structured compilation of chapters ranging from the foundations to applications in industry and hospital. It is edited and written by most prominent researchers in the field. With regular updates and growing in its volume it is suitable for academic readers and researchers regardless of their disciplinary expertise, and will also be accessible to students and serious general readers. The authors of chapters have established scholarly credentials and come from a wide range of disciplines. This is crucially important in a highly interdisciplinary field of electroporation and the use of pulsed electric fields of high intensity and its applications in different fields from medicine, biology, food processing, agriculture, process engineering, energy and environment. An Editorial Board of distinguished scholars from across the world has selected and reviewed the various chapters to ensure the highest quality of this Handbook. The book was edited by an international team of Section Editors: P. Thomas Vernier, Old Dominion University, Norfolk, USA Boris Rubinsky, University of California, Berkeley, USA Juergen F. Kolb Leibniz Institute for Plasma Science and Technology, Greifswald, Germany Damijan Miklavcic, University of Ljubljana, Slovenia Marie-Pierre Rols, IPBS CNRS, Toulouse, France Javier Raso, University of Zaragoza, Spain Richard Heller, Old Dominion University, Norfolk, USA Gregor Serša, Institute of Oncology Ljubljana, Slovenia Dietrich Knorr, Technische Universität Berlin, Germany Eugene Vorobiev Université de Technologie de Compiègne, France.**

**Effect of Pulsed Electric Field on Extraction and Quality of Carrot Juice**

**The Impact of Pulsed Electric Field (PEF) Processing on Solid Food Materials**

**Pulsed Electric Fields in Biotechnology**

**Effect of Thermal and Pulsed Electric Field Treatments on Carrot Texture**

**Effect of Pulsed Electric Field Treatments at Various Stages During Conditioning on Quality Attributes of Beef Longissimus Thoracis Et Lumborum Muscle**

*Pulsed Electric Fields to Obtain Healthier and Sustainable Food for Tomorrow illustrates innovative applications derived from the use of pulsed electric fields beyond microbial inactivation. The book begins with an introduction on how pulsed electric fields work and then addresses the impact of pulsed electric fields on bioaccessability/bioavailability and the development of nutraceuticals and food additives. Other sections explore the reduction of contaminants and assess the improvement of industrial process efficiency. A final section explores patents and commercial applications. This book will be a welcomed resource for anyone interested in the technological, physiochemical and nutritional perspectives of product development and the reduction of food toxins and contaminants. The concepts explored in this book could have a profound impact on addressing the concept of "food on demand," a concept that is a top priority in industry.*

*In this manual, protocols for the transformation of about 40 strains of bacteria are described, with the emphasis placed on the individual critical procedural steps, since the practical details mainly depend on the bacterial strain under investigation. This presentation together with the theoretical introductionary chapters, allows users to modify and adapt each protocol to their own experiments. Bacterial strains with relevance in the food industry, biotechnology, medical and veterinary fields, agroindustry and environmental sciences are covered.*

*Many novel technologies have been proposed in the attempt to improve existing food processing methods. Among emerging nonthermal technologies, high intensity pulsed electric fields (PEF) is appealing due to its short treatment times and reduced heating effects. This book presents information accumulated on PEF during the last 15 years by experienced microbiologists, biochemists, food technologists, and electrical and food engineers.*

*Effect of pulsed electric field application on bioaccumulation of selected metal ions in Lactobacillus rhamnosus B 442 cells*

*Effect of Emerging Processing Methods on the Food Quality*

*Pulsed Electric Fields to Obtain Healthier and Sustainable Food for Tomorrow*

*Advantages and Challenges*

*Pulsed Electric Fields in Food Processing*

Electromanipulation of Cells is the first comprehensive, balanced overview of this dynamic discipline. Edited by leading authorities in the field, the book surveys state-of-the-art research as well as recent practical applications of electric field technologies.

Pulsed Electric Fields (PEF) is one of the nonthermal processing approaches that is receiving considerable attention by scientists, government and the food industry as a potential technique to be fully adopted to process foods at the industrial level. PEF presents a number of advantages including minimal changes to fresh foods, inactivation of a wi

Food Preservation by Pulsed Electric FieldsFrom Research to ApplicationElsevier

Understanding the Impact of Pulsed Electric Field (PEF) Processing on Onions

From Research to Application

Effects of Pulsed Electric Field Treatment on the Quality of Apple Juices

Fundamental Aspects and Applications

Handbook of Electroporation

"A reflection of the intense study of the effects of electromagnetic fields on living tissues that has taken place during the last several decades, this book discusses the theoretical and experimental evidence and considerations the effects of strong electromagnetic fields and/or electric pulses and their importance in medicine and biology. The authors present the basic techniques applied in electroporation and the advanced methods for creation of nanopores, highlighting their basic science and clinical applications. Topics include nano electroporation, classic electroporaiton, experimental evidence for electroporation of living cells, and electroporation for cancer and wound healing"--Provided by publisher.

Pulsed electric fields (PEF) can (at nonthermal conditions) induce cell membrane permeabilization, thereby improving dehydration and extraction efficiencies in food plant materials. In this study, we used onion (Allium cepa L.) as a model plant material to investigate the impact of electrical field strength, number of pulses, and pulse frequency on the cellular integrity and viability. Tissue integrity before and after PEF was determined by electrical properties, ion leakage rate, texture, enzymatically-formed pyruvate, and percent weight loss. These methods differed in their sensitivity and specificity. Measurements of the electrical characteristic were the most sensitive and correlated with plasma membrane breakdown. Pyruvate formation by enzyme allinase was used to identify tonoplast (vacuole) membrane breakdown. The results suggest that there are two critical electrical field strengths or thresholds ($E_c$) necessary to initiate the rupture of the plasma and tonoplast membranes and that both critical $E_c$ are dependent upon the number of pulses applied. The plasma membrane is compromised at a lower $E_c$ compared to the tonoplast membrane. Application of ten 100-æs monopolar rectangular pulses indicate that the $E_c$ for plasma membrane is above 67 V/cm compared to about 200 V/cm for tonoplast membrane. A single pulse at electric fields up to 333 V/cm had no observable effect on any of the measured properties. The minimum electric field strength required to cause a measurable property change decreases with the number of pulses, suggesting that PEF treatment may be more efficient if a higher electric field strength is applied for fewer pulses. The effect of pulse frequency ranging from 0.01 - 5000 Hz was investigated. All measurements indicate that lower frequencies (f

"Results regarding the electrical conductivity and the changes in color revealed the similar effect of applying pulses with 100, 200 and 300 mus of duration. Increasing the number of pulses and/or the electric field strength resulted in increased electrical conductivity and discoloration rates of samples. PEF reduced the compressive strength of apple tissues between 21 to 47%. However, the compressive strength of potato tissues did not seem to be affected by the application of PEF. When PEF was applied as a pre-treatment, it caused an increase of up to 30% in the moisture diffusion coefficients of potatoes. In the case of apples, PEF pre-treated samples did not show any increase in drying rates." --

Effect of Pulsed Electric Fields on Physical Properties of Apples and Potatoes

Effects of Pulsed Electric Fields on the Quality of Foods

Effect of Pulsed Electric Fields on Aquatic Nuisance Species

A Thesis Submitted for the Degree of Masters in Food Science at the University of Otago, Dunedin, New Zealand

Fundamentals and Applications

The second edition of Emerging Technologies in Food Processing presents essential, authoritative, and complete literature and research data from the past ten years. It is a complete resource offering the latest technological innovations in food processing today, and includes vital information in research and development for the food processing industry. It covers the latest advances in non-thermal processing including high pressure, pulsed electric fields, radiofrequency, high intensity pulsed light, ultrasound, irradiation, and addresses the newest hurdles in technology where extensive research has been carried out. Provides an extensive list of research sources to further research development Presents current and thorough research results and critical reviews Includes the most recent technologies used for shelf life extension, bioprocessing simulation and optimization

While conventional technologies such as chilling and freezing are used to avoid deteriorative processes like autolytic and microbial spoilage of seafood, innovative technologies have also been developed as a response to economic and environmental demands. Innovative Technologies in Seafood Processing gives information on advances in chilling, freezing, thawing, and packaging of seafood and also updates knowledge of novel process technologies (high-pressure processing, irradiation, ultrasound, pulsed electric field, microwave and radio frequency, sous vide technology, novel thermal sterilization technologies, ozone and nanotechnological applications, and other innovative technologies such as cold plasma, ohmic heating, infrared heating supercritical carbon dioxide, and high-intensity pulsed light) for the seafood industry. Features ? Reviews novel process technologies applied in the seafood industry ? Highlights processing effects on product quality and safety of treated seafood ? Focuses on the development of safe and effective natural antimicrobials and additives ? Assesses alternative techniques to utilize fish discards and waste as high value products Further it highlights aspects related to quality of seafood treated with these innovative technologies, effect on food constituents, possible risk, security/safety both of seafood and consumers, the environmental impact, and the legislative aspects. The book also addresses the growing international environmental concern for fish discards and fish waste generated in the seafood processing industries by including a chapter, Advances in Discard and By-Products Processing, which assesses alternative techniques to utilize fish discards and waste as high value products. This book will be of value to researchers and technicians in the food technology area, especially those dealing with seafood.

Preservation of Foods with Pulsed Electric Fields discusses the basics of high voltage PEF as a low temperature food processing method, and the application of this technology in food preservation. This technology is attracting a great deal of interest around the world because it is more cost effective than conventional systems due to the conservative nature of PEF. This book thoroughly covers the electrical and food engineering aspects, as well as the food science components (i.e. food microbiology, enzyme inactivation kinetics, and sensory evaluation). Fundamentals of high intensity pulsed electric fields Design of PEF processing equipment Biological principles for microbial inactivation in electric fields PEF-induced biological changes PEF inactivation of vegetable cells, spores, and enzymes in foods Food processing by PEF HACCP in PEF processing PEF in the food industry for the new millennium

Effect of Pulsed Electric Field on Retaining Orange Juice Flavor Analyzed by Solid Phase Microextraction Gas Chromatography

Effect of Pulsed Electric Field on Electrodialysis of a NaCl Solution in Sub-limiting Current Regime

The Effect of Pulsed Electric Field on the Quality of Beef

Non-thermal Processing of Foods

Permeabilization of Plant Tissues by Pulsed Electric Fields

The impact of PEF treatment on onion tissue integrity was studied based on ion leakage measurements as well as cell viability staining techniques. PEF treatment (0.3 – 1.8 kV/cm, 0.5 kJ/kg) significantly (P

Reflecting current trends in alternative food processing and preservation, this reference explores the most recent applications in pulsed electric field (PEF) and high-pressure technologies, food microbiology, and modern thermal and nonthermal operations to prevent the occurrence of food-borne pathogens, extend the shelf-life of foods, and improve

Fluid milk processing is energy intensive, with high financial and energy costs found all along the production line and supply chain. Worldwide, the dairy industry has set a goal of reducing GHG emissions and other environmental impacts associated with milk processing. Although the major GHG emissions associated with milk production occur on the farm, most energy usage associated with milk processing occurs at the milk processing plant and afterwards, during refrigerated storage (a key requirement for the transportation, retail and consumption of most milk products). Sustainable alternatives and designs for the dairy processing plants of the future are now being actively sought by the global dairy industry, as it seeks to improve efficiency, reduce costs, and comply with its corporate social responsibilities. Emerging Dairy Processing Technologies: Opportunities for the Dairy Industry presents the state of the art research and technologies that have been proposed as sustainable replacements for high temperature-short time (HTST) and ultra-high temperature (UHT) pasteurization, with potentially lower energy usage and greenhouse gas emissions. These technologies include pulsed electric fields, high hydrostatic pressure, high pressure homogenization, ohmic and microwave heating, microfiltration, pulsed light, UV light processing, and carbon dioxide processing. The use of bacteriocins, which have the potential to improve the efficiency of the processing technologies, is discussed, and information on organic and pasture milk, which consumers perceive as sustainable alternatives to conventional milk, is also provided. This book brings together all the available information on alternative milk processing techniques and their impact on the physical and functional properties of milk, written by researchers who have developed a body of work in each of the technologies. This book is aimed at dairy scientists and technologists who may be working in dairy companies or academia. It will also be highly relevant to food processing experts working with dairy ingredients, as well as university departments, research centres and graduate students.

Nonthermal Preservation of Foods

Technology, Role in Food Science and Emerging Applications

Effects of Pulsed Electric Fields on Plant Tissue

Effect of Pulsed Electric Field on the Properties of Whey Proteins and on the Volatile Compounds in Milk

A Thesis Submitted for the Degree of Doctor of Philosophy in Food Science at the University of Otago, Dunedin, New Zealand

*This text comprehensively covers novel, innovative technologies used in the food and beverage industries in order to provide safe and healthy foods for consumers. The research provided in these chapters aims to show that the traditional pasteurization and commercial sterilization of foods result in unacceptable quality and nutrient retention, creating an important need for alternative methods used to minimize undesirable reactions such as thermal decomposition or degradation. Emerging processing methods to minimize heat induced alterations in foods and their applications are covered in-depth, demonstrating that these methods are useful not only for the inactivation of microorganisms and enzymes but also for improving the yield and development of ingredients and marketable foods with higher quality and better nutritional characteristics. Effect of Emerging Processing Methods on the Food Quality: Advantages and Challenges not only covers the advantages of using innovative processing methods, but also the disadvantages and challenges of using these techniques on food quality. Each chapter focuses on a different emerging processing technique, breaking down the sensory, textural and nutritional aspects for different food products in addition to the advantages and challenges for each method. New technologies and advanced theories are a major focus, pointing to innovative new paths for the quality and safety assurance in food products. From pulsed electric fields to ultrasounds, this work covers all aspects of emerging processing techniques for fruits and vegetables, foods and dairy products.*

*Food Safety Engineering*

*Opportunities for the Dairy Industry*

*Effect of Pulsed UV Lights and Pulsed Electric Fields on Selected Isolated Milk Proteins and Their Allergenic Properties*

*Effects of Pulsed Electric Fields on Structural Modification and Rheological Properties for Selected Food Proteins*