Advances in Food Process Engineering

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PREFACE

Food Process Engineering has witnessed remarkable transformations in recent decades, driven by the urgent need for sustainable technologies, effective waste valorization, and the growing consumer demand for natural, safe, and functional food products. The book “Advances in Food Process Engineering” is a compilation of recent innovations, emerging techniques, and interdisciplinary research in the domain, particularly focusing on bio-based materials, novel extraction techniques, and food preservation strategies.

This volume brings together eight carefully selected chapters that reflect the dynamic evolution of food process engineering. Each chapter is grounded in experimental work and offers insights into practical applications that contribute to enhanced food quality, safety, sustainability, and nutritional functionality. From the application of sodium alginate and kadam leaf extract coatings to extend the shelf life of cape gooseberry, to microwave-assisted protein extraction from mustard meal, the book explores cutting-edge research and development across diverse food matrices.

In particular, this book emphasizes the utilization of agro-industrial by-products, such as lemon waste, pineapple peel, coconut shell, and mustard meal, highlighting their potential to be transformed into valuable food additives, packaging materials, and bioactive compounds. It also introduces readers to eco-leather as a secondary packaging material, biodegradable films, and microencapsulation techniques, reflecting the growing trend toward green technologies and circular economy principles in food systems.

The intended audience includes food scientists, process engineers, researchers, graduate students, and industry professionals who are interested in sustainable innovation and novel applications in food processing. We hope this compilation will serve as both a reference and inspiration for ongoing research and industrial applications.

We extend our heartfelt gratitude to the contributing authors for their valuable research and to all those who supported the creation of this volume. It is our sincere belief that this book will contribute meaningfully to the growing body of knowledge in food process engineering and foster new ideas for future innovations.

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Chapter - 2

Sodium Alginate and Mustard Protein-Based Emulsion Gels

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Abstract

In this study mustard protein and sodium alginate-based emulsion gels were prepared by cold set gelation. The mustard protein isolate used in the study was isolated from defatted mustard meal using alkaline extraction and isoelectric precipitation. The protein content in the isolate was 90.5%. The concentration of oil was kept at 40% in all the emulsion gels having varying proportions of mustard protein and sodium alginate. Formulation of emulsion gel containing protein and sodium alginate in the ratio of 1:4 exhibited a good recovery rate of 91% and emulsion stability of 98%. Temperature sweep test showed that the fabricated emulsion gels were thermally stable. The ratio of mustard protein and sodium alginate significantly affects the characteristics of emulsion gels. Results of rheological analysis showed that PA21(emulsion gels having mustard protein and sodium alginate in the ratio of 2:1) and PA41 (emulsion gels having mustard protein and sodium alginate in the ratio of 4:1) were weak emulsion gels having low emulsion stability, oil binding capacity, and freeze-thaw stability. The protein and alginate content in emulsion gels also affected their color values. An increase in the ratio of protein resulted in the decreased strength of emulsion gels but played a significant role in the

stabilization of oil droplets in the gel matrix. The best emulsion gel was selected for the replacement of butter in cookies. The 100% replacement of butter with emulsion gel resulted in harder cookies with low sensorial scores. However, EG50, (cookies having 50% butter substituted with emulsion gels) were considered more comparable with control in terms of textural and organoleptic properties. Moreover, both EG50 and EG100 (cookies having 100% butter substituted with emulsion gels) cookies showed a significant decrease in fat content making them a healthier choice. Therefore, the fabricated emulsion gel can be potentially used in the preparation of low-fat processed food products with potential health benefits.

Keywords: Emulsion gel; Mustard protein; Alginate; Reduced fat cookies; Rheological properties

1. Introduction

Fats in food products directly influence the textural properties, taste, color, mouthfeel, and energy values of the products. Therefore, replacing the traditional food products with other ingredients is a complicated process. However, fat imposes negative health impacts due to the presence of saturated and trans fatty acids. Replacement of solid fat with liquid plant-based oils is considered a healthier option but it compromises the organoleptic properties, and oxidative stability of the products. Consequently, food researchers and industries are working hard to pave the way to restructure oil into a gel-like substance having textural and rheological properties similar to that of solid fats. And emulsion gels have come up as a solution for these techno-functional issues. Emulsion gels also known as emulsion hydrogels, emulsion-filled gels, and emulgels are soft solid-like materials having emulsified droplets entrapped in the gel matrix (Lu et al. 2021). Emulsion gels are widely utilized in the substitution of solid fat in bakery food and meat-based products without compromising much with the sensorial and textural properties (Brito et al., 2022). Emulsion gels not only help in the formation of reduced fat products but can also be used to improve