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.

CONTENTS

Chapter – 8

Microwave assisted protein extraction from mustard MEAL (*Brassica juncea)* and determination of its functional properties

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ABSTRACT

Microwave-assisted extraction, combined with response surface methodology (RSM), was utilized to extract protein from mustard meal. Typically used as a pretreatment step alongside alkaline extraction, microwave application disrupts cell walls, enhances the release of phytochemicals, improves extractability, and reduces processing time. This technique not only increases protein yield but also influences the functional characteristics of the extracted protein. Key factors affecting yield include microwave power, extraction duration, solid-to-liquid ratio, temperature, and pH. Optimal extraction conditions were determined to be 600 watts of microwave power for 90 seconds, at pH 11, using a solid-to-liquid ratio of 6 grams of mustard meal to 60 milliliters of distilled water (1:10). Following microwave treatment, the protein was isolated through centrifugation, neutralization, washing, and drying steps. The study assessed protein yield, purity, and functional attributes of the isolate. Results indicated a protein yield of 23.15% and a purity level of 93% at pH 11. Functional evaluations such as water absorption, fat absorption, emulsifying activity, and foaming capacity revealed strong emulsifying and foaming properties of the extracted protein.

Keywords: Mustard meal, protein extraction, microwave-assisted extraction, response surface methodology, functional properties.

1. Introduction

Mustard Plants belonging to the genus Brassica are of great economic and nutritional importance. It is mainly used for the oil extraction in India. Mustard has a beneficial composition as it is a rich source of oil, protein with a well-balanced amino acid profile, dietary fiber and antioxidants. The Production of mustard oil is in 4th position in the worldwide, after soybean oil, palm seed oil, and cottonseed oil. It is the most important oilseed crop in Europe. Canada is one of the major mustard producers with an annual production of over 200000 tons of white/yellow mustard. According to agricultural statistics (2017), India ranks third in terms of export after Canada and China with a per cent share of 8.8 from the production of 7.98 million tons in the financial year 2016–2017. Oilseeds are cultivated all around the world principally for their high oil and protein content. The extracted oil is used for edible purposes such as cooking oil, and salad dressing and non-edible purposes such as biodiesel. Oilseed meals or cakes are the residues remaining after the extraction of oil from oilseeds, are rich source of protein and are mostly used as animal feed and as fertilizers. The high percentage of protein makes the oilseed meal an alternative protein source and could result in the complete valorization of these by-products (Arrutia et al., 2020). Mustard was primarily used for cooking oil and used as a condiment with various foods such as sausages & salad dressings and also used for non-edible purpose such as Biodiesel or in medicine. In India, Mustard seeds/oil is used as Cooking oil and seasoning. Mustard meal is an important source of protein of high nutritional value and could have multiple uses in the human diet. Mustard plants are inexpensive than other oilseed crops and it usually grow in different soils and tolerate the utmost of weather. The major protein present in the Brassica genera is storage protein, cruciferin and napin comprising nearly 70% of the