Biomass Conversion and Biorefinery (2023) 13:16241–16251
https://doi.org/10.1007/s13399-023-04662-3

ORIGINAL ARTICLE

Boosting protein yield from mustard (*Brassica juncea*) meal via microwave-assisted extraction and advanced optimization methods

Kausar Jahan[1] · Samra Fatima[2] · Khwaja Osama[2] · Kaiser Younis[3] · Owais Yousuf[3]

Received: 12 April 2023 / Revised: 17 July 2023 / Accepted: 18 July 2023 / Published online: 22 July 2023

Abstract
In this study, we used microwave-assisted extraction to extract mustard protein isolates from defatted mustard meal, highlighting the importance of mustard as a versatile crop and the value addition potential of mustard protein isolates. We examined the effects of microwave power (425, 625, 800 W), treatment time (60, 90, 120 s), pH (8, 9.5, 11), and particle size (150, 375, 600 µm). A support vector regression–based model was developed and combined with a genetic algorithm for optimization. The maximum yield of 46.73% was achieved at microwave power 800 W, treatment time 120 s, pH 11, and particle size 150 µm. The functional properties of the protein isolates obtained under optimized conditions were analyzed. The protein isolates exhibited water absorption capacity of 2.48 g/g, oil absorption capacity of 0.66 g/g, emulsifying stability of 57.89%, foaming capacity of 83%, and stability of 91.6%. Microwave treatment did not affect the protein bands observed in SDS-PAGE analysis. The extracted protein showed a semi-crystalline and semi-amorphous nature, with a crystallinity index of 51.891%.

Keywords Support vector regression · Genetic algorithm · Microwave · Response surface methodology · Functional properties of proteins

1 Introduction

Mustard, a member of the *Brassica* genus, holds significant economic and nutritional values as its seeds are predominantly employed for oil production. Mustard is a versatile crop that is used for various purposes, including biodiesel production and food and non-food uses. Nepal and Canada are the world's top mustard seed producers, with 159,710 t and 121,600 t, respectively, in 2017 [1]. The overall process of white mustard oil production consists of seed harvesting, pre-cleaning, drying, storage, pretreatment, and oil recovery [1]. The cultivation and processing of mustard face various constraints, including low yield, poor quality seed, and lack of processing facilities [2]. Mustard is high in oil, protein, fiber, and antioxidants. Oilseeds are grown all over the world for their high oil content. Oilseed meals or cakes are the remnants left behind after extracting oil from oilseeds [3]. They are high in protein and are commonly used as animal feed and fertilizer. The high protein content of the oilseed meal makes it an alternative protein source and may result in the total valorization of these byproducts [4]. Mustard seed contains 30–40% oil, and after extracting the oil from the seed, around 60% of the residue remains as cake. Mustard meal, which remains after oil extraction, is a strong source of protein (23–30%) with high nutritional value. According to Puris et al. (2020) [5], the composition of amino acids in mustard seeds is characterized by an appreciable presence of aromatic acids (namely, phenylalanine and tyrosine), sulfur-containing amino acids (such as methionine and cysteine), and essential amino acids (such as leucine, valine, and lysine). When mustard protein is introduced as a functional component, it has the potential to supplement the cereal amino acid composition [6]. The global need for animal protein is anticipated to double by 2050, but environmental and health concerns about its production and consumption have prompted an examination of alternate sources

✉ Owais Yousuf
mirowais33@gmail.com

[1] Department of Biosciences, Integral University Lucknow, U. P, Lucknow 226026, India

[2] Department of Bioengineering, Integral University Lucknow, U. P, Lucknow 226026, India

[3] Department of Food Technology, Islamic University of Science & Technology, Awantipora, JK 192122, India