

Abstract

Pineapple is a non-climacteric tropical fruit with excellent juiciness, pleasant aroma, flavour, and immense health-beneficial compounds. Due to the huge amount of phytochemicals, nutritional potential, and valuable components, the pineapple industry worldwide has expanded quickly. The production of huge quantities of waste (650-800 kg per tonne) during pineapple processing, a rich source of residual sugars, pectin, hemicellulose, cellulose, and essential oils, can be produced. The study aimed to assess the functional attributes of dietary fiber from the Queen pineapple of northeast India. Queen pineapple waste was used to extract dietary fiber, which is one of the important bioactive compounds in the human diet and health. The ultrasound-assisted extraction method was used to compare the traditional alkali extraction method for extracting dietary fiber from Queen pineapple waste. The extracted dietary fiber was further examined for its functional attributes. The parameters used for ultrasound-assisted extraction (UAE) of dietary fiber were optimized using response surface methodology (RSM). The study also seeks to explore the transformative impact of enzymatic modification on dietary fiber sourced from queen pineapple waste, focusing on both its structural and functional characteristics. By analyzing the structural alterations resulting from enzymatic processes, the study delivers valuable insights into the underlying process of modification and its implications for dietary fiber quality; such as improving water holding capacity from 8.64 to 15.78 g/g; swelling capacity from 4.23 to 8.68 mL/g. Additionally, the enzymatic alteration improved the physicochemical, thermal, functional, and hypoglycemic attributes of dietary fiber extracted from queen pineapple waste. This includes enhancements in cation exchange capacity (3.98 to 7.38 mM/g) and glucose adsorption capacity (87.18 to 120.52 mM). Therefore, the modification by enzymes such as cellulase and xylanase enhances the qualities of the extracted dietary fiber (DF), suggesting a promising potential for incorporating pineapple waste into various food applications. The enzyme-modified DF was used to check the *in vitro* anti-diabetic activity at different concentrations based on their enzyme inhibition properties for α -amylase, α -glucosidase, and DPP-IV. For further investigation, two human cell lines were taken (Caco2 and HepG2). The cytotoxicity effect was investigated in both cell lines. Glucose uptake analysis was done on both the cell lines and RNA extraction and Differential expression genes were also analyzed. In this research, an enzyme-modified dietary fiber (EMDF) extracted from Queen pineapple waste was employed in varying concentrations (1%, 2%, 5%, and 10%) to enhance the functionality of bread. The investigation delved into the physico-chemical and functional attributes of EMDF, while also examining its impact on bread quality, including specific volume, texture, color, and sensory characteristics.

Notably, the hardness of the bread increased proportionally with the incorporation of EMDF, reaching 4.01 N with 10% EMDF content. Furthermore, the study assessed *in vitro* starch digestibility and predicted glycemic index (pGI), revealing a decline in pGI as EMDF content increases, reaching 67.03 for bread containing 10% EMDF. These findings underscore the potential of utilizing Queen pineapple waste-derived enzyme modified dietary fiber as an additive to produce functional bread with a lower glycemic index, offering a promising avenue for sustainable food production. The food processing industry is known for generating significant amounts of by-products, which not only go underutilized but also impose a growing burden on the environment. Utilizing agro-waste has become imperative for ensuring food security. The present investigation corroborate that Queen pineapple waste extracted dietary fibre could be used as a potential hypoglycaemic agent for functional food application.