Abstract

Food waste is a growing global concern, including in Thailand, where large quantities of banana peels (BP), rice bran fiber (RBF), and hemp seed milk residue (HSMR) are discarded. These byproducts are rich in dietary fiber and nutrients, offering opportunities to address both environmental and nutritional challenges. 3D food printing, an emerging technology, allows the incorporation of such food waste into value-added products like cookies. Therefore, fiber cookies can be developed through 3D printing using high dietary fiber food waste in Thailand (BP, RBF, HSMR). This study aimed to develop an optimal formulation of 3D-printed fiber cookies using mixture design and to compare their physicochemical and sensory properties with conventionally prepared cookies. Eleven formulations with varying fiber proportions were generated through mixture design, leading to three optimized combinations. One formulation (BP: 22.48%, HSMR: 65.44%, RBF: 12.08%) was selected based on its preferability in sensory evaluation. Cookies were produced using both 3D printing (3DC) and conventional methods (CC). No significant differences were found between initial formulations, likely due to the compositional limitations of rice bran, which was restricted due to its bitterness. Soluble fiber was associated with improved spreadability, while insoluble fiber influenced hardness and fracturability. 3DC samples showed superior textural characteristics and were preferred over CC, particularly for appearance and crunchiness. The results also indicated that 3D printing offers structural control and product consistency through manipulation of infill density. Additionally, low scores on the Food Technology Neophobia Scale suggested that consumers were open to 3D-printed foods, positively affecting acceptance. Overall, the study demonstrated that 3D food printing is a promising method for transforming high-fiber food waste into acceptable, nutritious, and appealing functional food products.

Keywords: 3D printing cookies, Fiber cookies, Food waste, Physicochemical analysis, Sensorial evaluation