ABSTRACT

Wheat (*Triticum aestivum*) is one of the most widely consumed cereals and it witnesses huge variation in its physicochemical and functional properties depending upon the pre- and post-harvest operations. Hence, it undergoes many physicochemical treatments to achieve optimum baking characteristics by altering the protein-protein and protein-starch interactions in wheat flour. In the current study, ultraviolet (UV-C, 254 nm wavelength) radiation was explored as a green technology to modify the functional characteristics of wheat flour and the UV-C induced changes in wheat flour were assessed. A continuous UV-C treatment system was designed and fabricated which was employed to treat the wheat flour in a uniform thin layer with total incident radiation power of 1.5, 3.0 and 4.5 W for varying exposure times.

Wheat flour of two varieties, *i.e.*, Sarbati (soft) and Punjab (hard) *var.* were treated with different power levels (1.5, 3.0, 4.5 W) of ultraviolet (UV-C) radiation for varying exposure time up to 250 s. The radiation power as well as exposure time had significant effects on the functional and physicochemical properties of wheat flour. Based on the impact on wheat flour, UV-C treatments were grouped into three classes, *i.e.*, gentle (3–12 J/g), mild (12–18 J/g) and severe (24–36 J/g) treatment. The variations in the protein solubility, conformation, and molecular distribution of the Osborne protein fractions upon UV treatment of wheat flour were studied. There was a drastic decrease (58.6 %) in extractable gluten content upon severe UV-C treatment attributed to variations in SH/SS group levels. FTIR study revealed the formation of β-sheets and α-helices at the expense of random coils and β-turns conformations while SDS-PAGE analysis confirmed about the no alteration in the primary chain of the proteins upon UV-C treatment of wheat flour. Oxido-reductive effects of UV-C radiation was demonstrated by the variation in the viscometric as well as rheometric behavior and pasting properties of the flour. The findings confirmed that UV-C radiation can alter the physicochemical and functional properties of wheat flour by altering the protein-starch interactions in wheat flour.

Further, UV-C treated flour was utilized to develop a novel *paneer* analogue, termed as "*Whaneer*". An additional method of mechanical disintegration was proposed and tested for *whaneer* preparation. The developed *whaneer* from both the methods were compared with conventional *paneer* and *tofu* based on different physicochemical, textural, microbiological properties, and sensory attributes. The developed *whaneer* had moisture content similar to *paneer* and the protein content was in the range of 38-42% (dry weight basis) which was approximately eight times and four times that of *tofu* and *paneer*, respectively. On the other hand, *whaneer* had lesser fat content of 4.20±0.07% as compared to *paneer* (52.3±0.89%) and tofu (37.5±0.42%). *Whaneer* had comparable textural properties and sensory scores and was microbiologically stable as compared to *paneer* and *tofu.* The whiteness index and hardness of *whaneer* samples increased upon storage and the shelf life was estimated as 11 days at 4 °C and 2 days at 30 °C of storage temperature. The estimated production cost for *whaneer* was ₹160-190/kg as compared to ₹275/kg for *paneer* and ₹129/kg for *tofu*. The total production cost and per cent benefit for *whaneer* were in between *tofu* and *paneer*, which justify the industrial feasibility of the *whaneer* production.

Keywords: Wheat; Wheat maturants; Ultraviolet radiation; Green technology; Design and fabrication; Protein-starch interactions; Oxido-reductive effect; Pasting properties; FTIR; *Paneer*; *Paneer* analogue; *Whaneer*; *Tofu*; Storage study