

Ultraviolet Radiation acts as a Universal Maturing Agent for Wheat flour: A future green technology for baking industries

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Abstract

Baking characteristics are the backbone of industrial importance of wheat (*Triticum*). Wheat is mostly consumed in the form of industrial products like baked or extruded products in developed countries. The baking characteristics are improved to desired level by adding some permitted chemicals prior to the baking/extrusion process. In current era, the consumer is becoming health conscious and demanding for chemical free foods. Thus, there is dire need for the suitable alternative technology which can improve the baking characteristics of the wheat flour without using the chemical substances. This opinion report details about the application of ultraviolet radiation as a universal maturing agent to improve the wheat flour. The industrial potential and applicability of UV irradiation in wheat processing plant is also discussed.

Opinion

Wheat (*Triticum*) is the most consumed staple cereal worldwide second to rice. The major proportion of Wheat is consumed in the form of Ready-To-Eat (RTE) products of which baked products and extruded products are the most consumer accepted products. For baked and extruded products, the characteristics of wheat grains play major roles in deciding the suitability of wheat for the industrial production of wheat products. All the varieties of wheat do not possess the similar characteristics and carries huge variation in grain properties and its industrial application. Based on grain hardness, wheat grains are classified in two broad groups, i.e., soft wheat and hard wheat. A particular wheat variety is found to best suitable for a specific category of products, e.g., hard wheat is best suitable for the production of extruded products like pasta, macaroni, etc. while soft wheat is used for baked products like bread, cake, etc. A common industrial practice is blend flours of different wheat varieties and/or to add certain set of chemicals called as flour maturing agents or maturants to the wheat flour before kneading process to obtain desired processability and/or final properties of end products. Maturing of bread flour using chemical treatment has similar action to natural aging as each is characterized by the application of an oxidation process to flour which changes its properties, so that the produced dough is a livelier, drier, more machinable, better baking, and whiter end-product [1]. A maturing agent are primarily oxidizing agents but can be a reducing agent depending upon the characteristics of native wheat flour and target functionalities. These maturing agents for wheat flour primarily impact the protein factor of wheat flour, especially gluten protein networks. Gluten, the main factor which exclusively decide the quality of wheat flour, is a macromolecule protein network developed due to cross-linking of glutenin and gliadin protein subunits present in the wheat flour in the presence of water during kneading process [2]. The added maturing agents take parts in the cross-linking process and improves the final properties like color, texture, softness, stretchability, etc. of

the dough and the end products. On the backside of improving the baking properties of wheat flour, these maturing agents also possesses huge potential to negatively affect the consumers health. Thus, governmental body permits the use of only certain chemical which are proved safe for human consumption and set the permissible limit for each permitted chemical to be used in particular process. There is great consumer demand in the retail market for the products which are chemical free and safe for human consumption. Thus, researchers in academia and industries are looking for safer and chemical free process to improve the wheat flour properties. Beside conventional hydrothermal treatment, several advanced technologies like extrusion shearing, microwave, high pressure processing, irradiation, etc. have been employed and evaluated in order to achieve the desired properties of wheat flour. Each process or technology has its own advantage and disadvantage with vantage of industrial applicability as well as desired properties of end products. Among the many advanced technologies used for wheat flour, ultraviolet (UV) radiation is also one of the promising technologies which can be used for maturing the wheat flour.

Ultraviolet radiation in the range of 230-400nm is generally considered as non-ionizing green technology which possesses the enough potential to impact the functioning of several biological macromolecules including proteins, DNA, RNA, etc. [3,4] demonstrated that UV radiation of wavelength 254nm can significantly affect the functionality of wheat flour by impacting the wheat gluten cross-linking networking pattern. It was shown that UV irradiation on common wheat (*Triticum Aestivum*) can result in fragmentation of gluten network indicating the severe impact of UV light with exposure time of 5 minutes. The study revealed that UV radiation acts both like oxidizing agent as well as reducing agent based on the UV irradiation power and exposure time. Therefore, UV radiation is termed as universal maturing agent for wheat flour as it can be employed for strengthening as well as leavening of dough prepared from UV treated flour. It was suggested that the irradiation process can be optimized to get the desired baking characteristics without addition of any maturing agent. In another study, [5] has exclusively demonstrated the impact of UV radiation on wheat proteins fractions. In this study wheat flour was treated with UV radiation and all the major wheat protein were extracted from irradiated wheat flour and analyzed for various characteristics and functionalities. Study revealed that UV radiation have potential to modify the secondary structure of the protein while the primary chain of proteins remains intact as confirmed by Fourier Transform Infrared (FTIR) Spectroscopy and Gel Electrophoresis (SDS-PAGE)

method. Extensive studies have been conducted to exploit the potential of UV radiation for microbial inactivation in solid powders (Rifna et al. 2019), modification in starch [6,7], photo-degradation of proteins [8], changes in liquid egg protein [9], and modification in the protein fractions of wheat flour [4]. The implication of UV radiation treatment on industrial level is not a big problem now a days. There are several very efficient UV sources are available in the commercial market which can attached in several possible units in wheat flour processing plant like, in crushing units, sieving units, conveyors, etc. while ensuring the total exposure time matches the calculated time to obtain the desired characteristics of the wheat flour being treated. The current status of UV irradiation in wheat flour industry is very prosperous and has great industrial applicability. UV radiation can be used as single point technology to improve the baking characteristics of wheat flour as well as significantly reducing the microbial load in the flour which will increase the shelf life of the wheat flour. Thus, by employing UV radiation, industrial will produced chemical free wheat flour with improved baking characteristics and desired baking qualities.

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