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Microwave Assisted Blanching of Fruits and Vegetables: A Mini Review

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ABSTRACT

Higher perishability of fruits and vegetables leads the various deterioration reactions and deteriorate the fruits and vegetables fastly. Blanching is one of the deterioration way of fruits and vegetables. Blanching is pretreatment method of food preservation method prior to freezing, refrigeration and canning methods. It is heat treatment method for inactivation of enzymes and prevents the quality of fruits and vegetables during storage. Conventional blanching process are highly effective for inactivation of enzymes but it have some drawbacks like longer processing time, high energy consumption, and nutrient degradation etc. Microwave assisted blanching is novel and current trending method for enzymes inactivation. Heating of food material is important principle of enzymes inactivation in microwave assisted blanching. This method inactivates the enzymes in very short time and prevents the quality of food material.

Keywords: Blanching, Microwave heating, Enzymes, Dielectric properties;

1. INTRODUCTION

Fruits and vegetables are characterized for highly perishable and seasonal food matrices. Due to higher perishability of fruits and vegetables leads the various deterioration reactions and deteriorate the fruits and vegetables fastly. Enzymatic browning is a costly concern in the food processing industry, because it is one of the primary causes of quality degradation of fruits and vegetables. Freezing, refrigeration, canning and drying etc are most commonly used food preservation method. Prior to these preservation methods, fruits and vegetables are being blanched in order to inhibit subsequent deteriorative enzymatic reactions. Blanching is pretreatment technology for food preservation method prior to freezing, refrigeration and canning methods. Blanching is an important step in the industrial processing of fruits and vegetables. Its main purpose is the inactivation of enzymes that may cause a deterioration of the quality attributes of vegetables and fruits, such as color, texture or flavor, during the subsequent processes or storage. It also reduced the microbial load, made tissue cell softer and decrease the volume of foods. It consists of a thermal process that can be performed by immersing vegetables in hot water, hot and boiling solutions containing acids and/or salts or steam. Conventional blanching technologies i.e hot water and steam methods are highly effective for enzyme inactivation and have some drawbacks like longer processing time, leaching out of nutrients and higher energy consumption over novel blanching technologies. Several novel technologies like high pressure processing, ohmic heating, radio frequency, ultrasound, infrared, and microwave heating. In order to achieve blanching, microwave heating can also be applied and it is gaining attention in microbial and enzyme inactivation research area. Microwave assisted blanching is one of the important technology for enzyme inactivation and making the food safe for storage and consumption. It is recognized as a technology that reduces the time and energy required to achieve the inactivation of enzymes since it is a method that allows high temperature short time (HTST) treatment of fruit and vegetables foods through volumetric heating in the electromagnetic waves. Due to high temperature and short time treatment process, it preserved the thermolabile compounds and heat sensitive vitamins.

2. Principle of Enzyme Inactivation

Enzymes are relatively heat labile; temperatures of more than 50ºC and proper time of treatment allow a decrease in activity, whereas they are inactivated at temperatures of 80ºC. Enzyme inactivation of fruit and vegetables by microwave is due to heat generation inside of food materials. Microwave heating is produced by the capability of the food product to absorb microwave energy and transform it to heat. Ionic polarization and dipole rotation are the two main principle of heating by microwaves. The presences of water or dipolar molecules are main substances for dielectric heating in food material. The heating caused by polarized dipolar molecules to arrange itself with the frequently varying alternating electrical field. Such oscillations produce intermolecular friction resulting in the volumetric heating of the material. This volumetric heating raise the temperature of food material and inactive the enzymes. Microwave heating also occurs in the presence of a high frequency oscillating electric field responsible for generation of heat, because of oscillatory ions migration in the food. Many factors are responsible for heat distribution and microwave heating, among which the depth of penetration and dielectric properties are most important. The various factors influencing the heating pattern of the product are frequency of microwave processing, microwave power and speed of heating, physical geometry of sample (size, thickness, shape) mobility of the product inside the oven (rotation/ non rotation), mass of product, moisture content of the product, density, dielectric constant of the product, physical geometry (size, thickness, shape), conductivity, and specific heat. In microwave processing, heat is produced all over the product uniformly, causing rapid heat rates, as compared to traditional thermal processes in which heat is mostly moved from the surface to the interior of the material.

3. Inactivation of enzymes

Dorantes-Alvarez et al. (2011) studied on blanching effect of microwave heating on peppers. The purpose of this research was to evaluate changes in antioxidant activity of *Capsicum annuum Jalapeno* type as induced by microwave-assisted blanching to inactivate polyphenol oxidase (PPO). The whole fresh peppers with 85% moisture content blended until a paste was obtained and 10g samples were heated with microwaves. The energy density required to achieve the complete inactivation of PPO enzymes was 0.38 KJ/g. The Antioxidant activity of the pepper was enhanced from 29 to 42 µM Trolox/g peppers (dry weight basis) after the microwave treatment.

Ramesh et al., (2002**)** studied the microwave blanching effect on spinach, carrot and bell peppers. They also compared the microwave blanching and conventional blanching method (water blanching). They concluded that vegetables treated by microbial method were more nutrious than conventional water blanching at same temperature.

Palma-Orozco et al., (2012) studied the effect of microwave blanching on the polyphenol inactivation, color changes, and microstructural damage of mamey fruit. It was observed that polyphenol oxidase was completely inactivated when the temperature reached 79ºC for 165 s. The optimum energy intensity for polyphenol oxidase inactivation by microwave treatment of 300 g of mamey was 0.51 kJ/g; and the microwave treatment was found to result in negligible damage of the mamey pulp's microstructure.

Application of microwave processing improved the quality of tea due to enzyme inactivation. Therefore, Huang, Sheng, Yang, and Hu (2007) studied on the effect of microwaves and compared with oven heating on the preservation of bioactive compounds, such as ascorbic acid and polyphenolic compounds, which are some of the components responsible for green tea quality. The results show that the tea from spring and autumn tea processed by microwave heating had higher content of vitamin C

(4.74 g/kg and 5.51 g/kg dry mass, respectively) in comparison with those treated by oven heating. During their studies, they concluded that microwave treated tea have higher ascorbic acid content, which decreased significantly slower during storage compared to that treated by conventional heating. The sensory quality was also improved in tea produced by microwave blanching.

The microwave treatment for inactivation of ascorbic acid oxidase (AAO) enzyme and effect of frozen storage on ascorbic acid of mango was studied by Xanthakis et al., (2018). They used microwave treatment in two heating method: high temperature short time (HTST) and low temperature long time. Both methods were effective for higher inactivation of AAO enzymes as compared to conventional water blanching process.

4. CONCLUSIONS

This paper reviewed about the microwave assisted blanching of fruits and vegetables and showed the various advantages of this novel method as compared to conventional blanching methods. This novel method saves time and energy during the processing. It can be used as HTST process for inactivation of enzymes. It retained the various phenolics and antioxidants compounds after the blanching treatments.

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