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State of Bound Water: Measurement and Significance in Food Processing

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Chapter 7
Significance of Bound Water Measurement

7.1 Introduction

Status of water is important over the course of harvesting, processing and storage of food materials. Fraction of bound water dominates in several key phenomenon including ripening, microorganism growth and energy requirement in whole food processing [1]. Therefore, fraction of bound water is not only vital for processed food rather it is equally important for fresh food during storage [2]. However, the scope of the book allow the discussion on the significance of bound water during food processing. Therefore, in the following section an extensive discussion on the significance of bound water removal has been discussed.

Water content in the form of bound water and free water plays a significant role during the water removing process including drying and frying. Bound water is captured by the solid matrix of water in the insoluble compounds in the fruit cells and the migration of bound water urges higher energy, once all the free water is migrated, whereas free water gives support to the chemical reactions, metabolism activities and acts as a medium for internal transport.

Moreover, product quality is negatively affected by the high temperature drying process over the course of moisture removal from the food product [3]. This process causes changes in the food quality like discolouring, aroma loss, textural changes, nutritive value, and physical properties significantly [4]. Drying conditions and time have a great effect on these quality changes of dried product. Mild drying conditions with lower temperature can improve the product quality but increase the drying time, whereas severe drying conditions with higher temperature reduces drying time and provides low quality dried food. Therefore, quality, energy consumption, processing time and cost need to be optimised carefully [5].

Bound water removal contributes in all of the aspects including quality, energy consumption, processing time, cost and even environmental pollution. There is no straight forward answer whether removal of bound water is beneficial, since removal of bound water needs more energy, time, and cost along with promising higher

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remove bound water effectively also increase the possibility of releasing phenolic compounds. For example, Hayat et al. found that bound phenolic compounds significantly released during appropriate microwave treatment [70, 71]. Therefore, it can be assumed that the condition that allows removal of bound water may increase the chance of releasing bound phenolic compounds of food materials.

7.3.4.4 Lipid Oxidation (Aroma)

Flavour of the food materials is considered as one the most important parameter to define food quality. More than 200 volatile aroma components are present in the fruits among which a single group is responsible for making a particular smell. These components are highly volatile in the presence of moisture and readily get evaporated during processing. However, lipid oxidates vary inversely with the a_w and reach a minimum value near the monolayer and the reaction rate increases with the additional moisture absorption above this layer [72–74]. As the water content is absorbed from the dry state, water quenching effect decreases the catalytic initiation of free radicals formation and hinders the oxidation rate. Moreover, oxygen diffusion rate remarkably decreases with the replacement of water by air in the pores and capillaries at the moisture sorption process. Low water activity state lowers the oxidation reaction rate. Consequently, fewer aromas prevail from the food where bound water is replaced by air molecules.

7.3.5 Water and Food Appearance

A physical view of the food products not only stands for the chromatic distribution and shininess but also the transparency to the spatial distribution of light and glow has similar effects on the appearance. The luminosity of light creates the visual sensitiveness of the colour of the food and this visual perception due to varying spatial distribution of light is termed as “cesia” by the architect Cesar Janello in 1965 [75–78]. The chromatic distribution pattern defines the colour of the food by means of hue, saturation and luminosity which has been further alleged by cesia as permeability, darkness and diffusivity for the vividness and sharpness of the image in case of generating human visualization by transmission and reflection [78]. However, the cesia behaviour gets less impact than the chromatic aptitude due to the deficiency in specifying and precisely measuring the ingredients solely responsible for these consequences. Apart from the change in colour or glow due to structural changes during food processing and preserving, the light emits from the object or the light reflects or transmits from the object causes the variation in colour and the later stimuli can be attributed as cesia effect. This variation in colour mainly depends on the micro-textural pattern of the surface exposed to light or the volume of the surface [78]. As the plant-based fruits and vegetables have higher moisture content (>85%), during drying this moisture content drastically reduces and contributes to

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