Trends in Food Science & Technology 55 (2016) 118–127

Contents lists available at ScienceDirect

Trends in Food Science & Technology

journal homepage: http://www.journals.elsevier.com/trends-in-food-science-and-technology

Review

Staling of Chinese steamed bread: Quantification and control

Fan Zhu

School of Chemical Sciences, University of Auckland, Private Bag 92019, Auckland 1142, New Zealand

ARTICLE INFO

Article history:
Received 4 March 2016
Received in revised form
14 July 2016
Accepted 18 July 2016
Available online 22 July 2016

Keywords:
Chinese steamed bread
Staling
Starch retrogradation
Additive
Texture
Shelf life

ABSTRACT

Background: Chinese steamed bread (CSB) is a traditional staple food consumed among Asian people. There is a trend to produce CSB on large and industrial scale due to the socio-economic changes. One major challenge is that CSB has a short shelf life due to staling. Even though the molecular basis of CSB staling is not well understood, various methods have been employed to improve the shelf life.

Scope and approach: This mini-review summarizes various methods for the quantification of different aspects of CSB staling. Diverse additives and process conditions have been used to effectively reduce the CSB staling. These methods impact the biopolymer interactions, decrease the amylopectin retrogradation, while affecting water distribution in CSB during storage. The molecular basis for the anti-staling properties is discussed. A portion of the literature is drawn from Chinese journals and theses.

Key findings and conclusions: Various methods for the quantification of CSB staling included texture analysis, NMR spectroscopy, thermal analysis, and sensory evaluation. Effective anti-staling materials included enzymes, hydrocolloids, oligosaccharides, lipids and surfactants, and soy and waxy wheat flours. Mixtures of some of these additives also showed anti-staling property. Manipulating processing/bioprocessing conditions, such as using sourdough technology, can also retard the CSB staling. There is a great similarity between bread and CSB in the staling mechanism as well as using food additives as anti-staling agents. Compared with the knowledge of bread staling, much work is needed to better understand various aspects of CSB staling by employing diverse instrumentation.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Chinese steamed bread (CSB) has been a staple food in China for many centuries (Zhu, 2014). Nowadays, CSB is also a popular food product among Asian population outside China. It comes into different shapes (e.g., buns and rolls) with or without fillings (Huang, 2014). The texture of CSB varies from dense, very firm and cohesive to soft and fluffy, depending on the regions and consumer preferences (Huang, 2014). In general, CSB is firm and chewy in northern part of China such as Shandong and Henan provinces. In southern China such as Hubei province, CSB is softer with a more open structure. There are other types of CSB (e.g., Guangdong style) consumed as dessert (Huang, 2014). Different formulation and process conditions determine the texture and style of CSB. There is much confusion in some reports where the type of CSB is not specified, though the majority of the reports are on the northern style CSB (Zhu, 2014).

The basic ingredients of CSB are wheat flour, water, and yeast/sourdough. There are optional ingredients for the formulation of various types of CSB with unique eating and nutritional quality (Zhu, 2014). There are two processing procedures (one-step fermentation and two-step fermentation) commonly used in China for CSB production (Liu, 2015). For the one-step fermentation procedure, all the ingredients are mixed to form a dough. Then the dough is fermented, sheeted and molded, proofed, and steamed. For the two-step fermentation procedure, the initial mixing involves a certain amount of ingredients for dough formation. After the first fermentation, more ingredients such as flour up to 40% are added into the dough and mixed for a second fermentation (Liu, 2015). The quality of CSB is dependent on the quality of the ingredients, as well as the formulation and processing conditions (Huang, 2014; Liu, 2015; Zhu, 2014). The criterion of the quality attributes and the impacts of diverse optional and basic ingredients have been reviewed recently (Zhu, 2014).

Traditionally, CSB are much produced in small workshops and on family basis. Socio-economic changes and urbanization of Chinese population require the efficient production of CSB at large and industrial levels (Li, 2012). A major challenge to meet this trend is the CSB staling. Like bread, CSB undergoes various

E-mail address: fzhu5@yahoo.com.

http://dx.doi.org/10.1016/j.tifs.2016.07.009
0924-2244/© 2016 Elsevier Ltd. All rights reserved.

physical–chemical changes during storage, resulting in firmness increase and freshness loss (Sha, Qian, Liu, & Li, 2007, Sha, Qian, Wang, Lu, & Li, 2007). There is increasing interest to develop strategies to enhance the shelf life of CSB. Various food additives (e.g., enzymes and hydrocolloids) have been used as anti-staling agents of CSB (Bai, Liu, & Han, 2009; Sim, NoorAziah, & Cheng, 2015). Manipulating production process and storage conditions also showed promising results (Sha, Qian, Liu, et al., 2007; Sheng, Guo, & Zhu, 2015). A large quantity of literature on CSB staling has been published in Chinese journals, and is summarised in this mini-review (Table 1). A portion of these Chinese literature presented the staling process in figures, and the staling rate was not quantitatively given. Nevertheless, these results are summarised here due to their possible practical applications for food industry. There tends to be a lack of mechanistic aspects of these methods for their anti-staling property. Therefore, possible mechanistic basis of particular components responsible for the anti-staling process is discussed. Methods used for the quantification of CSB staling are also surveyed.

2. Quantification of various aspects of CSB staling

2.1. Water content and water activity

Change in the moisture distribution of CSB is a major phenomenon during CSB staling. This is due to various factors such as physicochemical changes of the components (e.g., starch retrogradation), drying out, and moisture re-distribution among components and also between crumb and crust (Gray & Bemiller, 2003). The water content of the CSB crumb ranges around 39–44% (Sha, Qian, Wang, et al., 2007; Sheng et al., 2015; Wang, Khamchanxana, Zhu, Zhu, & Pan, 2016). The crust contains a higher amount of water than the crumb by ~3% (Sheng et al., 2015). However, another study showed that the skin had a moisture content of 42%, while that of the crumb was 39%, upon removal of CSB from the steamer (Sha, Qian, Wang, et al., 2007). This difference may be attributed to the difference in flour properties, formulation composition, and measuring procedures. During storage, there is a gradual decrease in the moisture content in both crumb and crust before levelling off (Sha, Qian, Wang, et al., 2007; Sheng et al., 2015). For example, Fig. 1 shows the changes in moisture content of CSB stored at 25 °C in active packaging (with oxygen absorber) (Sheng et al., 2015). In comparison with baked bread, the difference in moisture between crust and crumb of CSB and the changes in moisture content during storage are much smaller (Piazza & Masi, 1995). Water activity of CSB is around 0.96–0.97, making CSB susceptible to mould and bacteria growth (Sheng et al., 2015; Wang et al., 2016). During storage, moisture activity of CSB kept relatively constant (Sheng et al., 2015). Various strategies can be developed to increase the microbiological shelf life of CSB (Wang, Opassathavorn, & Zhu, 2015; Zhu, Sakulnak, & Wang, 2016), though this review focuses on the staling of CSB.

2.2. Water soluble starch content

The content of water soluble starch from CSB crumb during storage was quantified (He, Lin, Sun, & Li, 2008; Sha, Qian, Wang, et al., 2007; Wang, Ren, Pan, & Cao, 2015; Xiao, Ma, Li, & Sun, 2005). The results showed that water soluble starch content decreased in the initial few hours before levelling off during the storage (Sha, Qian, Wang, et al., 2007). Ghiasi, Hoseney, and Lineback (1979) showed that soluble starch from bread crumb is most from the amylopectin that has been degraded by α-amylase during processing (e.g., dough formation). Therefore, amylopectin recrystallization and amylose re-association decreased the amount of soluble starch in CSB during storage.

2.3. Nuclear magnetic resonance (NMR) spectroscopy

NMR spectroscopy is a technique that explores the magnetic properties of some atomic nuclei (e.g., ^{1}H and ^{13}C) in either solid or liquid state (Spyros & Dais, 2012). It can provide information on the dynamics, structure, chemical environment, and reaction state of molecules, and has been widely used in food analysis (Marcone et al., 2013; Spyros & Dais, 2012). Based on the basics of NMR, magnetic resonance imaging (MRI) further permits the direct visualization of the interior and components of foods (Marcone et al., 2013). Proton NMR technique has been used to monitor the water mobility in CSB during storage and its relationship with staling (He, 2006; Ding, 2013; Su, Su, & Ding, 2014). The amount of free water and its mobility in CSB decreased during storage, and showed positive correlations with the hardness of CSB. The water state in the crust and crumb during staling can be further probed to study the moisture distribution, which is a major cause for bread staling (Gray & Bemiller, 2003). There are other types of NMR-based techniques, such as solid state ^{13}C NMR (to monitor the structure and phase transition of starch in food systems) and MRI, which remain to be used in the CSB staling research (Vodovotz, Baik, Vittadini, & Chinachoti, 2001).

2.4. Texture analysis

The texture of CSB changes from being soft, elastic, and springy to firm and inflexible during storage. Uniaxial compression-type texture analyser is most used for the quantification of the CSB staling (Qian, 2005; Sha, Qian, Liu, et al., 2007, Sha, Qian, Wang, et al., 2007) (Table 1). CSB is sliced and changes in the hardness of crumb slice during storage are recorded. The staling rate is defined as the change in hardness per unit of time (day or hour). Texture profile analysis (TPA) is a double compression test for analysing the textural properties of foods, and the texture analyzer mimics the biting action of the mouth under TPA (Friedman, Whitney, & Szczesniak, 1963). TPA has been widely used to monitor the changes in the texture of bread (Fadda, Sanguinetti, Del Caro, Collar, & Piga, 2014; Gray & Bemiller, 2003). Qian (2005) explored the possible application of TPA to quantify the staling process of CSB. Various parameters, including hardness, adhesiveness, springiness, cohesiveness, chewiness, and resilience, were recorded for CSB stored at room temperature up to 72 h. These parameters were related to the sensory quality of CSB. The results showed that hardness and resilience were highly correlated to the sensory properties, and were suggested to be suitable for the quantification of CSB staling. The percentage of deformation of CSB was suggested to be 30–50% for the quantification (Qian, 2005). Stress-strain curves were also found to be useful for staling analysis (Qian, 2005), though they were much less used. Textural analysis showed that the staling rate increased fast in the initial 24 h before levelling off (Sha, Qian, Liu, et al., 2007, Sha, Qian, Wang, et al., 2007; Qian, 2005). This is probably due to the re-association and re-ordering of amorphous amylose, which is most responsible for the short-term retrogradation of starch (Miles, Morris, Orford, & Ring, 1985).

2.5. Thermal analysis

Differential scanning calorimetry (DSC) has been used to study the starch retrogradation and amylopectin re-crystallization in CSB (Sha, Qian, Wang, et al., 2007; Zhang, Zeng, & Sun, 2014; Sheng et al., 2015). Both the melting temperatures (T_o, T_p, and T_c) and enthalpy change (ΔH) of the starch fraction in CSB can be recorded

Download English Version:

https://daneshyari.com/en/article/2098484

Download Persian Version:

https://daneshyari.com/article/2098484

Daneshyari.com