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Extended Abstract

The Evaluation of Xanthan Gum Addition on the Characteristics of Local Sweet Bread (Kichi) and the Use of Image Processing to the Assessment of its Microstructural Properties

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Abstract

Kichi is a local sweet bread that is cooked in the west of Iran, especially in Chaharmahal and Bakhtiari Province. This product is traditionally produced and has a low shelf life and hard texture. Therefore, the aim of this study was to investigate the effect of xanthan gum (0, 0.1, 0.3 and 0.5%) to improve the quality of Kichi sweet bread. Also mean size area, porosity, fractal dimension, and color parameters of Kichi bread were evaluated. The results showed that addition of xanthan led to improving WHC. The results of the texture analysis showed that softer samples were obtained in the low concentrations of xanthan gum (0.1% based on flour) and gumminess in this sample was significantly less than other samples (P<0.050). Also, the porosity of the product in the low concentrations of xanthan (0.1%) was similar to the control, but in the high concentration of xanthan gum, the porosity of the product reduced. On the other hand, the results showed that the addition of xanthan gum did not affect the fractal dimension of the product texture. In the case of product color, the xanthan had a significant effect on the L* and b* values of the texture. Finally, it can be stated that using 0.1% of xanthan gum in the formulation of this local bread led to the production of a quality product regarding color and texture. The sensory evaluation results of the samples showed that the addition of xanthan improves the sensory properties of the samples. In general, samples containing 0.1% xanthan had better texture and sensory properties.

Keywords: Hydrocolloid, Image processing, Local sweet bread (Kichi), Sensory evaluation

Introduction

Kichi is a local sweet bread with short shelf life and hard texture cooked in the west of Iran. The final quality of baking products is affected by their formulation ingredients. For improving the quality of these products, various additives such as hydrocolloids are used (Anderson & Andon, 1988). Hydrocolloids improve the quality of the final products by changing the rheological properties of dough and bakery products. Xanthan is a hydrocolloid

produced by the bacterium Xanthomonas campestris. Using this gum can increase the volume, moisture content, and improve the texture of baking products (Phillips & Williams, 2000).

Numerous studies have been performed on the addition of hydrocolloids to the formulation of baking products. Rosell, Rojas, & De Barber (2001) investigated the effect of adding 0.1 and 0.5% of different hydrocolloids (sodium alginate, kappa carrageenan, xanthan, and hydroxypropylmethylcellulose) on the quality characteristics of wheat dough. Lazaridou, Duta, Papageorgiou, Belc, & Biliaderis (2007) investigated the effect of adding 1% and 2% of different hydrocolloids (pectin, carboxymethylcellulose, agarose, xanthan, and beta-glucan) on dough properties and quality properties of gluten-free breads based on rice flour and corn. Movahed, Khalatbari Mohseni, & Ahmadi Chenarbon (2014) evaluated xanthan gum and potato flour's effect on the quality characteristics of toast.

This study aimed to improve the quality characteristics of Kichi pastry bread by using improvers such as Xanthan. Digital image analysis was used to evaluate the effect of different xanthan gum concentrations on the color characteristics of crust and crumb, porosity, image texture characteristics, pore size, fractal dimension, and crust thickness of kichi.

Materials and methods

Dough preparation: Wheat flour 52%, water 7.3%, shortening 5.5%, sugar 15%, oil 5.5%, invert syrup 11%, eggs 2.5%, baking powder 0.2%, milk powder 0.5%, mono- and diglyceride 0.2%, vanilla slightly, and Xanthan gum (0, 0.1, 0.3 and 0.5%) were mixed completely. Then incubated at 25-30 °C for 150 min. Finally the doughs divided to 6*5*1 cm pieces and backed 175 °C for 20 min.

Water Holding Capacity (WHC): The weight ratio after and before centrifugation was used to measure WHC dough (Xu, Huang, Jia, Kim, & Liu, 2009). Texture profile analysis (TPA): From the samples' center, a square cube with 25 mm dimensions were cut. Using a 40 mm probe, it was compressed to 10 mm at a speed of 1.7 mm/s. texture parameters of hardness, cohesiveness, gumminess, and springiness were measured (Shi, Yu, & Lee, 2013). Special volume: To measure the volume, the method of replacing the volume with rapeseed was used. Bread weight was determined, and the specific volume was calculated according to (Xu, Hall III, & Manthey (2014). Crust and crumb color: ImageJ software was used to measure the crust and crumb color of images of samples. L*, a*, and b* parameter were calculated (Naji-Tabasi & Mohebbi, 2015). Porosity: crumb porosity was measured by image processing with ImageJ software, according to Shahidi, Mohebbi, & Ehtiai methods (2011). Pore shape and size: circularity, aspect ratio, roundness, and solidity were calculated according to Naji-Tabasi & Mohebbi methods (2015) with ImageJ software. Crust thickness: The crust thickness of the samples was measured using the image processing method and ImageJ software (Ghaitaranpour, Taghizadeh, Mahdavian Mehr, & Abdullahi moghadam, 2015). ImageJ software was used to examine the fractal dimensions of samples crumb. In this method, the fractal dimension was calculated by the box-counting method, according to Pourfarzad, Mohebbi, & Mazaheri-Tehrani (2012). Sensory evaluation: Ten judges by hedonic method (five-point) evaluated appearance (presence of rupture), up and down the surface (burn and color), firmness and softness of texture (doughiness, firmness, and brittleness), chewability, aroma, taste, and total acceptance.

Results and discussion

Xanthan increased WHC compared to the control sample (Fig. 1A), but no significant difference (P<0.5) was observed between WHC samples containing different concentrations of xanthan. This could be due to the ability of xanthan to hold water in the dough, and as a result, less water will drop out of the dough (Xu *et al*., 2009). As shown in Fig. (1B), samples containing 0.1% xanthan have the highest specific volume (1.82 cm^3/g). Further increase in xanthan concentration led to a decrease in specific volume in the samples; this is probably due

to an increase in viscosity, which leads to a lack of proper expansion of the dough and gas storage (Koocheki, Shahidi, Mortazavi, Karimi, & Milani, 2011).

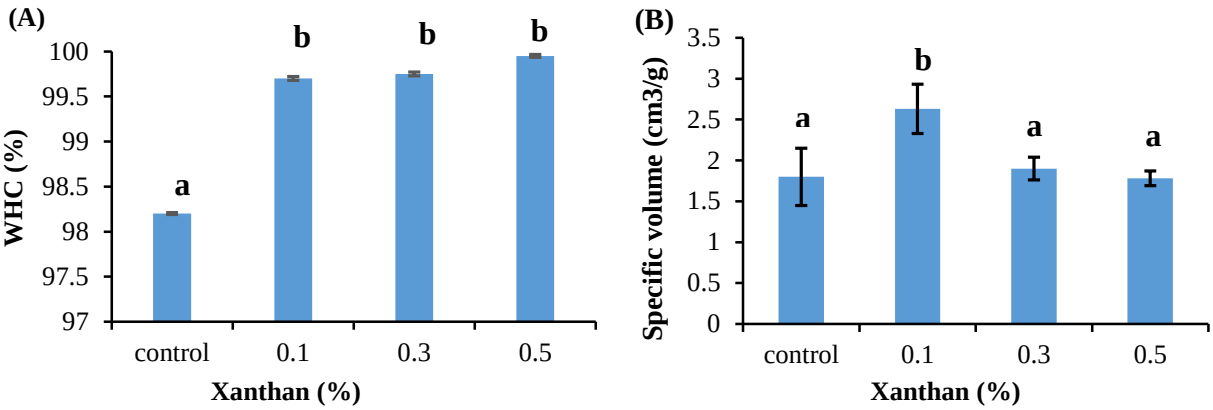

Fig. 1. Effect of different concentration of xanthan on A: WHC B: specific volume

By increasing the concentration of xanthan from 0.1 to 0.3 or 0.5, the samples' hardness increased. The use of different concentrations of xanthan increased the cohesiveness of the samples; however, the difference was not significant with the control sample. By adding xanthan gum in 0.1 and 0.3%, the samples' gumminess decreased compared to the control sample. Statistically, the addition of xanthan gum did not change the samples' springiness in this study (P<0.05).

The addition of xanthan in low concentration (0.1%) created the porosity similar to the control sample. The addition of more xanthan reduced the porosity of the samples (P<0.05). The roundness of samples containing 0.3 and 0.5% xanthan (0.63 and 0.68) was higher than the control sample (0.57), but there was no significant difference. The samples' solidity containing 0.3 and 0.5% xanthan was higher than the control samples and 0.1% xanthan. The aspect ratio in the control sample was higher than the samples containing xanthan. Samples containing xanthan gum had a thicker crust (both on the surface and floor) but not significant (P<0.05). The fractal dimension of the crumb texture increases with xanthan's addition, but there was no significant difference between the control and xanthan containing samples. Adding xanthan did not affect the crust color. With the addition of xanthan, the lightness of the product crumb increased, and the yellowness decreased.

Considering the product's general quality from the panelist's point of view, sensory evaluation of the product showed that xanthan gum's addition improves the product's sensory properties, but samples containing 0.5% xanthan scored lower.

Conclusions

The results showed that the use of xanthan gum (0.1%) in the formulation of sweet dough of kichi led to producing a high-quality product in terms of color and texture. The sensory evaluation results showed that the addition of xanthan improves the sensory properties of the samples. Generally, samples with 0.1% xanthan with higher WHC, suitable texture parameters, and sensory properties were selected as the optimum sample.

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