ABSTRACT: Chinese steamed bread (CSB) is a kind of traditional fermented food but it lacks dietary fiber. The effects of CSB flour fortification with oat β-glucan (OβG, 1-5% of wheat flour) on the rheological properties of dough and specific volume, texture and stalling characteristics of CSB have been examined. The addition of oat β-glucan to the dough formula increased the farinograph water absorption, dough development time and the resistance to deformation but decreased the dough stability, dough weakening degree, extensibility, peak, hold, final and setback viscosity and retrogradation value; CSB with 1-2% OβG addition possessed the higher specific volume and resilience and showed the similar hardness, springiness, cohesiveness, gumminess and chewiness compared to the control; while, CSB with 4-5% OβG addition exhibited a smaller specific volume, a larger hardness and the similar springiness, cohesiveness, gumminess, chewiness and resilience than did the control. OβG addition resulted in the higher freezable and unfreezable water content and in the lower firmness and amylopectin retrogradation during storage at 25°C, thus retarded CSB staling. The results also revealed that OβG at 1-2% addition levels was more effective in helping to soften CSB and preventing CSB staling and did at 4-5% addition.

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INTRODUCTION

Chinese steamed bread (CSB), also called Mantou, is a type of fermented and steamed wheat-based food of Chinese origin and represents approximately 40% of wheat consumption throughout China. It has been gaining popularity among the Asian countries and Asian communities outside Asia (Zhu et al., 2016). During its long-term development, numerous unique types of CSB have appeared, among which the most representative types are northern-style and southern-style CSB, based on the composition of basic ingredients and production processes (Zhu et al., 2001). Northern-style CSB has a chewy and dense texture and it is usually prepared from medium or strong gluten flour, while the southern-style tends to have an open and softer texture, and it is usually prepared from weak gluten flour. Consumers prefer CSB which has a smooth, white, thin skin and a moist, uniform and soft crumb (Su et al, 2005).

The processing method of CSB is different from that of bread in which the CSB is made by cooking the fermented dough through steaming whereas bread is produced by baking in an oven. This steaming method produces products with a soft, moist, and uniform crumb texture, and a thin, smooth, white skin rather than the brown crust of traditional bread (Su et al., 2005). However, CSB is easy to water loss, staling and crumble, so it has a pretty short shelf-life of approximately 1 to 3 days when being stored at room temperature and the shelf-life will become shorter at a warmer and drier storage condition (Qin et al., 2007).

CSB is mainly constituted by wheat flour, water and yeast. Diverse food ingredients such as bioactive compounds extracted from barley hull or flaxseed hull (Hao et al., 2012), sodium alginites and konjac glucomannan (Sim et al., 2011), dietary fiber and emulsifiers (Zhang et al., 2007; Lin et al., 2012) have been used for CSB formulation to impart CSB diversity, nutritional value and product appeal.

The non-starch polysaccharide β-glucan, located primarily in the cell walls of cereal grains and fungi, has been widely considered due to its outstanding functional and nutritional properties (Du et al., 2014). One of the most important processing characteristics is the high water holding capacity and viscosity-forming potential...
of β-glucan which can be used as thickeners, emulsifiers and stabilizers to improve the texture and flavor in the food industry (Brennan et al., 2005). In addition to the function as soluble dietary fiber, β-glucan has been associated with lots of other health benefits including better regulation of blood glucose and insulin levels, lowering of blood cholesterol levels and reducing the risk of heart disease (Moriarney et al., 2010). The potential use of β-glucan as texture improvers and fiber-enriching agents in bakery products to enhance consistency, resistance to deformation and elasticity of dough and to increase health benefits of products, has been reported by different authors (Skendi et al., 2010; Hager et al., 2011; Moriarney et al., 2010). They have found that β-glucan affects dough rheology in two ways: breaking the gluten matrix and increasing the whole dough viscosity, and this effect depends on the molecular size and the concentration of β-glucan, as well as their molecular features (e.g., DP3/DP4 ratio) (Mikuš et al., 2014; Skendi et al., 2010). They also have found there are some detrimental effects of on the dough handling properties and the volume and color of the β-glucan fortified bread (Dhingra et al., 2004; Knuckles et al., 1997). However, the effect of β-glucan on the functional properties of CSB flour and CSB is rarely reported.

Hence, this study was conducted in order to determine the effects of β-glucan from oat on the rheological properties of CSB flour and the texture and anti-staling characteristics of CSB.

MATERIALS AND METHODS

Materials and Reagents

CSB flour with 10.45% protein (14% moisture basis), 0.37% ash, 26.14% wet gluten (dry basis) and 10.70% moisture (dry basis) was provided by the Fengda Flour Manufacturing Co. Ltd., Anhui, China. Oat β-Glucan (OβG, 1.3×10⁷ Dal) was purchased from the Suolaibao Technology Co. Ltd., Beijing, China. Angel instant active dry yeast was obtained from the Changlong flavor food Co. Ltd., Leling, China. All chemicals used were of analytical grade.

Farinograph tests

The Farinograph properties of CSB flour with or without addition of OβG at 1%, 2%, 4% and 5% (wheat flour basis) were tested according to the standard method of GB/T 14614-2006. OβG was first mixed well with CSB flour (corrected to 14% moisture basis) in the 300-g mixing bowl of the “E” 810114 model farinograph (Brabender, Duisburg, Germany) that was connected with a circulating water pump and a thermostat which operated at 30±0.2°C, water absorption, dough development time, dough stability time and dough weakening degree were thus determined.

Extensograph tests

CSB flour doughs with or without addition of OβG at 1%, 2%, 4% and 5% were prepared in the 300 g mixing bowl of the farinograph (Brabender, Duisburg, Germany). The CSB flour was first mixed well with OβG at different concentration levels, before water addition, to produce the dough samples. Water was then added to produce dough with a consistency of 500 BU (Brabender Units), followed by 5 min of mixing. A test piece (150 g) was rounded into a ball, shaped into a cylinder and clamped into the holder. After 30, 60, and 90 min proofing times in the fermenting cabinet at 30-31°C, each dough piece was stretched in the (r)-E 860703 model Extensograph (Brabender, Duisburg, Germany) by a hook until rupture, as described in the method of GB/T 14615-2006. The stretching force was thus recorded as a function of time, the resistance to constant deformation after 50 mm stretching (R₀) and the extensibility (E) were obtained.

Pasting properties tests

CSB flour doughs with or without addition of OβG at 1%, 2%, 4% and 5% were studied using a Rapid Visco Analyser (RVA) (Newport Scientific Pty Ltd., Australia), using the Standard profile 1 and 3 gnm sample (14% moisture basis) as described by Sharma et al. (2011). The peak, hold, final, setback viscosity and retrogradation value were reported.

Preparation of CSB

CSB was prepared according to the method described by Bi et al. (2009). The formula consisted of 300 g CSB flour with or without addition of OβG at 1%, 2%, 4% and 5%, and 3.0 g instant active dry yeast. The instant active dry yeast was dissolved in 54 mL water (30°C) for 5 min. The ingredients were put into an aluminum basin, kneaded by hand until a consistent dough structure was formed, and kept for 15 min at room temperature before molding on a smooth panel over 2 min. The dough was then kneaded again by hand for 3 min and proofed for about 50 min in an incubator at 35°C and 85% RH before shaping into a near hemisphere with a height of 60 mm and then placing in a steamer filled with boiling water, and finally steaming for 20 min.

Determination of specific volume and texture of CSB

CSB volume was determined with the AACC rapsed displacement method, 10-10B. The specific volume (ml/g) of CSB was determined as: CSB volume/CSB weight. Textural analysis was done by using a TA.XT PLUS/50 Texture Analyser (Stable Micro Systems, Ltd., UK) equipped with a P36 probe. CSB was sliced horizontally and a bottom piece, 24 mm height, was compressed to 50% of its height. The test parameters were as follows: pre-test speed 1.0 mm/s, test speed 1.0 mm/s, post-test speed 1.0 mm/s and trigger force 5 g. From the TPA test profile, textural parameters including hardness, springiness, cohesiveness, gumminess, chewiness and resilience were obtained. The maximum force or firmness of samples was also determined. Change in firmness during storage was used as a parameter in the evaluation of CSB staling. Staling index or increase of firmness is calculated as follows:

\[
\text{Increase of firmness} = (\text{Firmness after storage-Initial firmness}) ÷ \text{Initial firmness} × 100\%
\]

Differential scanning calorimetry of CSB

Differential scanning calorimetry analysis was conducted for all CSB at days 0, 1, 3 and 5 of storage by a DSC TA instruments (New Castle, Del., USA). CSB with or without OβG or OβG addition (10 mg) was placed in hermetically sealed aluminum pans (Perkin Elmer Instruments LLC, Shelton, Conn., USA)
with an empty pan used as a reference and quench cooled inside a DSC 2920 cell of TA instruments (New Castle, Del., USA) purged with nitrogen gas. Samples were then heated at 5 °C/min, from -60 °C to 150 °C. DSC was calibrated using indium. Heat flow was recorded in mW and plotted against temperature. "Freezable" water (FW) content was calculated from the DSC endotherm around 0 °C (Hallberg et al., 2002). "Unfreezable" water (UFW) was obtained by subtracting the FW content from the total moisture content. Amylopectin recrystallization was measured from an endothermic melting enthalpy corresponding to a peak at 60-80 °C ranges (Bosmans et al., 2013). Moisture content of CSB was determined by weight loss via heating at 105 °C until attaining a constant weight.

Statistical analysis
All the tests were in independent triplicate. Statistical analysis was carried out by one-way ANOVA using SPSS software. Significance level was defined at p < 0.05 by Tukey HSD (Honestly Significant Difference).

RESULTS AND DISCUSSION

Effects of OβG on farinograph properties of CSB flour
Table 1 shows the dough mixing properties of CSB flour with and without addition of OβG at the levels of 1.0% ~ 5.0% (wheat flour basis). Generally, the farinograph properties of CSB flour with OβG differed from those of control.

Water absorption of CSB flour added with OβG increased with the increasing addition levels. There means to say, to reach 500 FU, relatively higher amount of water is required in the presence of excessive OβG. The same behavior has been observed when β-glucan enriched flour fractions from different sources (Cavallero et al., 2002; Knuckles et al., 1997; Mohamed et al., 2005) or isolated and purified β-glucan (Skendi et al., 2010) have been added to wheat flours; such effects have been attributed to the high water absorbing capacity of these non-starch polysaccharides and their ability to compete for water with other constituents in the dough system.

Compared to the control samples, addition of β-glucan to CSB flour increased the development time and decreased the dough stability time and the dough weakening degree (Table 1). In contrast, Mohamed et al. (2005) showed that, with increased amounts of β-glucan, there was no large reduction in dough stability. But Skendi et al. (2010) found that, addition of β-glucans to the dough formula increased the development time and improved the stability of the poor breadmaking quality doughs. Discrepancies related to the influence of the β-glucan on the farinograph characteristics of CSB flour may arise from differences in the molecular size and the concentration range of β-glucan, as well as the used flour types amongst the various studies.

Effects of OβG on dough extensograph properties of CSB flour
Desirable dough properties are usually associated with good dough resistance and extensibility values. The effects of β-glucan addition at 1-5% levels on the extensograph parameters throughout 90 min of proofing time are shown in Fig.1. It showed that the resistance to constant deformation after 50 mm stretching (R50) of all samples increased progressively and the extensibility (E) decreased gradually with

<table>
<thead>
<tr>
<th>Samples</th>
<th>Water absorption (%) (500 FU)</th>
<th>Dough development (min)</th>
<th>Dough stability (min)</th>
<th>Dough weakening (FU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>57.0±4.9</td>
<td>2.5±0.1</td>
<td>7.4±0.7</td>
<td>49.8±4.7</td>
</tr>
<tr>
<td>1.0% OβG</td>
<td>59.5±5.1</td>
<td>2.9±0.3</td>
<td>6.0±0.6</td>
<td>48.8±4.3</td>
</tr>
<tr>
<td>2.0% OβG</td>
<td>62.5±5.4</td>
<td>2.7±0.3</td>
<td>5.9±0.6</td>
<td>47.5±4.2</td>
</tr>
<tr>
<td>4.0% OβG</td>
<td>67.5±5.7</td>
<td>2.7±0.3</td>
<td>6.1±0.5</td>
<td>48.3±4.2</td>
</tr>
<tr>
<td>5.0% OβG</td>
<td>69.0±6.2</td>
<td>2.7±0.2</td>
<td>6.3±0.6</td>
<td>48.1±3.5</td>
</tr>
</tbody>
</table>

FIGURE 1. Extensograph parameters of CSB flour with or without YβG or OβG addition
proofing time. At proofing times, all doughs with β-glucan exhibited higher $R_w$ and lower $E$ than did the control. The same behavior has been observed when barley β-glucan with a molecular weight of $2.03 \times 10^6$ had been added to the good bread making wheat flours (Skendi et al., 2010); such effects shows that doughs with OβG demonstrated high resistance with limited elongation, therefore, the samples were failed easily upon stretching. Skendi et al. (2010) also found that barley β-glucan with a molecular weight of $1.0 \times 10^5$ increased the resistance to deformation and the extensibility of the poor breadmaking quality doughs.

**Effects of OβG on pasting properties of CSB flour**

The paste viscosity is dependent on the composition of flour and the gelatinization of starch. The effects of OβG on pasting properties of CSB flour were shown in Table 2. All doughs with OβG exhibited lower peak viscosity (PV), hold viscosity (HV), final viscosity (FV), setback viscosity (SV) and retrogradation value (RV) than did the control. There was a remarkable up trend of PV, HV, FV, SV and RV as the proportion of β-glucan increased, and a reverse trend was observed when the addition level of OβG increased to 4% and 5%. Pasting is governed by the starch characteristics, such as swelling potential, degree of gelatinization and reassociation of amylose and amylopectin, upon subsequent cooling after cooking the starch. Setback viscosity is used as synonym for retrogradation to describe the rise in paste viscosity as the starch paste cools. Similar results have also been reported by Sharma and Gujral (2014) upon incorporation of barley β-glucan to wheat flour. Brennan and Cleary (2007) incorporated β-glucan into wheat flour at levels of 2.5% and 5.0% and reported that this significantly lowered the pasting viscosities. The decrease in pasting viscosities in the presence of β-glucan may be attributed to the dilution of starch in the blends (Brennan et al., 2007). It may also be due to the fact that the β-glucan binds to water and forms a gel therefore, less water is available for starch gelatinization (Symons et al., 2004). Moreover, another possible reason for the decrease in pasting viscosities may be that β-glucan chains may surround starch particles thus lowering the amount of water imbibed by the particles (Skendi et al., 2009).

**Effects of OβG on specific volume and texture of CSB**

It was found that the specific volume of CSB with OβG at 1% and 2% levels became higher than did the control (Table 3). This was probably due to a certain level of dough strength which can increase loaf volume (Goesaert et al., 2005). This observation was in line with the extensograph result discussed earlier wherein when OβG was added. On the other hand, compared to the control, specific volume of CSB was reduced with addition of OβG at 4% and 5% levels and the value decreased with increase in OβG concentration (Table 3). The higher water retention capacity and the dilution of gluten and disruption of the gluten network structure caused by the high presence of OβG could account for the result observed (Sim et al., 2015).

**TABLE 2. Effects of OβG on pasting parameters of CSB flour dough.** Results are shown as means ± SD. Different upper cases in the same columns are significantly different ($P< 0.05$).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Peak viscosity (cP)</th>
<th>Hold viscosity (cP)</th>
<th>Final viscosity (cP)</th>
<th>Setback viscosity (cP)</th>
<th>Retrogradation value (cP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>487.9±25.3$^d$</td>
<td>277.2±15.5$^c$</td>
<td>1032.2±54.7$^d$</td>
<td>210.7±11.2$^d$</td>
<td>755.0±39.6$^d$</td>
</tr>
<tr>
<td>1.0% OβG</td>
<td>368.5±19.3$^b$</td>
<td>228.8±12.6$^b$</td>
<td>760.6±39.2$^b$</td>
<td>139.7±7.7$^b$</td>
<td>531.8±27.8$^b$</td>
</tr>
<tr>
<td>2.0% OβG</td>
<td>391.4±21.2$^{bc}$</td>
<td>246.6±13.9$^b$</td>
<td>829.8±43.7$^c$</td>
<td>144.4±7.8$^c$</td>
<td>583.2±31.6$^c$</td>
</tr>
<tr>
<td>4.0% OβG</td>
<td>350.3±19.8$^{ab}$</td>
<td>235.8±12.7$^a$</td>
<td>744.1±39.5$^{ab}$</td>
<td>114.5±6.1$^a$</td>
<td>508.3±26.8$^a$</td>
</tr>
<tr>
<td>5.0% OβG</td>
<td>329.0±18.6$^a$</td>
<td>225.3±12.7$^a$</td>
<td>689.3±36.8$^a$</td>
<td>103.7±6.4$^a$</td>
<td>464.0±25.9$^a$</td>
</tr>
</tbody>
</table>

**TABLE 3. Effects of OβG on specific volume and texture of CSB.** Results are shown as means ± SD. Different upper cases in the same columns are significantly different ($P< 0.05$).

<table>
<thead>
<tr>
<th>Sample</th>
<th>Specific volume (ml/g)</th>
<th>Hardness (g)</th>
<th>Springiness</th>
<th>Cohesiveness</th>
<th>Gumminess</th>
<th>Chewiness (g)</th>
<th>Resilience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>2.43±0.17$^{bc}$</td>
<td>1078.9±60.8$^a$</td>
<td>0.551±0.031$^a$</td>
<td>0.826±0.047$^a$</td>
<td>891.2±50.3$^a$</td>
<td>491.0±27.8$^a$</td>
<td>0.375±0.021$^a$</td>
</tr>
<tr>
<td>1.0% OβG</td>
<td>2.73±0.14$^c$</td>
<td>1062.3±59.4$^b$</td>
<td>0.601±0.034$^b$</td>
<td>0.895±0.051$^b$</td>
<td>857.6±48.6$^b$</td>
<td>466.8±26.3$^b$</td>
<td>0.456±0.026$^b$</td>
</tr>
<tr>
<td>2.0% OβG</td>
<td>2.64±0.18$^b$</td>
<td>1068.4±60.1$^c$</td>
<td>0.581±0.037$^{ab}$</td>
<td>0.879±0.049$^a$</td>
<td>865.8±47.8$^c$</td>
<td>471.9±27.1$^c$</td>
<td>0.435±0.025$^c$</td>
</tr>
<tr>
<td>4.0% OβG</td>
<td>1.87±0.12$^a$</td>
<td>1423.5±80.3$^b$</td>
<td>0.558±0.034$^{ab}$</td>
<td>0.831±0.046$^a$</td>
<td>888.5±50.9$^b$</td>
<td>489.2±27.6$^b$</td>
<td>0.394±0.023$^b$</td>
</tr>
<tr>
<td>5.0% OβG</td>
<td>1.87±0.11$^a$</td>
<td>1562.4±88.6$^b$</td>
<td>0.553±0.031$^{ab}$</td>
<td>0.833±0.047$^a$</td>
<td>890.1±51.7$^a$</td>
<td>490.8±28.3$^a$</td>
<td>0.396±0.024$^a$</td>
</tr>
</tbody>
</table>
A summary of the given text:  

**Effects of OβG on Firmness of CSB during storage**

CSB staling is a complicated phenomenon and firmness increase is usually serves as an index of bread staling during storage (Gray et al., 2003). As seen in Table 4, the firmness rate of all samples increased progressively during storage at 25 °C, but all CSB with OβG exhibited lower firmness increase than did the control. At 1% and 2% addition levels, OβG gave a remarkable softening effect to CSB and firming was delayed throughout the storage when compared with the control, whilst CSB added with OβG at 4% and 5% addition levels became firmer when compared with those at addition levels of 1% and 2%. The initial staling rate as denoted by the initial slope value was found to decrease upon OβG addition. This leads support to the view that gums present in dough at could hinder the development of macromolecular entanglements and retard starch recrystallization (Gujral et al., 2004; Sim et al., 2015). Non-starch polysaccharides have previously been reported to soften crumb texture by helping retain moisture (Sim et al., 2015) and therefore the water distribution during storage was further studied.

**Effects of OβG on “Freezable” and “unfreezable” water contents of CSB during storage**

Change in the moisture distribution of CSB is a major phenomenon during CSB staling. FW has been associated with the mobility of water indicating stability in stored starch gels and other carbohydrate systems (Nilufer-Erdil et al., 2012) As seen in Table 5, FW contents of all CSB decreased while UFW content increased progressively during storage at 25 °C, but all CSB with OβG exhibited higher FW and UFW contents than did the control. At 1% and 2% addition levels, CSB had higher FW content throughout the storage when compared with the control and those at 4% and 5% levels. Calculate results showed that the FW content of the control, the low addition level and the high addition level samples decreased by 5.23%, 3.24% and 5.48%, respectively; while, by contrast the UFW content increased by 2.45 %, 1.35 % and 1.25 %, respectively, after 5 d of storage. The loss in freezable water was a result of the migration of freezable water from the amorphous matrix to the crystalline hydrate of retrograded starch (Sha et al., 2007).

**Effects of OβG on Amylopectin recrystallization of CSB during storage**

Retrogradation of starch molecules remains as the main factor that caused staling of starch-based products (Gray et al., 2003). Staling of starch gels typically shows development of an endotherm at 60-80 °C (Bosmans et al., 2013) of amylopectin. The endothermic peak of amylopectin recrystallization observed at 60-80°C in DSC thermograms was found to increase during storage for all samples (Table 4). For each day of storage, CSB with OβG addition had significantly lower amylopectin recrystallization enthalpy from that of control (p < 0.05). Sim (Sim et al., 2013) found that non-starch polysaccharides at 0.8% addition level retarded the CSB staling, while 0.2% addition increased the staling (Sim et al., 2013). This may be due to the differences in their structures. OβG incorporation increased the water holding capacity of CSB and restricted water migration, thus retarding the long-term starch retrogradation by interacting with amylopectin

### Table 4.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Firmness increase rate (%)</th>
<th>ΔH (J/g dm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0d</td>
<td>1d</td>
</tr>
<tr>
<td>Control</td>
<td>0</td>
<td>65.7±3.4d</td>
</tr>
<tr>
<td>1.0% OβG</td>
<td>0</td>
<td>17.6±1.0c</td>
</tr>
<tr>
<td>2.0% OβG</td>
<td>0</td>
<td>18.3±0.9c</td>
</tr>
<tr>
<td>4.0% OβG</td>
<td>0</td>
<td>10.9±0.6b</td>
</tr>
<tr>
<td>5.0% OβG</td>
<td>0</td>
<td>8.7±0.5c</td>
</tr>
</tbody>
</table>

### Table 5.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Freezable water (%)</th>
<th>Unfreezable water (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0d</td>
<td>1d</td>
</tr>
<tr>
<td>Control</td>
<td>22.4±1.5ab</td>
<td>21.0±1.3a</td>
</tr>
<tr>
<td>1.0% OβG</td>
<td>24.7±1.6b</td>
<td>24.9±1.6a</td>
</tr>
<tr>
<td>2.0% OβG</td>
<td>24.0±1.6b</td>
<td>24.4±1.6a</td>
</tr>
<tr>
<td>4.0% OβG</td>
<td>22.8±1.5ab</td>
<td>22.9±1.5a</td>
</tr>
<tr>
<td>5.0% OβG</td>
<td>21.4±1.5a</td>
<td>21.8±1.4ab</td>
</tr>
</tbody>
</table>
chains (BeMiller, 2011). They may also reduce starch-protein interactions and associations in CSB which is considered a factor leading to firming of bread (Gray et al., 2003).

**CONCLUSIONS**

CSB is a type of steamed wheat-based fermented food of Chinese origin and it has been gaining popularity among the Asian countries and Asian communities outside Asia. The non-starch polysaccharide β-glucan has been widely considered as thickeners, emulsifiers and stabilizers to improve the texture and flavor and as fiber-enriching agent to regulating the blood glucose and insulin levels, lowering of blood cholesterol levels and reducing the risk of heart disease in the food industry. This experiment makes a research of the effects of OβG addition on properties of CSB wheat flour and CSB. Adding OβG can reduce the degree of softening of flour, enhance the resistance to deformation, improve the rheological properties of dough, so that the dough is easier to operate and improve the quality of flour in a certain extent. In general, the increase of moisture content in CSB has a positive effect on anti-aging, so the addition of OβG has positive effects on CSB anti-aging and CSB nutrition improvement. With the increasing of the amount of OβG, the tensile resistance increases and the elongation decreases, which has a positive effect on the improvement of the quality of CSB. Adding OβG leads setback value and retrogradation value to reduced, therefore, it can improve the stability of the gel during the processing of CSB and increase the anti-aging performance of CSB. Results of the experiment showed that the addition of OβG has a positive effect on improve the quality of CSB wheat flour and the anti-aging of CSB. In the selected experimental conditions, the quality of CSB was better when the content of OβG was 1-2%.

**ACKNOWLEDGEMENTS**

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