ABSTRACT

The importance of wholegrain buckwheat flour is that it is a gluten free food and it is abundant in nutrients, such as proteins, essential amino acids, dietary fibers, starch, vitamins and minerals. Addition of aromatic and spice plants improves the nutritional and health potential of food, improves taste and odour and prevents its deterioration. As rheological properties have great relevance in predicting the final product quality, the effect of Vitaplant® herbal mixture addition on dough rheological properties was studied. The dough was made with wheat-wholegrain buckwheat flour mixture (70:30 w/w) and 2, 3, 5 and 7% of Vitaplant®, where the amount of wheat flour was reduced for the Vitaplant® portion. The addition of herbal mixture Vitaplant® changes the rheological properties of dough. Based on cluster analysis and Euclidean distances, in order to achieve better functional properties of food products, Vitaplant® is recommended in portion of 7%.

Key words: wholegrain buckwheat, flour, dough, rheology, herbal mixture.

INTRODUCTION

As the nutritional value of buckwheat (Fagopyrum esculentum Moench) is similar to that of cereals, it is usually grouped with cereals. The integral buckwheat flour is especially abundant in nutrients, such as proteins, essential amino acids, dietary fibers, starch, vitamins B1, B2, C and E (Watanabe, 1998; Wijngaard and Arendt, 2006) and a good source of minerals (Pomeranz, 1983; Ikeda and Yamashita, 1994). Buckwheat protein is of high nutritional quality due to relatively high levels of lysine and arginine (Watanabe, 1998) and due to well-balanced amino acid composition (Pomeranz and Robbins, 1972). When part of the wheat flour is substituted with wholegrain buckwheat flour, the final product has lower gluten content and it is enriched with buckwheat components. Using aromatic herbs and spices in food purposes expanded in the last years when the functional food has become a world trend (Biliaderis, 2008). Bakery products as popular food where wheat flour is supplemented with other cereals or some specific ingredient could be used for the prevention of nutritive deficiencies. For example, such product is white wheat bread with by-product sugar beet (Lević et al., 2005). Addition of aromatic and spice plants improves the nutritional and health potential of food, enhances taste and odour. More from antiquity it is well known that aromatic herbs and spices exhibit a role of preservatives, so their addition might prevent food deterioration (Mimica-Dukić Neda, 2003).

As dough rheological properties are important in predicting the final product quality such as mixing behaviour, sheeting and baking performance (Dobraszczyk and Morgenstern, 2003), in this paper the effect of herbal mixture Vitaplant® addition on dough rheological properties was studied. Vitaplant® is a mixture of various parts of plants such as buckthorn, mentha, caraway and parsley. Buckthorn is known as laxative, vasodilator, diuretic and cardiotonizer (Huang et al., 1991; Zhou and Chen, 1988) and mentha has anti inflammatory, antimicrobial and antioxidative effects (Fuchs et al., 1999; Mimica-Dukić Neda and Božin, 2008). Caraway (Zheng and Wang, 2001; Woydly et al., 2007) and parsley (Wong and Kitts, 2006; Zhang and Chen, 1988) are especially abundant in nutrients, such as proteins, essential amino acids, dietary fibers, starch, vitamins B1, B2, C and E (Watanabe, 1998; Zhang and Chen, 1988) and due to well-balanced amino acid composition (Pomeranz, 1983; Ikeda and Yamashita, 1994). Buckwheat protein is of high nutritional quality due to relatively high levels of lysine and arginine (Watanabe, 1998) and due to well-balanced amino acid composition (Pomeranz and Robbins, 1972). When part of the wheat flour is substituted with wholegrain buckwheat flour, the final product has lower gluten content and it is enriched with buckwheat components. Using aromatic herbs and spices in food purposes expanded in the last years when the functional food has become a world trend (Biliaderis, 2008). Bakery products as popular food where wheat flour is supplemented with other cereals or some specific ingredient could be used for the prevention of nutritive deficiencies. For example, such product is white wheat bread with by-product sugar beet (Lević et al., 2005). Addition of aromatic and spice plants improves the nutritional and health potential of food, enhances taste and odour. More from antiquity it is well known that aromatic herbs and spices exhibit a role of preservatives, so their addition might prevent food deterioration (Mimica-Dukić Neda, 2003).

As dough rheological properties are important in predicting the final product quality such as mixing behaviour, sheeting and baking performance (Dobraszczyk and Morgenstern, 2003), in this paper the effect of herbal mixture Vitaplant® addition on dough rheological properties was studied. Vitaplant® is a mixture of various parts of plants such as buckthorn, mentha, caraway and parsley. Buckthorn is known as laxative, vasodilator, diuretic and cardiotonizer (Huang et al., 1991; Zhou and Chen, 1988) and mentha has anti inflammatory, antimicrobial and antioxidative effects (Fuchs et al., 1999; Mimica-Dukić Neda and Božin, 2008). Caraway (Zheng and Wang, 2001; Woydly et al., 2007) and parsley (Wong and Kitts, 2006; Zhang and Chen, 2006) also have antioxidative effects. In order to find the optimal portion of herbal mixture Vitaplant®, in this paper the rheological properties of dough made from wheat-wholegrain buckwheat flour mixture (70:30 w/w) with different portion of Vitaplant® were investigated.

RHEOLOGICAL PROPERTIES OF DOUGH MADE FROM WHEAT-WHOLEGRAIN BUCKWHEAT FLOUR SUPPLEMENTED WITH HERBAL MIXTURE VITAPLANT®

REOLOŠKA SVOJSTVA TESTA OD PŠENIČNOG I INTEGRALNOG HELJDINOG BRAŠNA SA BILJNOM SMEŠOM VITAPLANT®

**Nada NIKOVIĆ**, Marijana SAKAĆ**, Jasna MASTILOVIĆ**

*Faculty of Technology, 16000 Leskovac, Bulevar oslobodjenja 124, Serbia
**Institute for Food Technology, 21000 Novi Sad, Bulevar cara Lazara, 1 Serbia


UDK: 625.074:582.665.11

Original Scientific Paper

Originalni naučni rad

**Institute for Food Technology, 21000 Novi Sad, Bulevar cara Lazara, 1 Serbia
** Faculty of Technology, 16000 Leskovac, Bulevar oslobodjenja 124, Serbia

**Nada NIKOVIĆ**, Marijana SAKAĆ**, Jasna MASTILOVIĆ**
MATERIALS AND METHODS

Flour and herbal mixture

Wheat flour and integral buckwheat flour were bought from the local market. Flour protein content was determined by the Kjeldahl method (N x 5.95). The ash, fat and moisture contents of flour were determined according to standard test procedures. The values for samples are from triplicate analysis and followed by standard deviation.

Plants, buckthorn (Frangulae cortex), mentha (Mentha piperita), caraway (Carvi fructus) as well as parsley (Petroselini fructi), used for the herbal drugs Vitaplant® are products of the Institute for Medicinal Plant Research „Dr Josif Pančić“, Belgrade. Vitaplant® is a mixture of Frangulae cortex (35%), Mentha piperitae folium (20%), Carvi fructus (20%) and Petroselini fructus (25%). All ingredients in the herbal mixture were previously controlled: identity was established, sensory properties and level of cleanliness were determined and health validity was tested (Mišan Aleksandra, 2009).

Rheology measurement

For testing the dough rheological properties, 90 g of integral buckwheat flour, 204, 201, 195 and 189 g of wheat flour and 6, 9, 15 and 21g of Vitaplant® were used to make 300 g of dough with 2% (V2%), 3% (V3%), 5% (V5%), and 7% (V7%) (w/w) Vitaplant® portion, without adding improvers (the amount of wheat flour is reduced for the Vitaplant® portion).

The Brabender farinograph (Brabender Model 8 10 101, Duisburg, Germany) according to ISO 5530-1 test procedure, was used for water absorption values (WA value in ml), development time (DT in minutes), dough stability (DS in minutes), degree of softening (DSF in B.U.) and farinograph quality number (QN) determination.

For extensigraph measurements, the Brabender extensigraph (Brabender, Model 8600-01, Duisburg, Germany) and test procedure ISO 5530-2 were used. The samples were prepared from flour, distilled water and salt, and data for extensigraph area (E in cm2), resistance (R in B.U.), extensibility (Ex in mm) and ratio number (R/Ex) were recorded on the extensigraph curve.

To obtain amylograph data, gelatinization temperature (Tmax in °C) and gelatinization maximum (tmax in B.U.), the amylograph (Brabender Model PT 100, Duisburg, Germany) and ISO 7973 test procedure were used.

Statistical analysis

Statistical analysis, correlation coefficients and cluster analysis were performed by program STATISTICA version 5.0. The cluster analysis was used in order to classify doughs made from mixture of wheat and wholegrain buckwheat flour with different Vitaplant® portions into groups on the basis of multiple variables. The Euclidian method and complete linkage was used.

RESULTS AND DISCUSSION

The wheat flour was B2 quality number (QN), and had 9.86±0.3% proteins, 0.51±0.04% ash, 1.9±0.1% fat and 24.6±0.4% gluten. The protein content in the wholegrain buckwheat flour was 10.5±0.5%, ash content was 1.9±0.05% and fat content was 2.2±0.1%.

Rheological properties of four flour mixture with different Vitaplant® portions (2%-7%, w/w) obtained by farinograph, extensigraph and amylograph are presented in Table 1. Dough made with wheat and wholegrain buckwheat flour in ratio of 70:30 w/w (WIBW) was a control dough.

The results of farinograph, extensigraph and amylograph data show that the rheological properties depend on the Vitaplant® portion in the flour mixture. By rising the Vitaplant® portion in wheat-wholegrain buckwheat flour mixture, the water absorption rises, from 59.0 to 64.8%. As the main component responsible for water absorption is gluten and as buckwheat flour is gluten free, the better absorption properties are probably due to protein components such as globulin and albumin (Pomeranz and Robbins, 1972) as well as the Vitaplant® addition. These results could indicate the economic justification of the Vitaplant® use in the production of food products.

With higher Vitaplant® portion, the dough development time is longer (4.8 to 5.2 minutes instead 4.5 minutes), dough stability is slightly different and degree of softening varies, from 95 to 120 B.U. The flour quality group remains the same, and it is B2. Extensigraph data shows that the rising Vitaplant® portions in wheat- wholegrain buckwheat flour mixture decrease dough extensigraph area from 31.1 to 26.4 cm2 whereas dough resistance varies from 150 to 170 B.U., and extensibility decreases from 126 to 87 B.U. By amylograph data, the gelatinization temperature decreases from 86.5 to 82.7°C and the maximal viscosity decreases from 1460 to 900 B.U.

Table 1. The rheological properties of wheat-wholegrain buckwheat (WIBW), 70:30 w/w dough and wheat–integral buckwheat dough with 2%-7%, w/w portion of Vitaplant® (V2%-V7%)

<table>
<thead>
<tr>
<th>Farinograph data</th>
<th>WIBW</th>
<th>V2%</th>
<th>V3%</th>
<th>V5%</th>
<th>V7%</th>
</tr>
</thead>
<tbody>
<tr>
<td>WA (ml)</td>
<td>59.0</td>
<td>60.6</td>
<td>61.6</td>
<td>63.1</td>
<td>64.8</td>
</tr>
<tr>
<td>DT (min)</td>
<td>4.5</td>
<td>4.8</td>
<td>4.5</td>
<td>5.0</td>
<td>5.2</td>
</tr>
<tr>
<td>DST (min)</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>DST (B.U.)</td>
<td>110</td>
<td>110</td>
<td>120</td>
<td>105</td>
<td>95</td>
</tr>
<tr>
<td>QN</td>
<td>47.9</td>
<td>45.4</td>
<td>45.7</td>
<td>49.0</td>
<td>52.2</td>
</tr>
<tr>
<td>Extensigraph area (E cm²)</td>
<td>31.1</td>
<td>32.5</td>
<td>29.2</td>
<td>30.9</td>
<td>26.4</td>
</tr>
<tr>
<td>R (B.U.)</td>
<td>150</td>
<td>155</td>
<td>170</td>
<td>170</td>
<td>160</td>
</tr>
<tr>
<td>Ex (B.U.)</td>
<td>126</td>
<td>116</td>
<td>114</td>
<td>106</td>
<td>87</td>
</tr>
<tr>
<td>Re/x</td>
<td>1.19</td>
<td>1.36</td>
<td>1.46</td>
<td>1.60</td>
<td>1.84</td>
</tr>
<tr>
<td>Amylograph data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tmax (°C)</td>
<td>86.5</td>
<td>85.7</td>
<td>84.2</td>
<td>84.2</td>
<td>82.7</td>
</tr>
<tr>
<td>Tmax (B.U.)</td>
<td>1460</td>
<td>1135</td>
<td>1055</td>
<td>970</td>
<td>900</td>
</tr>
</tbody>
</table>

The correlation coefficients and significance levels between the all obtained rheological properties are presented in Table 2. The sample size was ten (N=10, five dough: dough obtained from wheat- wholegrain buckwheat flour (70:30 w/w), four wheat–wholegrain buckwheat dough with 2, 3, 5 and 7% Vitaplant® portion and two determinations). Only the correlations with absolute value above 0.8 were taken into consideration. There are 24.4% correlations, among which 8.9% were proper, and 15.5% were opposite. The proper correlations are that high value of WA goes with high DT and DST value, high Ex value with high E and Tmax value. On the other hand, the opposite correlations are that the high WA value goes with low Ex and Tmax, high DT with low E and Ex value, high DST with low Ex and Tmax value and high DST with low QN value.

By cluster analysis, dough from wheat-wholegrain buckwheat flour, 70:30 w/w (WIBW) and wheat– wholegrain buckwheat dough with 2% (V2%), 3% (V3%), 5% (V5%) and 7% (V7%) Vitaplant® portion were classified into groups on the basis of multiple variables.

Nikolić, Nada et al. / Rheol. Prop. of Dough Made from Wheat-Whole. Buckwheat Flour Supplem. with Herbal Mixture Vitaplant®
Table 2. Correlation matrix for five dough: dough from wheat-integral buckwheat flour, 70:30 w/w, wheat–integral buckwheat dough with 2, 3, 5 and 7% Vitaplant® portion and two determinations (N=10, correlations are significant at p≤0.5)

<table>
<thead>
<tr>
<th></th>
<th>WA</th>
<th>DT</th>
<th>DST</th>
<th>DSf</th>
<th>QN</th>
<th>E</th>
<th>R</th>
<th>Ex</th>
<th>T max</th>
<th>(T_{\text{max}})</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT</td>
<td>1</td>
<td>-0.88</td>
<td>-0.73</td>
<td>-0.53</td>
<td>-0.16</td>
<td>-0.17</td>
<td>-0.06</td>
<td>0.23</td>
<td>-0.13</td>
<td>-0.27</td>
</tr>
<tr>
<td>DSf</td>
<td>0.93</td>
<td>1</td>
<td>-0.32</td>
<td>0.67</td>
<td>-0.33</td>
<td>-0.01</td>
<td>0.04</td>
<td>0.72</td>
<td>-0.03</td>
<td>0.26</td>
</tr>
<tr>
<td>DST</td>
<td>-0.30</td>
<td>-0.57</td>
<td>1</td>
<td>-0.30</td>
<td>0.06</td>
<td>0.02</td>
<td>0.01</td>
<td>-0.05</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>QN</td>
<td>0.71</td>
<td>0.79</td>
<td>0.72</td>
<td>1</td>
<td>-0.04</td>
<td>-0.06</td>
<td>-0.02</td>
<td>-0.03</td>
<td>-0.01</td>
<td>-0.01</td>
</tr>
<tr>
<td>E</td>
<td>-0.57</td>
<td>-0.83</td>
<td>-0.35</td>
<td>-0.75</td>
<td>1</td>
<td>-0.15</td>
<td>-0.07</td>
<td>-0.07</td>
<td>-0.05</td>
<td>-0.10</td>
</tr>
<tr>
<td>R</td>
<td>0.59</td>
<td>0.17</td>
<td>0.68</td>
<td>0.48</td>
<td>0.01</td>
<td>1</td>
<td>0.06</td>
<td>0.08</td>
<td>0.52</td>
<td>0.52</td>
</tr>
<tr>
<td>Ex</td>
<td>-0.94</td>
<td>-0.92</td>
<td>-0.81</td>
<td>-0.74</td>
<td>0.51</td>
<td>-0.78</td>
<td>1</td>
<td>0.81</td>
<td>-0.30</td>
<td>0.30</td>
</tr>
<tr>
<td>T max</td>
<td>-0.98</td>
<td>-0.76</td>
<td>-0.91</td>
<td>0.25</td>
<td>-0.67</td>
<td>0.52</td>
<td>-0.61</td>
<td>0.91</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>(T_{\text{max}})</td>
<td>0.02</td>
<td>0.04</td>
<td>-0.05</td>
<td>0.39</td>
<td>-0.22</td>
<td>0.07</td>
<td>0.13</td>
<td>0.04</td>
<td>0.02</td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSIONS

Rheological properties depend on the Vitaplant® portion in the food products, the herbal mixture Vitaplant® is recommended in portion of 7%.

REFERENCES


Received:04.11.2010. Accepted:25.11.2010.