INFLUENCE OF SOME NATURAL IMPROVER ON THE RHEOLOGICAL PROPERTIES OF WHEAT FLOUR DOUGH
Tabekhia, M.M.; M.A. Abou-Raya; A.H. Fahmi and A.A. Youssef
Food Indust. Dept., Fac. Of Agric., El-Mansoura Univ., Egypt

ABSTRACT
The present study aims to investigate the effects of the addition of thermally modified wheat flour, thermally modified starch at (160ºC, 180ºC and 200ºC) for 5 hrs. and maltodextrin on the rheological properties of wheat flour dough. From the obtained results it was cleared that addition modified wheat flour to dough increased water absorption, and decreased tolerance index, and dough weakening but addition modified starch increased dough stability, and decreased tolerance index. Also addition of modified starch increased resistance to extension, proportional no., extensogram area (cm²) while addition of modified flour increased resistance to extension, proportional no., Extensogram area and decreased extensibility, also maltodextrin addition increased all parameters except extensibility. On the other hand, addition of modified wheat flour and modified starch increased falling number in most treatments.

INTRODUCTION
The Egyptian balady bread is vitally important to millions of bread consumers in Egypt. It is the most popular and widely consumed bread among many types of backed bread made in Egypt. However, staling of bread is responsible for significant financial losses to both consumers and bread producers, which in truth, means losses in the Egyptian national economy. It is corresponds to loss of freshness in terms of flavor, texture, moisture level and other characteristics (Abd El-Motaleb, Nadia et al., 2004 and Mohey El-Deen, Fatma, 2004). It has been reported that maltodextrins and modified starches can retain moisture and retard staling properties in baked products (Thayer, 1992).

In addition, when modified starch is added in bakery formulation, it increases the volume of loves, the amount of water retained, extends the shelf life of starch bakery products, and increases the freeze thaw stability of frozen doughs and batters, increases the strength of flour and softens the bite of baking process, and increases the volume amnd specific volume of baked products prepared from soft wheat. Vasin et al. (1986) and Wang (2000).

The quality of a baked product depends on the properties of the dough during processing (Tronsmo et al., 2003). Thus, the knowledge about the effects of any treatments on the rheological properties of dough is important and several rheological instruments can be used to determine the dough behavior and quality (Lee et al., 2001; Menjivar, 1990 and Stampfi et al., 1996).

Study aims to investigate the effect of addition of modified starch, modified wheat flour and maltodextrin on the rheological properties of the wheat flour dough.
MATERIALS AND METHODS

Materials:
Wheat flour (82% extraction rate) was obtained from Abu-Shaban stone Mill, East Selta flour mills Company, Zagazig City, El-Sharkia governorate, Egypt. Maltrodextrin (Food Grade) was purchased from the National Company for corn products, 10th of Ramadan City, Egypt. Corn starch was obtained from the Egyptian starch and Glucose Company, Turra Factory, Cairo, Egypt.

Methods:
Modification of starch and wheat flour:
Portion of starch and wheat flour were modified by heating at 160ºC, 180ºC and 200ºC for 5 hrs in an electric oven as described by Fahmi (1976).

Preparation of the flour blends:
The obtained bulk of wheat flour was divided into 8 portions. The first portion consisted of 100% wheat flour (without any addition to serve as a control). The second portion consisted of 94% wheat flour and 6% of starch that thermally modified at 160ºC. The third portion consisted of 94% wheat flour and 6% of starch that thermally modified at 180ºC. The fourth portion consisted of 97% wheat flour and 3% of starch that thermally modified at 200ºC. The fifth portion consisted of 94% wheat flour and 6% of starch that thermally modified at 160ºC. The sixth portion consisted of 94% wheat flour and 6% of wheat flour that thermally modified at 180ºC. The seventh portion consisted of 97% wheat flour and 3% of wheat flour that thermally modified at 200ºC. The last portion consisted of 96% wheat flour and 4% of maltodextrin.

Rheological measurements of dough samples:
The rheological measurements were carried out for each of the above mentioned flour portions under investigation using farinograph, extensograph, visco-amylograph and falling number tests at the Egyptian Center for Bread Technology, Giza, Egypt.
The farinograph and extensograph tests were carried out according to AACC (1995). Visco-amylograph test was carried out according to the procedures of Kim and D’Appolonia (1977) using falling number test was carried out according to AACC (1995).

RESULTS AND DISCUSSION

Farinograph parameters of wheat flour dough as affected by the addition of modified wheat flour, modified starch and maltodextrin:
Table (1) illustrates the effects of adding thermally modified wheat flour, thermally modified starch and maltodextrin on the farinogram values of the wheat flour.
From this table, it could be noticed that the addition of thermally modified wheat flour induced apparent increases in the water absorption of the wheat flour from 68% to 70%, 70.5% and 69.5% in samples of flour mixtures contained thermally modified wheat flour at 160ºC, 180ºC and 200ºC, respectively.
The addition of starch that thermally modified at 160ºC decreased the water absorption of the wheat flour from 68% to 67%, while at 180ºC slightly
increased the water absorption to 68.5%, meanwhile at 200ºC showed no effects on the water absorption of wheat flour.

Table (1) : Farinograph parameters of wheat flour dough as affected by the addition of thermally modified wheat flour, thermally modified starch and maltodextrin

<table>
<thead>
<tr>
<th>Treatment Parameters</th>
<th>Control wheat flour</th>
<th>Addition of modified wheat flour 6% at 160c</th>
<th>Addition of modified wheat flour 6% at 180c</th>
<th>Addition of modified wheat flour 3% at 200c</th>
<th>Addition of modified starch 6% at 160c</th>
<th>Addition of modified starch 6% at 180c</th>
<th>Addition of modified starch 3% at 200c</th>
<th>Addition of 4% maltodextrin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (%) absorption</td>
<td>68</td>
<td>70</td>
<td>70.5</td>
<td>69.5</td>
<td>67</td>
<td>68.5</td>
<td>68</td>
<td>62.5</td>
</tr>
<tr>
<td>Mixing time (min)</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Dough stability (min)</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>Dough tolerance index (B.U)</td>
<td>170</td>
<td>140</td>
<td>140</td>
<td>160</td>
<td>150</td>
<td>160</td>
<td>160</td>
<td>140</td>
</tr>
<tr>
<td>Dough weakening index (B.U)</td>
<td>190</td>
<td>180</td>
<td>170</td>
<td>170</td>
<td>170</td>
<td>190</td>
<td>190</td>
<td>140</td>
</tr>
</tbody>
</table>

Regarding maltodextrin, it is clear that the flour mixture contained maltodextrin showed a marked decrease in the water absorption being 62.5% compared with 68% for the control sample.

These results indicates that the thermally modified wheat flour had the best effect on increasing the water absorption of the wheat flour especially that modified at 180ºC. This may be due to the ability of the 82% wheat flour to absorb the water than starch or maltodextrin as indicated by Shogren et al. (1981), Chen et al. (1988a) and Shouk (1996). They stated that as bran and pentosans content increased the water absorption of flour increased.

The results tabulated in table (1) further show that the addition of modified wheat flour, modified starch, and maltodextrin did not effect on the dough development time of the wheat flour and all the examined sample gave the same value as the control. The obtained results agree with those reported by Sherif (2002) who found that the addition of thermally modified starch did not affect the dough development time of wheat flour.

Table (1) also shows that the dough stability of the wheat flour was not affected neither by adding wheat flour modified at 160ºC nor adding wheat flour modified at 180ºC.

However, the addition of wheat flour that modified at 200ºC increased the dough stability from 1.5 min. to 2 min. Moreover, the addition of starch that modified either at 160ºC, 180ºC and 200ºC similarly increased the dough stability to 2 min. compared with 1.5 min. for the control sample. This may be due to the increasing of dextrinization of corn starch due to the high temperature treatment. The obtained results agree with those reported by Sherif (2002) who found that the addition of enzymatic modified starch increased the dough stability of wheat flour.

On the other hand, the addition of maltodextrin showed the highest effect on increasing the dough stability which increased to 2.5 min. compared to 1.5 min. in the control sample.

Addition of thermally modified wheat flour or modified starch decreased the tolerance index, but wheat flour modified at 160ºC and 180ºC were more efficient in this reduction than that modified at 200ºC (Table 1) this may be due to different in level addition.
Moreover, addition of maltodextrin also decreased the tolerance index to value similar to those obtained by the addition of wheat flour modified at 160°C and 180°C. The results in table (1) illustrate that the dough weakening of wheat flour reduced as a result of the addition of modified wheat flour especially at the highest temperature. Also the addition of starch that modified at 160°C reduced the dough weakening of the wheat flour, while starch that thermally modified at 180°C and 200°C had no effects on the dough weakening their values were similar to the control sample. Maltodextrin showed the highest effect on reducing the dough weakening as its value decreased to 140 B.U compared to 190 B.U in the control sample, this means when maltodextrin addition dough weakening improved highly, this may be due to strengthening effect of maltodextrin on gluten net work, the obtained results agree with those reported by Shouk (1996) who found that the addition oxidants and improver (energy 100) reduced the dough weakening.

**Extensograph parameters of wheat flour dough as affected by the addition of modified wheat flour, modified starch and maltodextrin.**

Table (2) shows the extensograph data for wheat flour dough as influence by the addition of thermally modified wheat flour, thermally modified starch and maltodextrin. From this table, it is noticeable that the addition of thermally modified wheat flour reduced the extensibility of the wheat flour with lower effect for wheat flour that modified at 200°C.

<table>
<thead>
<tr>
<th>Treatment Parameters</th>
<th>Control wheat flour 82%</th>
<th>Addition of modified wheat flour</th>
<th>Addition of modified starch 3% at 180°C</th>
<th>Addition of 4% maltodextrin</th>
<th>Addition of modified starch 6% at 180°C</th>
<th>Addition of modified maltodextrin 6% at 160°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extensibility (m.m)</td>
<td>140</td>
<td>125</td>
<td>125</td>
<td>135</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>Resistance to extension (B.U)</td>
<td>70</td>
<td>90</td>
<td>120</td>
<td>110</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>Proportional Number</td>
<td>0.5</td>
<td>0.72</td>
<td>0.96</td>
<td>0.74</td>
<td>0.65</td>
<td>0.64</td>
</tr>
<tr>
<td>Extensogram area (cm²)</td>
<td>11</td>
<td>12</td>
<td>28</td>
<td>21</td>
<td>22</td>
<td>18</td>
</tr>
</tbody>
</table>

Meanwhile, addition of modified starch showed no effects on the extensibility of the wheat flour.

Addition of maltodextrin induced the highest reduction in the extensibility of the wheat flour being 120 (mm) compared to 140 (mm) in the control sample. The obtained results agree with these reported by Sherif (2002) who found that the addition of wheat pyro, and enzymatic modified starch reduced extensibility of the wheat flour dough.

The same table illustrates that the resistance to extension (B.U) for the wheat flour increased due to the addition of the modified wheat flour, modified starch and maltodextrin. However, the highest increases were observed for samples contained modified wheat flour at 180°C (120 B.U), this means that gluten net work was improved in this treatment highly compared with other treatment, modified wheat flour at 200°C (100 B.U), and maltodextrin (110 B.U) respectively, compared to (70 B.U) for the control sample. The obtained
results agree with these reported by Sherif (2002) who found that the addition of 5% pyro modified starch increased the resistance to extension of wheat flour.

The proportional no. for wheat flour increased due to the application of all additions under investigation. However, the rate of increase was lower in samples contained the modified starch than those contained the modified wheat flour. The highest increases in the proportional no. were observed in samples contained modified wheat flour at 180ºC (being 0.96) followed by sample contained maltodextrin (being 0.83) as compared to 0.5 for the control sample, this means that proportional number take same trend.

On the other hand, the addition of the different modified wheat flour as well as the modified starch increased the extensogram area (cm²) for wheat flour. Meanwhile, maltodextrin had no effect on the extensogram area as indicated in Table (2), the obtained results agree with those reported by Sherif (2002) who found that the addition of 5% wheat pyro modified starch increased the extensogram area.

**Pasting properties (Viscosity) of wheat flour as affected by the addition of modified wheat flour, modified starch and maltodextrin**:

Table (3) represents the effect of the addition of thermally modified wheat flour, thermally modified starch and maltodextrin on the pasting properties of the wheat flour.

From these results, it is clear that all addition used in this study reduced the heat of transition for the wheat flour dough.

The lowest decrease was observed in samples contained starch modified at 180ºC and those contained wheat flour modified at 180ºC being 66.5 ºC and 65 ºC respectively, compared 74ºC for the control sample, this lead to the increasing of gelatinization degree of starch then improving produced bread.

**Table (3) : Pasting properties (Viscosity) of wheat flour as affected by the addition of modified wheat flour, modified starch and maltodextrin**

<table>
<thead>
<tr>
<th>Treatment Parameters</th>
<th>Control wheat flour 82%</th>
<th>Addition of modified wheat flour 6% at 160c</th>
<th>Addition of modified starch 6% at 160c</th>
<th>Addition of 4% maltodextrin 6% at 160c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat of transition (ºC)</td>
<td>74 62 65 63.5 62 66.5 62 62</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum viscosity (B.U)</td>
<td>370 400 350 430 350 320 380 210</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp. of Max. viscosity (ºC)</td>
<td>89 93.5 89 87.5 86 89 87.5 92</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakdown viscosity (B.U)</td>
<td>290 350 300 350 310 280 330 210</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity at 50ºC (B.U)</td>
<td>590 630 570 640 540 540 670 520</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set back viscosity (B.U)</td>
<td>-220 -230 -220 -210 -190 -220 -290 -310</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Set back = Maximum viscosity - viscosity at 50ºC

Furthermore, the same table shows that the maximum viscosity increased in samples contained wheat flour that modified at 160°C and 200°C but slightly decreased in samples contained wheat flour that modified at 180°C. In addition, the maximum viscosity decreased in samples contained...
starch that modified at 160°C and 180°C and slightly increased in the presence of starch that modified at 200°C.

Meanwhile, samples contained maltodextrin showed the highest decrease in the maximum viscosity as it was 210 B.U compared to 370 B.U in the control sample. As shown in table (3) the temperature of maximum viscosity increased from 89°C in the control sample to 93.5°C in sample contained wheat flour modified at 160°C. While the addition of wheat flour that modified at 180°C and starch that modified at 180°C did not affect the temperature maximum viscosity being 89°C.

The addition of wheat flour modified at 200°C and starch modified at 200°C slightly reduced the temp. of maximum viscosity reaching 87.5°C. Meanwhile the temperature of maximum viscosity high decreased in sample contained starch modified at 160°C. Maltodextrin, however, increased the temperature of maximum viscosity reaching 92°C as shown in Table (3).

From table (3) it is obvious that the addition of thermally modified wheat flour increased the breakdown viscosity of the wheat flour dough. Moreover, addition of starch that modified at 160°C and 200°C increased the breakdown viscosity, while starch modified at 180°C slightly reduced the breakdown viscosity. These parameters are correlated with the protein level of wheat flour dough and different levels of addition. Maltodextrin showed the highest affect as reducing the breakdown viscosity.

On the other hand, the viscosity at 50°C, increased due to the addition of wheat flour modified at 160°C and 200°C but the addition of starch that modified at 180°C slightly reduced the viscosity at 50°C of the wheat flour dough. Meanwhile, the viscosity at 50°C reduced in all samples contained thermally modified starch except at 200°C as well as maltodextrin.

**Falling number, falling time and liquefaction number on wheat flour dough as affected by the addition of modified wheat flour, modified starch and maltodextrin:**

The tabulated results in Table (4) indicates that the addition of wheat flour modified at 160°C increased the falling number of wheat flour, while wheat flour that modified at the higher temperatures decreased the falling number of the wheat flour dough but at lower rate in case of modification at 200°C. Addition of starch that modified at 160°C slightly decreased the falling number of the wheat dough, while addition of starch that modified at 180°C or 200°C similarly increased the falling number of the wheat flour dough. The falling number of wheat flour dough also showed a slight increase due to the addition of maltodextrin.

Regarding the falling time, the same table shows that the addition of wheat flour that modified at 160°C increased the falling time of the wheat flour dough. Meanwhile, the falling time of wheat flour dough showed a slight increase due to the addition of starch modified at 180°C and marked decrease in case of addition of starch modified at 200°C. Addition of maltodextrin showed no remarkable effect on the falling time of the wheat flour dough.

Table (4) further shows that the addition of wheat flour that modified at 160°C slightly decreased the liquefaction number of the wheat flour dough, but the addition of wheat flour that modified at 180°C showed no remarkable
effect. Addition of wheat flour modified at 200°C induced a marked increase in the liquefaction number of the wheat flour dough.

Table (4) : Falling number, falling time and liquefaction number as affected by the addition of modified wheat flour, modified starch and maltodextrin.

<table>
<thead>
<tr>
<th>Treatment Parameters</th>
<th>Control wheat flour 82%</th>
<th>Addition of modified wheat flour</th>
<th>Addition of modified starch</th>
<th>Addition of 4% maltodextrin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6% at 160c</td>
<td>6% at 180c</td>
<td>3% at 200c</td>
</tr>
<tr>
<td>Falling number (FN) (sec)</td>
<td>279</td>
<td>290</td>
<td>277</td>
<td>245</td>
</tr>
<tr>
<td>Falling Time (sec)</td>
<td>219</td>
<td>230</td>
<td>217</td>
<td>185</td>
</tr>
<tr>
<td>Liquefaction number (LN)</td>
<td>26.20</td>
<td>25.00</td>
<td>26.43</td>
<td>30.77</td>
</tr>
</tbody>
</table>

Where
* Falling time = FN - 60
** Liquefaction number = 6000 / (FN – 50)

Concerning the addition of modified starch, the results show that starch that modified at 160°C increased the liquefaction number of wheat flour dough, while starch that modified at 180°C or 200°C decreased the liquefaction number of the tested dough at similar levels. The addition of maltodextrin had no remarkable effect on the liquefaction number of the tested dough. This means that falling number of tested treatment was at the normal range of amylase activity (245 – 290) sec.

REFERENCES

Tabekhia, M.M. et al.


تأثير بعض المحسنات الطبيعية على الصفات الريولوجية لعجين دقيق المحمص محمد محمد منصور طبخية - مساعد عبد العزيز أبو رية - عزيز حسن فهمى و أحمد عبد المنعم يوسف

قسم الصناعات الغذائية - كلية الزراعة - جامعة المنصورة

بحث البحث إلى دراسة تأثير إضافة النشا المحمص وتقليل الفحم استناداً إلى درجات (120، 180، 240، 300) مي و وكذلك الملوثوكسترين الغير معامل حاريا على الصفات الريولوجية للعجين.

ولظهرت الدراسة النتائج الآتية:

أولا: بالنسبة للفرنوجراف

تم زيادة نسبة الماء المستخدم لكل الحالتة عدا حالة إضافة النشا المحمص باستخدام 120 مي و وكذلك الملوثوكسترين حيث انخفضت نسبة من (26.5) على الترتيب. لوحظ عدم تأثر زمن نضج الالجية في كل حالات الإضافة، أما صفة صفة توصلت إلى النتائج للفحص مع انخفاض النسبة إلى (21%) في الحالة 811 مي.

ثانيا: بالنسبة للكارستنوجراف

آظهرت النتائج زيادات في رقم السقوط في بعض حالات إضافة والنشا المحمص، وثانيًا انخفضت نسبة من (81) على الترتيب. لوحظ عدم تأثير زمن السقوط في كل حالات الإضافة، أما صفة صفة توصلت إلى النتائج للفحص مع انخفاض النسبة إلى (71%) في الحالة 811 مي.

ثالثا: بالنسبة للفسكاميلوجراف

آظهرت النتائج زيادات في رقم السقوط في بعض حالات إضافة والنشا المحمص، وثانيًا انخفضت نسبة من (81) على الترتيب. لوحظ عدم تأثير زمن السقوط في كل حالات الإضافة، أما صفة صفة توصلت إلى النتائج للفحص مع انخفاض النسبة إلى (71%) في الحالة 811 مي.