EFFECT OF ADDING DATE PASTE ON THE RHEOLOGICAL PROPERTIES OF WHEAT BREAD FLOUR.

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Summary
Four instruments i.e. Farinograph, Alveograph, Zymotachigraph and Amylograph were used in studying the effect of adding date paste on the rheological properties of the wheat flour bread dough. Date paste was used as a partial replacer for wheat flour at the rates of 4, 6, 8 and 12%. Two control treatments were included: the first is a sugar free control while, the second contains 3% sucrose.

The obtained results showed that the addition of 4-6% date paste as a partial replacement of wheat flour in the bread dough formula caused an improvement in some of the dough characteristics as shown by the marked increases in the malt index, extensibility, maximum over pressure, deformation energy values as well as the gassing properties. On the other hand, higher levels of added date paste (8-12%) had adversely affected the rheological properties of the wheat flour-date paste blends.

Introduction
The increased availability of dates (Phoenix dactylifera L.) in the most date producing countries has raised interest in the utilization of date paste in baking items, specially, in bread. The moisture retention capacity of yeast-raised products depends mainly on the percentage of fructose present in them (4). Bread containing little fructose tend to dry out rapidly when exposed to air of low humidity. Since date paste contains substantial quantities of invert sugar (about 80% on dwb) and fructose accounts for about 50% of the sugar (14). Then it is possible to emphasize the importance of using date paste in breadmaking. Due to its high level of sugars, fiber, vitamins and minerals, the addition of date paste to bread formula is expected to improve the rheological properties of the dough, external and internal bread characteristics, the nutritive value of the produced bread as well as retard staling (15).

Various concentrations of date syrups were used in bread formulae (2). It was found that the addition of date syrup to bread flour caused a slight change in the water absorption as measured by the Farinograph and also increased slightly the dough development time, whereas dough softening was reduced considerably. On the other hand, the diastatic activity of the flour was not affected by the addition of date
syrup as shown by the Amylograph test. Date paste was used as a wheat flour replacer in cookies formulæ with replacement level ranging between 4 and 20% (11). A decrease of flour water absorption with increasing amounts of date paste replacement was apparent.

More recently (15), date paste was used as a partial replacer of English flour (Sovereign flour) in white pan bread formulæ. It was found that moderate levels (4-8%) of date paste modified bread dough as indicated by Farinograph and Alveograph studies. Addition of date paste decreased the malt index and delayed gelatinization. Total gas production and retention were improved by 4-6% addition compared with the sugar free control. A higher concentration (12%) of date paste resulted in a negative effect on the gassing and handling properties of the bread dough.

The use of date paste as a substitute for sugar in breadmaking is possible only if it does not adversely affect the rheological properties of the bread dough. Accordingly, this study was conducted to evaluate the effect of adding date paste as a partial replacer of wheat flour in the bread dough characteristics.

Materials and Methods

A commercially treated (25 ppm potassium bromate and 87 ppm iron and B complex vitamin), milled wheat bread flour was obtained from Alhasa Bakery at Alhofuf, Saudi Arabia. It is a composite made from Yecora Rojo and Probread wheat (Triticum vulgare) (Personal Communication By Dr. Bayoumi M., Saudi Silo Estab, Riyadh). The proximate composition (on 14% mb) for the wheat flour was:

- protein 14.0%;
- moisture 11.5%;
- ash 0.58%;
- starch damage 33%;
- Farrand and absorption 59%.

The flour was packed in 2 Kg polyethylene bags and kept in a deep freezer (−20°C) prior to further treatments and analysis.

Date paste was prepared from Ruzeiz dates. Preparation and composition of date paste was as reported previously (14). Fat suitable for bread making (of the trade name Ambrex) , table salt, table sugar and dried yeast were procured from the local market.

Chemical analytical methods

Moisture content was determined by the modified vacuum oven method (1). Protein was determined by the macro-Kjeldahl method (1). Ash was determined using the basic method (1) whereas damaged starch was measured colorimetrically (13).

Physical dough testing

The rheological properties of the wheat bread flour-date paste blends were measured using four instruments. These included Farinograph, Amylograph, Alveograph and Zymotachigraph. Two controls (sugar free control, C1, and 3% sucrose-contained control, C11) and four treatments containing 4, 6, 8 and 12% date paste as bread wheat flour replacement were used in the rheological properties study.
Farinograms were determined by AACC approved method (1). The constant flour weight procedure was followed. The combined weight of flour and date paste used was 50 grams based on 14% flour moisture basis. The maximum consistency was centered on the 500 B.U. line. The flour date paste mixture were mixed for 1 minute in the Farinograph bowl before adding water. Four parameters i.e. water absorption, dough development time (DDT), stability and softening (time to breakdown) were obtained from the Farinograms. Absorption was calculated on 14% moisture basis using the following equation:

\[ A = \frac{86(B+M)}{100-M} - 14. \]

Where \( A \) = absorption equivalent to 14% moisture; \( B \) = absorption that has been measured, \( M \) = moisture percentage in the wheat bread flour.

Alveograms were obtained by following the method of Chen and D'Appolonia (5). Doughs were prepared from 250 g flour on a 14% moisture basis using an absorption that was 8% less than that obtained with the Farinograph and 1% salt concentration. Date paste was dissolved in 40 mls of the salt solution before adding it to the flour. Doughs from the different treatments were mixed in the Alveograph mixer according to the Farinograph peak time. Dough temperature was maintained at 25°C. The Alveograms were evaluated in terms of upset pressure, P; extensibility, L; curve configuration ratio, P/L; and deformation energy, W.

The Brabender Amylograph was used to examine the pasting properties of the different wheat bread flour-date paste mixtures. The Amylograph was run according to an AACC procedure (1). The Amylograms were obtained using 65 g of wheat bread flour or wheat bread flour-date paste mixture on 14% flour moisture basis. Viscosity was recorded as temperature increased from 30 to 95°C. Temperature increase was at the rate of 1.5°C per min. The information obtained from the curves included pasting temperature, gelatinization temperature, maximum viscosity, temperature and malt index (peak value or maximum viscosity).

Gassing properties of the wheat bread flour-date paste mixtures were measured using the Chopin Zymotachigraph. Zymotachigrams (triplicate) were obtained by following the technique described in the Chopin Zymotachigraph instruction booklet. Dough ingredients used in testing the effect of adding date paste on the gas properties of wheat bread flour were as follows: bread wheat flour, 250 g; date paste substituted 12% of wheat flour; sucrose 3%; salt 2%; and yeast 1%. All the above ingredients were added on 14% flour moisture basis. Water was added at 75% of the dry weight of the flour except for the 8 and 12% date paste treatments where it was reduced to 70%. Doughs were fermented up to 210 min. and the dough temperature was maintained at 27 ± 1°C.

**Statistical analysis**

Data were analysed using a SAS computing system. The analysis of variance procedure was used and the LSD values were calculated for all means (12).
Results and Discussion

Farinograph results (Table 1) show that partial replacement of wheat flour by sucrose or different levels of date paste (4, 6, 8 and 12%) significantly decreased water absorption. It is clear that increasing date paste replacement results in a consistent decrease in the water absorption. This decrease in water absorption of the wheat flour-date paste doughs may be due to the role of sugars present in date paste (78%) in limiting the water availability to the dough system and finally reducing the water holding capacity of the gluten (8). Another possibility for decreased water absorption in the interaction between gluten and one or more of the date paste components (sugars, minerals, amino acids... etc.). This interaction may change the physical state of the gluten and consequently its water holding capacity (7).

Results in Table 1 show that the used flour is a strong flour: a high dough development time (15 min.) is characteristic of this flour. Replacement of wheat flour with date paste caused a marked decrease in DDT. The highest decrease was with the 12% date paste replacement (from 15 to 7.4 min). However, this decrease in DDT might be acceptable since it saves more than 50% of the energy required in dough preparation.

Regarding stability and softening (time to breakdown), data in Table 1, show that addition of sucrose or date paste decreased these two parameters. It is clear that addition of 4% date paste (about 3% sugar) has a higher weakening effect compared with the sucrose treatments, these results suggest that date paste component other than sugar or a date paste-wheat flour interaction may account for this weakening effect. Nevertheless, the weakening effect impaired by date paste is more apparent when using a high level of date paste such as 12%. Similar weakening effect as a result of partial replacement of English wheat flour with date paste was reported (15). Almost similar absorption and stability values and lower DDT values for the used Saudi wheat flour were reported by other researchers (9).

Table 1. Effect of adding date paste on the Farinograms of the Studied wheat flour.

<table>
<thead>
<tr>
<th>Farinograms*</th>
<th>% Date paste added to wheat flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>parameters</td>
<td>C1 Control</td>
</tr>
<tr>
<td>Absorption %</td>
<td>59.0a**</td>
</tr>
<tr>
<td>DDT (min)</td>
<td>15.0a</td>
</tr>
<tr>
<td>Stability (m in)</td>
<td>20.3a</td>
</tr>
<tr>
<td>Softening (min)</td>
<td>29.2a</td>
</tr>
</tbody>
</table>

* Mean of three determinations.
** Values in the same row bearing the same scripts are not significantly different by the LSD test (α = 0.5)
The Alveograph data are presented in Table 2. It can be observed from these results that replacing wheat bread flour with increasing amounts of date paste result in a progressive increase in the maximum over pressure (P) values which is a measure of flour stiffness, shortness and tightness. The same trends can also be observed for extensibility (L) values which is a measure of elasticity, curve configuration ratio values (P/L) which is a measure of flour quality and deformation energy which is a measure of overall strength of the gluten. It is interesting to note that all date paste replacement level caused greater increase in the measured Alveograph values (Table 2) compared with the sucrose control. It is also clearly evident from these results that the 4% date paste replacement level, which contains a similar amount of sugar as that of the sucrose control (3%) treatment caused greater increase in P, L, P/L and W values compared with the sucrose control. This provides evidence that factors other than sugars are involved in strengthening the gluten protein network. Evidence indicating the beneficial effect of sugars on the gluten development in the dough system has been reported (8). Partial replacement of the wheat flour with 4% date paste will provide about 85% mg protein or amino acids/100g date paste-wheat flour blend (14). The interaction of the date paste protein or amino acids with the wheat gluten may account for the improvement of the gluten of the wheat flour-date paste doughs. Date paste is rich in minerals and trace elements (14) and according to previous work (10), high solute concentration increase DDT and L of wheat flour. As a result, addition of date paste to the bread formula may aid the strengthening effect.

Table 2. Effect of adding date paste on the Alveograph mean values of the studied wheat bread flour.

<table>
<thead>
<tr>
<th>Alveogram *</th>
<th>% Date paste added to wheat flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean values</td>
<td>C1 Control</td>
</tr>
<tr>
<td>Maximum over pressure (P/mm)</td>
<td>63.0 f**</td>
</tr>
<tr>
<td>Extensibility (L/mm)</td>
<td>80.0 d</td>
</tr>
<tr>
<td>Curve configuration ratio (P/L)</td>
<td>0.078 d</td>
</tr>
<tr>
<td>Deformation on energy W (10 erg/g dough)</td>
<td>195.0 f</td>
</tr>
</tbody>
</table>

* and ** as in Table 1.
Amylograph data (Table 3) show that the partial replacement of wheat flour with data paste (4-12%) or sucrose (3%) increases the malt index and has no effect on both pasting and gelatinizing temperatures. The present results are at variance with those reported by Yousif et al. (15) who found that addition of date paste as a partial replacement of English flour caused a decrease in the malt index and an increase in the pasting temperature. This discrepancy however, may be due to varietal differences between the studied wheat flour and the English wheat flour.

Gas production and retention are of great importance in bread making. Date paste which contains high levels of sugars and minerals (14), the two essential nutrients for yeast to produce gas in the dough, is expected to improve the gassing properties of the bread dough if added to flour at the optimum level. Figure 1 shows that addition of date paste at the level 4% achieved the highest total gas production and retention at the end of the fermentation time of 210 min., whereas addition of date paste at the level of 12% achieved the lowest figures. The improvements in the gassing properties caused by both 4 and 6% date paste treatments could be due partly to the improved ability of the composite mixture to control the balance between elasticity and extensibility. On the other hand, the poor gassing properties of 8 and 12% date paste treatments could be attributed to the effect of the high sugar content present in this blend on the yeast cells caused by the high osmotic pressure. These results, however, are in agreement with other earlier results (3) on the effect of various sugars on dough and bread properties and also support the findings of Yousif et al. (15) on the functionality of date paste in an English wheat flour bread formula.

Table 3. Effect of adding date paste on the pasting properties of the studied wheat bread flour.

<table>
<thead>
<tr>
<th>Pasting properties</th>
<th>C1 control</th>
<th>C11 control</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malt index values (B.U) 907b**</td>
<td>957a</td>
<td>937a</td>
<td>960a</td>
<td>945a</td>
<td>957a</td>
<td></td>
</tr>
<tr>
<td>Pasting temperature C</td>
<td>59.0a</td>
<td>59.0a</td>
<td>59.0a</td>
<td>59.0a</td>
<td>59.0a</td>
<td>58.0b</td>
</tr>
<tr>
<td>Gelatinizing temp. C</td>
<td>91.7ab</td>
<td>92.3a</td>
<td>91.1bc</td>
<td>90.5c</td>
<td>90.4c</td>
<td>89.2d</td>
</tr>
</tbody>
</table>

* and ** are as in Table 1.

References
تأثر اضافة عصبة النمور خلطة الحبر على الصفات البيولوجية لدقيق الحبر
علي كامل يوسف
قسم التغذية والتصنيع الغذائي
كلية الزراعة - الجامعة الأردنية - عمّان - الأردن

الأختلافات

استعملت أربع عينات من الأجهزة وهي المصابيح حاف، الألومنيوم، الزئبق، في الأ passwd النمور، والألمونيوم لدواسة تأثير اضافة عصبة النمور على الصفات البيولوجية لدقيق الحبر. اضافة عصبة النمور إلى الدقيق بنسبة تراوح حتى ما بين 4 - 12٪ كما استعملت معايير معايير الأولى لاختيار على مصلور سكري بينما احتوت النائمة على 3٪ سكر زرد.

ما النتائج المتحالفة عليها على اضافة عصبة النمور بنسبة 4 - 6٪ كمثيل غروي لدقيق الحبر، العينات ملحوظة في الصفات البيولوجية لدقيق الحبر والتي تشتمل نسبة وقت التخليط، ملاطية الجبن، مقاومة الجبن للشدة، الحجم الكلي للفازات المترجحة وحجم الفازات المترجحة. من ثابته أن اضافة عصبة النمور إلى خلطة الحبر بنسبة متقطعة (8 - 12٪) كان له تأثير سلبي على الصفات البيولوجية لدقيق الحبر.