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INFLUENCE OF SOME NATURAL IMPROVER ON THE RHEOLOGICAL PROPERTIES OF WHEAT FLOUR DOUGH

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ABSTRACT

The present study aims to investigate the effects of the addition of theremally 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 talerence 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 (cm^2) while addition of modified flour increased resistance to extension, proportional no., Extensogram area and decreased extensibility, also maltodextrin addition increased all parameters except extensibility. Meanwhile addition of modified wheat flour increased breakdown viscosity, maximum viscosity. 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 freshnes 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 thr freeze thaw stability of frozen doughs and batters, increases the strength of flour and softens the bite of baking process, and increases the volume amd 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 propertiesof dough is important and several rheological instruments can be used to determine the dough behavior and quality (Lee et al., 2001 ; Menjivar, 1990 and Stampfli 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 overnorate, Egypt. Maltrodextrin (Food Grade) was purchased from the National Company fpr 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 farinograpg, 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

Treatment / Parameters	Control wheat flour	Addition of modified wheat flour			Addition of modified starch			Addition of 4% maltodextrin
		6% at 160c	6% at 180c	3% at 200c	6% at 160c	6% at 180c	3% at 200c	
Water (%) absorption	68	70	70.5	69.5	67	68.5	68	62.5
Mixing time (min)	2	2	2	2	2	2	2	2
Dough stability (min	1.5	1.5	1.5	2	2	2	1.5	2.5
Dough tolerance index (B.U)	170	140	140	160	150	160	160	140
Dough weakening index (B.U)	190	180	170	170	170-	190	190	140

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 absorp 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 160ºC and 180ºC. 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 160ºC reduced the dough weakening of the wheat flour, while starch that thermally modified at 180ºC and 200ºC 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 strengthing 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 200ºC.

Table (2) : Extensograph parameters of wheat flour dough as affected by the addition of thermally modified wheat flour, thermally modified starch and maltodextrin

Treatment / Parameters	Control wheat flour 82%	Addition of modified wheat flour			Addition of modified starch			Addition of 4% maltodextrin
		6% at 160c	6% at 180c	3% at 200c	6% at 160c	6% at 180c	3% at 200c	
Extensibility(m.m)	140	125	125	135	140	140	140	120
Resistance to extension (B.U)	70	90	120	110	80	90	80	100
Proportional Number	0.5	0.72	0.96	0.74	0.65	0.64	0.57	0.83
Extensogram area (cm^2)	11	12	28	21	22	18	23	11

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 180ºC (120 B.U), this means that gluten net work was improved in this treatment highly compared with other treatment, modified wheat flour at 200ºC (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 (cm^2) for wheat flour. Meanwhile, maltodextrine 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

Treatment / Parameters	Control wheat flour 82%	Addition of modified wheat flour			Addition of modified starch			Addition of 4% maltodextrin
		6% at 160c	6% at 180c	3% at 200c	6% at 160c	6% at 180c	3% at 200c	
Heat of transition (c)	74	62	65	63.5	62	66.5	62	62
Maximum viscosity (B.U)	370	400	350	430	350	320	380	210
Temp. of Max. viscosity (c)	89	93.5	89	87.5	86	89	87.5	92
Breakdown viscosity (B.U)	290	350	300	350	310	280	330	210
Viscosity at 50ºC (B.U)	590	630	570	640	540	540	670	520
***Set back viscosity (B.U)**	- 220	-230	-220	-210	-190	-220	-290	-310

*** 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 160ºC and 200ºC but slightly decreased in samples contained wheat flour that modified at 180ºC. In addition, the maximum viscosity decreased in samples contained

starch that modified at 160ºC and 180ºC and slightly increased in the presence of starch that modified at 200ºC.

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 89ºC in the control sample to 93.5ºC in sample contained wheat flour modified at 160ºC. While the addition of wheat flour that modified at 180ºC and starch that modified at 180ºC did not affect the temperature maximum viscosity being 89ºC.

The addition of wheat flour modified at 200ºC and starch modified at 200ºC slightly reduced the temp. of maximum viscosity reaching 87.5ºC. Meanwhile the temperature of maximum viscosity high decreased in sample contained starch modified at 160ºC. Maltodextrin, however, increased the temperature of maximum viscosity reaching 92ºC 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 160ºC and 200ºC increased the breakdown viscosity, while starch modified at 180ºC slightly reduced the break down 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 50ºC, increased due to the addition of wheat flour modified at 160ºC and 200ºC but the addition of starch that modified at 180ºC slightly reduced the viscosity at 50ºC of the wheat flour dough. Meanwhile, the viscosity at 50ºC reduced in all samples contained thermally modified starch exept at 200ºC 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 160ºC 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 200ºC. Addition of starch that modified at 160ºC slightly decreased the falling number of the wheat dough, while addition of starch that modified at 180ºC or 200ºC 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 160ºC 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 180ºC and marked decrease in case of addition of starch modified at 200ºC. 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 160ºC slightly decreased the liquefaction number of the wheat flour dough, but the addition of wheat flour that modified at 180ºC showed no remarkable

effect. Addition of wheat flour modified at 200ºC 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.

Treatment / Parameters	Control wheat flour 82%	Addition of modified wheat flour			Addition of modified starch			Addition of 4% maltodextrin
		6% at 160c	6% at 180c	3% at 200c	6% at 160c	6% at 180c	3% at 200c	
Falling number (FN) (sec.)	279	290	277	245	264	295	295	280
*Falling Time (sec)	219	230	217	185	260	235	235	220
**Liquefaction number (L.N)	26.20	25.00	26.43	30.77	28.04	24.49	24.49	26.09

Where

*** Falling time = FN - 60**

**** Liquifaction number = 6000 / (FN – 50)**

Concerning the addition of modified starch, the results show that starch that modified at 160ºC increased the liquefaction number of wheat flour dough, while starch that modified at 180ºC or 200ºC 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.

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تأثير بعض المحسنات الطبيعية على الصفات الريولوجية لعجين دقيق القمح

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يهدف البحث إلى دراسة تأثير إضافة النشا المحور ودقيق القمح استخلاص ٨٢% والمعامل حراريا على درجات (١٦٠م ، ١٨٠م ، ٢٠٠م) ، وكذلك المالتودكسترين الغير معامل حراريا على الصفات الريولوجية للعجينة .

وأظهرت الدراسة النتائج الآتية :

أولا : بالنسبة للفارينوجراف

تم زيادة نسبة الماء الممتص لكل الحالات عدا حالة إضافة النشا المحور باستخدام ١٦٠م وكذلك المالتودكسترين حيث انخفضت النسبة من (٦٨%) إلى (٦٧% و ٦٢,٥%) على الترتيب . لوحظ عدم تأثر زمن نضج العجينة فى كل حالات الإضافة ، أما صفة Dough Tolerance Index ، فقد انخفضت فى كل حالات الإضافة مقارنة بالكنترول ، كذلك أظهرت النتائج أيضاً أن زمن ثبات العجين قلم يتأثر فى بعض الحالات وازداد فى البعض الآخر . بينما أعطى ضعف العجين قيم أقل من الكنترول والبعض مشابها للكنترول

ثانيا : بالنسبة للاكستنسوجراف

أوضحت النتائج زيادة قيم كل من الرقم النسبي ، المساحة تحت المنحنى والمقاومة للمطاطية فى كل حالات الإضافة مقارنة بالكنترول . أما صفة المطاطية فقد أظهرت انخفاض فى أربعة حالات إضافة وهى الدقيق المعامل على الدرجات المختلفة وكذلك المالتودكسترين غير المعامل وتشابه مع الكنترول فى ثلاث حالات إضافة وهى النشا المحور على الدرجات المختلفة من الحرارة (١٦٠م ، ١٨٠م ، ٢٠٠م) بالنسب المختلفة (٦% ، ٦% ، ٣%) .

ثالثا : بالنسبة للفسكو-اميلوجراف

أظهرت النتائج انخفاض حرارة التحويل (فى كل حالات الإضافة) واللزوجة القصوى فى حالات (النشا المحور على ١٨٠م ، ١٦٠م) و(دقيق القمح المعامل على ١٨٠م) والمالتودكسترين . أيضا الزيادة فى درجة حرارة اللزوجة القصوى فى كل الحالات عدا (النشا المحور على ٢٠٠م) و (الدقيق المعامل على ٢٠٠م) . كما أظهرت النتائج أيضا زيادة فى قيم اللزوجة عند ٩٥م فى بعض حالات الإضافة والانخفاض فى البعض الآخر ، وذلك نتيجة الاختلاف فى المعاملة الحرارية ونسب الإضافة .

بالنسبة لنتائج اختبار رقم السقوط :

أظهرت النتائج الزيادة فى قيم رقم السقوط فى بعض حالات الإضافة (النشا المحور على ٢٠٠م ، ١٨٠م) ، و(الدقيق المعامل على ١٦٠م) والمالتودكسترين . وأظهرت النتائج أيضا انخفاضا فى قيم رقم السقوط عند بعض حالات الإضافة مثل (الدقيق المعامل على ١٨٠م و ٢٠٠م) .، (والنشا المحور على ١٦٠م) .