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EFFECT OF FATTY MATTERS ON DOUGH RHEOLOGICAL PROPERTIES AND SENSORY EVALUATION OF BAKERY PRODUCTS.

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*** Modern Bakeries Company (Rich Bake), 6th October, Egypt**

ABSTRACT

Crunchy toast is a high fat roasted bread that produced using strong wheat flour of 72% extraction. Sunflower oil, palm oil shortening, hydrogenated soy bean oil (HSBO) and soft margarine were used by different ratios (5, 10, 15, 20 and 25%) in preparation of this product. The rheological parameters evaluated on farinograph and extensograph indicated very clear effect of fat type and ratio. Consequently, bread volume and the sensory properties of finished products obviously affected. An extreme reduction in water absorption, extensibility and mixing tolerance index were observed by increasing the fat ratio whereas marked increase in arrival time, development time, stability and resistance to extension recorded as the fat ratio raised. The adding ratio of 5%-10% fat showed the best loaf volume where 15% fat attained best sensory evaluation. Not only the fat type and ratio affect the sensory characteristics of this product but also the heat treatment of roasting process as 140°c/25 min obtained the highest sensory score compared with 110°c/1 hr and 170°c/15 min.

Keywords: Dough rheology; Crunchy toast; Sensory evaluation; Roasted products.

INRODUCTION

Rheology is the study of how materials deform, flow or fail when force is applied. Farinograph and extensograph clearly fit this definition of rheological study. The overall shape of the extensograph curve or the ratio of curve height (R) to extensibility (Ext.) gives an estimation of the dough's viscoelastic balance that determine and classify flour to very strong, strong, medium, weak (Hoseney 1994).

Among the cereal flours, only wheat flour can form a three-dimensional viscoelastic dough when mixed with water. Characterization of rheological properties of dough is effective in predicting the processing behaviour and in controlling the quality of wheat products. Farinograph, mixograph and extensograph is the most common empirical instruments used for characterizing dough rheology (Yihu and Qiang 2007).

The rheological properties of bread dough are important to the baker for two reasons.

First; they determine the behaviour of dough pieces during mechanical handling and second; they affect the processes governing bubble growth and stability during proofing and baking. (Spies, 1989)

Dynamic rheological parameters of gluten are able to indicate the wheat quality. Lipids play an important role in the affinity of proteins to water presumably due to the interaction with amino acid residuals. On the other hand, defatting of gluten improves water uptake and increases cross-linking degree between proteins. (Keentok *et al.*, 2002)

Mousia *et al.* (2007) listed several hypotheses have been developed to explain the beneficial effects of shortening on bread based on the physical properties of fats and their interactions with the dough ingredients include : (1) the lipoprotein structure of gluten , and its interaction with lipids to form gluten-lipid complexes that strengthen the gluten network and facilitate plastic deformation, (2) The lubrication hypothesis, in which fats are perceived to act as lubricants between gluten and starch matrix, enabling it to retain the gas during expansion, (3) The pore-sealing hypothesis, according to which the melting of fats at a critical stage of baking, facilitate the expansion of bread by flowing and sealing the pores in the structure to retard the escape of gas and (4) The structural support hypothesis that fats enhance the dough structure during expansion, thus providing mechanical support to the dough.

On the other hand, Indrani and Rao (2007) reported that the addition of oil decreases strength and viscosity of the dough. They also explained the effect of adding oil on rheological parameters due to delay in the development of gluten.

Harper (1981) reported that fats or oils tend to weaken the dough, reducing the strength of the extruded product and increasing its plasticity.

Measurement of cookie dough consistency in Farinograph showed that the one containing the oil behaved differently than those containing the other three types of fats; bakery shortening, margarine and vegetable hydrogenated fat and . This dough did not break down during mixing and the fariongram had a relatively stable and wider band. This could be probably because there was more free water in the dough which had not formed an emulsion with the oil. And this free water was being utilized for the development of the gluten proteins making the dough more elastic and offering more resistance to mixing. Cookies containing oil had relatively harder texture and probably so because of the poor entrapment of air during creaming. (Jacob and Leelavathi 2007)

Sudha *et al.* (2007) stated that the colour of biscuit became pale at 70% fat reduction and the appearance decreased significantly. The sensory parameters that were greatly affected by fat reduction were texture, taste and flavour of biscuits. The biscuit became hard, developed dry mouth feel, lacking the lubricity and moistness imported by fat. Biscuit containing lower fat also lacked their wholesome flavour and taste. The breaking strength and the hardness of biscuits increased as a result of fat reduction which highly correlated to hardness of biscuit dough.

This research is designed to explore the effect of fat type and its adding level on the rheological properties of dough and the sensory evaluation of crunchy toast bread. On the other hand, determine the effect of heat treatment of roasting process on the organoleptic characteristics of crunchy toast that produced using different types and ratios of fats to find out the best type and ratio as well as the best heat treatment.

MATERIALS AND METHODS

1. Materials

1.1 Wheat Flour:

Wheat flour of 72% extraction used in this study as a result of milling Australian prime hard wheat (APH) and produced by Five Stars Flour Mills – Suez- Egypt. The analysis of this flour showed the following ;14% protein, 0.53% ash , 0.5% fat , 35% wet gluten and 11.8% dry gluten and 93% gluten index. This type of flour is the common type used in the largest bakery in Egypt (Modern Bakeries Company).

1.2 Fatty matters:

All fatty matter used in this study; Sunflower oil, palm oil shortening, hydrogenated soy bean oil (HSBO) and soft margarine were obtained from IFFCO Company –Suez –Egypt.

1.2 Crunchy toast recipe ingredients:

Sugar, yeast, salt, soy flour, skimmed milk powder, and bread improvers were obtained from Modern Bakeries Co. – 6th October city- Egypt as its regular ingredients.

2. Methods

2.1 Preparation of bread (Crunchy Toast):

The research followed straight dough method according to AACC (2002) and applied the same recipe and technique used by Modern Bakeries Company in Crunchy Toast product, that contains The following as gm/100 gm flour, sugar 5, yeast 1.4, salt 1.65, skimmed milk powder 2.5, soy flour 2.5 and bread improver 1.2 .While water varied depending on the fat ratio added where four different fatty matters used with five adding-ratios on flour basis (5, 10, 15, 20 and 25%). As the regular recipe of fresh normal toast contain 5% fat, the sample of 5% is considered as a control sample during baking trials and following investigation steps. The bread loaves were kept in the refrigerator at 5°c over night after baking and cooling them, then sliced into 10 mm slices and subjected to the roasting process using different heat treatments (110°c/60 min, 140 °c /25 min and 170 °c /15 min)

2.2 Farinograph test :

Farinograph tests were carried out on wheat flour and its mixtures with different fats levels using 300gm. Brabender Faringraph (Brabender OHG , Duisburg , Germany)and following constant flour weight procedure according to AACC method (2002), at the Chemetic company laboratory – El Maadi – Cairo – Egypt.

2.3 Extensograph test :

Extensograph parameters were measured with a Brabender Extensograph (Brabender OHG) according to AACC (2002) at the Chemetic Company Laboratory – El Maadi – Cairo – Egypt. Extensograph measurements included: maximum resistance to extension (R_{max}) , resistance to extension after 5 Cm. (R_5), extensibility (Ext.), Ratio (R_5/Ext.) and energy (area under curve in Cm^2). R_{max} is reported in BU, whereas Ext. is reported in millimeters. Extensographic measurements were taken after dough resting times of 45, 90 or 135 min. where data of 135 min. resting time used in different comparison and research steps. All Extensograph tests were carried out at the Chemetic Company laboratory – El Maadi – Cairo – Egypt.

2.4 Bread volume determination

All bread loaves volume was determined for baked loaves after cooling it down to 30° C. AACC method (2002) was followed to determine the volume in cubic centimeters using rape seeds volumeter.

2.5 Sensory evaluation

The organoleptic (sensory) evaluation of all crunchy toast samples were achieved using the scoring sheet of Pyller (1988) and El-Adl (1995) that was modified and applied at Modern Bakeries Company (Rich bake),6th October, Egypt .

3. Statistical Analysis

The statistical analysis was done using analysis of variance (ANOVA) according to SAS (2006).

RESULTS AND DISCUSSION

The wheat flour used in this study of 72% extraction can be classified as very strong flour based on its chemical analysis and particularly the high protein content (14.0%) and wet and dry gluten (35% and 11.8% respectively in agreement with Valentina *et al.* (2007) and Fu *et al.* (2008). The flour recorded high and balanced extensibility and elasticity by which good processing behaviour and high quality product can be predicted as mentioned by Yihu and Qiang (2007).

Liquid oils, represented by sunflower oil, reduce the water absorption dramatically as shown in Table (1). The addition of 25% of sunflower oil reduces the water absorption by 25.3% flour basis (Baker percent) which negatively affects the product yield and process economics.This may be due to the important role of lipids in the affinity of proteins to water as a result of the interaction with amino acids residuals that proved by Yihu and Qiang (2007).

On the other hand, the arrival time, development time and stability of dough increased gradually by increasing the oil ratio . All extensograph parameters show a marked improvement with adding 5% sunflower oil, then the extensibility decreases and resistance to extension continues in rising by increasing the oil level affecting the ratio and energy. Ratio and energy can not be determined with 20% oil as resistance to extension records higher than 1000 Bu. Same effect trend of adding oil was reported by El-Hofi (1995)

From the technical point of view, the addition of more than 15% oil need to increase the mixing time tc reach the proper consistency for other production steps . So, such level of oil added negatively affects the process economics by consume more time and dough quality as adding oil delays the development of gluten. Indriani and Rao (2006) stated the same conclusion to explain the effect of adding oil on rheological properties of dough. Moreover, due to the higher level of oil (more than 15%), more mixing time reduced the dough consistency and machinability that is reflected on loaf volume (Figure 1) and the symmetry of form as a side breakage takes place.

Table (1): The Effect of Adding Sunflower Oil on rheological properties of Wheat Flour

Ratio %	Farinograph						Extensograph				
	W.A	A.T	D.T	S.T	M.T.I	W	EXT.	R5	Rmax.	Ratio	Energy
0	61.8	1.6	8.0	∞	20	Zero	175	490	855	2.8	180
5.0	56.0	1.5	8.2	∞	10	Zero	181	510	900	2.82	195
10.0	51.7	5.5	15.0	∞	10	Zero	192	430	780	2.24	177
15.0	47.3	1.5	10.5	∞	5	5	172	530	1025	3.08	205
20.0	37.5	14.0	24.5	∞	--	--	130	>1000	>1000	--	--
25.0	36.5	16.5	24.0	∞	Zero	Zero	75	>1000	>1000	--	--

W.A = Water Absorption (%) ST = Stability (min) Ext. = Extensibility (mm)
A.T = Arrival Time (min) M.T.I = mixing tolerance index (BU)
R. = Resistance to extension (BU)
D.T = Development Time (min) W. = weakening (BU)

Hard oils, represented by two different types of shortening which are palm oil, and partially hydrogenated soy oil, clearly affect the farinograph and extensograph parameters by the same manner of sunflower oil.

The water absorption decreased by increasing the hard oil ratio while arrival time and development time increased as shown in Tables (2), and (3) that may be due to the delay in gluten development as indicated by Indrani and Venkatesara (2006).

Extreme increase in resistance to extension and noticeable decrease in extensibility by raising the ratio of different fatty matters which shown in the same tables, that may take place due to the lipoprotein structure of gluten and its interactions with lipids to form gluten-lipid complexes that strengthen the gluten network in agreement with Mousia *et al.* (2007).

The effect rate of hard oils on rheological parameters does not equal with that of soft oils because of their physical properties specially melting point which affects the ability of mixing and homogenous distribution. So, they have same direction of effect but with different rates. These results are in agreement with Jacob and Leelavathi (2007).

Table (2): The Effect of Adding Palm Oil Shortening on rheological properties of Wheat Flour

Ratio %	Farinograph						Extensograph				
	W.A	A.T	D.T	S.T	M.T.I	W	EXT.	R5	Rmax.	Ratio	Energy
0	61.8	1.6	8.0	∞	20	zero	175	490	855	2.8	180
5.0	57.1	5.5	13.0	∞	5	5	155	560	885	3.61	153
10.0	52.0	7.0	13.8	∞	15	5	128	695	960	5.43	165
15.0	47.7	12.0	16	∞	15	5	124	>1000	>1000	--	--
20.0	41.0	15.5	28.3	∞	zero	zero	93	1000	>1000	--	--
25.0	36.0	16.3	22.0	∞	10	zero	89	1000	>1000		

W.A = Water Absorption (%) ST = Stability (min Ext. = Extensibility (mm)
A.T = Arrival Time (min) M.T.I = mixing tolerance index (BU)
R. = Resistance to extension (BU)
D.T = Development Time (min) W. = weakening (BU)

Table (3): The Effect of Adding Soy Shortening (Partially Hydrogenated) on rheological properties of Wheat Flour

Ratio %	Farinograph						Extensograph				
	W.A	A.T	D.T	S.T	M.T.I	W	EXT.	R5	Rmax.	Ratio	Energy
0	61.8	1.6	8.0	∞	20	zero	175	490	855	2.8	180
5.0	56.1	3.5	7.5	∞	20	20	195	475	900	2.4	215
10.0	51.9	3.2	7.5	∞	20	25	184	520	950	2.8	215
15.0	48.4	2.3	7.0	12.5	30	37	160	700	>1000	4.4	--
20.0	43.8	3.0	8.9	∞	20	25	160	740	>1000	4.6	--
25.0	39.5	0.7	9.0	∞	15	20	160	860	>1000	5.4	--

W.A = Water Absorption (%) ST = Stability (min) Ext.= Extensibility (mm)
A.T = Arrival Time (min) M.T.I = mixing tolerance index (BU)
R. = Resistance to extension (BU)
D.T = Development Time (min) W. = weakening (BU)

Table (4): The Effect of Adding Soft Margarine on rheological properties of Wheat Flour

Ratio %	Farinograph						Extensograph				
	W.A	A.T	D.T	S.T	M.T.I	W	EXT.	R5	Rmax.	Ratio	Energy
0	61.8	1.6	8.0	∞	20	zero	175	490	855	2.8	180
5.0	55.9	5.5	10.0	14.5	30	25	195	410	830	2.1	191
10.0	51.0	6.0	10.5	13.0	30	25	169	580	995	3.4	196
15.0	45.2	7.2	10.5	9.7	35	40	155	760	>1000	4.9	--
20.0	39.1	7.5	10.5	12.5	30	35	135	>1000	>1000	--	--
25.0	32.0	6.5	10.3	∞	20	5	130	>1000	>1000	--	--

W.A = Water Absorption (%) ST = Stability (min) Ext. = Extensibility (mm)
A.T = Arrival Time (min) M.T.I = mixing tolerance index (BU)
R. = Resistance to extension (BU)
D.T = Development Time (min) W. = weakening (BU)

As fats delay the gluten development and decrease the cross-linking degree between proteins the arrival and development times become longer by raising the margarine ratio.

The added margarine behaves the same as other types of fatty matters concerning the dough rheological properties where continuous increase in resistance to extension and gradual decrease in extensibility with increasing the adding ratio of margarine were observed. This is may be due to the structural support of fat solids which provides mechanical support to the dough during expansion as mentioned by Mousia *et al.* (2007).

During the application of margarine, the mixing ability and the dough machinability were much better than the liquid oil whereas the adding ratio of 20% and 25% from both of them needed more mixing time and showed bad consistency as increasing the levels of fats has a softening effect on the consistency of the dough and reduce the effective cross-links in gluten as agreed with Jacob and Leelavathi (2007) & Yihu and Qing (2007).

The effect of adding fatty matters on bread volume :

Figure (1) indicates that the overall trend is improving the loaf volume by increasing fatty matter level up to 10% which is fully agreed by Hardeep and Napinder (1999) and Stauffer (1998). The positive effect of fats on bread volume can be explained by the ability of fats to change the permeability of dough to water vapour and carbon dioxide and delay protein denaturation and starch gelatinization as concluded by Elton and Fisher (1966). Moreover, the lipids form complexes with gluten and contribute to the stabilization of gas cell structure (Day L., 2008). All these effects appeared clearly in a considerable and extreme improvement in resistance to extension on extensograph by adding different fat types. Starting from 10% and clearly with 15% added fat, the volume decreased steadily by fat level raising (Figure 1) and this may be due to the unbalanced effect on resistance to extension and extensibility expressed by ratio and also can be indicated by energy value Tables (1-4). In other words, the excess of oils and fat tend to weaken the dough and increasing its plasticity as mentioned by Harper (1981) or decrease the dough strength and viscosity as found by Indrani and Rao (2006).

The variation between fatty matter concerning its effect on bread volume may be resulted in the percentage of fat content and how the fat easily mix and distributed to interact and support the gluten network and gas cell structure.

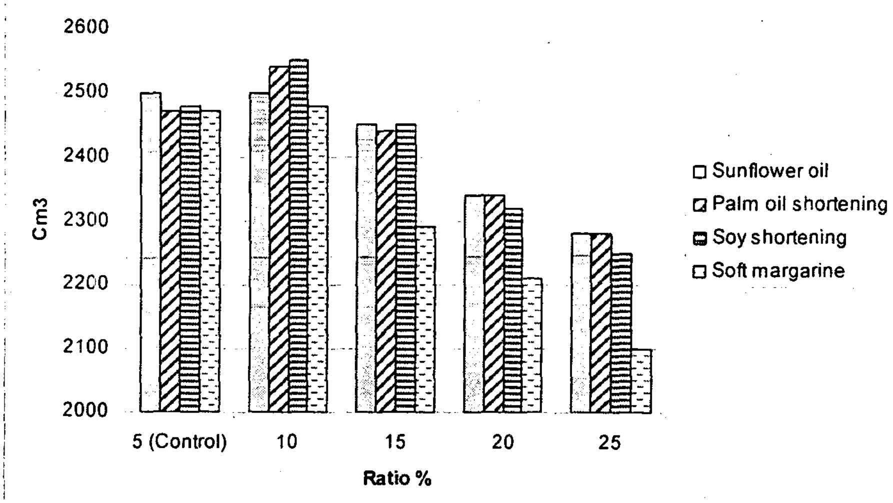

Figure (1): The Effect of different fatty matters and their adding ratios on bread volume

The Effect of adding different fatty matters on sensory characteristics of crunchy toast bread:-

The sensory characteristics of bakery products (Crunchy toast bread) are generally evaluated on a regular schedule as part of quality assurance program. The sensory properties of the produced crunchy toast were appreciably differed due to fat type and ratio which indicated by the values of total evaluation; particularly concerning volume, grains, odour and symmetry of form that agreed with Stauffer (1998). Whereas the rest of the properties affected not only by the fatty matter and its ratio but also by roasting heat treatment which are crispiness, hardness, taste and colour, as this group of properties depending on the first group of properties during the roasting especially the grains.

The grains, volume and symmetry of form were clearly affected by the increasing ratio of fats and oil especially more than 15%. Accordingly, as the grain is negatively affected by the higher level of fat to be more open (larger) and bad distributed, the hardness and crispiness score value became lower in all fat types. These findings coincide with those obtained by Sudha *et al.* (2007) who proved that the sensory quality is affected clearly by the fat reduction (ratio).

On the other hand, the effect of roasting temperature and time was not equal along the slice of the product due to the bad distribution of large grains that leads to bad colour and presence of burnt areas especially with the highest heat treatment (170° C), finally the resultant taste and odour values score declined.

Table (5) shows the average score for each sensory characteristic affected only by fat type. The best two types as a total evaluation were palm oil shortening and partially hydrogenated soy oil with no significant difference that obtained 86.79 and 87.33 with standard deviation of (± 3.15) and (± 3.46) respectively. Soft margarine was the third with total score of (85.21) and standard deviation of (± 3.7) while the worst fat type organoleptically was the sunflower oil that obtained 77.68 (± 3.63). Moreover, the individual organoleptic properties show both of hard soy and palm oil shortening record the best evaluation in crispiness, hardness, taste, odour and colour with no significant difference (5 out of 8) while hard soy records the best value in grains and symmetry of form with significant difference with all other fats.

Table (5): Statistical analysis of the effect of different fat types in the sensory characteristics of crunchy toast

Sensory characteristics	Max. Score	Fat type			
		Sunflower	Palm oil Shortening	Soy Shortening	Soft margarine
Crispiness	15	12.46 ± 0.33 c	13.57 ± 0.43 a	13.69 ± 0.46 a	13.58 ± 0.36 a
Hardness	15	12.00 ± 0.51 b	13.73 ± 0.29 a	13.41 ± 2.03 a	13.54 ± 0.22 a
Taste	15	11.42 ± 0.59 c	12.67 ± 0.51 a	12.75 ± 0.54 a	12.22 ± 0.62 b
Odour	15	8.98 ± 0.48 d	12.65 ± 0.66 a	12.84 ± 0.71 a	12.30 ± 0.79 b
Grains	10	8.14 ± 0.49 c	8.81 ± 1.12 b	9.08 ± 0.61 a	8.78 ± 0.63 b
Colour	15	12.07 ± 0.93 a	12.00 ± 1.56 a	12.03 ± 1.55a	11.94 ± 2.14 a
Volume	10	9.13 ± 0.54 bc	9.20 ± 0.40 b	9.13 ± 0.45 c	8.93 ± 0.55 d
Symmetry of form	5	3.48 ± 0.33 de	4.17 ± 0.26 b	4.41 ± 1.08 a	3.92 ± 0.29 c
Total	100	77.68 ± 3.63d	86.79 ± 3.15 a	87.33 ± 3.46 a	85.21 ± 3.70 b

*** Means with the same letter are not significantly different.**

Table (6) shows that the best fat ratio for improving the sensory properties as a total evaluation was 15% recording (83.44) with standard deviation of (± 5.1) with significant difference compared with other concentrations. The highest adding ratios (20 and 25% fat) showed the worst sensory scores. All these results are strongly correlated with the rheological results and with the findings of Elton and Fisher (1968) and Hardeep and Napinder (1999) .

On the other hand the heat treatment of 140° C/25 min.was found as the best condition for roasting process and significantly different from all other treatments concerning all related properties which are crispiness, hardness, taste, odour and colour, accordingly it attains the best total score (table 7).

Table (6): Statistical analysis of the effect of different concentration of fat types in the sensory characteristics of crunchy toast

Sensory characteristics	Max. Score	Concentration of fat				
		5.00% (Control)	10.00%	15.00%	20.00%	25.00%
Crispiness	15	12.65 ± 0.73 d	12.94 ± 0.67 c	13.24 ± 0.75 a	13.09 ± 0.76 b	12.94 ± 0.91 c
Hardness	15	13.19 ± 0.49 a	13.42 ± 0.49 a	13.63 ± 0.70 a	13.30 ± 0.86 a	12.60 ± 2.16 b
Taste	15	10.94 ± 1.42 d	11.38 ± 1.44 cb	11.67 ± 1.36 a	11.53 ± 1.48 ab	11.25 ± 1.61 c
Odour	15	11.04 ± 1.16 c	11.33 ± 1.16 cab	11.57 ± 1.41 a	11.59 ± 1.69 a	11.43 ± 1.91 a
Grains	10	8.92 ± 1.08 ab	9.00 ± 0.51 ab	8.64 ± 0.63 c	7.84 ± 0.36 e	7.62 ± 0.38 e
Colour	15	11.39 ± 1.31 b	11.68 ± 1.38 ab	11.96 ± 1.41 a	11.77 ± 1.43 ab	11.45 ± 2.11 b
Volume	10	9.57 ± 0.13 b	9.48 ± 0.23 c	9.02 ± 0.27 e	8.54 ± 0.27 g	8.20 ± 0.38 h
Symmetry of form	5	4.09 ± 0.35 a	3.96 ± 0.39 ab	3.72 ± 0.37 cb	3.50 ± 0.31 cd	3.36 ± 0.34 d
Total	100	81.80 ± 4.23 cd	83.19 ± 4.51 ab	83.44 ± 5.10 a	81.16 ± 5.56 d	78.84 ± 6.12 e

* Means with the same letter are not significantly different.

Table (7): Statistical analysis of the effect of different toasted temperatures in the sensory characteristics of crunchy toast

Sensory characteristics	Max. Score	Toasted temperature - °C		
		110/60 min	140/25 min	170/15 min
Crispiness	15	12.82 ± 0.63 b	13.36 ± 0.79 a	12.75 ± 0.73 b
Hardness	15	13.24 ± 0.72 a	13.36 ± 1.43 a	13.30 ± 0.63 a
Taste	15	11.35 ± 1.51 b	11.75 ± 1.46 a	10.97 ± 1.27 c
Odour	15	11.33 ± 1.31 b	11.89 ± 1.56 a	10.91 ± 1.17 c
Grains	10	8.48 ± 0.90 a	8.57 ± 0.73 a	8.57 ± 0.73 a
Colour	15	12.09 ± 1.03 b	12.89 ± 0.59 a	10.03 ± 0.85 c
Volume	10	9.07 ± 0.55 a	9.07 ± 0.55 a	9.06 ± 0.54 a
Symmetry of form	5	3.78 ± 0.42 a	3.76 ± 0.43 a	3.85 ± 0.85 a
Total	100	82.15 4.89 b	84.65 ± 4.93 a	79.45 ± 4.10 c

* Means with the same letter are not significantly different.

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تأثير المواد الدهنية على خواص العجين الريولوجية والصفات الحسية لمنتجات المخابز.

ممدوح محمد ربيع، ابو بكر محمد حسن، مسعد ابو ريه، احمد عزت و اسامة العدل*
قسم الصناعات الغذائية- كلية الزراعة – جامعة المنصورة ٢٠٠٩.
*** شركة المخابز الحديثة (ريتش بيك) – ٦ اكتوبر – مصر**

- التوست المقرمش هو احد انواع الخبز المحمص ذو المحتوى الدهنى العالى والذى ينتج باستخدام دقيق القمح القوى استخلاص ٧٢%.
- وقد تم استخدام زيت عباد الشمس وسمن زيت النخيل وسمن زيت الصويا المهدرج جزئيا والمارجرين اللين (السوفت) بنسب اضافة مختلفة (٥ % ، ١٠ % ، ١٥ % ، ٢٠ % ، ٢٥ %) من وزن الدقيق فى انتاج المنتج موضوع الدراسة.
- ومن دراسة الصفات الريولوجية للعجين على الفارينوجراف والاكستنسوجراف تبين ان نوع المادة الدهنية ونسبتها تؤثر بشكل كبير على كافة الصفات الريولوجية وبالتالى حجم الخبز الناتج وكذلك الصفات الحسية للمنتج النهائى.
- وقد اثبتت الدراسة انخفاضا كبيرا فى نسبة امتصاص الدقيق للماء وانخفاضا فى المرونة ودليل مقاومة الخلط بزيادة نسبة اضافة المادة الدهنية بينما لوحظت زيادة كبيرة فى قيم المقاومة للشد والثبات وزمن الوصول وزمن نضج العجين.
- سجلت نسب الاضافة ٥ % ، ١٠% مادة دهنية افضل قيم لحجم الخبز الناتج الذى تناقص تدريجيا بزيادة النسبة اكثر من ١٠% فى حين كانت نسبة الاضافة ١٥% هى الافضل من ناحية التقييم الحسى.
- ولم يكن نوع المادة الدهنية ونسبتها فقط هما المؤثران على الصفات الحسية للتوست المقرمش بل اثبتت الدراسة ان المعاملة الحرارية اثناء التحميص تؤثر بشكل واضح وكبير على الصفات الحسية لمنتجات المخابز المحمصة حيث حققت المعاملة الحرارية ١٤٠° م/٢٥ دقيقة افضل واعلى تقييم فى كافة الصفات الحسية مقارنة بالمعاملات ١١٠° م/٦٠ دقيقة ، ١٧٠° م/ ١٥ دقيقة.