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EFFECT OF PARTICLE SIZE OF CORN FLOUR ON THE QUALITY OF BALADY BREAD

AMAL A. EL-HOFY; SAMIHA M.M. ABDEL-SALAM AND ZEINAB H. DARWEESH

Food Technol. Res. Institute, Agric. Research Center, Egypt.

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Abstract

Corn flour was fractionated using 40, 50 and 60 mesh seives. Each fraction was separately blended with wheat flour (82 and 72% extraction rates) at levels of 10, 20 and 30%. The chemical composition of each blend was determined. The gas production of wheat-corn flour mixtures under investigation varied from 10 to 67 gas unit according to the corn flour granulation, time of fermentation and also the extraction rate of wheat flour. Meanwhile, the gas production of wheat flour ranged from 51-213 and 59-235 for the 82 and 72% extraction rates respectively. Falling number reached a maximum for wheat flour blended with 10% corn flour, then decreased gradually opposite to liquefaction number. Balady bread characteristics indicated significant differences in all parameters due to wheat flour extraction rate. Also blending of corn flour fractions (40, 50 and 60 M. seives) with wheat flour produced loaves significantly differed in their proporties.

Blends of corn flour fraction of 50 M sieve at the level of 20% with wheat flour was the most effective and favourable treatment resulted in improving balady bread characteristics. Staling of the produced balady bread was determined after 48h. storage period using alkaline water retention capacity (AWRC). The data revealed that AWRC decreased significantly with increasing corn flour fractions during storage period.

INTRODUCTION

Cereals contribute more than any other food groups as a source of energy and protein content. The bread consumed in Egypt is mainly prepared from wheat flour. In baking industry, corn flour has been used because of its flavor and its economical cost in dry mixes such as muffins, pancake composite flour and corn bread (Gurbachan, 1972). Miller *et al.*, (1967) observed that each baked product requires an optimum granulation of flour for its production. Starch damage usually increases as the size of endosperm particles is reduced. Good bread flour requires coarser granules. Bean *et al.*, (1969) reported that the dough and bread properties of the blends were significantly influenced by both the high protein fraction and base flour, that is, regrinding the parent flour reduced particle size and cookie diameters. Tipples (1969) reported that in general, an increase in damaged starch will result in an increase in flour water absorption but the level of damaged starch at certain level is desired. The percent of damaged starch is depending on the flour protein content, level of a amylase, and the type of baking process. Kim and D'Appolonia (1977) mentioned that the presence of different amounts of protein can isolate the starch granules to different degrees and in this way, the retrogradation of starch is reduced. Ramadan (1986) found that bread texture, colour and loaf volume were not affected by the addition of maize flour. Moreover, addition of maize for up to 10% produced an acceptable bread. He and Hoseney (1991) studied the difference in gas retention of dough prepared from corn, rice and rye flours compared to wheat flour. They found that during proofing the loss of carbon dioxide was the greatest in the corn flour dough. Larrsson (1993) mentioned that a small amount of damaged starch is beneficial as the enzymatic hydrolysis starts more quickly in the presence of damaged starch granules. If the amylase activity of the flour is very low (a very high falling number) extra malt can be added.

The aim of the present investigation is to study the effect of different parcticle size of corn flour blended with wheat flour on the acceptability of the produced loaves.

MATERIALS AND METHODS

Wheat flours (82% and 72% extraction rates) were obtained from Egyptian Mill Co., Giza. Corn grains (hybride double cross 10) was obtained from Field Crops Institute, A.R.C. Giza.

Sieve fractionation of corn meal:

Corn grains were milled using cyclon mill. The corn meal was sieved at 40,50 and 60 M sieves.

Chemical analysis

Wheat flour (82% and 72% extraction rates), corn meal, its sieve fractions and their blends with wheat flour at 10, 20 and 30% were analysed for moisture, ash, protein, oil and fiber according to the meathods outlined in the A.O.A.C. (1983). Total carbohydrates were calculated by difference.

Determination of gas production:

Gas production was determined using a 12 channel recording Gasograph according to the method described by Rubenthaler *et al.*, (1980).

Falling and liquefaction number:

Falling no. was determined according to the A.A.C.C. (1990). Liquefaction no. (L.N.) is calucated according to the following equation.

$$L.N. = \frac{6,000}{\text{Falling no-50}}$$

Bread making:

Corn flour (whole meal) and its sieving fractions at the levels of 10.20 and 30% were separately blended with wheat flour (82% or 72%). Each formula was mede into balady bread using the straight method described by El-Samahy and Cho (1982).

Organoleptic evaluation:

Balady bread loaves baked from wheat and corn flour formulas were organolepically evaluated for general appearance, separation of layers, texture, roundness, color, odor and taste by 10 experienced pannalists. The quality scores of the evaluated loaves were conducted as reported by El-Farra *et al.*, (1982).

Staling of balady bread loaves:

The staling of balady bread loaves were tested by alkaline water retention capacity (AWRC) according to the method described by Yamazaki (1953) and modified by Kitterman and Rubenthaler (1971).

Statistical analysis :

The results of sensory evaluation were statistically analysed according to the methods described by Snedecor and Cochran (1969).

RESULTS AND DISCUSSION

Chemical composition of wheat flour, corn flour and its sieving fractions:

Results in table 1 show the chemical composition of wheat flour (82 and 72% extraction rates), corn flour (whole meal) and its sieving fractions (40, 50 and 60 M). The obtained data revealed that wheat flour (82%), corn whole meal and its sieved fraction of 40 M contained almost the same protein content (10.72, 10.93 and

10.30% respectivley), while wheat flour (72%) and sieved corn flour (50 M) had protein content of 9.83 and 9.77%, respectively. The lowest protein content was found for the 60 M Sieving fraction (8.54%). Ash content showed the highest value for corn flour (whole meal) being 1.62% and gradually decreased as a result of sieving to 1.53, 1.42 and 1.21 for 40, 50 and 60 M, respectively. Meanwhile wheat flour 72% recorded the lowest ash content being 0.62%, while 82% showed 0.92%. Crude oil content showed that whole corn meal flour contained the highest value (4.51%) followed by the sieving fractions being 3.61, 2.52 and 1.61% for 40.50 and 60 M., respectively. Wheat flour showed the lowest crude oil content (0.95 and 0.85%). Similar trend was observed concerning crude fiber content as that of oil and ash. Results show that corn meal contained 2.01% of fiber, while the lowest value was found for wheat flour (0.5 and 0.6%). The calculated total carbohyrates showed that wheat flour, 72% extraction; contained the highest total carohydrate (88.82%) followed by 60 M corn flour sieve fraction (87.42%), wheat flour 82% (86.10%). The lowest carbohydrate content was recorded for corn flour (whole meal) being 80.93%.

From the above mentioned data, it could be concluded that sieving play an important role in the chemical composition of the produced corn flour fractions.

The obtained results agree with those reported by Hayashi *et al.*, (1976).

Chemical composition of wheat flour, blended with different sieving fraction of corn flour:

Resullt in table 2 show that the protein content ranged from 10.07 to 10.78% and 9.40 to 10.16% for the blends contained wheat flour 82% and 72% extraction rates, respectively. However total carbohydrates show an opposite trend of protein and ranged from 85.05 to 87.0% and 86.03 to 88.12% for the above mentioned blends, respectively. Ash, oil and fiber contents showed slight increase in blends contained wheat flour 82% extraction compared to the 72% which was in parallel with the protein content. This may be attributed to that wheat flour 82% extraction contained some particles of germ and bran, which are high in oil and ash.

Gas production of wheat flour, dough blended with different sieving fraction of corn flour:

Results in table 3 show that gas production increased rapidly for the control from 51 to 213 for the 82% and from 59 to 235 GU for the 72% at 30 and 120 min of fermentation time. Addition of corn flour showed a large reduction in gas produc-

Table 1. Chemical composition of wheat flour and corn flour sieving fractions.

Sample	Protein %	Ash %	Oil %	Fiber %	T.C. %*
Wheat flour 82%	10.72	0.92	0.95	0.60	86.10
Wheat flour 72%	9.83	0.62	0.85	0.50	88.82
Corn flour (whole meal)	10.93	1.62	4.51	2.01	80.93
40 M sieve fraction	10.30	1.53	3.61	1.73	82.35
50 M sieve fraction	9.77	1.42	2.52	1.41	84.88
60 M sieve fraction	8.54	1.21	1.61	1.22	87.42

* T.C. means total carbohydrates.

Table 2. Chemical composition of wheat flour blended with different sieving fractions of corn flour .

Wheat flour / Maize flour %	Protein		Ash		Oil		Fiber		T.C *	
	82 %	72 %	82 %	72 %	82 %	72 %	82 %	72 %	82 %	72 %
Whole meal										
10	10.74	9.94	1.0	0.72	1.31	1.22	0.74	0.65	86.21	87.47
20	10.76	10.05	1.05	0.82	1.66	1.58	0.88	0.80	85.65	86.75
30	10.78	10.16	1.13	0.92	2.02	1.95	1.02	0.94	85.05	86.03
40 M sieving fraction										
10	1068	9.88	0.98	0.71	1.22	1.13	0.71	0.62	86.41	82.66
20	10.64	9.92	1.04	0.80	1.48	1.40	0.83	0.75	86.0	87.13
30	10.60	99.97	1.10	0.90	1.75	1.68	0.94	0.87	85.62	86.58
50 M sieving fraction										
10	10.63	9.82	0.97	0.70	1.11	1.02	0.68	0.60	86.61	87.86
20	10.53	9.81	1.02	0.78	1.26	1.18	0.76	0.68	86.43	87.59
30	10.44	9.81	1.07	0.86	1.42	1.35	0.84	0.77	86.23	87.21
60 M sieving fraction										
10	10.50	6.70	0.95	0.68	1.02	0.93	0.66	0.57	86.63	88.21
20	10.28	99.57	0.98	0.74	1.08	1.00	0.72	0.64	86.94	88.05
30	10.07	9.40	1.00	0.88	1.15	1.08	0.78	0.72	87.00	87.95

* T.C. means total carbohydrates.

Table 3. Gas production of wheat flour doughs blended with different sieving fractions of corn flour after 30 , 60 , 90, and 120 min.

Corn flour %		Fermentation time min.							
		Wheat flour 82 % extraction				Wheat flour 72 % extraction			
		30	60	90	120	30	60	90	120
Whole meal	10	15	22	32	49	22	33	34	44
	20	12	18	32	37	20	27	32	43
	30	10	17	28	32	17	25	24	43
40 M sieving	10	17	25	46	55	26	33	48	56
	20	15	20	43	54	24	33	44	53
	30	12	20	42	53	24	30	42	51
50 M sieving	10	18	25	47	58	26	37	51	60
	20	17	23	45	55	26	33	50	55
	30	13	23	45	50	25	33	46	51
60 M sieving	10	20	28	50	61	29	37	56	67
	20	19	24	47	57	24	32	53	66
	30	17	24	43	55	21	32	49	62
Control *		51	94	137	213	59	106	146	235

* Wheat flour dough.

tions. The data revealed that the corn flour particle size also affected the gas production. For example after 120 min. of fermentation the gas production was found in the range of 49-61 gas unit (GU.) when 10% of the corn flour and its sieving fraction were added and decreased to 32-55 GU upon the addition of 30%, when wheat flour 82% extraction rate was used. A slight increase was found in gas production when wheat flour of 72% extraction was used. This means that the addition of corn flour caused a loss in gas production. In this respect, He and Hoseney (1991) studied the difference in gas retention between dough made from corn, rice and rye flours compared to wheat flour. They found that during proofing, the loss of carbon dioxide was the greatest in the corn dough.

Falling number of dough blends:

Falling number is considered an important index for amylase activity in wheat flour dough. The effect of blending wheat flour dough with different sieving fractions of corn flour on the falling number are presented in table 4. The data indicate that the addition of corn flour (whole meal) and sieving fraction of 40 M at all levels reduced falling number slightly compared to the 82 % wheat flour dough while the other sieving fraction showed similar effect (except 50 M 30% addition) or slightly increased than the control.

Meanwhile, when whole meal of corn flour was blended with wheat flour (72%), a slight decrease was found in falling no. compared to the control. On the contrary all other sieving fractions of corn flour resulted in higher falling no. than that of control. The data revealed also that the falling no. of blends containing wheat flour 72% increased by about 1.26 to 1.8 fold for that containing the 82% wheat flour . It could also be mentioned that falling no. of wheat flour dough of 72% extraction is higher than that of 82% by about 1.25 times. This means that the particle size of the starch play an important role in the falling no. which reflect the amylase activity. It is reported that a relation between falling no. and liquefaction no exists where the later is proportional to α amylase activity and falling no. and maximum viscosity where

$$\text{Liquefaction no. (L.N.)} = \frac{\text{Falling no. -50}}{6000}$$

The liquefaction no. increases in parallel to the α amylase activity and decrease in the maximum viscosity, (Perten, 1964).

Concerning the effect of flour extraction on bread characteristics, data indicate

Table 4. Falling number and liquefaction number of wheat flour doughs blended with different sieving fractions of corn flour.

Corn flour %	Wheat flour 82 % extraction		Wheat flour 72 % extraction	
	Falling No.	Liquefaction No.	Falling No.	Liquefaction No.
Whole meal				
10	255	34.29	285	25.53
20	222	34.88	282	25.86
30	220	35.29	280	26.10
40 M sieving				
10	228	33.71	382	17.91
20	220	35.30	352	19.87
30	178	46.88	329	21.51
50 M sieving				
10	231	33.15	385	18.07
20	231	33.15	370	18.75
30	202	39.47	346	20.27
60 M sieving				
10	248	30.3	406	16.85
20	243	31.1	381	18.13
30	242	31.25	340	20.70
Control *	230	33.33	287	25.32

* Wheat flour dough.

significant differences in all characters of Balady bread (Table 5). The72% wheat flour extraction is exhibiting the highest values of all characters, except bread odor which produced in bread made from the 82% wheat flour extraction. Total bread scores had similar trend. Wheat flour of 72% extraction gave the highest total scores. These results might be due to the higher protein quality and the reduction of fiber in the 72% compared to the 82% extraction flour

Addition of corn flour at different sieving fractions i.e. 40, 50 and 60 M. to Balady bread formula gave loaves with significant differences in their characters and total scores (Table 6). All character scores were decreased with increasing the particle sizes of corn flour (from 50 to 40 Mesh). These results may be due to the largest granules sizes which led to unsuitable mixing of the dough and decreased bread quality. Characters and total scores of bread made of parent (wheat only) flour lay in between.

Balady bread obtained from formula contained corn flour of 60 M had the lowest total scores. These results indicated that adding corn flour (50 Mesh) to wheat flour improved bread characters and its quality.

Data in Table 7 show that the various studied characters of Balady bread (i.e. appearance, separation of layers, texture, roundness, crust colour, odor and taste) responded to the addition of corn flour to bread formula. Bread score characteristics increased gradually with the increase in corn flour addition till 20%, after that characters of bread loaves decreased by adding 30% of corn flour, thus adding corn flour up to 20% gave Balady bread with superior characters as compared to the 30% corn flour addition level or the control treatments.

Data in Table 8 indicate that Balady bread character scores were highest under 10% and 20% corn flour addition, 40 mesh corn flour sieving rate treatment, which was added to wheat flour of 72% extraction. However the highest score of odor was obtained in loaves made of corn flour as fine particles (sieving at 50 and 60 mesh).

From the previously mentioned results, it could be suggested that addition of 20% corn flour with medium particles (sieving at 50 mesh) being the most effective and favourable treatment in improving Balady bread characters compared to the other treatment, this may led to saving large quantities of wheat flour, which is demanded to decrease the gap in wheat flour requirement in our country.

Staling of Balady bread prepared from 82% and 72% wheat flour blended with maize flour with different sieving rates was measured by the determination of alkaline

Table 5. Effect of wheat flour extraction on Balady bread characteristics (mean scores ± SD).

	Appearance (20)	Separation of layers (20)	Texture (15)	Roundness (15)	Colour (10)	Odor (10)	Taste (10)	Total scores (100)
Extraction 82	17.33	18.13	13.42	14.13	8.42	8.63	8.46	88.50
	±0.87	±0.82	±0.51	±0.43	±0.66	±1.02	±0.66	±3.16
Extraction 72	18.42	18.65	14.06	14.50	8.96	8.60	9.04	92.23
	±0.93	±0.97	±0.56	±0.52	±0.54	±1.10	±0.65	±1.55
L.S.D at 5 %	0.34	0.27	0.29	0.30	0.26	n.s	0.29	0.67

Table 6. Effect of corn flour sieving fractions on Balady bread characteristics (mean scores ± SD).

Parent	18.17	18.58	13.96	14.58	8.50	9.0	8.75	91.54
	±1.21	±0.88	±0.62	±0.57	±1.22	±0.80	±0.53	±1.14
Sieving (M) 40	17.83	18.25	13.63	14.38	8.17	9.21	8.50	89.96
	±0.86	±0.94	±0.58	±1.32	±0.88	±1.21	±0.58	±2.45
50	18.63	19.08	14.29	14.50	9.04	8.50	9.29	93.33
	±0.97	±0.91	±0.66	±0.84	±1.16	±0.88	±0.86	±1.04
60	16.88	17.63	13.08	13.79	9.04	7.75	8.46	86.63
	±0.88	±0.86	±0.67	±0.65	±1.10	±0.68	±0.67	±3.25
L.S.D at 5 %	0.41	0.36	0.48	0.32	0.30	0.47	0.51	1.67

Table 7. Effect of, %, corn flour addition on Balady bread characteristics (mean scores ± SD).

Replacement of maize flour (%)	control	17.50	19.08	14.13	14.42	8.46	8.79	9.25	91.63
		0.70	0.67	0.43	0.96	0.81	1.60	0.87	1.16
	10	18.54	19.38	14.38	14.79	9.25	9.46	9.38	95.17
		0.69	0.91	0.51	0.63	0.63	0.91	1.21	0.89
	20	19.38	19.63	14.63	14.88	9.71	9.42	9.17	96.79
		0.78	0.87	0.49	0.71	0.74	1.21	0.98	0.77
	30	16.08	15.46	11.83	13.17	7.33	6.79	7.21	77.88
		0.88	0.77	0.58	0.77	0.91	1.11	1.36	4.17
L.S.D at 5 %		0.49	0.39	0.41	0.42	0.36	0.43	0.41	1.07

Table 8. Effect of interaction (sieving X addition of flour on the characters of Balady bread of wheat flour 82% and 72% extraction (mean scores ± SD)

Sieving (M)	Maize Flour	Appearance (20)		Separation layer (20)		Texture (15)		Roundness (15)		Colour (10)		Odor (10)		Taste (10)		Total score (100)	
	addition %	Ex 82%	Ex 72%	Ex 82%	Ex 72%	Ex 82%	Ex 72%	Ex 82%	Ex 72%	Ex 82%	Ex 72%	Ex 82%	Ex 72%	Ex 82%	Ex 72%	Ex 82%	Ex 72%
Whole meal	Control	17.00±1.44	18.33±1.11	18.67±0.88	19.33±0.71	13.67±1.16	14.33±1.06	14.67±0.44	15.00±0.00	8.33±1.43	8.67±1.11	9.00±0.22	10.00±0.00	9.00±0.33	9.67±0.12	90.33±3.17	95.33±2.15
	10	18.33±1.50	19.33±1.17	19.67±0.91	19.67±1.03	14.33±1.05	15.00±0.00	15.00±0.00	15.00±0.00	8.67±1.32	9.00±0.92	9.67±0.11	10.00±0.00	9.00±0.33	9.67±0.12	94.67±2.06	97.33±1.12
	20	19.00±0.87	20.00±0.00	19.67±0.78	16.67±1.06	14.67±1.27	15.00±0.00	15.00±0.00	15.00±0.00	9.67±0.45	9.33±0.73	9.67±0.11	9.00±0.23	8.67±0.42	9.00±0.32	96.33±1.88	97.00±1.23
	30	16.00±0.98	17.33±1.20	15.33±0.93	16.67±0.92	11.67±0.92	13.00±0.92	13.33±0.96	13.67±1.11	6.67±1.14	7.67±0.98	7.00±0.23	7.00±0.41	7.00±0.68	8.00±0.71	77.67±2.52	83.33±4.71
40	Control	16.67±0.88	18.00±1.12	18.67±0.79	19.33±0.63	13.67±0.55	14.33±1.10	14.00±1.50	14.33±1.67	7.33±0.66	7.67±0.81	9.00±0.27	9.67±0.18	9.00±0.31	9.67±0.11	88.33±4.02	93.00±3.17
	10	18.00±1.20	19.00±0.97	19.33±0.80	19.33±0.72	14.00±0.73	14.67±0.81	14.67±1.14	14.67±0.88	8.00±1.15	8.67±0.93	9.67±0.12	10.00±0.00	8.33±0.97	9.67±0.10	92.33±2.15	96.00±1.42
	20	19.00±1.11	19.67±0.98	19.33±1.02	19.67±0.81	14.33±1.41	14.33±1.13	14.67±0.98	15.00±0.00	9.33±0.41	9.67±0.33	10.00±0.0	10.00±0.0	8.33±0.48	8.67±0.45	95.00±1.21	97.00±1.05
	30	15.67±1.07	16.67±1.22	14.67±1.07	15.67±0.65	11.33±1.11	12.33±1.22	13.67±1.15	14.00±1.17	6.33±2.15	8.33±1.08	8.00±1.11	7.33±1.08	6.67±1.27	7.33±1.08	76.33±4.66	81.67±4.22
50	Control	17.33±1.17	19.00±1.27	19.33±0.87	19.33±0.81	14.33±0.97	15.00±0.00	14.67±1.17	14.67±1.41	8.00±1.21	9.00±0.96	8.33±0.56	9.00±0.37	9.33±0.22	9.67±0.13	91.33±2.03	95.67±1.07
	10	19.00±1.18	19.67±1.14	19.67±0.78	20.00±0.00	14.67±1.13	15.00±0.00	15.00±0.00	15.00±0.32	9.67±0.32	10.00±0.00	9.33±0.23	9.67±0.17	9.67±0.12	10.00±0.0	97.00±0.98	99.33±0.06
	20	19.33±0.98	20.00±0.00	19.67±0.93	20.00±0.00	15.00±0.00	15.00±0.00	15.00±0.00	15.00±0.00	9.67±0.32	10.00±0.00	9.67±0.10	9.00±0.31	10.00±0.00	10.00±0.0	48.33±0.63	99.00±0.14
	30	16.67±0.97	18.00±2.16	16.67±0.84	18.00±0.72	12.00±0.48	13.33±0.41	12.67±2.40	14.00±3.10	7.33±1.27	8.67±1.13	6.67±1.13	6.33±0.98	7.33±1.14	8.33±0.99	79.33±2.13	86.67±1.19
60	Control	16.33±0.77	17.33±1.02	18.67±0.77	19.33±0.87	13.67±1.19	14.00±0.76	14.67±1.37	14.33±1.11	9.33±0.66	9.33±0.66	7.67±1.41	7.67±1.52	8.67±0.63	9.00±0.36	88.00±2.75	91.00±1.17
	10	17.00±0.91	18.00±0.99	18.67±0.68	18.67±0.00	13.67±1.07	13.67±0.50	14.33±1.15	14.67±1.27	10.00±0.00	10.00±0.00	8.33±0.91	9.00±0.63	9.00±0.34	9.33±0.22	91.00±1.25	93.00±1.04
	20	18.67±1.04	18.00±0.87	19.33±0.72	19.67±0.65	14.00±1.11	14 67±0.43	14.33±1.12	15.00±0.00	10.00±0.00	10.00±0.00	9.33±0.43	8.67±0.72	9.00±0.35	9.67±0.13	94.67±0.97	97.00±1.2
	30	13.33±1.18	15.00±1.03	12.67±0.91	14.00±0.76	9.67±1.13	11.33±0.63	11.33±2.20	12.67±2.20	6.33±1.98	7.33±1.44	6.00±1.25	5.33±2.01	6.00±2.5	7.00±1.75	65.33±4.77	72.67±3.92
L.S.D. at 5%		1.32		1.05		1.11		N.S		1.00		1.14		1.08		2.93	

water retention capacity.

From the data in Table 9, it could be observed that alkaline water retention capacity of bread significantly decreased with storage time and these decreases varied from one treatment to the other. The loss was relatively low in the crumb of bread made of the 82% compared to the 72% wheat flour extraction, with non-maize flour additions. Thus water retention capacity significantly decreased with increasing storage period or /and the addition of maize flour fractions, and increased with higher protein contents and with coarse than fine fraction. By storage of fresh bread 48 hrs. hydration capacity decreased in all treatments. Generally it can be concluded that the loss in hydration capacity of bread during storage corresponded to the progress of staling in bread. This drop in hydration capacity could be attributed to changes in starch molecules which caused their degradation.

From the same data, it could be observed that the loss in crumb moisture was relatively low in crumb of bread made of wheat flour blended with high damaged starch (fine fraction) which may be due to the formation of more dextrine and sugars, which have a relatively high water holding capacity.

Pomeranz (1971) indicated that increasing the protein content of the bread decreased the average crumb firmness.

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تأثير حجم حبيبات دقيق الذرة الشامية على جودة الخبز البلدى

آمال عبد الله الحوفى ، سميحه محمد محمد عبد السلام،
زينب حسن درويش

معهد بحوث تكنولوجيا الأغذية - مركز البحوث الزراعية - الجيزة - ج.م.ع

تم فصل دقيق الذرة الى اجزاء باستخدام المناخل ٤٠ ، ٥٠ ، ٦٠ M. تم خلط كل جزء بمفرده بدقيق القمح استخلاص ٧٢٪ ، ٨٢٪ بمستويات ١٠ ، ٢٠، ٣٠ ٪.

تم تقدير التركيب الكيماوى ومعدل انتاج الغاز لكل خلطه . ووجد أن معدل انتاج الغاز يترواح بين ١٠ - ٦٧ وحدة غاز ويرجع هذا الى اختلاف حبيبات دقيق الذرة ووقت التخمير ومعدل استخلاص دقيق القمح.

أما عينات المقارنة (دقيق القمح) بدون إضافة دقيق الذرة وجد أن انتاج الغاز بها يتراوح بين ٥٠ - ٢١٢ وحدة غاز ٥٩ - ٢٣٥ وحدة غاز لاستخلاص ٨٢٪ ، ٧٢٪ على التوالى .

رقم السقوط وصل الى أقصى معدلاته مع نسبة ١٠٪ دقيق ذرة ثم قل بعد ذلك تدريجيا عكس رقم السيولة.

تشير خصائص الخبز الى وجود اختلافات معنوية فى كل الصفات ويرجع ذلك الى درجة استخلاص دقيق القمح وحجم حبيبات دقيق الذرة (٤٠ ، ٥٠ ، ٦٠ M) ونسب الخلط.

وكانت افضل الصفات الحسية للخبز البلدى عند خلط دقيق الذرة ٥٠ M بنسبة ٢٠٪ مع دقيق القمح .

كذلك وجد انه بتقدير التجلد حتى ٤٨ ساعة تخزين (بإستخدام طريقة A.W.R.C.) أنها تقل بزيادة اضافة دقيق الذرة اثناء فترة التخزين .