THE BAKING QUALITY OF SOME WHEAT FLOUR MIXTURES

By

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There is a great interest in the nutritive value of bread as it provides 20 to 30 per cent of the total energy and about 20 per cent of the protein intake. These figures vary in different countries according to the average consumption per capita of the population [4]. In A. R. E., bread makes up to 72 per cent of the total calories and 70 per cent of the total protein intake [7].

Experience as well as many studies have indicated that flour for bread making should be of high protein content, high water absorption, longer mixing time with high mixing tolerance, large extensogram area and farinogram readings. Furthermore, dough should have considerable high gas retention capacity and appreciable resistance to extention [5, 6 and 8].

In Egypt, the annual production of wheat amounts to ten million ardabs [3]. This amount is not enough for the local consumption. The amount of the imported grain wheat and wheat flour averaged two million tons per year in the last decade.

The suitability of wheat flour for bread making is attributed to its best physical and chemical properties. In Egypt, bread marketed in cities is, in general, made from wheat flour. However in villages where about 80% of the bread is consumed, home-baked bread is always made from wheat mixed with various cereals or other seeds such as fenugreek (Trigonella foenum G.).

This investigation was designed to evaluate the baking quality of some wheat flour mixtures, in order to reduce the amount of wheat and wheat flour imported.

Materials and methods

Wheat variety Giza 155 was used in this study. Other seeds included in the mixtures were maize (double hybrid Giza 186), sorghum (Giza 144), and fenugreek (Giza 2).

* Details of a research work done at the department of Biochemistry and Food Technology, Technical University, Budapest

Samples were cleaned in a laboratory cleaning unit followed by sieving and manually recleaning. Grains were conditoned to 14 per cent moisture content before milling, by a micro Brabender laboratory mill into straight flour. Samples of flour obtained were of 82% extraction.

Flour mixtures tested were as follows:

No.	Flour mixture %			
	Wheat	Maize	Sorghum	Fenugreek
1.	100	—	—	—
2.	80	10	10	—
3.	60	20	20	—
4.	40	30	30	—
5.	80	15	—	5
6.	70	25	—	5
7.	60	35	—	5
8.	50	45	—	5
9.	80	—	15	5
10.	70	—	25	5
11.	60	—	35	5
12.	50	—	45	5

Different flour mixtures were analyzed for their moisture, ash, and protein content according to the methods of the A. O. A. C. [2]. Wet and dry gluten content were determined using the methods by KENT-JONES and AMOS [6]. Gluten strength was measured by the "sedimentation test" as outlined by PINCKNEY et. al. [9].

The Brabender Farinograph and Extensograph were used to evaluate the physical characteristics of the dough. Tests were run according to the standard methods outlined in the Cereal Laboratory Methods (A. A. C. C.) [1].

Baking test was done by the straight dough method. Dough was prepared with 1,5% yeast and 1,5% table salt. The quantity of mixing waters was taken to suit the farinograph absorption figures. Fermentation time was one hour. 830 gr of dough was baked at 240 °C for 20 minutes in a tin plate iron form of $20 \times 10{,}5 \times 8$ cm.

This technique was used to facilitate the accurate measurement of loaf volume using small seeds. The chemical, physical and baking tests were made on three samples each.

Results

Table 1 represents the moisture, ash, raw protein, wet and dry gluten content and sedimentation values of wheat flour and the tested mixtures.

Mixing wheat flour with either maize or sorghum appeared to significantly increase the ash content of the mixture.

Protein content of wheat flour averaged 12,16%. Adding maize (9,21 protein) or sorghum (8,27% protein) to wheat significantly reduced the protein content of the mixture. On the other hand, when the mixture contained fenugreek flour (32.60% protein), the protein content increased almost to the level of the neat wheat. As an exception if maize constitutes more than 25% of the mixture, protein content was kept at lower values.

Table 1

Chemical and physical properties of wheat flour and different mixtures

Mixtures	Moisture, %	Properties				
		Ash, D. W. B.*	Protein, % D. W. B.*	Wet gluten, %	Dry gluten, %	Sediment value
1	9.11	1.14	12.16	36.00	14.00	20.9
2	8.98	1.42	10.70	32.00	11.20	16.1
3	9.82	1.41	10.30	22.80	9.60	14.3
4	9.09	1.45	10.01	3.00	1.32	14.1
5	9.87	1.64	11.80	23.20	7.00	17.9
6	8.62	1.53	11.70	7.20	3.24	15.1
7	9.08	1.38	10.60	2.80	1.32	15.1
8	9.34	1.27	10.03	2.00	1.10	13.2
9	7.50	1.35	12.70	18.40	5.60	16.7
10	7.16	1.41	12.20	10.40	4.40	16.6
11	6.17	1.48	12.15	3.04	1.24	14.6
12	8.15	1.58	12.09	1.60	0.72	12.6
Maize	9.09	1.44	9.21	—	—	—
Sorghum	10.90	1.70	8.27	—	—	—
Fenugreek	7.60	4.33	32.60	—	—	—
L. S. D. 05	0.63	0.09	1.23	0.53	0.36	0.34

* D. W. B.: Dry weight basis

The data also indicated that mixing maize or sorghum to wheat flour significantly reduced both wet and dry gluten content.

The sedimentation value significantly decreased when maize or sorghum was added in mixtures 2, 3 and 4. Fenugreek flour raised this value when it was included in the mixture (mixtures 5 to 12).

Table 2 and Figs 1 and 2 represent the physical properties of the different flour mixtures tested by the Farinograph and Extensograph.

Adding maize and sorghum flour to the mixture evidently reduced the water absorption capacity much below the average of wheat flour (63.7%). This was more pronunced when maize and sorghum flour were added in equal amounts up to 60% of the mixture (mixtures 2, 3 and 4). When fenugreek flour was included water absorption capacity of the flour was improved, except in cases where sorghum constituted 35% or more of the mixture (Table 2).

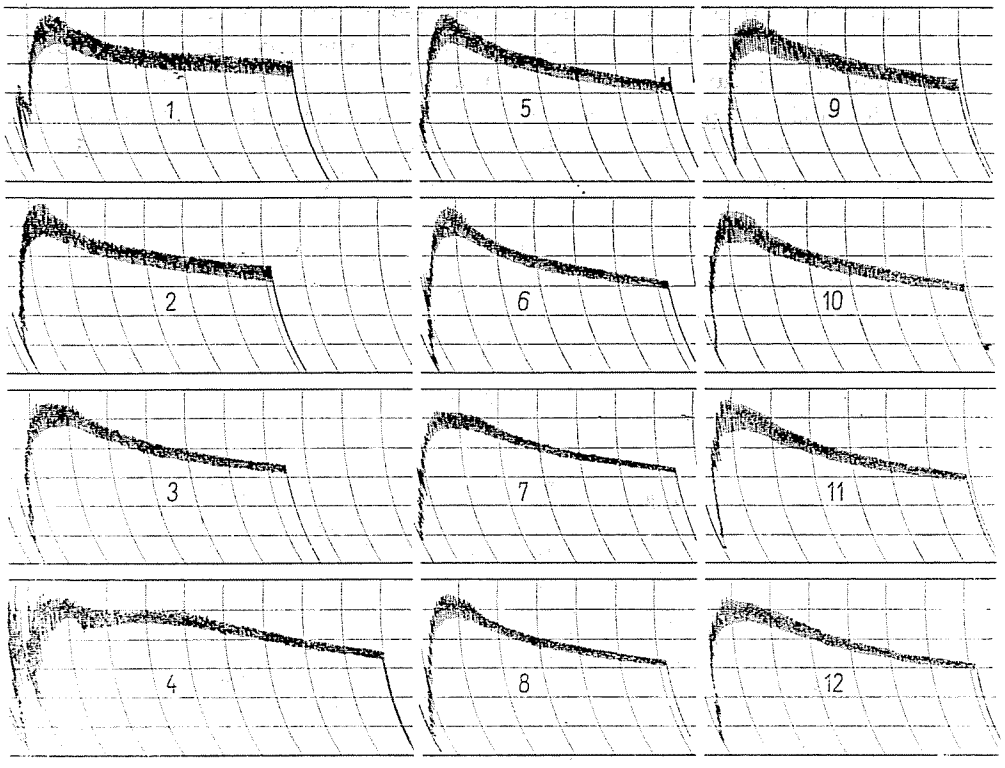

Fig. 1. Farinograms

The data indicated no significant differences between the mixing times of doughs of different mixtures. In general, Table 2 and Figure 1 reveal a a significant decrease in the dough stability with the increase in the amount of maize and sorghum added. In certain mixtures fenugreek slightly improved dough stability when it was included in the mixture.

Dough weakening was significantly increased with the increase in the amount of maize and sorghum flour in the mixture. Fenugreek flour did not seem to have a role in this respect (Table 2 and Fig. 1).

It was also evident that valorimeter number of the dough decreased by adding maize and sorghum flour.

Table 2 and Fig 2 score the relative energy resistances and extensibilities in comparison to the different mixtures. Maize and sorghum significantly decreased dough resistance to extension. Fenugreek flour did not seem affect the mixture when added to maize. On the other hand, the 80:15:5 mixture of wheat, sorghum, and fenugreek scored higher energy resistances whereas the increase of sorghum flour in the mixture reduced both values.

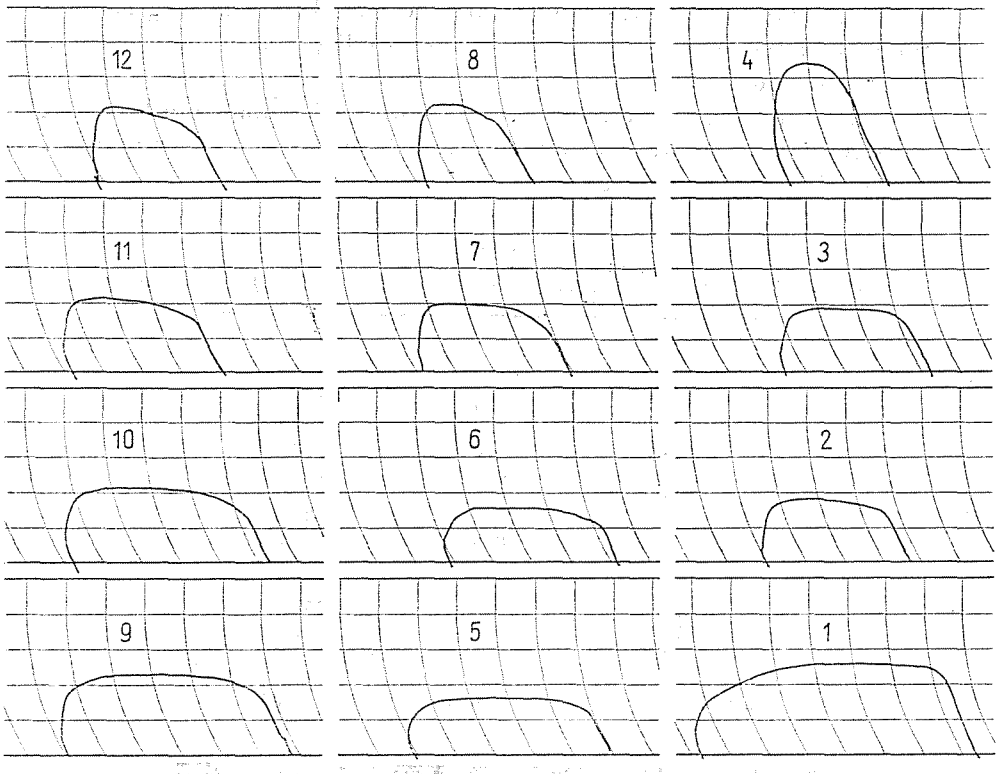

Fig. 2. Extensograms

Table 2

Farinograph and Extensograph results of flour extracted from wheat and other mixtures

Samples	Farinogram values					Extensogram values	
	Water absorption, cm^3	Mixing time, min	Stability, min	Weakening B. U.	Valorimeter	Resistance to extension B. U.	Extensibility, mm
1	63.7	1.75	3.75	110	55	240	144
2	63.2	1.50	3.00	160	46	180	75
3	60.8	1.50	3.50	170	48	190	78
4	56.6	3.00	2.50	150	48	180	53
5	65.5	2.00	2.75	180	48	160	100
6	65.0	2.00	2.50	190	43	160	87
7	65.5	2.25	3.25	170	51	190	73
8	64.7	2.00	2.75	180	45	160	65
9	63.5	1.50	2.50	170	36	230	107
10	62.3	1.50	2.75	200	421	210	95
11	60.6	1.50	3.00	200	43	190	75
12	60.4	1.50	3.50	190	49	180	63
L. S. D. 05.	4.0	1.69	0.32	12	4	48	12

Dough extensibility was significantly decreased by admixing maize and sorghum flour too. Fenugreek increased extensibility if also more maize and sorghum were added.

Table 3 and Fig 3, reveal decrease in both loaf volume and loaf weight when sorghum or maize was added to mixtures 3 and 4. Adding fenugreek improved baking characteristics (mixtures 5 to 12).

Table 3

Physical characteristics of bread made from wheat flour and different mixtures

Mixtures	Volume .cc.	Weight, g
1	2263	722.5
2	2168	730.0
3	2131	700.0
4	1873	712.5
5	1966	752.5
6	1913	735.0
7	1886	720.0
8	1883	740.0
9	2123	752.5
10	1951	755.0
11	1846	742.5
12	1841	740.0
L. S. D. 05.	10.85	16.03

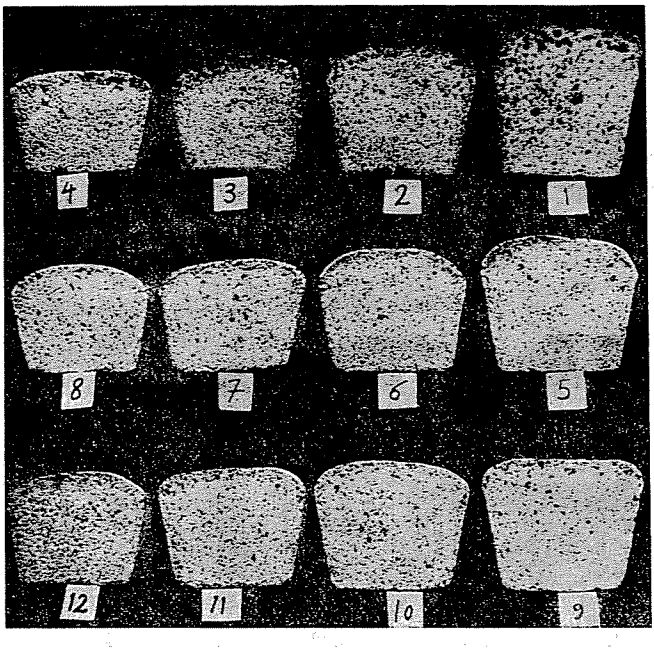

Fig. 3

Discussion

Addition of maize or sorghum flour to wheat mixtures reduced the protein content. This result was expected and needs no further explanation. From technological point of wiew the decrease of gluten content is more important. It seems that in the presence of other proteins the formation of gluten network is partly inhibited. Probably the lower possibility of interactions between the gluten and other proteins has the main role in this effect.

Farinograph and Extensograph tests showed that maize and sorghum reduced dough water absorption and the tested rheological properties of dough changed in an infavourable direction. The presence of fenugreek in the mixture had an improving effect, which fact is very interesting from both theoretical and practical points of view.

Thus, it can be concluded that maize or sorghum could be added to wheat in bread manufacturing in a proportion over 20% provided that fenugreek added to improve dough chemical and physical properties.

Summary

This investigation concerned the effect of the addition of maize, sorghum and fenugreek flours to wheat flour on the physical and chemical properties and baking quality of the dough.

The mixtures were analyzed for moisture, ash, protein, wet and dry gluten. The Brabender Farinograph and Extensograph apparatus were used for measuring the physical properties of the dough.

The data obtained showed that adding maize or sorghum flour to the mixtures reduced the protein content. In some of the mixtures containing fenugreek flour, the protein content almost equalled that of wheat. Other chemical and physical properties tested were in no contradiction with this conclusion.

The Farinograph and Extensograph tests showed the physical properties of the dough mixture to improve upon adding fenugreek flour.

Loaf weight as well as loaf volume increased when fenugreek was included in the mixture.

References

1. American Association of Cereal Chemists (1962). Cereal Laboratory Methods (A. A. C. C.), St. Paul, Minnesota, USA
2. Association of Official Agriculture Chemists, (1960). Official methods of analysis of the Association of Official Agriculture Chemists (A. O. A. C.). 9th Ed. Washington, USA
3. Central Agency for Public Mobilization and Statistics (1968). Selected General Statistical Data of U. A. R.
4. FANCE, W. J.: The Student's Technology of Bread Making and Flour Confectionery. Routledge and Kegan Paul London. (1960)
5. JOHNSON, J. A.—SCHELLENBERGER, J. A. and SWANSON, C. O.: Farinograms and mixograms as evaluating flour for specific purposes. Cereal Chem. *23*, 388, (1946)
6. KENT-JONES, D. W. and AMOS, A. J.: Modern Cereal Chemistry. The Northern Publishing Co. Ltd. Liverpool. England. (1957)

7. Ministry of Agriculture (1956). Food balance sheets.
8. PELSHENKE, P. F.: Quality considerations as to Durum Wheat. Milling, 6. (1957)
9. PINCKNEY, A. J.—GREENAWAY, W. T., and ZELENY, L.: Further development in the sedimentation test for wheat quality. Cereal Chem. *34*, 16, 1957.

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