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PRODUCTION OF SESAME FLOUR FORTIFIED BISCUIT

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ABSTRACT

Biscuit were prepared with 10,20 and 30% sesame seed flour substituted for wheat flour, Results declared that chemical composition and farinograph properties of biscuits were improved by using sesame flour in producing biscuits.

Biscuits with 10 and 20% sesame flour had better baking properties as well as high nutritive value as the protein content and amino acid profile and scores were improved.

Baking quality and organoleptic scores of biscuit containing 30% sesame flour were scored low by the panelists. Biscuit fortified with 10 and 20% sesame flours gave high scores to the flavour and also scored as acceptable by these panelists.

INTRODUCTION

Biscuit usually have a low protein efficiency ratio. Protein fortified biscuits can carry nutrients in concentrated forms and can complement other foods that are low in some essential amino acids and that have low protein efficiency ratios. To improve nutritional value, biscuits can be prepared from wheat flour supplemented with non wheat flours like seaame flour.

High protein bisouits would be particularly useful for child-feeding programs, and can be prepared from such composite flours as wheat flour fortified with soy flour (Tsen et al., 1973, Tsen, 1974), cottonseed (Fogg and Tinklin, 1972, Bacigalupo, 1969), sesame flour (Hoojjat and Zabik, 1984) peanut (Subrahmanyan, 1958), or corn germ flour (Blessin et al., 1972).

The objective of this study was to investigate the effect of sesame flour on the chemical composition, rheological properties, baking properties and organoleptic characteristics of biscuit.

MATERIALS AND METHODS

I. Materials:

1. **Wheat flour**
   French wheat flour obtained from the General silo company, Manshait El-Bakari, Giza, Egypt. It had 72% extraction.
2. Sesame seeds variety Giza 25 were obtained from the Agricultural Research Center, Ministry of Agriculture, Giza, Egypt.

II. Methods:

1. Technical Methods:

a) Sesame seed flour of 72% extraction was used.
b) Sesame seed flour was defated and prepared according to (Boloorforooshan and Markakis 1979).
c) Preparation of different recipes: Wheat flour were well blended with, sesamae flour to produce mixtures 10,20, and 30% of sesame flour.

2. Analytical Methods:

a) Moisture, ash, ether extract and protein contents were determined according to the A.O.A.C. method (1984).
b) Total Carbohydrates: Total carbohydrates were determined colorimetrically according to the method described by Michel Dubois, et al., (1956).
c) Amino acids were determined according to Pellett and Young (1980) using LKB Alfa plus 4151 amino acid analyzer, high performance system, a product of LKB Biochrom LTD, England.
Results were calculated using LKB 2220 Recording Integrator, Centeral Lab., Faculty of Agriculture, Cairo University. Tryptophan was determined using the method of Blauth et al ., (1963).
d) Chemical scores: Chemical scores (C.S) were calculated according to Block and Mitchell (1946).
e) Essential amino-acid index (E A A I): The (E A A I) had been calculated according to Oser (1959).

3. Rheological Properties of Composite flours were evaluated according to the A A C C (1983).

4. Baking quality of the biscuits were conducted according to the method described in the A.A.C.C. (1983).

a) Apparatus: Used, included Braun Mixer, aluminum cookie sheet of 14 gauge (0.078 in.). 12x16 in, two metal gauge strips, 7 mm (0.27 in.) thickness on 38 cm. (15 in.). Rolling Pin, cookie citter 60 mm. i.d. and Memmert electric oven 854 Schwabach with a maximum temperature of 300 °C, W. Germany.

b) Formula: The experimental baking formulas were as follows:

Ingredient	Weight g.	Wt. g.* based on 100 g. of flour
Control:		
Wheat flour (14% moisture)	225.00	100.00
Water	16.00	7.10
Sugar	130.00	57.77
Shortening	64.00	28.44
Salt	2.10	0.93
Sodium bicarbonate	2.50	1.11
Dextrose solution (8.9 g dextrose Powder in 150 ml H_2O)	33.00	14.66

* % flour basis, 14% moisture.

Biscuits were backed at 400°F for 15 minutes and lifted with wide spatula and placed on absorbent paper. Biscuits were wiped with dry paper towel to removing grease and crumbs. After cooled for 30 minutes, spread ratio was calculated.

$$\text{Spread ratio} = \frac{\text{The average diameter}}{\text{The average thickness}}$$

Specific volume was measured according to the method described by Damier et al., (1976), through the displacement of sesame seeds:

$$\text{Specific Volume} = \frac{\text{Volume (C.C.)}}{\text{Weight (gm.)}}$$

5. Organoleptic Characteristics of Biscuits: The method of Cooper et al., (1984) was applied for organoleptic evaluation. The scoring values were differentiated to the following units:

Name: ---------- **Date :** ---------- **Points**

A. Appearance:

1. Colour
   - (a) Excellent 10
   - (b) Fair 7
   - (c) Poor 3

2. Surface apperance
   - (a) Excellent 10
   - (b) Fair 7
   - (c) Poor 3

3. Internal appearance:
   - (a) Excellent 10
   - (b) Fair 7
   - (c) Poor 3

B. Eating Characteristics:

1. Crispness:

(a) Excellent	10
(b) Fair	7
(c) Poor	3

2. Mouth feel:

(a) Excellent	10
(b) Fair	7
(c) Poor	3

3. Flavour:

(a) Excellent	10
(b) Fair	7
(c) Poor	3

RESULTS AND DISCUSSION

Fortification of biscuit by sesame flour: Chemical, Rheological, baking quality and organoleptic properties of a dough formulated by using sesame flour at 10,20 and 30% substitution levels of wheat flour as well as of the produced biscuit.

The chemical constiuents of wheat and sesame flours were given in Table (1).

Table (1): Chemical constituents of wheat and sesame flours

Parameters		Wheat flour	Sesame flour
Moisture	(%)	12.06	8.39
Total lipid	(%)	2.42	30.40
Total protein	(%)[a]	11.66	10.53
Ash	(%)	0.47	6.72
Total carbohydrate	(%)[b]	72.12	39.74
Fibre	(%)	1.27	4.22

Calculated on dry weight basis (D.W.B.)

(a) For wheat flour, N X 5.7; Seasme flour, N X 6.25.
(b) Obtained by difference.

The results revealed that addition of sesame flour to wheat flour improved protein content of the biscuits. It raised the protein of the produced biscuit to a level which is higher than initial wheat flour. However, it could be noticed that parallel correlation was realized between level of sesame flour substitution and the protein percentage.

Fat, ash and fibre percentages of sesame flour were very higher than those of wheat flour. Consequently, adding sesame flour to wheat flour improved fat, ash and fibre contents of the produced biscuit than wheat flour only.

These results in agreement with those obtained by Yaseen (1985).

Rheological properties of the dough: The effect of replacing wheat flour by sesame flour on the farinograph test is presented in Table (2).

The water absorption capacity of the prepared doughs with increasing sesame flour levels. Similarly, Yaseen (1985) reported that soy flour contain 48.67% protein Higher water absorption in bread dough.

Regarding the arrival time, it was found that no noticeable changes was realized with 10,20 and 30% levels of the addition.

Table (2): Farinograph parameters for mixture of wheat flour and sesame flour.

% of Mixtures	Water absorption (%)	Arrival time (min)	Peak time (min)	Dough stability (min)	Departure (min)	Dough weakening (B.U.)
Control (100 % wheat flour)	57.00	0.50	2.00	17.25	5.00	90.00
10% Sesame flour +90% Wheat flour	57.90	0.75	2.00	16.25	15.00	90.00
20% Sesame flour +80% Wheat flour	58.90	1.00	9.00	16.00	24.50	60.00
30% sesame flour +70% wheat flour	61.30	1.50	10.50	15.50	21.50	50.00

Results of peak time indicate that supplementation of sesame flour had a significant effect on the peak time. The increase in peak time may be due to the differences in the physical and chemical properties between sesame protein and wheat protein in the mixture (Morad et al., 1980).

Dough stability showed a same trend as that of the water absorption till 20% substituteion. The previous results showed that, dough stability decreased at levels of 10,20, and 30%, this is may be due to the high fat content in the sesame flour and the effect of sesame lipids in homogenizing the daugh.

The dough weakening was increased upon incorporating 10,20 and 30% of sesame flour. This results show the effect

and the behavior of rheological properties for the fortification with sesame flour and wheat flour. Such results are in paralleled with those obtained by Yaseen (1985).

The baking quality of biscuit: The relation between the sesame flour + wheat flour and weight, volume, specific volume diameter, thickness and spread ratio of the resulted biscuit are given in Table (3).

Table (3): Baking quality properties of biscuit produced by using wheat flour and sesame flour.

Recipe mextures	Weight (g)	Volume (cc)	Specific Volume (cc/g)	Specific Volume %or (+) (−)	Diamter (Cm)	Thickness (Cm)	Spread ratio (Cm)	Spread ratio %or (+) (−)
Control	24.89	54.59	2.19	0.00	7.43	1.06	7.01	0.00
10% Sesame flour +90% Wheat flour	24.00	49.89	2.08	-5.02	7.32	1.09	6.72	-4.14
20% Sesame flour +80% Wheat flour	23.33	46.66	2.00	-8.68	7.10	1.12	6.34	-9.56
30% Sesame flour +70% Wheat flour	22.87	44.34	1.94	-11.42	6.78	1.23	5.51	-21.40

Weight and volume decreased slightly till 20% addition, then the higher additions of sesame flour caused high decreasing. The decreasing in weight, volume and specific volume may be due to the differences in protein content of the different recipes of the biscuit. The baking quality properties depend on the quality and quantity of the protein. (Matweef, 1966, and Matsu et al., 1972).

On the other hand, as the substitution level increased diameter of biscuit decreased, thickness increased. Tsen et al., (1973) fortified wheat flour with up to 25% soy flour and found that fortifing wheat flour with soy flours and soy protein isolate drastically reduced cookie diameter and increased thickness. Both effects were enhanced progressively as fortification increased.

The mechanism by which biscuit spread is reduced by certain wheat flour supplements is not understood completely. Kissel and Yamazaki (1975) enriched biscuit flours with wheat gluten and soy flour derivatives. They reported that nonwheat proteins used in biscuit formulas exhibit greater water retention than wheat flour, and thus posses a greater capacity for competing for the limited free water in biscuit dough. Consquently, typical spread and specific volume characteristics of biscuit containing these types of proteins fail to develop during baking.

Yamazaki et al., (1977) also found that biscuit spread was depressed by increasing the relative quantity of hydrophilic additives in biscuit dough.

Organoleptic properties of biscuits: Results of organoleptic properties of the biscuits made from wheat flour and sesame flour are shown in Table (4).

Table (4): Organoleptic properties of biscuit made of wheat flour and sesame flour

% of Sesame flour	Appearance			Eating Characteristics			A.V. of Total Score
	Colour	Surface appearance	Internal appearance	Crispness	Mouth feel	Flavour	
Control	9.36	9.64	9.29	9.21	9.86	9.79	57.15
10% Sesame flour +90% Wheat flour	8.57	8.60	8.55	8.50	8.79	9.85	52.86
20% Sesame flour +80% Wheat flour	5.93	5.43	5.40	5.64	5.50	9.90	37.80
30% Sesame flour +70% Wheat flour	3.86	3.14	2.71	2.57	2.67	9.90	24.85

Acceptability of biscuits untill 20% sesame flour was similar to those with all wheat flour. Biscuits containing sesame flour sp read uniformly during baking and developed a typical specific volume.

Finally it can be concluded that the addition of increments of sesame flour improved the flavor while decreased the average of total scores of the biscuits.

The results were in agreement with tnose reported by Hoojjat and Zabik (1984).

The results of Table (5) showed the chemical composition of biscuit prepared from wheat and sesame flours.

Table (5): Chemical composition of biscuits made from wheat flour + Sesame flour. (Calculated on D.W.B.).

Parameters	Control	10% S.F. +90% W.F.	20% S.F. +80% W.F.	30% S.F. +70% W.F.
Moisture (%)	5.20	6.70	6.83	6.91
Total lipid (%)	17.35	19.00	20.02	20.17
Total protein (%)	6.00	8.51	9.20	9.52
Ash (%)	0.89	1.11	1.23	1.56
Total carbohydrate (%)	69.00	62.99	60.84	59.79
Fibre (%)*	1.56	1.69	1.88	2.05

* Obtained by difference. S.F.= Sesame flour. W.F.= Wheat flour

It could be noticed that the moisture, fat, protein, ash and fibre contents were increased with increasing of sesame flour levels

On the other hand, total carbohydrate content of the investigated samples showed a reversible trend with that of the other contents.

Amino acids composition: Comparison of the analyzed aminoacid composition of the control and the biscuit samples contained 20% sesame flour were given in Table (6).

Table (6): Amino acids composition (g/16 g N) of biscuit made from wheat flour supplemented with 20% sesame flour.

Amino acids (A.A.)	Control	20 % Sesame flour
Essential A.A.:		
Lysine	1.19	3.22
Threonine	1.70	2.51
Valine	2.60	4.05
Methionine	0.91	1.21
Isoleuoine	2.02	2.96
Leucine	3.95	6.65
Phenylalanine	2.68	5.05
Tryptophan	1.02	1.59
Mon E.A.A.:		
Histidine	1.12	2.99
Arginine	2.90	4.63
Aspartic acid	2.84	4.68
Glutamic acid	18.98	26.36
Serine	2.62	4.23
Proline	6.35	7.19
Glycine	2.05	3.33
Alanine	1.73	2.63
Tyrosine	0.83	2.25
Cystin	0.86	0.97
Total No E.A.A.	40.28	59.26
Total A.A.	56.35	86.50

The identified amino acids were improved after addition of sesame flour to wheat flour with the exception of methionine, proline and cystime, Biscuit with 20% seasme flour was characterized by a higher content of total amino acids compared to the control.

On the other hand, Table (7) shown the comparison of the essential amino acids of control, biscuits with 20% sesame flour and F A O/W H O reference protein. The results

Table (7): Essential amino acids of biscuits made from wheat flour and sesame flour

Essential amino acids	F A O/ W H O reference protein* (g/16 g N)	Control (O) (g/16 g N)	Treatment (T) (g/16 g N)
Lysine	5.50	1.19	3.22
Threonine	4.00	1.70	2.51
Valine	5.00	2.60	4.05
Methionine	2.20	0.91	1.21
Isoleucine	4.00	2.02	2.96
Leucine	7.00	3.95	6.65
Phenylalanine	2.80	2.68	5.05
Tryptophan	1.00	1.02	1.59
Total	31.50	16.07	27.24

* Joint FAO/WHO Committee (FAO, 1973).

(O) Biscuit 100% wheat flour (W.F.)
(T) Biscuit 80% W.F. with 20% sesame flour

indicated that the total essential amino acids were improved when using 20% sesame flour to produce the biscuits.

The chemical scores and essential amino acid index (E A A I) of the control and the biscuits with 20% sesame flour were calculated as given in Table (8).

Table (8): Chemical scores, limiting amino acids and E A A I of biscuits fortified with sesame flour.

Essential amino acids	Control	20 % sesame flour
Lysine	21.64*	58.55**
Threonine	42.50	62.75
Valine	52.00	81.00
Methionine	41.36**	55.00*
Isoleuoine	50.50	74.00
Leucine	56.43	95.00
Phenylalanine	95.71	180.36
Tryptophan	102.00	159.00
First limiting amino acid*	Lysine	Methionine
Second limiting amino acid**	Methionine	Lysine
E A A I	52.48	87.10

The results showed that methionine was the first limiting amino acid of biscuits with 20% sesame flour while the first limiting amino acid of control was lysine. It could be noticed that the biscuits manufactured from 80% wheat + 20% sesame flour came in the first order with respect to the degree of improving of amino acids since the essential amino acid index value of biscuits with 20% sesame flour was higher than the essential amino acid index of control.

The previous results means the presence of sesame flour succeeded in raising the scores of the limiting amino acids and the essential amino acid index and improved the nutritive value of biscuit protein.

Chemical and organoleptic results show that sesame flour can be a good suplement for wheat flour for producing biscuit.

Biscuits contaning 10 and 20% sesame flour were scored as acceptable by panelists.

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انتاج بسكويت مدعم بدقيق السمسم

حسن حسن خلف

قسم علوم الاغذية ـ كلية الزراعة بشتهر ـ ج . م . ع .

أجريت هذه الدراسة لغرض امكانية استبدال دقيق القمح (استخلاص ٧٢ ٪) جزئيا بدقيق السمسم بنسب (١٠ ، ٢٠ ، ٣٠٪) فى صناعة البسكويت حيث تم عمل خلطات عجينة البسكويت بالنسب الاتية :

١ـ بسكويت مصنع من دقيق القمح فقط (كونترول) .
٢ـ بسكويت مصنع من (٩٠ ٪ دقيق قمح + ١٠ ٪ دقيق سمسم) .
٣ـ بسكويت مصنع من (٨٠ ٪ دقيق قمح + ٢٠ ٪ دقيق سمسم) .
٤ـ بسكويت مصنع من (٧٠ ٪ دقيق قمح + ٣٠٪ دقيق سمسم) .

هذا وقد اجريت كل من التقديرات الكيمائية والريولوجية وخواص جودة الخبيز والصفات الحسية لعينات البسكويت الناتجة كما تم تقدير كمية الاحماض الامينية الموجودة فى الناتج النهائى .

ودلت النتائج على مايلى :

أولا : باجراء التقديرات الكيمائية وجد تحسن فى نسبة البروتين والدهن والرماد والالياف فى البسكويت الناتج مع زيادة نسبة الاضافة من دقيق السمسم .

ثانيا : اوضحت التقديرات الريولوجيه أن أفضل نسبة للاضافة من دقيق السمسم هى ١٠ ، ٢٠ ٪ حتى لايحدث تاثير على الخواص الريولوجية .

ثالثا : وجد أن خواص جودة الخبيز كانت جيدة عند استعمال نسبة اضافة ١٠٪ دقيق سمسم واعلى نسبة للاضافة هى ٢٠ ٪ حيث ينتج بسكويت مقبول فى صفات جودة الخبيز وأعلى من ذلك ينتج بسكويت غير مقبول .

رابعا : لوحظ أن الصفات الحسية كانت أفضل عند استعمال نسبة اضافة ١٠ ، ٢٠ ٪ دقيق سمسم .

خامسا : بتقدير الاحماس الامينية وجد أن أفضل محتوى من الاحماض الامينية الاساسية كانت فى عينات البسكويت المصنعة من دقيق قمح ٨٠ ٪ مضاف اليه دقيق سمسم بنسبة ٢٠ ٪ بالمقارنة بعينات الكونترول كما احتوت هذه العينات على اعلى قيمة من الرقم الدال على الاحماس الامينية الاساسية (E A A I) .