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EFFECT OF DEFATTED RICE BRAN ADDITION ON THE QUALITY OF PAN BREAD AND BISCUIT

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ABSTRACT: *Rice bran was defatted and used as a partial replacement for wheat flour 72% at levels of 0, 10, 20 and 30%. Replaced wheat flour was used to produce pan bread and biscuit. Chemical composition, rheological properties, color attributes, baking test and organoleptic properties were evaluated. The obtained results revealed that defatted rice bran is a good source for protein, ash, and dietary fiber. Rheological properties of dough containing rice bran were negatively affected. Darking of bread and biscuits increased as defatted rice bran increased. Loaf volume decreased as defatted rice bran level increased, while, spread ratio of biscuits increased. Finally it could be concluded that, acceptable bread and biscuit can be produced with high content of protein, ash and dietary fiber using defatted rice bran up to 10 and 30% for ban bread and biscuit respectively.*

Key words: rice bran, bread, biscuit, rheological, baking quality, sensory properties

INTRODUCTION

Rice, one of the major cereals, is used almost exclusively as a food for humans. Rice contain significant amounts of dietary fiber (Normand *et al* 1987). Rice bran can be also used as a dietary fiber source when prepared by the stabilization treatment (Randall *et al* 1985). The hypocholesterolemic effect of rice bran was suggested by several studies in which cholesterol-lowering activity was demonstrated by a number of components in rice bran (Sunders 1990). Hemicellulose B-preparation isolated from defatted rice bran prevented the elevation of serum cholesterol levels in cholesterol-fed rats (Aoe *et al* 1989). Also, rice bran is thought to be a good source of high quality protein for food uses (Hamada, 1999). Rice bran contained more than 20% dietary fiber also rich in proteins, minerals, unsaturated fats and vitamins. Rice bran fiber showed a water binding capacity of 14.43%. Viscosity of solution of dietary fiber increased with concentration (Abdul-Hamid and Luan, 2000). Also, Al-Jasser and Mustafa (1996) reported that mineral content of rice bran revealed the high content of potassium, calcium and magnesium and contained an appreciable amount of the iron. So, the aim of this study was to investigate the possibility of partial replacement of wheat flour using defatted rice bran during breadmaking and biscuit manufacture. Also, to evaluate the rheological properties of the produced doughs and to study the effect of defatted rice bran on bread and biscuit quality.

MATERIALS AND METHODS

Materials:

Rice brans of (Skha101 and Skha103) were obtained from Delta Company for rice milling, Zagazig, Egypt.

Wheat flour (72% extraction), shortening, sugar, salt and yeast were obtained from local market, Cairo, Egypt.

TDF100 kits were obtained from Sigma Company. USA.

Methods:

Preparation of defatted rice bran.

Oil was extracted using hexane. Defatted rice brans were autoclaved (121°c/1.5 A. P) for 30 min., then dried and ground to obtain fine powder.

Preparation of flour mixtures.

Wheat flour 72% extraction was partially replaced using defatted rice bran to obtain flour mixtures containing 10, 20 and 30% defatted rice bran from two rice varieties (Skha101 and Skha103). All prepared mixtures were used to manufacture pan bread and biscuit.

Chemical analysis:

Total, soluble and insoluble dietary fiber were determined by gravimetric method using kits (TDF100, Sigma, USA) as described by AOAC (1995). Protein and ash content were determined according to the methods described by AOAC (1995).

Rheological properties

Rheological properties were evaluated using Farinograph and extensograph Barabender as described by AACC (1983).

Baking test

Baking test was performed to manufacture pan bread and biscuits as described by AACC (1983).

Color analysis

Color attributes of pan bread and biscuit were evaluated using a spectro-colorimeter with CIE color scale (Hunter, Lab Scan XE).

Sensory evaluation:

Sensory evaluation of pan bread was performed as described by Kulp *et al.* (1985).

Sensory evaluation of biscuit was performed according to Zabik and Hoojjat (1984).

Statistical analysis:

Data of sensory evaluation of pan bread and biscuit were subjected to analysis of variance and LSD calculated according to the method described by McClave and Benson (1991).

RESULTS AND DISCUSSION

Rheological properties

Data presented in Tables (1 and 2) represent the rheological properties of doughs as affected by addition of defatted rice brans. As shown in table (1) water absorption and stability of doughs increased as defatted rice bran increased. That increase may be referred to high protein and fiber contents of rice bran compared to wheat flour. Protein and dietary fiber tend to bind more water and dietary fibers characterized by its higher water holding capacity. Protein and dietary fiber in rice bran my be interact with wheat flour ingredients and water, consequently stability of doughs increased. In this respect, Kim *et al* (1997a) reported that water absorption and stability of doughs increased as rice bran dietary fiber increased.

Extensibility and energy decreased, while, resistance to extension increased as defatted rice bran level increased (Table 2). That effect related to the presence of fiber in defatted rice bran that dilute gluten content of dough. Viscoelastic properties of wheat doughs depend on gluten quality and quantity. So, as gluten content increased, viscoelastic properties improved.

Table (1): Farinograph parameters as affected by defatted rice bran levels.

Treatments	Water absorption (%)	Arrival time (min)	Dough development time (min)	Stability (min)	Weakening (Bu)*
Control	53	0.5	1.5	8	80
10% Skha101	56.3	1	2.0	10	40
20% Skha101	53.5	1.5	2.5	11	40
30% Skha101	58.5	2	2.5	12	40
10% Skha103	56.0	1	1.5	10	60
20% Skha103	56.3	1.5	2	12	60
30% Skha103	59.5	1.5	2	13	40

*BU=Brabender unit

Table (2): Extensograph parameters as affected by addition of different levels of defatted rice bran.

Treatments	45min			90min			135min		
	Exten-sibility (mm)	Resistance to extension (BU)*	Energy (cm^2)	Exten-sibility (mm)	Resistance to extension (BU)*	Energy (cm^2)	Exten-sibility (mm)	Resistance to extension (BU)*	Energy (cm^2)
Control	90	280	36	120	320	56	120	400	72
10% Skha101	90	520	74	80	600	60	75	600	60
20% Skha101	60	580	47	55	680	41	50	640	34
30% Skha101	40	620	17	45	620	24	40	680	30
10% Skha103	100	300	46	110	380	68	100	460	66
20% Skha103	80	420	53	70	520	52	70	620	63
30% Skha103	60	520	34	50	480	25	50	480	24

*BU=Brabender unit

Baking quality of pan bread.

As presented in table (3), loaf volume decreased, while loaf weight increased as defatted rice bran level increased. That effect may be due to the high fiber content of defatted rice bran. Fiber characterized by its higher water holding capacity. Kim *et al* (1997b) reported that rice bran dietary fiber increased bread weight and decreased bread volume. Also, Sekhon *et al* (1997) reported that bread volume decreased but muffin volume increased with the addition of different types of bran to wheat flour.

Also, Tangkanakul *et al* (1995) stated that fiber enrichment of wheat flour breads led to decrease loaf volume and increase the density of bread. Fiber enrichment increased hardness of bread. Such findings were also obtained by Singh *et al* (1995), as they reported, bread volume decreased with the addition of various rice brans and the decrease was more pronounced in flours containing defatted rice bran.

The same table also revealed that loaf weight increased and loaf volume decreased regardless of fermentation time. As baking quality data shown, the best loaf volume was obtained after 120 min. of fermentation. So, the best fermentation time was 120 min. under investigated conditions. Also, loaf volume decrease was proportional to increasing level of defatted rice brans regardless of rice bran variety or fermentation time used. So, control sample was the best sample regarding to loaf volume.

Data presented in the same table revealed that, as replacement level of defatted rice bran increased, loaf volume of bread decreased. These observations were detected in all tested samples regardless of rice variety or fermentation time conducted.

Sensory evaluation of bread

Data presented in tables (4, 5 and 6) show the sensory evaluation results of bread which replaced using defatted rice bran and subjected to three fermentation times.

As shown in these tables all tested parameters were adversely affected as defatted rice bran content increased.

Regarding to bread fermented to 60 min., the control sample was the best sample concerning all tested parameters. These trends were observed in all tested samples regardless of rice bran variety. The adverse effect of defatted rice bran was clearer in crumb color and crumb texture. These effects may be due to the high fiber content of defatted rice bran which affect the color and texture of crumb. Also, it could be detected that, as defatted rice bran level increased the adverse effect increased regarding to all tested characteristics.

Concerning bread fermented at 90 or 120min., slight increase in the score of evaluated characteristics was observed compared to bread fermented at 60min. revealing that 120min. is more suitable fermentation time to obtain acceptable bread. As the obtained results revealed, acceptable bread could

Table (3): Baking quality of pan bread as affected by different levels of defatted rice bran replacement.

Fermentation time	60 min			90 min			120 min		
Treatments	Volume (cc)	Weight (g)	Specific volume (cc/g)	Volume (cc)	Weight (g)	Specific volume (cc/g)	Volume (cc)	Weight (g)	Specific volume (cc/g)
Control	600	280	2.14	650	279	2.33	775	278	2.79
10% Skha101	575	283	2.03	625	281	2.22	700	276	2.54
20% Skha101	525	282	1.86	525	280	1.88	525	276	1.90
30% Skha101	450	279	1.61	425	277	1.53	425	275	1.55
10% Skha103	625	279	2.24	675	278	2.43	750	275	2.73
20% Skha103	600	276	2.18	650	276	2.36	725	271	2.68
30% Skha103	500	278	1.80	475	277	1.71	450	275	1.64

Table (4): Sensory evaluation of pan bread as affected by addition of different levels of defatted rice bran (fermentation time 60 min.)

Treatments	Sym. Shape (5)	Crust color (10)	Break & shred (10)	Crumb color (10)	Crumb texture (15)	Mouth feel (10)	Aroma (20)	Taste (20)
Control	4.15^{a}	7.90^{a}	7.95^{a}	8.20^{a}	11.70^{a}	7.4^{a}	14.30^{a}	15.00^{a}
10% Skha101	3.20^{b}	6.80^{ab}	6.80^{ab}	6.75^{b}	10.95^{ab}	6.25^{ab}	11.40^{ab}	12.00^{ab}
20% Skha101	2.65^{b}	6.15^{bc}	6.35^{b}	5.50^{b}	9.70^{bc}	5.10^{bcd}	9.50^{b}	9.50^{bcd}
30% Skha101	2.40^{c}	5.30^{c}	5.90^{b}	3.50^{c}	9.00^{c}	4.10^{d}	8.60^{b}	8.20^{cd}
10% Skha103	2.85^{bc}	6.60^{b}	6.20^{b}	6.40^{b}	9.10^{c}	5.95^{bc}	11.00^{ab}	11.10^{bc}
20% Skha103	2.75^{bc}	6.05^{bc}	6.45^{b}	5.80^{b}	9.80^{bc}	4.80^{cd}	10.30^{b}	9.10^{bcd}
30% Skha103	2.60^{bc}	5.25^{c}	5.80^{b}	3.40^{c}	8.10^{c}	3.70^{d}	8.10^{b}	7.40^{d}
LSD (0.05)	0.772	1.113	1.269	1.417	1.775	1.413	3.616	3.233

Values with the same superscript letter in the same column insignificantly different ($P \leq 0.05$).

Table (5): sensory evaluation of pan bread as affected by addition of different levels of defatted rice bran (fermentation time 90min.)

treatments	Sym. Shape (5)	Crust color (10)	Break & shred (10)	Crumb color (10)	Crumb texture (15)	Mouth feel (10)	Aroma (20)	Taste (20)
Control	4.20^{a}	8.80^{a}	7.60^{a}	8.90^{a}	12.30^{a}	8.65^{a}	16.80^{a}	18.05^{a}
10% Skha101	3.25^{b}	7.25^{ab}	6.25^{ab}	6.75^{b}	9.90^{bc}	7.45^{ab}	13.50^{ab}	14.60^{ab}
20% Skha101	2.20^{cd}	5.20^{cd}	5.50^{b}	5.00^{cd}	8.90^{bc}	6.05^{bc}	10.00^{bc}	9.60^{cd}
30% Skha101	1.50^{d}	3.50^{ef}	5.10^{b}	4.70^{cd}	7.90^{cd}	5.60^{c}	10.00^{bc}	8.90^{cd}
10% Skha103	2.90^{bc}	6.05^{bc}	6.60^{ab}	6.90^{b}	10.40^{ab}	7.90^{a}	12.30^{b}	11.30^{bc}
20% Skha103	2.60^{bc}	4.40^{de}	6.10^{ab}	6.30^{bc}	9.00^{bc}	6.10^{bc}	11.20^{bc}	6.90^{d}
30% Skha103	1.60^{d}	2.60^{f}	5.00^{b}	4.30^{d}	5.90^{d}	4.95^{c}	8.00^{c}	6.10^{d}
LSD (0.05)	0.842	1.612	1.645	1.703	2.334	1.650	3.915	3.864

Values with the same superscript letter in the same column insignificantly different ($P \leq 0.05$).

Table (6): sensory evaluation of pan bread as affected by addition of different levels of defatted rice bran (fermentation time 120 min.)

treatments	Sym. Shape (5)	Crust color (10)	Break & shred (10)	Crumb color (10)	Crumb texture (15)	Mouth feel (10)	Aroma (20)	Taste (20)
Control	4.55^{a}	8.45^{a}	8.15^{a}	8.95^{a}	12.95^{a}	7.70	17.05^{a}	16.20^{a}
10% Skha101	3.65^{b}	6.90^{ab}	6.60^{bc}	6.70^{bc}	12.20^{ab}	6.75	13.00^{ab}	13.10^{ab}
20% Skha101	2.70^{bd}	4.50^{cd}	5.00^{cd}	5.60^{cde}	9.20^{cde}	5.60	10.50^{bc}	10.00^{bc}
30% Skha101	2.45^{d}	4.00^{d}	5.40^{cd}	4.80^{de}	8.00^{de}	5.10	10.10^{bc}	9.70^{bc}
10% Skha103	4.00^{ab}	8.50^{a}	7.70^{ab}	8.00^{ab}	11.10^{abc}	6.20	12.70^{bc}	12.90^{ab}
20% Skha103	3.50^{bc}	6.10^{bc}	6.80^{bcd}	6.20^{cd}	9.90^{bcd}	6.00	11.20^{bc}	10.70^{bc}
30% Skha103	2.10^{d}	3.40^{d}	4.40^{d}	4.40^{e}	7.00^{e}	4.70	8.50^{c}	8.10^{c}
LSD (0.05)	0.857	1.609	1.709	1.473	2.574	NS*	4.318	3.804

Values with the same superscript letter in the same column insignificantly different (P ≤ 0.05).
***NS=Not Significant**

be produced using defatted rice bran up to 10% and fermentation time 120 min. In this respect, Kim *et al* (1997a) reported that raw rice bran dietary fiber up to 9% had lower score compared to control sample regarding to sensory evaluation, while, extruded or roasted rice bran dietary fiber up to 9% had no significant effects concerning to sensory evaluation. Zumbado *et al* (1997) reported that sensory scores decreased with increasing level of rice bran added.

Color attributes of bread

Data presented in table (7) show the effect of addition of defatted rice bran on color quality of pan bread under three different fermentation times. As shown in the table, lightness (L values) decreased as defatted rice bran level increased, while redness (a value) and yellowness (b values) increased as defatted rice bran level increased. So, the produced bread was darker than control.

In this respect, Kim *et al* (1997) reported that L-value of bread containing rice bran dietary fiber decreased.

Regarding to fermentation time and color quality of pan bread, there was no clear relationship between color quality and fermentation time under investigated conditions. The major effect on color quality attributes was related to the concentration of rice bran added. As defatted rice bran level increased darkness of pan bread increased. The same trend was observed in both varieties of rice bran used.

Chemical composition of bread

Data presented in table (8) show protein, ash and total dietary fiber (TDF) of wheat flour, defatted rice brans and produced bread. It's clear that defatted rice bran is a good potential source of protein, ash and total dietary fiber. As defatted rice bran level increased, TDF, ash and protein content of bread increased. The trend was observed in all tested samples regardless of rice bran variety. Rice bran addition improved the lysine content of the bread (Lynn,1969).

Color attributes of biscuits as affected by defatted rice bran

As shown in Table (9), lightness (L-values) decreased as defatted rice bran level increased, while, redness (b-values) and yellowness (a-values) increased. Defatted rice bran is darker than wheat flour. So, darkening increased as a result of the presence of defatted rice bran in biscuits. As reported by Kim *et al* (1997b), adding of rice bran dietary fiber to bread dough increased L- value, resulting more darkness. Data in the same table revealed that, the same trend was observed in all tested samples regardless of rice bran variety.

Table (7): color attributes of pan bread as affected by defatted rice bran added.

treatments	60 min			90 min			120 min		
	L	a	b	L	a	b	L	a	b
Control	77.20	2.1	20.11	76.60	1.48	19.89	75.20	1.12	19.50
10% Skha101	65.90	4.93	24.16	65.59	4.40	23.15	65.11	4.75	24.12
20% Skha101	56.90	6.30	25.50	55.95	6.14	24.80	57.40	6.11	24.55
30% Skha101	54.20	7.12	25.65	53.60	6.63	24.90	53.35	6.30	23.70
10% Skha103	68.88	3.80	23.30	71.11	3.40	22.50	68.90	3.60	23.80
20% Skha103	61.80	5.14	25.11	62.14	4.66	25.11	60.50	5.11	25.40
30% Skha103	58.70	5.30	28.70	57.44	5.10	22.50	59.80	4.85	23.45

Table (8): Protein, ash and total dietary fiber (TDF)% of pan bread as affected by defatted rice bran content.

Treatments	Protein (%)	Ash (%)	TDF (%)
Wheat flour 72%	8.50	0.46	6.50
Defatted rice bran(Skha101)	16.60	8.95	44.98
Defatted rice bran(Skha103)	14.50	9.25	46.18
Control	9.4	2.46	6.8
10% Skha101	10.15	3.21	10.12
20% Skha101	10.90	4.10	13.47
30% Skha101	11.50	4.98	17.95
10% Skha103	9.98	3.22	11.50
20% Skha103	10.47	4.60	14.35
30% Skha103	11.25	4.89	18.67

Table (9): Surface color attributes of biscuits as affected by addition of different levels of defatted rice bran.

treatments	L	a	b
Control	59.29	9.66	31.64
10% Skha101	59.03	9.87	32.14
20% Skha101	57.70	10.90	32.02
30% Skha101	56.87	11.39	32.77
10% Skha103	56.06	11.71	32.88
20% Skha103	56.85	11.94	33.65
30% Skha103	54.58	12.47	33.58

Baking quality of biscuit

Data presented in Table (10) show the effect of replacing of wheat flour with different levels of defatted rice bran. Biscuit weight decreased, while volume increased as a result of increasing the level of defatted rice bran. Also, the diameter of replaced biscuits increased and the thickness decreased as defatted rice bran level increased. Defatted rice bran characterized by its high content of protein and dietary fiber. The major effect of defatted rice bran referred to protein and dietary fiber. Tangkanakul *et al*

Table (10): Baking quality of biscuits as affected by addition of different levels of defatted rice bran.

treatments	Weight (g)	Volume (cc)	Specific volume (cc/g)	Diameter (cm)	Thickness (cm)	Spread ratio
Control	27.29	50.00	1.83	6.80	1.31	5.19
10% Skha101	26.76	51.25	1.92	7.43	1.14	6.52
20% Skha101	26.68	52.50	1.97	7.50	1.18	6.36
30% Skha101	26.37	53.75	2.39	7.50	1.15	6.52
10% Skha103	26.88	51.25	1.91	7.60	1.15	6.61
20% Skha103	26.62	52.50	1.97	7.70	1.10	7.00
30% Skha103	25.08	53.75	2.14	7.80	1.05	7.43

(1995), revealed that, spread ratio increased as a result of replacing wheat flour using various sources of dietary fiber. Data presented in the same table showed that as defatted rice bran increased, biscuit weight and thickness decreased, while, volume, diameter and spread ratio increased. The same trend was observed in all replaced samples regardless of rice bran variety.

Sensory evaluation of biscuit as affected by defatted rice bran

Data presented in Table (11) showed the effect of replacing wheat flour using defatted rice bran on sensory evaluation of biscuit. Wheat flour replaced by defatted rice bran up to 30%. There were no significant differences between control sample and all replaced samples. This means that wheat flour can be replaced using defatted rice bran up to 30% without adverse effect regarding sensory evaluation. Slight difference was observed (but not significant) revealed that control sample was the best sample. The same trend was observed in all tested samples regardless of rice bran variety.

Table (11): sensory evaluation of biscuits as affected by addition of different levels of defatted rice bran.

treatments	Shape (10)	Surface color (10)	Surface characteristics (10)	Distribution of cell (10)	Mouth feel (20)	Texture (20)	Flavor (20)
Control	7.78	7.33	6.78	6.89	15.67	15.89	14.22
10% Skha101	7.22	7.44	7.00	6.89	15.44	15.33	14.89
20% Skha101	7.22	7.33	6.78	7.22	14.44	13.00	14.33
30% Skha101	7.22	6.33	6.67	6.44	13.33	12.22	13.11
10% Skha103	7.67	7.44	7.00	7.33	15.67	14.67	14.11
20% Skha103	6.44	6.67	6.00	6.00	12.89	11.67	12.56
30% Skha103	5.67	5.89	5.56	6.11	13.67	13.11	14.22
LSD (0.05)	NS*	NS*	NS*	NS*	NS*	NS*	NS*

*NS=Not Significant

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تأثير إضافة ردة الأرز منزوعة الدهن على جودة الخبز والبسكويت

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الملخص العربي

تم استخدام ردة الأرز منزوعة الدهن الناتجة من صنفي سخا ١٠١، ١٠٣ وذلك في الإحلال الجزئي لدقيق القمح استخلاص ٧٢% وذلك بنسب إحلال ١٠، ٢٠، ٣٠% وتم استخدام المخاليط السابقة في تصنيع كل من الخبز والبسكويت.

وتم دراسة التركيب الكيماوي والخواص الريولوجية للعجائن بالإضافة إلى جودة كل من الخبز والبسكويت الناتج وكذلك دراسة تأثير عملية الإحلال على جودة اللون في كل من الخبز والبسكويت كما تم دراسة تأثير الإحلال على الخواص الحسية لكل من المنتجين.

وقد أظهرت النتائج زيادة في نسبة امتصاص الماء بزيادة نسبة الإحلال بينما قلت الانسيابية وكذلك طاقة العجينة. وقد أدت زيادة نسبة الإحلال إلى قلة حجم الرغيف وزيادة وزنه بينما زادت نسبة معامل الفرد في البسكويت بزيادة نسبة الإحلال.

وقد أدت زيادة نسبة الإحلال باستخدام ردة الأرز منزوعة الدهن إلى زيادة اللون الداكن في كل من الخبز والبسكويت وقد اظهر التحليل الكيماوي أن ردة الأرز منزوعة الدهن تعتبر مصدرا جيدا لكل من البروتين والأملاح المعدنية والألياف الغذائية وتزداد نسبة هذة المكونات في الناتج النهائي بزيادة نسبة الإحلال.

ويمكن التوصية بأنه يمكن الحصول على خبز مقبول الصفات الحسية وغني بالبروتين والألياف والأملاح المعدنية بالإحلال الجزئي لدقيق القمح حتى نسبة ١٠% بينما يمكن إنتاج بسكويت مقبول الصفات الحسية وغني بنفس المكونات السابقة باستخدام الإحلال الجزئي لدقيق القمح بردة الأرز منزوعة الدهن حتى نسبة ٣٠% وقد لوحظ أن كل من نوعي ردة الأرز المستخدمة في الدراسة أوضحت وجود فروق طفيفة بين الصنفين.