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STUDIES ON UTILIZATION OF SECOND GRADE BISCUITS (SGB) AS ADDITIVE TO DOUGH IN MANUFACTURING OF BISCUITS

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ABSTRACT: Biscuit manufacturing generates second grade biscuits (SGB) in the form of loose biscuits, overweight biscuits, underweight biscuits, unpacked biscuits and packing defective, which are considered waste. The objective of this study was aimed to produce low cost biscuits. In the present study, SGB were utilized as additive to dough of biscuits aim to low the cost and to improve the quality of biscuits. The results indicated that there were no discernible sharp destroyed in the specific attributes of crust appearance, texture, crispness, taste, odour and overall preference between all biscuit samples produced with addition of biscuit powder (SGB) and control. From the same results, it could be noticed that overall acceptability of biscuit samples with addition of SGB did not differ significantly from control.

Key words: Biscuits, second grade biscuits, substitutes, overall acceptability, sensory evaluation, chemical composition, physical composition.

INTRODUCTION

Cookies are popular staple food in the human diet in many countries and are generally well accepted by consumers due to their sensory attributes, long shelf life and convenience (**Fradinho *et al.,* 2015**). Generally, the name cookies are used in the USA and biscuit is used in the European countries **(Sivasankar, 2002)**.

Biscuit is most popular bakery product worldwide. They are high in carbohydrates, fat and calorie. Because of its acceptability in all age groups specially child, longer shelf life, better taste and its position as snacks **(Mishra and Chandra, 2012)**. Hence, cost of biscuit making plays a large part in the kind of food consumed. Hence, it is important to low the cost and to improve the quality of biscuits.

The main ingredients of cookies are wheat flour, fat (margarine), sugar and water. While other ingredients such as milk, salt, aerating agent, emulsifier, flavour and colour can be included. They can also be enriched or fortified with other ingredients in order to meet specific nutritional or therapeutic needs of consumers **(Ajibola *et al.,* 2015)**. Some manufacturers maintain that ground biscuits crumb (from the same type of biscuits) aid the texture and structure. Care should be taken not to include crumbs from over baked product as it will adversely affect the flavor and colour of the baked product **(Khatkar, 2006)**. It has been successfully incorporated with other vegetable oils in the production of plastic shortenings and the functionality has been proven to be effective **(Abdulazis, *et al.,* 2011; Pande and Akoh, 2013)**. Fat replacement studies have been carried out over the years for various reasons which include finding a cheaper alternatives and an option that is more beneficial for the health. In finding alternatives, palm oil has caught the attention of various industries and studies are carried out to see how it can be applied accordingly due to their quality and properties **(Abdulazis *et al.,* 2011)**. The industry has been

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hydrogenating oil to produce commercial plastic fats for baking purposes (**Zhou *et al.,* 2011**). The problem with these fats are due to the presence of trans-fatty acid that is causing health problems such as increase body fat, obesity and increased risk of coronary heart diseases (**Dogan *et al.,* 2007**). Therefore, studies have been done to find mixtures of different oil blends that could provide the same functionality as fats without the trans-fatty acids. Palm stearin is a very promising substitute that could be used as an alternative based on its natural high level of solid fat.

The study aimed to produce improved quality and low cost biscuits *via* utilizing the second grade biscuits (SGB) as additive to dough of biscuit's manufacture.

MATERIALS AND METHODS

Wheat flours (72% extraction for biscuits making) were obtained from the East Cairo Flour Mills Company, Egypt. Commercial bakery shortening and palm stearin were purchased from Arma Industry of Fats and Oils CO., 10th of Ramadan City, Egypt.

Second Grade or Refused Biscuits (SGB)

Biscuit manufacturing generates waste in form of loose biscuits, over weight biscuits, under weight biscuits, unpacked biscuits and packing defective. Other materials include sugar, vanilla, baking powder, skim milk powder, salt, sodium bicarbonate, ammonium bicarbonate, and sodium meta bisulphate were purchased from local Market, Giza, Egypt.

Preparation of Wheat Flour and Second Grade Biscuits

Wheat flour 72% extraction (WF) and second grade biscuits (SGB) used to prepare the following blends:

Control =100% Wheat flour 72% extraction (WF).

B1 = 100% wheat flour (W.F) + 5% second grade biscuits (SGB).

B2 = 100% wheat flour (W.F) + 10% second grade biscuits (SGB).

B3 = 100% wheat flour (W.F) + 15% second grade biscuits (SGB).

B4 = 100% wheat flour (W.F) + 20% second grade biscuits (SGB).

B5 = 100% wheat flour (W.F) + 25% second grade biscuits (SGB).

B6 = 100% wheat flour (W.F) + 30% second grade biscuits (SGB).

Preparation of Biscuits

Seven formulas were prepared using the same quantity of the all ingredients except the Second grade biscuits (SGB) was added with flour to the dough after creaming stage. The blends were used to prepare biscuits according to the method described by **Wade (1988)**.

The ingredients included shortening, sugar, salt and vanillin were mixed in a dough mixer using the flat beater for 1 min., then scraped down and continued to mix for 3 min at high speed. Wheat flour and ammonium bicarbonate and sodium bicarbonate were added to the mixture and mixed at low speed, and then it was sheeted to 3mm thickness. Circles cut of paste pieces by using of templates with an outer diameter of 60mm. The biscuits were backed at 170 -180ºC for 12 min. and allowed to cool at room temperature.

The produced biscuits diameter (W) was measured by Boclase (HL 474938, STECO, Germany). Also, volume (V) and thickness (T) of biscuits were determined according to standard methods **AACC (2002).** The spread ratio W/T was calculated. Percent spread ratio was calculated according to **AACC (2002)** by dividing the average value of diameter (W) by the average value of thickness (T) of biscuits. Volume and specific volume of biscuits were measured five pieces of biscuits one above the other were used according to **Bennion and Bamford (1983)**.

Breaking strength and breaking work of the biscuits were measured using a TA-XT2i Texture Analyser (Stable Micro Systems Ltd, Godalming, UK) and a three-point-fracture technique similar to that described by **Mamat *et al*. (2010)**.

Rheological Properties of Wheat Flour

The rheological properties of wheat flour was evaluated by Extensograph and Farinograph (Model Type No: 81010 (31, 50 and 63 rpm), ©Brabender® OHG, Duisburg, 1979, Germany) according to the standard methods of **AACC (2000)**.

Table 1. The ingredients used in biscuits manufacture in gram (g)

Ingredient	(g)
Wheat flour (72%)	100.00
Skim milk powder	2.00
Shortening	10.00
Sucrose	35.00
Sodium bicarbonate	0.04
Ammonium bicarbonate	0.08
Vanillin	0.04
Water	21.0 ml

Sensory Characteristics

Sensory characteristics evaluation of the produced biscuits were subjectively assessed by a panel of ten judges. Whole samples were arranged in white plates so that a 100% wheat flour samples were identified as control. Panelists were asked to use the control sample as the basis for determining acceptance by first treated assigning score it and then evaluating each sample in comparison to control. The quality attributes evaluated were appearance (10), colour (20), texture (15), crispness (15), taste (20), odour (10), mouthfeel (10) and overall acceptability (100) (**Hooda and Jood, 2005**).

Chemical Composition

Moisture, protein, fat, ash and fiber of raw materials and biscuits were determined according to **AOAC (2007)**. Carbohydrates were estimated by difference as follows:

Available carbohydrates = 100 – [protein (%) + fat (%) + ash (%) + fiber (%) + moisture (%)] according to **AOAC (2000)**.

Statistical Analysis

Data were analyzed and statistical significance of the difference in values of control and treatments were calculated by (F) test with 5% significance level. Data of the present study were statistically analyzed by using Duncan's Multiple Range Test **(SAS, 1986)**.

RESULTS AND DISCUSSION

In the present study, second grade or refused biscuits (SGB) were utilized as additive to dough of biscuits, while, palm stearein (PSt) at different levels were used to replacing part of shortening in the processing of biscuits. Biscuit manufacturing generates second grade biscuits (SGB) in the form of loose biscuits, overweight biscuits, underweight biscuits, unpacked biscuits and packing defective, which are considered waste.

Chemical Composition of Raw Materials

The chemical composition of wheat flour (WF) and some raw materials were studied and the obtained results are shown in Table 2.

Chemical analyses presented in Table 2 showed that wheat flour contained 9.2% protein, 0.64% ether extract, 0.66% crude fiber, 0.47% ash and 89.03% carbohydrates.

Analysis of raw materials for ash showed that skim-milk powder had the highest ash content (7.1%) and protein content of (34. 5%) and had the lowest fat content (0.32%).

Concerning fat content, shortening contained the highest percentage of ether extract (99.8%). On the other hand, skim-milk powder and shortening had no content of crude fiber.

Results in Table 2 show that wheat flour contained the highest level of carbohydrates

Table 2. Proximate chemical composition of wheat flour (WF) and some raw materials

Sample	Moisture (%)	Item (%) (on dry basis)				
		Protein	Fat	Crude fiber	Ash	Total carbohydrates
Wheat flour (WF)	12.9	9.2	0.64	0.66	0.47	89.03
Shortening	-	-	99.8	-	-	-
Skim-milk powder	9.4	34.5	0.32	-	7.1	58.08

(89.03%). Results indicated that wheat flour had the highest moisture contents 12.9%, followed by skim-milk powder (9.4%). All above results are found to be closely near that obtained by **Doweidar (2002), Kamel (2003), Caballero *et al.* (2007) and Ibrahim (2011)**.

Rheological Properties of Wheat Flour

Farinograph and extensograph characteristics of wheat flour are presented in Table 3 and Fig. 1.

Water absorption value was 62.0% for wheat flour. The results also showed that the wheat flour recorded (1.0 min) arrival time, (1.5 min) dough development and (7.0 min) dough stability, while degree of weakening was 50.0 B.U.

Resistant to Extension (R), Extensibility (E), Proportional number (R/E) and Energy of wheat flour were 560 (B.u), 105 (mm), 5.33(R/E) and 78 (cm^2), respectively.

The results showed that wheat flour contained wet and dry gluten as much as 18.05% and 5.89%, respectively. Gluten index was 98.99%. The results in Table 4 are nearly agrees with the results reported by **Doweidar (2002), Kamel (2003), Caballero *et al.* (2007) and Ibrahim (2011).**

Chemical Composition of Biscuit

Chemical composition of produced biscuits

The chemical composition of produced biscuit from wheat flour containing 5, 10, 15, 20, 25 and 30 g/100 g wheat flour second grade biscuits (SGB) are presented in Table 5.

From the results in Table 5 it could be concluded that the addition of 5, 10, 15, 20, 25 and 30% SGB to biscuit dough led to slightly increases in moisture contents, ash and total carbohydrate contents of produced biscuits in comparison with control sample. The same results also showed that fat content and protein contents of biscuits were decreased by addition of SGB to the dough of biscuits in comparison with control.

Physical measurements of biscuits produced

Biscuits were subjected to physical measurements including weight, volume, specific volume, diameter, thickness, spread factor, density and break strength. Measurements of biscuits with various addition levels (5, 10, 15, 20, 25 and 30 g/100 g wheat flour) SGB to biscuit dough are shown in Table 6.

Results indicated that specific volume of biscuit samples (which relate with good crispness and texture) with various SGB addition levels were lower than that of control biscuit. A negative relationship could be noticed between addition level and biscuits specific volume. Biscuits specific volume was gradually decreased by increasing addition level, such decrease in biscuits specific volume could be attributed to water holding of SGB. For other measurements, it could be noticed that biscuits spread ratio, density and break strength increased as addition level of SGB powders increased.

Sensory characteristics of biscuit produced by addition of second grade biscuits (SGB) to biscuits dough

The analyses of the mean sensory scores for the biscuits are shown in Table 7. A cursory look at the Table shows that the hedonic scores of all the biscuits samples were generally high indicating a strong consumer appeal for samples.

Table 3. Rheological properties of wheat flour from farinograph and extensograph apparatus

Sample	Farinograph properties					Extensograph properties			
	Water absorpation (%)	Arrival time (min)	Dough development (min)	Stability time (min)	Degree of weakening (B.u)	Resistant to extension (R) (B.u)	Extensibility (E) (mm)	Proportional number (R/E)	Energy (Cm^2)
Wheat flour 72%	62.0	1.0	1.5	7.0	50	560	105	5.33	78

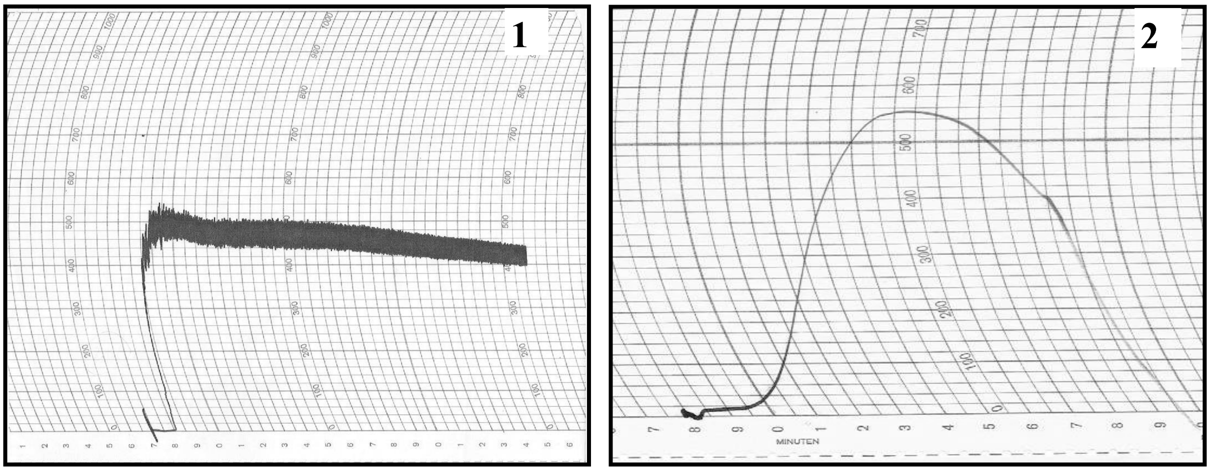

Fig. 1. Rheological properties of wheat flour from farinograph (1) and extensograph (2) apparatus

Table 4. Gluten properties of wheat flour

Sample	Gluten properties (%)		
	Wet gluten	Dry gluten	Gluten index
Wheat flour	18.05	5.89	98.99

Table 5. Chemical composition of biscuit produced from wheat flour with different levels of second grade biscuits (SGB)

Sample	Moisture Content (%)	Item (on dry basis) (%)			
		Fat	Protein	Ash	Total carbohydrate
Wheat flour 100%	3. 30	9. 88	7.88	0. 49	78. 97
Wheat flour 100% + 5% SGB	3. 53	9. 55	7.79	0. 52	79. 55
Wheat flour 100% + 10% SGB	3. 81	9.28	7.73	0. 56	79. 87
Wheat flour 100% + 15% SGB	3. 95	9.08	7.69	0. 58	80. 33
Wheat flour 100% + 20% SGB	4. 08	9.03	7. 65	0. 60	80. 39
Wheat flour 100% + 25% SGB	4. 28	8.98	7. 61	0. 60	80. 43
Wheat flour 100% + 30% SGB	4. 68	8. 94	7. 59	0. 61	80.50

Table 6. Effect of addition of second grade biscuits (SGB) to biscuit dough on physical properties of biscuits

Samples No.	Physical properties of biscuits							
	Specific volume						Density (g/cm^3)	Break strength (g)
	Weight (g)	Volume (cm^3)	Specific volume (cm^3/g)	Diameter (mm)	Thickness (mm)	Spread ratio		
Wheat flour 100%	2.07	5.60	2.71	56.80	5.88	9.66	0.37	291.35
Wheat flour 100% + 5% SGB	2.82	5.20	1.84	53.64	5.18	10.35	0.54	293.48
Wheat flour 100% +10% SGB	2.65	4.20	1.58	52.60	4.84	11.74	0.63	310.13
Wheat flour 100% +15% SGB	3.02	4.60	1.52	51.85	4.65	11.78	0.66	318.66
Wheat flour 100% +20% SGB	3.11	4.0	1.28	50.55	4.38	11.84	0.78	332.87
Wheat flour 100% +25% SGB	3.31	4.20	1.27	48.83	3.87	12.61	0.79	348.35
Wheat flour 100% +30% SGB	3.75	4.58	1.22	46.30	3.65	12.68	0. 82	368.86

Table 7. Effect of addition of second grade biscuits (SGB) to biscuit dough on sensory properties of biscuits

Sample (g)	Colour 10	Crust appe. 20	Texture 15	Crispness 15	Taste 20	Odour 10	Mouthfeel 10	Overall acceptability 100
Wheat flour 100	10.00^{a}±0.0	19.44^{b}±0.5	14.33 ^{b}±0.5	14.89^{a}±0.33	19.44^{b}±0.53	9.33 ^{d} ±0.50	9.66^{b}±0.50	99.67^{a} ±1.0
Wheat flour 100 + 5 SGB	9.67^{b}±0.5	19.44^{b}±0.5	14.67^{a}±0.50	14.89^{a}±0.33	19.67^{a}±1.4	10.00^{a}±0.0	9.89^{a}±0.33	95.56^{b}±2.2
Wheat flour 100 + 10 SGB	9.67^{b}±0.5	19.56^{a}±0.53	14.56^{b}±0.73	14.78^{b}±0.73	19.44^{b}±0.53	9.22^{e}±0.44	9.44^{d}±0.52	92.67^{c}±1.6
Wheat flour 100 + 15 SGB	9.22^{c}±0.66	19.44^{b}±0.5	14.33^{c}±0.50	14.26^{c}±0.50	19.67^{a}±0.5	9.44^{c}±0.53	9.33^{e}±.050	92.00^{d} ±3.0
Wheat flour 100 + 20 SGB	8.78^{e}±0.72	19.22^{c}±0.0	14.33^{c}±0.50	14.22^{c}±0.60	19.44^{b}±0.53	9.55^{b}±0.53	9.55^{c}±0.53	90.22^{e} ±3.3
Wheat flour 100 + 25 SGB	8.55^{f}±0.92	19.00^{d}±0.5	14.33^{c}±0.50	14.00^{d}±0.71	18.89^{c}±0.71	9.22^{e}±0.44	9.55^{c}±0.52	84.56^{f} ±3.7
Wheat flour 100 + 30 SGB	8.89^{d}±0.78	18.89^{e}±0.30	13.11^{d}±0.83	13.67^{e}±1.0	17.67^{c}±0.60	7.33^{f}±0.99	9.22^{f}±0.44	83.22^{g} ±3.8
LSD at 0.05	0.03	0.04	0.04	0.05	0.06	0.06	0.06	0.27

Specifically in terms of biscuits colour, crust appearance, texture, crispness, taste, odour, mouthfeel and overall acceptability were scored values ranged from 8.78 to 9.67, from 18.89 to 19.56, from 13.11 to 14.67, from 13.67 to14.89, from 17.67 to 19.67, from 7.33 to 10.0, from 9.22 to 9.89 and from 83.22 to 95.56, respectively for biscuits with different addition of SGB. While control sample scored 10.0, 19.44, 14.33, 14.89, 19.44, 9.33, 9.66 and 99.67 for the same characteristics, respectively.

Furthermore, taste and odour were more affected by addition of biscuit powder (SGB) than other characteristics.

More importantly, these results indicate that there were no discernible sharp destroyed in the specific attributes of crust appearance, texture, crispness, taste, odour and overall preference between all biscuit samples produced with addition of SGB and control.

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دراسات على استخدام بسكويت الدرجة الثانية باضإفته إلى العجينة في صناعة البسكويت

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تهدف الدراسة الحالية إلى خفض تكاليف صناعة البسكويت عن طريق حل مشكلات صناعة البسكويت فى مصر، وفى هذه الدراسة تم استخدام بسكويت الدرجة الثانية الناتج أثناء التشكيل بالفورمة أو الزائد فى الوزن أو المنخفض وزنه وكذلك البسكويت غير المغلف أو الذى به عيوب تغليف والذى يعد فاقد حيث يضاف مطحونا أثناء عمل عجينة البسكويت بهدف تقليل التكلفة الإنتاجية مع المحافظة على جودة البسكويت الناتج، وخلصت النتائج إلى انه لا توجد اختلافات معنوية بين العينات المصنعة وعينة الكنترول عند نسب الإضافة ٥، ١٠، ١٥ و٢٠ جم/١٠٠جم دقيق قمح (٧٢%) من بسكويت الدرجة الثانية المضاف من حيث المظهر والقوام والهشاشية والطعم والرائحة ودرجة القبول العام وفى نفس النتائج لوحظ بأنه توجد فروق معنوية عند إضافة مطحون بسكويت الدرجة الثانية ٢٥ و٣٠جم/١٠٠جم دقيق قمح (٧٢%).

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