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NUTRITIVE VALUE OF BISCUITS SUPPLEMENTED WITH SOME NUTRITIONAL WASTES

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ABSTRACT

Supplementation of wheat flour with some dried nutritional wastes (lettuce leaves and peanut hulls at the levels of 5, 7.5 and 10 % to produce biscuits was investigated. The effect of supplementation on the rheological properties of wheat dough, baking quality, nutritive value and organoleptic properties of biscuits were studied. Results indicated that, the dough weakening decreased by addition of nutritional wastes at all used levels. Addition of nutritional wastes to wheat flour also enhanced the baking quality of biscuits. On the other hand, the quality of protein in biscuits was improved by supplementation with nutritional wastes, since the lysine content in supplemented biscuits was higher than the unsupplemented one. Moreover, mineral content was higher in nutritional wastes samples than in wheat flour, hence, biscuits supplemented with nutritional wastes were favorable than standard ones probably due to higher amounts of important minerals contained. The organoleptic evaluation showed no significant differences between standard biscuits and those supplemented with 5 % nutritional wastes. Therefore, it might be recommended that wheat flour could be supplemented with at the level of 5% dried lettuce leaves and 10% of dried peanut hulls for making biscuits.

INTRODUCTION

In semisweet biscuit dough, the main components are wheat flour, fat, sugar, and water. The low content of fat and sugar, and the relatively high water content allow a gluten network to be developed during mixing (Oliver and others, 1995). In the biscuit processing, the dough is sheeted and laminated in several steps, and the gluten network is stretched and aligned in the direction of sheeting (Levine and Drew, 1994). After sheeting, the dough is allowed to relax for a short period of time before cutting. The elasticity and stresses applied during processing will make the dough shrink, which may result in biscuits with oval dimensions.

Peanuts are characterized by high oil and protein content and a low percentage of carbohydrates and ash (Grosso and Guzman, 1995). A large proportion of peanut production in the world goes into domestic food use, the end products being peanut butter, salted peanut products, confections, and roasting stock. These peanut containing foods have widespread popularity because of their unique roasted peanut flavor. The rest of the peanut production is used for an edible source of high-quality oil. Peanuts are continually applied for preparation of new and improved food products; thus, a more complete knowledge of their composition and flavor properties is desirable (Ahmed and Young,1982).

Several studies on the antioxidant components from peanut hulls have been performed. Duh and Yen (1992) extracted and identified luteolin as antioxidant component. Duh and Yen (1992) described the relationship

between antioxidant activity of methanol extracts and maturity of peanut hulls and reported that the total phenolic content increased with maturity. Yen and Duh (1994) reported a marked radical-scavenging effect of methanolic extracts of peanut hulls; in 1995, they also found that the Spanish peanut cultivar had higher total phenolic content than other peanut cultivars. Finally, Duh and Yen (1997) reported that antioxidant compounds of methanolic extracts from peanut hulls had antioxidant efficacy in soybean and peanut oils. Nepote *et al.* (2002) have found antioxidant activity in vegetable oil of compounds from peanut skins.

Peanut skins are a waste from blanched processing of peanut kernels. In Argentina, peanut skins are sometimes used to feed cattle; however, their value could be increased if other more valuable uses like natural antioxidant sources could be found for that waste.

Lettuce (*Lactuca sativa L.*) is 1 of the most popular green salad vegetables around the world. In recent years, the consumption of lettuce in the United States has increased, particularly among non-head types such as Romaine and leaf lettuce (USDA 2005). According to the USDA (2005), per capita consumption of Romaine and leaf lettuce in the United States increased from 5.0 lb/y in 1993 to 9.5 lb/y in 2003. For all types of lettuce, Glaser *et al.* (2001) reported the average per capita consumption in the United States to be 33 lb/y. This vegetable provides relatively little nutrient value per unit weight, but considering that its per capita consumption is high, lettuce is an important contributor of dietary fiber and other nutrients, such as vitamin A, vitamin C, calcium, potassium, and magnesium to the American diet (Ryder 1999).

Baked products are consumed world wide. Investigations to improve the nutritional value have shown that, the mineral, fat and protein content in wheat flour has been improved by supplementation with peanut hulls (Howe., 2000). Also, fortification of wheat flour with non-wheat proteins has increased protein quality by improving its amino acid profiles (Stark *et al.*, 2003). Biscuits backed from supplemented wheat flour with dried peanut hulls and lettuce leaves (Onweluzo & Iwezu, 2005) have both higher protein and calorific value than biscuits baked from wheat flour only.

On the other hand, biscuits made from wheat flour supplemented with 15 % peanut scored the highest flavor characteristics. Thickness, diameter and spread ratio of biscuits containing different levels of peanuts hulls was significantly different from control samples (Singh *et al.*, 2000).

Use of peanuts powder as a partial substitute for wheat flour in sweet biscuits has increased water absorption, decreased dough developing time and weakening of the dough (Villarroel *et al.*, 1993).

A metabolic study on biscuits containing lettuce powder shows decrease in total and low-density-lipoprotein (LDL) cholesterol and increase in the high- density-lipoprotein (HDL) cholesterol. It has been proved that lettuce powder had a beneficial effect on blood lipids (Tumbull *et al.*, 1992).

Due to the above mentioned information a research study has been performed to evaluate the effect of supplementing wheat flour with different levels of dried peanuts hulls and lettuce leaves on the nutritive, organoleptic and baking qualities of biscuits.

MATERIALS AND METHODS

- **Materials** :
- **Wheat flour :**

Soft wheat flour 72 % extraction, obtained from North Mills Company Egypt, was used in this study.

- **Lettuce leaves :**

Lettuce (*Lactuca sativa L.*) leaves obtained from local market, was dried at 55°C over night. Dried Lettuce leaves was milled using 0.5 mm mesh sieves and was added to wheat flour at the levels of 5, 7.5 or 10 %.

- **Peanut hulls :**

Peanut hulls obtained from EL-Naser Toaster in Tanta governorate was dried at 55°C over night and milled using 0.5 mm mesh sieves and was added to wheat flour at the levels of 5, 7.5 or 10 %.

- **Methods :**

a- Analytical methods

Samples were analyzed for moisture content, total nitrogen using microKjeldahl apparatus, crude fiber, fat (ether extract) and ash as described in the A.O.A.C. (1995). The digestible crude protein was calculated, N x 6.25 for nutritional wastes as mentioned by Crisan & Sands (1978) and N x 5.7 for wheat flour. Carbohydrates were calculated by difference.

Determination of cupper, zinc, manganese, iron, and potassium were estimated as mentioned by Chapman & Pratt (1961). Phosphorus was measured according to Jackson (1958). Calcium and magnesium were estimated as described by Lau (1982).

Lysine was determined using the ninhydrin colorimetric analysis as described by Rosen (1956).

Amino acid score (A.A.S.) as mentioned by FAO/WHO (1973) was as follows:

$$\text{Amino acid score (\%)} = \frac{\text{mg of amino acid in 1 g test protein}}{\text{mg of amino acid in reference protein}} \times 100$$

It has been indicated; in the same reference that lysine concentration in references casein protein is 55 mg per g of protein.

b- Organoleptic quality

The organoleptic characteristics of biscuits, i.e. taste, odor, texture, color, shape, and appearance were examined as described by Zobik and Hoojjat(1984).

c-Rheological properties of the dough :

Water absorption and mixing characteristics of tested flours were determined using Brabender Farinograph and Extensograph methods as described in A.O.A.C. (1995).

d- Baking quality of biscuits

Baking quality tests were conducting to the methods described in the A.O.A.C. (1995). Cookie measures included, cookie weight, volume, specific volume, diameter, thickness, and spread ratio. The spread ratio was calculated as the average diameter/average thickness.

The standard formula prescribed by the A.O.A.C. (1995) used for of biscuits was as follows:

Ingredients	*wt. g /100 g flour*
Wheat flour (14% moisture basis)	100.0
Water	7.1
Sugar	57.77
Shortening	28.44
Salt	0.93
Sodium bicarbonate	1.11
Dextrose solution in 150 ml H20	14.66

Recipe:

- Sugar and Sodium bicarbonate were melted in cold Dextrose solution in plastic bowl and stirred by using a wooden spoon.
- Shortening was added then turned over the mixture for 15 minutes.
- Wheat flour for control sample, wheat flour with 5, 7.5 and 10% of nutritional wastes as a replace from the weight flour for the tested sample, water and salt were added to the mixture with manual continuous stirring with a wooden spoon. The mass (dough) was formed manually in ball-shopped and let in refrigerator for 15-30 minutes.
- After words, dough was flattened spread out manually to obtain a thin layer less than 0.25 cm, which cut in small round disks by using a sharp borer and the surface pierced with fork before baking on lightly grease trays with oil .
- Finally baked in a baking oven.

RESULTS AND DISCUSSION

1- Chemical composition of wheat flour and dried lettuce leaves and Peanut hulls:

Wheat flour, dried lettuce leaves and peanut hulls were analyzed for their chemical composition i.e., carbohydrates, protein, lipids, fiber and ash. The obtained results are shown in table (1) on the dry weight basis.

From the results presented in table (1) it could be noticed that, the wheat flour 72% extraction contained 84.33%, 13.19%, 1.24%, 0.56% and 0.68% carbohydrates, protein, fats, fiber and ash respectively. Concerning dried lettuce leaves, it was found to contain 32.6, 14.1, 8.5, 12.4 and 32.4% protein, lipids, ash, fiber and carbohydrates respectively, while in case of Peanut hulls contained 13.3, 18.7, 11.5, 3.17 and 53.33% of the same content respectively.

From these results it could be noticed that, the dried lettuce leaves was the higher in protein and fiber while Peanut hulls contained the higher fat, ash and carbohydrates.

These results confirmed those obtained by El- badrawy (1994) who found that wheat flour 72% extraction contained 84.35% carbohydrates. 13.11 protein, 1.51% lipids and 0.415 fiber.

Our results were found also to agree with those of (Bock *et al.*,1996). As they found dried lettuce leaves contains 27-31%protein, and 10-16%ash, and with Kelawala *et al.,* (2004) who reported that Peanut hulls contained 5.56-21.31% fat.

Table (1): Chemical composition of wheat flour and dried lettuce leaves and peanut hulls (% dry weight basis).

Constituents	Wheat flour (72%)	Dried lettuce leaves	Dried peanut hulls
Crud protein	13.19	32.6	13.3
Fat	1.24	14.1	18.7
Ash	0.68	8.5	11.5
Fiber	0.56	12.4	3.17
Carbohydrate	84.33	32.4	53.33

2- Effect of supplementation of biscuits with different levels of lettuce leaves and peanut hulls:

Carbohydrates, protein, fats, fiber and ash were determined in control biscuits (100% wheat flour) and the biscuits which supplemented with different levels of lettuce leaves and peanut hulls.

The obtained results are shown in table (2). Regarding the changes in the protein, fiber and carbohydrates of biscuits under investigation. The biscuits which supplemented with dried lettuce leaves at all levels resulted in increasing protein, and in decreasing lipids, fiber, ash and carbohydrates than the control and the biscuits with peanut hulls.

From the same table, it could be noticed that, supplementation of biscuits with peanut hulls was associated with the increasing of protein, lipids, fiber and ash than that of biscuits without supplementation and increasing of lipids, fiber, ash and carbohydrates than the biscuits with lettuce leaves. These increases in protein, lipids, fiber and ash may due to increase these nutrients in lettuce leaves and peanut hulls.

Table (2): Effect of supplementation of biscuits with different levels of lettuce leaves and peanut hulls:

Sample	Protein	Fat	Ash	Fiber	Carbohydrate
Control	7.27	19.7	0.64	0.45	71.94
Supplemented with 5% lettuce leaves	8.21	20.32	1.01	1.07	69.39
Supplemented with 7.5% lettuce leaves	9.06	20.59	1.21	1.36	67.78
Supplemented with 10% lettuce leaves	9.89	21.03	1.42	1.67	65.99
Supplemented with 5% peanut hulls	7.89	20.54	1.11	0.51	69.95
Supplemented with 7.5% peanut hulls	8.12	20.91	1.32	1.12	68.53
Supplemented with 10% peanut hulls	8.43	21.38	1.63	1.95	66.61

3- Effect of supplementing wheat flour with different levels of dried lettuce leaves and Peanut hulls on the protein quality of biscuits.

Data mentioned in table (2) clearly show that supplementation of biscuits with dried lettuce leaves and peanut hulls increased both the amount of total crude protein and the quality of the protein evaluated by its lysine content. The protein content reached 7.27, 8.21, 9.06, 9.89,7.89, 8.12 and 8.43 %in standard biscuits and in supplemented with 5, 7.5, or 10 % dried lettuce leaves and peanut hulls, respectively. In table (3) Lysine content also increased from 5.80 mg/g protein in standard biscuits to 6.3, 6.5, 6.74, 6.09, 6.21and 6.54 mg/ g protein when biscuits were supplemented with 5, 7.5 or 10 % dried lettuce leaves and peanut hulls, respectively. The lysine score shown in the same table has increased in the supplemented biscuits as compared with the unsupplemented ones due to the improvement in lysine

contents, which is limiting in wheat flour and present at high concentrations in dried lettuce leaves. (Table 3)

Lysine score reached 10.55, 11.45, 11.82, 12.25, 11.07, 11.3and 11.89 % for standard biscuits and biscuits supplemented with 5, 10 or 15 % dried lettuce leaves and Peanut hulls, respectively was calculated using the following formula

$$\text{A.A.S. (\%) for lysine} = \frac{\text{mg of lysine in 1 g test protein}}{55} \times 100$$

Also, Hassan *et al.*, (1990) and Faheid and Hegazi, (1991) have improved the protein quality of biscuits by adding fish protein flour and legume flour which are rich in lysine content.

Table (3): Effect of supplementing wheat flour with different levels of dried lettuce leaves and peanut hulls on protein quality and quantity of biscuits.

Type of biscuits	Crude protein, %	Lysine (mg/g protein)	Lysine score, %
Wheat flour	13.19	5.4	9.82
Dried lettuce leaves	32.6	7.6	13.82
Peanut hulls	13.3	3.4	6.21
Standard biscuits	7.27	5.8	10.55
Biscuits supplemented with 5% lettuce leaves	8.21	6.3	11.45
Supplemented with 7.5% lettuce leaves	9.06	6.5	11.82
Supplemented with 10% lettuce leaves	9.89	6.74	12.25
Supplemented with 5% peanut hulls	7.89	6.09	11.07
Supplemented with 7.5% peanut hulls	8.12	6.21	11.3
Supplemented with 10% peanut hulls	8.43	6.54	11.89

4- Mineral content (p.p.m) of dried lettuce leaves , peanut hulls and wheat flour.

Minerals contents of dried lettuce leaves , peanut hulls and wheat flour are shown in table (4).

Dried lettuce leaves content of such elements were 205 p.p.m Fe , 78 p.p.m Cu , and 314 p.p.m Zn.

On the other hand, peanut hulls had high content of these elements. It had 314 p.p.m Fe, 111 p.p.m Cu, and 521 p.p.m Zn. From the above results all the tested samples with lettuce leaves and peanut hulls at different levels were had higher content in the determined minerals than the wheat flour.

Dried lettuce leaves , peanut hulls and wheat flour contained had very low amounts of pb and these amounts lower than the suggested by FAO and WHO, the average of lead was 100-300µg/day (Maria, 1991).

Table (4): Mineral content (p.p.m) of dried lettuce leaves, Peanut hulls and wheat flour.

Materials	Iron	Cupper	Zinc	Lead
lettuce leaves	205	78	314	0.006
peanut hulls	314	111	521	0.005
wheat flour	20	21	20	0.007

5- Organoleptic properties of biscuits with dried lettuce leaves and peanut hulls.

A five member taste panel scored color, odor, flavor, texture and overall acceptability of biscuits baked with 100% wheat flour and dried lettuce leaves and peanut hulls at the levels of 5, 7.5 and 10% as shown in tables (5).

Data from table (5) show that, all organoleptic properties for biscuits supplemented with 5, 7 and 10% of peanut hulls were increased significant ($P<0.05$). Biscuits baked using wheat flour alone was better in organoleptic qualities than that fortified with 7.5 and 10% of dried lettuce leaves.

Statistical analysis of the results indicated a significant decrease ($P<0.05$) of all organoleptic properties for biscuits supplemented with 7.5 and 10% of dried lettuce leaves as compared to control .

The best organoleptic properties for supplemented biscuits with 5 ,7 and 10 % of peanut hulls because these treatments showed no significant changes in total scores as compared with the lowest supplementation . Such results were in agreement with those obtained by Orr *et al.*, (1982).

The same results reported by Sharma, (2002) reported that biscuits with 10% peanut hulls gave a product of acceptable quality.

Table (5): Organoleptic properties of biscuits with dried lettuce leaves and Peanut hulls.

Organoleptic properties	Control	biscuits with peanut hulls			biscuits with lettuce leaves		
Properties	Wheat flour	Wh.f+ 5%	Wh.f+ 7.5%	Wh.f + 10	Wh.f+ 5%	Wh.f+ 7.5%	Wh.f + 10%
Color	9a	9a	9a	9a	8a	7.7b	6c
Odor	9a	9a	9a	9a	7b	6c	6c
Flavor	9a	9a	9a	9a	7b	6c	6c
Texture	9a	9a	8a	8a	8a	7b	6c
Overall acceptability	9a	9a	8a	8a	8a	7b	6c
LSD	0.003	0.002	0.05	0.07	1.03	4.02	1.031

6- Extensogram properties for dough prepared from flour containing 0-10% dried lettuce leaves and peanut hulls.

From the results presented in table (6) it could be noticed that, extensibility of the dough decreased from 250 mm for wheat flour alone to 200mm for wheat flour containing5% lettuce leaves, while increasing the addition of lettuce leaves to 7.5, 10% caused a decrease in dough stability to 170 and 145 mm, respectively. Maximum resistance to extension was found to be increased from 420 for wheat flour alone to 634 mm for wheat flour containing5% lettuce leaves, while increasing the addition of lettuce leaves to 7.5, 10% caused a increase in dough resistance to (B.U) extension to 851 and 957 B.U, respectively.

From the results presented in table (6) it could be noticed that , extensibility of the dough decreased from 250 mm for wheat flour alone to 210mm for wheat flour containing 5% peanut hulls, while increasing the addition of peanut hulls to 7.5,10% caused a decrease in dough stability to

196 and170mm, respectively. Maximum resistance to extension was found to be increased from 420 for wheat flour alone to 563 mm for wheat flour containing5% peanut hulls, while increasing the addition of peanut hulls to 7.5, 10% caused a increase in dough resistance to extension to 781 and 833 B.U, respectively.

From the above results, it could noticed that the extensibility of the dough decreased in case of lettuce leaves followed by peanut hulls which recorded the lowest decrease. Whereas in case of, maximum resistance to extension increased for lettuce leaves dough followed by peanut hulls dough. The extensibility of the dough decreased and for all samples by increasing and maximum resistance to extension was found to be increased by increasing the levels of nutritional wastes.

Table (6): Extensogram properties for dough prepared form flour containing 0-10% lettuce leaves.

Blends		Dough extensibility		Resistance to (*B.U) extension	
Wheat Flour	additives	lettuce leaves	peanut hulls	lettuce leaves	peanut hulls
100	0	250	250	420	420
95	5	200	210	634	563
93	7	170	196	815	781
90	10	145	170	957	833

* B.U. = Brabender Unit

7- Farinogram parameters for dough prepared flour containing 0-10% lettuce leaves and peanut hulls

The results presented in table (7) showed the effect of addition of lettuce leaves and peanut hulls to wheat flour 72% extraction on farinograph reading.

From these results it could be noticed that, addition of lettuce leaves to wheat flour increase in water absorption of the dough. It was increased from 55.5 for wheat flour to 70.4, 79.2 and 88.1% with addition of 5, 7.5 and 10% of lettuce leaves respectively.

The results indicated also that addition of lettuce leaves to wheat flour caused a increased in arrived and decreased in dough stability. Arrived time was found to be 1.5 for wheat flour and 4.5, 5.75 and 9.45 min with addition of 5, 7.5 and 10% of lettuce leaves, dough stability was found to be 11.5 for wheat flour and 11.67, 12.21 and 12.33min at the levels 0, 5, 7.5 and 10% of lettuce leaves.

Softening of dough after 20 min found to be 40 for wheat flour where the addition of lettuce leaves cause decrease in the time needed for softening (34, 30 and 26 min), while after 10 min was 0 at different levels.

The results presented in table (7) showed the effect of addition of peanut hulls to wheat flour 72% extraction on farinograph reading.

From these results it could be noticed that, addition of peanut hulls to wheat flour increase in water absorption of the dough. It was increased from

55.5 to 67.7, 71.6 and 77% for wheat flour and with addition of 5, 7.5 and 10% of peanut hulls.

The results indicated also that addition of peanut hulls to wheat flour caused a increased in arrived time and decreased in dough stability. Arrived time was found to be 1.5, 3.5,5.0 and 6.1 min , dough stability was found to be 11.5 for wheat flour and 9.51, 8.64 and 8.45 min at the levels 0, 5,7.5 and 10%.

Table (7): Farinogram parameters for dough prepared flour containing 0-10% potato peel.

Blends		Water absorption		Arrived time min		Stabillty min		Softening of dough			
								After 10min		After 20 min	
Wheat Flour	additives	lettuce leaves	peanut hulls	lettuce leaves	peanut hulls	lettuce leaves	peanut hulls	lettuce leaves	peanut hulls	lettuce leaves	peanut hulls
100	0	55.5	55.5	1.5	1.5	11.5	11.5	0	10	40	40
95	5	70.4	67.7	4.5	3.5	11.67	9.51	0	10	34	70
93	7	79.2	71.6	5.75	5.0	12.21	8.64	0	10	30	88
90	10	88.1	77.0	9.45	6.1	12.35	8.45	0	10	26	106

Softening of dough after 20 found to be 40 for wheat flour and 70, 88 and 106 min, while after 10 min was 10 at different levels.. These results agreed with those found by Shams-El-Din and Yassen (1997).

8-The effect of supplementing wheat flour with dried lettuce leaves and peanut hulls on the baking quality of biscuits.

Data in table (8) show that biscuit weight increased with increasing lettuce leaves concentration. It increased from 3 to wheat flour (72% extraction) to 3.1,3.2 and 3.3g at the levels 0,5,7.5 and 10% . This enrichment due to the very high water retention of very high fiber content of lettuce leaves .

Biscuit volume and specific volume were decreased by increasing lettuce leaves addition. Biscuit volume decreased from 8cm. at control sample to 7.91, 7.85 and 7.74 cm. with 5, 7.5 and 10% respectively. These decreases may due to the dilution of gluten (Pomeranz *et al.*, 2005), and high fiber content of lettuce leaves beside the slow formation of gluten network, which the parameter dough development time cleared it. This may be due to the high ability of dietary fiber components to swell and absorb more water as cited by Sosulski and Cadden, (1982).

Specific volume of biscuits decreased from 2.66 cm/g in control sample to 2.55, 2.54, 2.35 cm/g. with 5, 7.5 and 10% addition of peanut hulls respectively.

The results presented in the same table showed that biscuits weigh increased with increasing peanut hulls concentration. It increased from 3 to wheat flour (72% extraction) to 3.04,3.12 and 3.24g at the levels 0,5,7.5 and 10% . This enrichment due to the high water retention of high fiber material content of peanut hulls.

Peanut hulls volume and specific volume were decreased by increasing peanut hulls addition. biscuit volume decreased from 8cm. at control sample to 7.96,7.94 and 7.81cm. with 5, 7.5 and 10%respectively.

These decrease may due to the dilution of gluten (Pomeranz *et al.*, 2005), and high fiber content of peanut hulls.

Specific volume of biscuits decreased from 2.66cm/g in control sample to 2.62, 2.55, 2.41 cm/g. with 5, 7.5 and 10% addition of peanut hulls respectively. From the results, it could be concluded that, fiber of peanut hulls have a real weakness effects in dough blends, attributed to the dilution of gluten by fibers. Same conclusion was found by Sharaf *et al.*, (2002) for wheat bran fiber. Generally, it could be concluded that the poor baking quality of high biscuits produced from lettuce leaves and peanut hulls has been attributed to several factors : 1- the dilution of the functional gluten proteihs, 2- the interaction between fibrous materials and gluten which can partly explain the poor baking quality of both lettuce leaves and sugar beet pulp fiber additives.

Same results obtained by Chen *et al.*, (1988) when they used apple fiber, wheat and oat bran as a source of fiber.

Table (8): Effect of supplementing wheat flour with different levels of dried lettuce leaves and peanut hulls on the baking quality of biscuits.

Blends		biscuit weight (g)		biscuit volume cm^3		specific volume (cm^3/g)	
Wheat Flour	additives	lettuce leaves	peanut hulls	lettuce leaves	peanut hulls	lettuce leaves	peanut hulls
100	0	3	3	8	8	2.66	2.66
95	5	3.1	3.04	7.91	7.96	2.55	2.62
93	7	3. 2	3.12	7.85	7.94	2.54	2.55
90	10	3.3	3.24	7.74	7.81	2.35	2.41

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القيمة الغذائية للبسكويت المدعم ببعض المخلفات الغذائية

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تناول هذا البحث دراسة تأثير تدعيم دقيق القمح ببعض المخلفات الغذائيـــة الجافـــة (أوراق الخس وقشر فول السوداني) عند تركيز ٥، ٧,٥، و ١٠% علي جودة البسكويت الناتج. حيث تمـــت دراسة تأثير هذه الإضافة علي الخواص الريولوجية للعجينة وجودة الخبيز والخواص الحسية والقيمة التغذوية للبسكويت الناتج. أشارت النتائج أن إضافة تلك المخلفات بجميع المستويات أدت إلي خفـــض درجة الضعف للعجينة وتحسين جودة البسكويت الناتج. كما أدت إلي تحسين جودة بروتين البسكويت حيث زاد محتوي الليسين في البسكويت المدعم عن الكنترول. علاوة علي ذلك زيادة محتوي الأملاح في العينات المدعمة. وأظهرت النتائج الحسية أنه لا يوجد فرق معنوي بين العينة الكنترول والعينـــات المدعمة ب ٥% من المخلفات الغذائية. وعلي ذلك يمكن تدعيم دقيق القمح بأوراق الخس المجففة عند تركيز ٥% وقشر فول السوداني المجفف عند تركيز ١٠% لإنتاج البسكويت.