



Effect of using high fiber plant wastes, by-products and composite flour on the quality of the resulted biscuits

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ABSTRACT:

In this research, wheat flour 72% was partially replaced by oat flour, orange peel powder and red wheat pollard during making biscuit in order to raise the level of fibers in the produced biscuit. The percentage of replacement for such additives with 2, 4, 8, and 12% regarding to the wheat flour used in biscuit recipes. The study follows the changes which happened in the chemical components of biscuits, data indicated that a significant differences for all determinants of chemical composition between control biscuits in comparison with the oat biscuits, red wheat pollard biscuits and orange peel powder biscuits, except for the moisture content, which does not show significant differences ($p < 0.05$) for it. The contents of ash, fat and crude fiber of biscuits were increased with adding the red wheat pollard, also the whole oat flour led to an increase in protein content in biscuit samples. Organoleptic evaluation was also followed to the quality attributes of biscuit. Results showed that there were significant differences ($p < 0.05$) between all biscuits treatments of the evaluated characteristics, except the piece size, uniformity and taste. The red wheat pollard biscuits had the highest score in the sensory evaluation, followed by oat flour biscuits, while orange peel powder biscuits recorded the lowest values. The acid value of biscuits was also determined and registered after a storage period up to 6 months at room temperature of $25 \pm 2^\circ\text{C}$. Data mentioned that the acid value increased with increasing the addition rate of additives and with increased storage period up to 6 months.

KEYWORDS: Biscuits, Oat flour, Orange peel powder, Red wheat pollard, Chemical composition, Sensory evaluation, Acid value.

1-INTRODUCTION:

Biscuits are an important and famous foodstuff and are consumed by a wide range of people due to the variety of their taste, long shelf life and relatively low cost. Because of the large consumers demand for natural and functional products that are healthy and safe, efforts are being made to improve the nutritional value.

And functionality of biscuits by modifying their composition, by increasing the proportion of whole grains with ingredients other than wheat or using many types of dietary fiber in the basic recipes of biscuits, with an attempt to increase the proportion of protein and minerals for quality and availability (Tyagi et al., 2007).

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The main ingredient used in the manufacture of biscuits is wheat flour, which lacks in many nutrients such as vitamins, minerals and dietary fiber (Ayo and Nkama, 2003). Wheat flour lacks in the essential amino acids, like lysine and tryptophan. The process of enrichment biscuits with some nutrients is important because of the increased nutritional awareness of consumers. Hence, there is an acceptance of partial replacement of wheat flour with other food ingredients in order to produce functional food (Awan et al., 1991).

Sudha et al. (2005) reported that, the demand for health-safe food products, such as products rich in dietary fiber, are increasing. One of the recent trends is to increase the content of dietary fiber in food products, due to its role to overcome some diseases such as high blood pressure, diabetes, colon cancer, and others. Consuming food products rich in dietary fiber, such as cellulose, hemicellulose, lignin and gum has many health benefits. The use of whole flour of some cereals and legumes with wheat flour in biscuit production improves its nutritional and functional properties (Vitali et al., 2009). Dietary fiber has been used for the treatment of various gastrointestinal disorders and health benefits including lowering cholesterol levels, reducing risk of colon cancer and losing weight. Dietary fiber has also been reported to have some nutraceutical potentials (Kushwaha and Maurya, 2019; Gill et al., 2020).

Nowadays, oat products are very popular due to their health benefits. Oat is one of the cereal products that has good nutritional qualities due to its content of protein, fiber, minerals and vitamins (Sterna et al., 2016). The most important type of fiber in oats is the soluble β -glucan, which is a heterogeneous group of non-starch polysaccharides. There are many studies that have confirmed that this type of fiber has beneficial effects on some diseases such as obesity, diabetes, hypertension, dyslipidemia and others (El Khoury et al., 2011).

Orange peels contain soluble sugars about (16.9%), cellulose (9.21%), hemicellulose (10.5%) and pectin around 42.5% (Beatriz et al., 2008). Several studies have shown that most of the phytonutrients are found in the peel and in the inner white pulp, not in the juice of orange (Brett, 2011).

Schalow et al. (2018) reported that the amount of peel and pulp obtained from citrus fruit processing accounts for 50% of the original amount of the whole fruit. These peel and pulp contain among other things, high levels of vitamin C, dietary fiber and some bioactive substances believed to have positive health implications. These facts notwithstanding citrus peels and pulps are most often discarded.

Due to the nutritional value of bran as a by-product of the milling process In addition, it is cheaply and readily available, the researchers have recently tended to incorporate bran from different grains in the manufacture of biscuits as a high source of dietary fiber (Hegazy et al., 2009). Wheat bran represents about 14.5 of the weight of the kernel, and it is a high source of dietary fiber and some other nutrients such as proteins with around 14%, minerals around 5% and fats by 6%, in addition to containing vitamins of B group. (Anwarul et al., 2002; Kent and Evers, 1994). The aim of the present study is production of high-fiber biscuits by replacement of wheat flour 72% with different levels of plant wastes, by-products and composite flour (orange peels powder, red wheat pollard and whole oat flour). Then studying the quality attributes of the resulted biscuits.

2. MATERIALS AND METHODS:

Materials.

Wheat flour and red wheat pollard;

Wheat flour (72% extraction rate) and red wheat pollard were obtained from Middle Egypt Flour Mills Co., (Buhler mills) located at Fayoum Governorate, Egypt.

Whole oat flour:

Whole oat flour was obtained by purchasing through the market, and it was within the

shelf life for use and conforms to the Egyptian standard specifications.

Orange peels:

The orange peel powder was obtained by collecting the orange peels, then cutting it into small pieces, placing it on stainless steel trays, after that transferring to the drying oven at a temperature of 100 °C until the weight was constant, then the dried peels were electrically ground to obtain the dried orange peels powder.

Other components:

The other components that used in the manufacture of biscuits; sugar, butter, eggs,

baking powder and vanilla were purchased from the local market in Fayoum city and used according to the standard specification.

Methods.

Preparation of biscuits:

The blends were prepared by partial replacement of 72% wheat flour with different levels of oat flour, orange peel powder and red wheat pollard as precisely described in **Table (1)** Biscuits formula was, according to the method described by Mostafa (1991) and after AACC methods No.10-52 (2000).

Table 1. Blends of 72% extraction rate wheat flour with oat flour, orange peels powder and red wheat pollard

Treatments No.	Wheat flour (g)	Oat flour (g)	Orange peels powder (g)	Red wheat Pollard (g)
Control	150	0	0	0
2%	147	3	3	3
4%	144	6	6	6
8%	138	12	12	9
12%	132	18	18	18

Dough preparation:

The dough was prepared by mixing 150 g of wheat flour (72% ext.) supplemented with different levels of oat flour, orange peel powder and red wheat pollard as precisely described. The other components were as follows: 5 g baking powder, 37.5 g butter, 0.5 g vanilla, 25 g eggs, 50 g sugar and 10-25 ml water. The ingredients were mixed in a laboratory mixer for 10 min and the dough was hand-kneaded until homogeneity.

Biscuits making:

The dough was sheeted to a thickness of 3.5 mm using an aluminum platform and a frame rolled with a rolling pin. Biscuits were shaped with a cutter at (4.6 mm dim), and baked on an aluminum tray at 220°C ± 5°C for 25-30 min. The number of pieces ranges between 30-35 pieces. The biscuits were cooled for 30 min and stored in airtight jars for 24 h for further analysis. Biscuit samples were packed in polyethylene bags and stored

at room temperature of 25 ± 2°C for other analysis.

Chemical analysis:

The components of chemical composition, of moisture, protein, ash, fat and crude fibers were determined according to AOAC (2016). Total carbohydrates were calculated by difference, according to the following equation:

Total carbohydrates = 100 - (Ash + Total Lipid + Total protein + Crude fiber).

Acidity measured as the acid value (AV), which determined as follows; a fifty grams of biscuit samples were ground, extracted three times with 150-ml n-hexane; the extract was filtered through a Whitman No.1 filter paper over anhydrous sodium sulfate. From this extract 10 ml of being pipette into a weighted dried dish and the solvent was removed in an oven at 100 °C, then the residue was weighted and percentage of fat in

10 ml extract was calculated. The acid value was determined according to the methods of AOAC (2016).

Sensory evaluation:

Sensory evaluation of biscuits was conducted by 10 panelists from the staff of Food Science and Technology Department, Faculty of Agriculture, Fayoum University, Fayoum, Egypt. Quality characteristics of biscuit blended with whole oat flour, orange peels powder and red wheat pollard. The examined characters included; external appearance, piece size, uniformity, color, texture, taste, sweetness, flavor and mouthfeel. The evaluation was done according to Ogunjobi and Ogunwolu (2010).

Statistical analysis:

The data collected was statistically analyzed by the variance (ANOVA) using the least significant differences (L.S.D.) at (5% level) with applying Duncan test according to Steel et al. (1997).

3. RESULTS AND DISCUSSION:

Chemical composition of biscuits partially substituted with oat flour, red wheat pollard and orange peels powder:

Biscuits samples made from 72% wheat flour and those made from wheat flour and oat flour, red wheat pollard and orange peels powder were analyzed for its chemical composition constituents, the results obtained are indicated in **Table (2)**. The results show that there are significant differences for all determinants of chemical composition between control biscuits in comparison with the oat biscuits, red pollard biscuits and orange peel biscuits, except for moisture content, which does not show significant differences for it.

The moisture content of control biscuits made from wheat flour 72% extraction was 4.67%, while the moisture content of biscuits blended with oat flour, red wheat pollard and orange peels powder at levels 2,4,8 and 12% were determined between (3.77 to 4.27%), (3.07 to 4.75%) and (4.27 to 5.83%), respectively. These results agreed with

Mostafa et al. (2017) and El-Qatey et al. (2018).

For the ash content of control biscuits was 0.67%, whereas ash content of biscuits containing oat flour, red pollard and orange peels at levels 2,4,8 and 12% varied from (0.77 to 0.93%), (0.82 to 1.0%) and (0.77 to 0.89%), respectively. Data indicated that increasing the ash content of biscuits blended with oat flour, orange peels powder and red pollard with an increased in the percentage of their addition. The 12% red wheat pollard biscuits achieved the highest value of ash content at 1.00%. The percentage of ash was increased in biscuits containing some sources of crude fiber, i.e. oat flour and agreed with what stated by (Yang et al., 2012).

The results indicated that the fat content of control biscuits was 15.60%, while the fat content of oat biscuits, red pollard biscuits and orange peels biscuits at levels 2,4,8 and 12% was found in the range (18.30 to 20.50%), (15.60 to 21.60%) and (17.50 to 19.60%), respectively. The red pollard biscuits at a level 12 % has a higher value of fat content (21.60%). These results are in agreement with Xhabiri et al (2014) who found that fat content of biscuit containing 15% wheat bran was 26.79%.

In case of protein content the control biscuits was 9.77%, whereas the protein content of biscuits partially substituted with oat flour, red pollard and orange peels powder at levels 2,4,8 and 12% between (10.30 to 11.50%), (1.40 to 2.60%) and (2.80 to 4.30%), respectively. Data refer to increasing the protein content of biscuits blended with oat flour compared to the control biscuits and other its additives. The 12% oat flour biscuits recorded the highest value of protein content at 11.50 %. The protein content in biscuits increased with increasing the levels of additives (Salehifar and Shahedi, 2007; El-Qatey et al., 2018).

The data showed that the crude fiber content of control biscuits was 11.67%, on the other hand the crude fiber content of biscuits

blended with oat flour, red wheat pollard and orange peels powder at levels 2,4,8 and 12% were between (12.16 to 13.02%), (12.20 to 13.20%) and (12.18 to 13.08%), respectively. Results indicated that increasing the crude fiber content of biscuits blended with oat flour, orange peels powder and red pollard with an increased in the percentage of their addition. The 12% red wheat pollard biscuits has a higher value of crude fiber content of 13.20% in comparison of the control biscuits and other its additives. The high content of dietary fiber in biscuits because of the high content of fiber in oat flour (Youssef et al., 2016). Nwosu et al. (2022) found that an increasing crude fiber in biscuits containing

orange peel powder. On the same trend Sharnouby et al. (2012) they found that the biscuits blended with red wheat flour led to an increase in its crude fiber content.

The obtained results indicated that the total carbohydrate content of control biscuits was 57.62%, while the total carbohydrate contents of oat biscuits, red pollard biscuits and orange peel biscuits at levels 2,4,8 and 12% ranged from (51.01 to 53.52%), (58.53 to 64.04%) and (57.59 to 68.06%), respectively. In this regard, Zaki and Hussien (2018) they found that the increase of oat flour in the biscuit ingredients led to a decrease in the total carbohydrate content compared to the control biscuit sample.

Table 2. Chemical composition of biscuits fortified with oat flour, red wheat pollard and orange peel powder

Biscuits samples	Component (%)					
	Moisture	Ash	Fat	Protein	Fibers	Total Carbohydrates
Wheat flour biscuits (control)	4.67a	0.67g	15.60h	9.77e	11.67e	57.62H
2% Oat flour	4.13a	0.83e	19.70c	10.30d	12.16d	52.88J
4% Oat flour	4.27a	0.77f	18.30f	10.80c	12.34d	53.52I
8% Oat flour	4.07a	0.85 c-e	20.50 b	10.90b	12.67bc	51.01I
12% Oat flour	3.77a	0.93b	18.80e	11.50a	13.02a	51.98K
Wheat flour biscuits (control)	4.67a	0.67g	15.60h	9.77e	11.67e	57.62H
2% Red wheat pollard	4.77a	0.82e	17.50 g	1.70i	12.20d	63.01C
4% Red wheat pollard	3.07a	0.85de	18.25f	1.40m	12.40cd	64.04D
8% Red wheat pollard	4.43a	0.99a	18.72e	2.50k	12.40cd	60.96E
12% Red wheat pollard	3.07a	1.00a	21.60a	2.60j	13.20a	58.53G
Wheat flour biscuits (control)	4.67a	0.67g	15.60h	9.77e	11.67e	57.62H
2% Orange peel powder	4.53a	0.78f	17.70g	2.80i	12.18d	62.01D
4% Orange peel powder	5.83a	0.77f	17.50 g	4.30f	12.36d	59.24F
8% Orange peel powder	5.77a	0.88cd	19.05d	4.00h	12.72b	57.59H
12% Orange peel powder	4.27a	0.89c	19.60i	4.10g	13.08a	68.06A
LSD (Value at 5%)	NS	0.040	0.240	0.026	0.295	0.403

Sensory evaluation of produced biscuits at zero time and during storage up to six months at room temperature:

External appearance:

Table (3) shows the external appearance of control biscuits made from wheat flour (72%

ext.), and biscuits substituted with oat flour, orange peel powder and red wheat pollard at levels 2,4,8 and 12% at zero time and during

storage up to six months. The results indicated that at zero time the control biscuits scored 9.20, while the values scored of external appearance oat biscuits, orange peel biscuits and red pollard biscuits ranged from 7.30 to 8.65, 7.60 to 8.70 and 8.50 to 9.90, respectively. The red wheat pollard has a higher value with level 12% at 9.90, whereas the lowest value obtained with oat biscuits at a level 2 % (7.30) compared the control biscuits, thus there are a significant differences between the biscuits samples among them of external appearance.

After storage of all biscuits samples for a period of three to six months, The results obtained of external appearance showed the control biscuits have values 8.60 and 9.20, during storage a period of three to six months, respectively. The highest value of external appearance scored to biscuits blended with red wheat pollard at a level 12 % (9.60) after storage a period of three months compared with control sample, the lowest value of external appearance obtained from 4% red pollard biscuits at 7.60 after storage a period of six months compared with the control sample.

Table 3. Effect of using oat flour, orange peel powder and red wheat pollard on biscuits external appearance during storage up to six months

Additives (A)	Storage time (S)			
	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits (control)	9.20a-d	8.60b-g	9.20a-d	9.00AB
2% Oat flour	7.30h	9.00a-d	7.70f-h	8.00C
4% Oat flour	8.65b-f	9.00a-d	7.90e-h	8.52BC
8% Oat flour	8.40c-g	9.20a-d	8.30c-h	8.63B
12% Oat flour	8.60b-g	9.00a-d	8.60b-g	8.73B
Wheat flour biscuits (control)	9.20a-d	8.60b-g	9.20a-d	9.00AB
2% Orange peel powder	8.50c-g	9.20a-d	8.50c-g	8.83B
4% Orange peel powder	8.70b-f	8.80b-e	8.20d-h	8.53BC
8% Orange peel powder	8.70b-f	8.60b-g	8.70b-f	8.90B
12% Orange peel powder	7.60gh	9.10a-d	8.70b-f	9.50A
Wheat flour biscuits (control)	9.20a-d	8.60b-g	9.20a-d	9.00AB
2% Red wheat pollard	9.30a-c	8.70b-f	8.50c-g	8.73B
4% Red wheat pollard	9.20a-d	8.80b-e	7.60gh	8.57BC
8% Red wheat pollard	8.50c-g	9.00a-d	9.20a-d	8.67B
12% Red wheat pollard	9.90a	9.60ab	9.00a-d	8.47BC
Average for (S)	8.66B	8.97A	8.47B	
LSD at 0.05	8.66	8.97	8.47	
A			0.600	
S			0.288	
A x S			1.04	

Also, after storing biscuits and its additives during six months a significant differences between treatments were appeared ($p < 0.05$). The explanation of external appearance results could be due to the presence of high percent of the fiber which lower the binding between ingredients of biscuit dough and

consequently affect evaluation scores. These results are in agreement with that mentioned by Leelavathi and Rao (1993).

Piece size:

From **Table (4)** it appears the piece size of control biscuits and its additives from oat flour, orange peel powder and red wheat

pollard at levels 2,4,8 and 12% at zero time and during storage up to six months. The results refer to at zero time the piece size value of control biscuits was 9.30, whereas the values scored of piece size of oat biscuits, orange peel biscuits and red pollard biscuits

were between 8.25 to 9.10, 8.30 to 8.60 and 9.10 to 9.60, respectively. The highest value of piece size obtained with biscuits containing red wheat pollard at a level 2 % (9.60), while the biscuits 2% oat flour has a lower score of 8.25.

Table 4. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit piece size during storage up to six months

Storage time (S)	Zero time	Three months	Six months	Average for (A)
Additives (A)				
Wheat flour biscuits (control)	9.30a	8.70a	9.20a	9.07AB
2% Oat flour	8.25a	8.70a	8.20a	8.38CD
4% Oat flour	9.10a	8.60a	8.30a	8.67A-D
8% Oat flour	8.30a	8.20a	8.00a	8.17D
12% Oat flour	8.70a	8.70a	8.80a	8.73A-C
Wheat flour biscuits (control)	9.30a	8.70a	9.20a	9.07AB
2% Orange peel powder	8.60a	8.80a	8.60a	8.67A-D
4% Orange peel powder	8.60a	8.60a	8.50a	8.57B-D
8% Orange peel powder	8.30a	8.80 a	8.30a	8.47CD
12% Orange peel powder	8.50a	8.80a	8.20a	8.50CD
Wheat flour biscuits (control)	9.30a	8.70a	9.20a	9.07AB
2% Red wheat pollard	9.60a	8.70a	9.10a	9.13 A
4% Red wheat pollard	9.50a	8.50a	8.70a	8.90A-C
8% Red wheat pollard	9.10a	8.90a	8.50a	8.83A-C
12% Red wheat pollard	9.40a	9.10a	8.90a	9.13 A
Average for (S)	8.87	8.70	8.56	
LSD at 0.05				
A			0.537	
S			NS	
A x S			NS	

Results indicated that no a significant differences between the biscuits samples at zero time and after storing the biscuits and its additives up to six months. The explanation of piece size results could be due to the presence of high percent of the fiber which lower the cohesiveness of biscuit dough and consequently affect piece size evaluation scores. These results are in agreement with that mentioned by (Nassar et al., 2008; Mahmoud, Marwa et al., 2017).

zero time and after storing the biscuits and its additives up to six months.

Uniformity:

The results that are shown in the **Table (5)** mention to the uniformity of 72% control biscuits and its blends with oat flour, orange peel powder and red wheat pollard. Data indicated that no a significant differences ($p < 0.05$) between all biscuits treatments at zero time and after storing it up to six months for uniformity property.

Table 5. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit uniformity during storage up to six months.

Additives (A)	Storage time (S)			
	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits (control)	9.00a	8.70a	9.30a	9.00A
2% Oat flour	8.55a	8.70a	8.40a	8.55A-D
4% Oat flour	8.65a	8.40a	8.50a	8.52A-D
8% Oat flour	8.20a	8.50a	8.00a	8.23B-D
12% Oat flour	8.30a	9.10a	8.90a	8.77AB
Wheat flour biscuits (control)	9.00a	8.70a	9.30a	9.00A
2% Orange peel powder	8.10a	8.10a	8.10a	8.10CD
4% Orange peel powder	8.90a	8.70a	8.40a	8.67A-C
8% Orange peel powder	8.50a	8.80a	8.20a	8.50A-D
12% Orange peel powder	8.20a	8.50a	8.60a	8.43A-D
Wheat flour biscuits (control)	9.00a	8.70a	9.30a	9.00A
2% Red wheat pollard	9.20a	8.60a	8.60a	8.80AB
4% Red wheat pollard	8.60a	7.90a	7.50a	8.00D
8% Red wheat pollard	9.40a	8.90a	8.20a	8.83AB
12% Red wheat pollard	9.30a	9.20a	8.50a	9.00A
Average for (S)	8.68	8.62	8.40	
LSD at 0.05				
A		0.628		
S		NS		
A x S		NS		

The explanation of uniformity results could be due to the presence of high percent of fiber in the replaced materials, which lower the cohesiveness of biscuit dough and

consequently affect the uniformity evaluation scores. These results are in agreement with that mentioned by (Nassar et al., 2008; Mahmoud, Marwa et al., 2017).

Color:

The obtained results in **Table (6)** appears the color of control biscuits and its additives from oat flour, orange peel powder and red wheat pollard at levels 2,4,8 and 12% at zero time and during storing up to six months. The data refer to at zero time the color value of control biscuits was 8.80, whereas the values scored of color of oat biscuits, orange peel

biscuits and red pollard biscuits were between 6.90 to 8.95, 7.50 to 8.60 and 8.50 to 9.20, respectively. The highest value of color obtained with biscuits containing red wheat pollard at a level 12 % (9.20), while the biscuits 2% oat flour has a lower score of 6.90.

Table 6. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit color during storage up to six months

Additives (S)	Storage time (A)			
	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits (control)	8.80a-f	8.50a-h	8.90a-e	8.73A-C
2% Oat flour	8.6.90j	8.60a-g	8.20c-i	7.90D
4% Oat flour	8.95a-e	8.80a-f	7.60h-j	8.45B-D
8% Oat flour	8.50a-h	9.00a-d	8.00e-i	8.50A-C
12% Oat flour	8.50a-h	8.90a-e	8.60a-g	8.67A-C
Wheat flour biscuits (control)	8.80a-f	8.50a-h	8.90a-e	8.73A-C
2% Orange peel powder	8.60a-g	8.50a-h	7.90f-i	8.33CD
4% Orange peel powder	8.60a-g	8.90a-e	7.70g-j	8.40B-D
8% Orange peel powder	8.40b-i	9.10a-c	8.10d-i	8.53A-C
12% Orange peel powder	7.50ij	9.00a-d	8.70a-f	8.40B-D
Wheat flour biscuits (control)	8.80a-f	8.50a-h	8.90a-e	8.73A-C
2% Red wheat pollard	9.00a-d	9.00a-d	8.70a-f	8.90AB
4% Red wheat pollard	8.50a-h	8.80a-f	9.40a	8.90AB
8% Red wheat pollard	8.80a-f	8.90a-e	8.10d-i	8.60A-C
12% Red wheat pollard	9.20ab	9.30ab	8.60a-g	9.03A
Average for (S)	8.48	8.87	8.35	
LSD at 0.05				
A			0.564	
S			0.271	
A x S			0.977	

During storage of all biscuits samples for a period of three to six months, the data obtained of color showed the control biscuits have values 8.50 and 8.90, during storage a period of three to six months, respectively. The highest value of color scored to biscuits blended with red wheat pollard at a level 4 % (9.40) after storage a period of six months compared with the control sample, the lowest value of color obtained to 4% oat biscuits at 7.60 after storage a period of six months compared to control sample. Results indicated that a significant differences between the biscuits treatments at zero time and after storing the biscuits and its additives for up to six months. The explanation of color results could be due to the presence of constituent with different

color level, which lower biscuit color and consequently affects evaluation scores. The direction of results are in parallel with what mentioned by Mousa, Marwa (2022) about the acceptance of biscuits blended with oat flour at a higher level regarding the color evaluation.

Texture:

Through **Table (7)** showing the texture of control biscuits and its blends from oat flour, orange peel powder and red wheat pollard at levels 2,4,8 and 12% at zero time and during storage up to six months. Data refer to at zero time the texture score of control biscuits was 8.60, while the values of the texture of oat biscuits, orange peel biscuits and red pollard biscuits ranged from 7.90 to 8.75, 7.40 to 8.30 and 9.30 to 9.70, respectively.

Table 7. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit texture during storage up to six months

Additives (S)	Storage Time(A)			
	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits(control)	8.60b-h	8.20d-i	9.10a-d	8.63A-C
2% Oat flour	7.90e-i	8.80a-f	7.40i	8.03D
4% Oat flour	8.50c-h	8.90a-e	7.70g-i	8.37B-D
8% Oat flour	8.50c-h	8.90a-e	8.20d-i	8.53B-D
12% Oat flour	8.75a-f	8.60b-h	8.10d-i	8.48B-D
Wheat flour biscuits (control)	8.60b-h	8.20d-i	9.10a-d	8.63a-c
2% Orange peel powder	8.30c-i	8.80a-f	8.10d-i	8.40B-D
4% Orange peel powder	7.90e-i	8.70a-g	7.40i	8.00D
8% Orange peel powder	7.80f-i	9.00a-d	7.40i	8.07 CD
12% Orange peel powder	7.40i	8.30c-i	8.40c-i	8.03D
Wheat flour biscuits (control)	8.60b-h	8.20d-i	9.10a-d	8.63A-C
2% Red wheat pollard	9.60ab	8.20d-i	8.60b-h	8.80AB
4% Red wheat pollard	9.30a-c	7.60hi	8.70a-g	8.53B-D
8% Red wheat pollard	9.30a-c	7.40i	8.20d-i	8.30B-D
12% Red wheat pollard	9.70a	8.80a-f	8.90a-e	9.13A
Average for (S)	8.58	8.48	8.17	
LSD at 0.05				
A				0.591
S				0.284
A x S				1.024

The highest value of texture obtained with biscuits blended with 12% red wheat pollard at 9.70, whereas the biscuits 12% orange peel powder has a lower score of 7.40. Results indicated that there are a significant differences between biscuit treatments, except red pollard biscuits samples with no a significant differences among them.

During storage of all biscuits samples for a period of three to six months, results obtained of texture show the control biscuits have values 8.20 and 9.10, during storage a period of three to six months, respectively. After storing biscuits and its additives during six months, a significant

difference between the samples were appeared ($p < 0.05$). The explanation of texture results could be due to the presence of high percent of fiber which lower the cohesiveness of biscuit dough and consequently affect evaluation scores. These results are agreed with the study of; Zaki, Hoda et al. (2018).

Taste:

The results that are shown in **Table (8)** mention to the taste of 72% control biscuits and its blends of oat flour, orange peel powder and red wheat pollard at levels 2,4,8 and 12%.

Table 8. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit taste during storage up to six months

Additives(S)	Storage Time (A)			
	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits (control)	8.50a	8.00a	9.10a	8.53AB
2% Oat flour	8.05a	8.70a	8.30a	8.35A-C
4% Oat flour	9.05a	8.90a	8.40a	8.78AB
8% Oat flour	9.10a	8.70a	8.20a	8.67AB
12% Oat flour	9.20a	8.40a	8.40a	8.67AB
Wheat flour biscuits (control)	8.50a	8.00a	9.10a	8.53AB
2% Orange peel powder	8.80a	9.10a	7.90a	8.60AB
4% Orange peel powder	8.00a	8.20a	7.20a	7.80C
8% Orange peel powder	8.30a	8.70a	7.80a	8.27BC
12% Orange peel powder	8.00a	8.70a	8.00a	8.23BC
Wheat flour biscuits (control)	8.50a	8.00a	9.10a	8.53AB
2% Red wheat pollard	9.10a	8.50a	8.60a	8.73AB
4% Red wheat pollard	8.90a	8.20a	8.70a	8.60AB
8% Red wheat pollard	9.00a	7.80a	8.10a	8.30BC
12% Red wheat pollard	9.30a	9.30a	8.10a	8.90A
Average for (S)	8.72	8.55	8.22	
LSD at 0.05				
A			0.595	
S			0.286	
A x S			NS	

Data indicated that no significant differences ($p < 0.05$) between all biscuit additive treatments at zero time and after storing them for six months, regarding the taste property.

The explanation of taste results could be due to the presence of high percent of fiber with no taste materials of biscuit dough and consequently affect evaluation scores. These results agreed with what reported by Mousa, Marwa (2022) about the acceptance of biscuits blended with oat flour at a higher level regarding taste, crispy and overall acceptability.

Sweetness:

From **Table (9)** showing the sweetness of control biscuits and its additives from oat flour, orange peel powder and red wheat

pollard at levels 2,4,8 and 12% at zero time and during storage up to six months. Results indicated that at zero time the sweetness value of control biscuits was 8.80, while the values of the sweetness of biscuits containing oat biscuits, orange peel biscuits and red pollard biscuits were between 8.40 to 9.30, 7.30 to 8.60 and 8.60 to 9.60, respectively. Data mentioned that a little significant differences between biscuit additive treatments were appeared among them of sweetness.

Table 9. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit sweetness during storage up to six months

Storage Time (A) Additives (S)	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits (control)	8.80a-g	8.00e-k	9.00a-e	8.60AB
2% Oat flour	8.40b-j	9.40ab	7.90f-k	8.57AB
4% Oat flour	9.10a-d	8.50b-i	8.20d-k	8.60AB
8% Oat flour	9.30a-c	8.80a-g	7.70h-k	8.60AB
12% Oat flour	9.00a-e	8.90a-f	8.00e-k	8.63AB
Wheat flour biscuits (control)	8.80a-g	8.00e-k	9.00a-e	8.60AB
2% Orange peel powder	8.60a-i	8.90a-f	8.40b-j	8.63AB
4% Orange peel powder	8.30c-k	8.50b-i	7.60i-k	8.13BC
8% Orange peel powder	8.20d-k	8.60a-i	7.40jk	8.07BC
12% Orange peel powder	7.30k	8.50b-i	7.80g-k	7.87C
Wheat flour biscuits (control)	8.80a-g	8.00e-k	9.00a-e	8.60AB
2% Red wheat pollard	9.60a	8.20d-k	9.40ab	9.07A
4% Red wheat pollard	8.60a-i	8.50b-i	9.10a-d	8.73A
8% Red wheat pollard	9.20a-d	8.70a-h	8.90a-f	8.93A
12% Red wheat pollard	9.30a-c	8.30c-k	8.90a-f	8.83A
Average for (S)	8.70	8.60	8.33	
LSD at 0.05				
A			0.596	
S			0.286	
A x S			NS	

After storage of all biscuits samples for six months, results obtained of sweetness show the control biscuits have values 8.00 and 9.00, during storage a period of three to six months, respectively. During storing biscuits and its blends up to six months, there a significant difference ($p < 0.05$) between biscuits samples of sweetness.

The explanation of sweetness results could be due to the presence of high percent of fiber with no taste materials of biscuit dough and consequently affect evaluation scores. These results agreed with what reported by Sudha et al. (2005).

Flavor:

Table (10) shows the flavor of control biscuits and its additives from oat flour, orange peel powder and red wheat pollard at levels 2,4,8 and 12% at zero time and during

storage up to six months. The results refer to at zero time the flavor score of control biscuits was 8.70, whereas the values of the flavor of oat biscuits, orange peel biscuits and red pollard biscuits ranged from 8.30 to 9.10, 7.20 to 8.60 and 9.00 to 9.80, respectively. The highest value of flavor obtained with the biscuits blended with 12% red wheat pollard at 9.80, while the 12% orange peel powder biscuits has a lower score of 7.20.

Table 10. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit flavor during Storage up to six months

Additives (S)	Storage Time (A)			
	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits (control)	8.70b-g	8.10d-j	9.10a-d	8.63 AB
2% Oat flour	8.30c-i	9.20a-c	8.10d-j	8.53A-C
4% Oat flour	9.00a-d	8.90a-e	7.80f-j	8.57A-C
8% Oat flour	9.10a-d	8.90a-e	8.20c-j	8.73A
12% Oat flour	8.60b-h	8.40c-i	8.50b-i	8.50A-C
Wheat flour biscuits (control)	8.70b-g	8.10d-j	9.10a-d	8.63AB
2% Orange peel powder	8.60b-h	8.70b-g	8.20c-j	8.50A-C
4% Orange peel powder	7.70g-j	8.40c-i	7.90e-j	8.00CD
8% Orange peel powder	7.80f-j	8.80a-f	7.50ij	8.03B-D
12% Orange peel powder	7.20j	8.80a-f	7.50ij	7.83D
Wheat flour biscuits (control)	8.70b-g	8.10a-j	9.10a-d	8.63AB
2% Red wheat pollard	9.50ab	8.90a-e	8.90a-e	9.10A
4% Red wheat pollard	9.50ab	7.80f-j	8.40c-i	8.57A-C
8% Red wheat pollard	9.00a-d	7.60h-j	8.90a-e	8.50A-C
12% Red wheat pollard	9.80a	8.10d-j	9.00a-d	8.97A
Average for(S)	8.68A	8.51AB	8.31B	
LSD at 0.05				
A			0.626	
S			NS	
A x S			1.08	

Results indicated that there are a significant differences between biscuit additive treatments, except red pollard biscuits samples has no a significant differences among them.

During storing biscuits and its additives up to six months, there a significant difference ($p < 0.05$) between biscuits samples of flavor property.

The explanation of flavor results could be due to the presence of high percent of fiber with no taste materials in biscuit dough and consequently affect flavor evaluation scores. These results are in accordance with the study of (El-Qatey et al., 2018).

Mouthfeel:

The results that are shown in **Table (11)** indicated that the mouthfeel of control biscuits and its blends from oat flour, orange peel powder and red wheat pollard at levels 2,4,8 and 12% at zero time and during

storage up to six months. The results refer to at zero time the mouthfeel value of control biscuits was 8.80, whereas the values of the flavor of oat biscuits, orange peel biscuits and red pollard biscuits ranged from 8.45 to 8.70, 7.10 to 8.60 and 8.90 to 9.80, respectively. The highest value of mouthfeel recorded with biscuits blended with biscuits containing 2% red wheat pollard at 9.80, while the 12% orange peel powder has a lower score of 7.10.

Table 11. Effect of using oat flour, orange peel powder and red wheat pollard on biscuit mouthfeel during storage up to six months

Additives (S)	Storage Time(A)			
	Zero time	Three months	Six months	Average for (A)
Wheat flour biscuits (control)	8.80a-e	8.80a-e	9.30a-c	8.97 AB
2% Oat flour	8.45c-g	9.00a-d	7.60gh	8.35CD
4% Oat flour	8.70b-f	9.00a-d	7.70f-h	8.47BC
8% Oat flour	8.70b-f	9.30a-c	8.10d-h	8.70A-C
12% Oat flour	8.70b-f	8.60b-g	8.10d-h	8.47BC
Wheat flour biscuits (control)	8.80a-e	8.80a-e	9.30a-c	8.97AB
2% Orange peel powder	8.60b-g	8.90a-d	7.80e-h	8.43BC
4% Orange peel powder	8.30c-g	8.80a-e	8.10d-h	8.40B-D
8% Orange peel powder	8.50c-g	9.00a-d	7.60gh	8.37B-D
12% Orange peel powder	7.10h	8.30c-g	8.00d-h	7.80D
Wheat flour biscuits (control)	8.80a-e	8.80a-e	9.30a-c	8.97AB
2% Red wheat pollard	9.80a	8.50c-g	8.50c-g	8.93A-C
4% Red wheat pollard	8.90a-d	7.60gh	8.70b-f	8.40B-D
8% Red wheat pollard	9.00a-d	9.00a-d	8.90a-d	8.97AB
12% Red wheat pollard	9.60ab	8.70b-f	9.30a-c	9.20A
Average for (S)	8.70	8.73	8.28	
LSD at 0.05				
A			0.609	
S			0.292	
A x S			1.055	

Data indicated that there are a little significant differences between biscuit additive treatments, except red pollard biscuits samples has no a significant differences among them. After storing biscuit samples and its additives up to six months, there a significant difference ($p < 0.05$) between biscuits treatments were shown of mouthfeel property.

These data agreed with what stated by El-Sharnouby et al. (2012) about the effect of adding high fiber materials from plant on mouthfeel and other characteristics of biscuit.

Acidity (acid value AV) levels of biscuits affected by addition of different levels of oat flour, orange peel powder and red pollard during storage:

The Figures (1,2 and 3) refer to acid value (AV) levels of biscuits affected by blending with different levels of oat flour, orange peel and red pollard during storage at room temperature up to six months. Data mentioned that the acid value increased with increasing the addition rate of additives and with increased storage period up to 6 months. Results indicated that the highest value of

(AV) obtained with biscuits 8% oat flour after six months of storage, and the 12% orange peel powder biscuits have a higher value of (AV) after six months of storage, on the same trend the 12% red wheat pollard biscuits recorded higher value of (AV) after 6 months of storage at room temperature in comparison all biscuit samples. While mostly wheat flour biscuits (control) have a lower level of acid value when compared to other biscuit additives and with an extended storage period of up to six months. Similar findings were reported by (Jeyasanta et al., 2013; Mohamed et al., 2014; Omran, Azza et al., 2016; Mostafa et al., 2017) they found that The percentage of acid value increased

with the increase in biscuit additives and with the extension of the storage period.

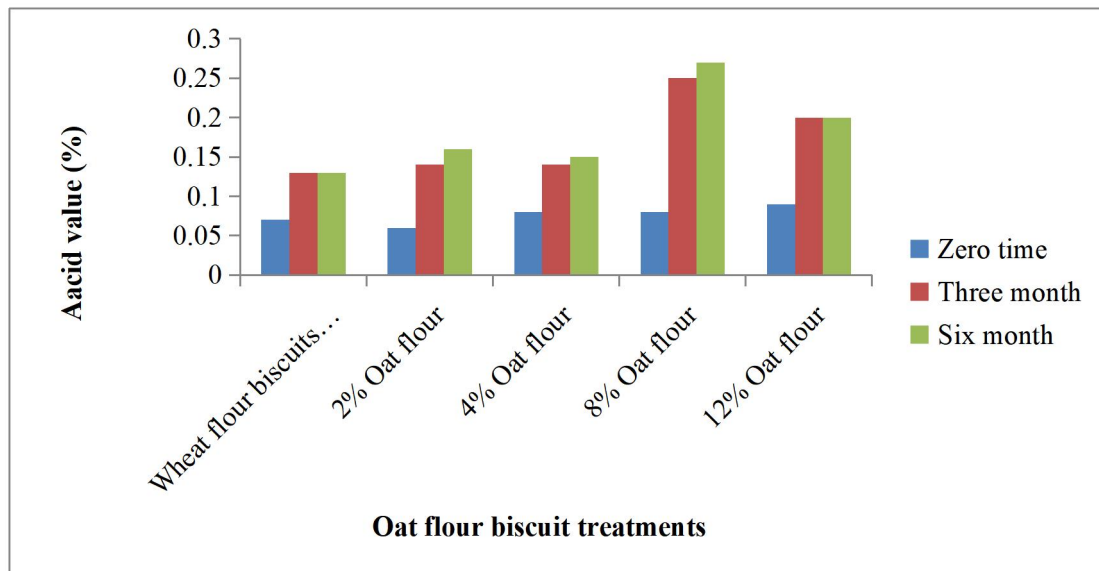


Figure 1. Changes in acid value (AV) levels of biscuits affected by addition of different levels of oat flour during storage at room temperature up to six months.

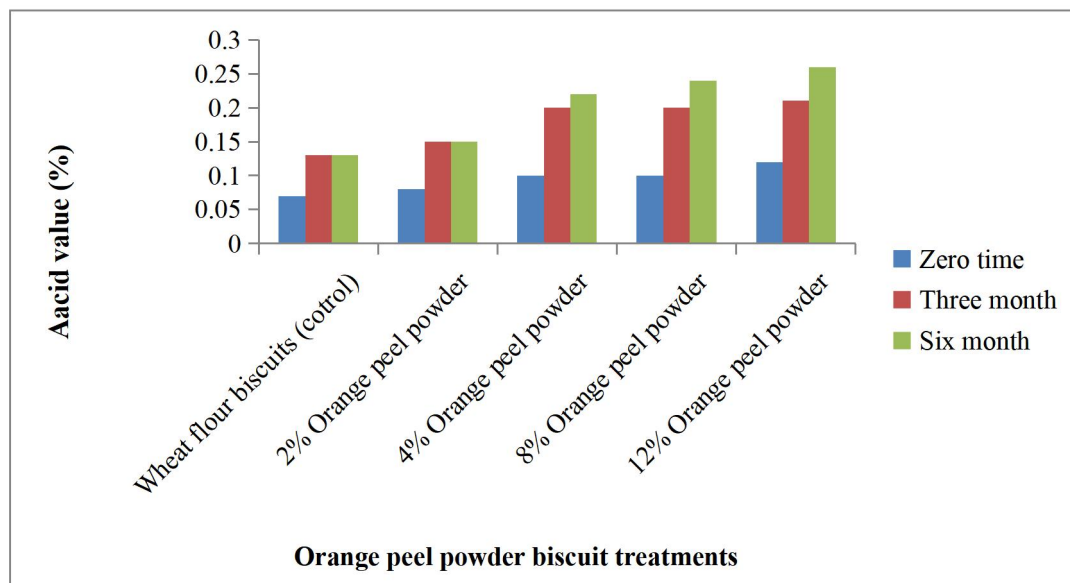


Figure 2. Changes in acid value (AV) levels of biscuits affected by addition of different levels of orange peel powder during storage at room temperature up to six months.

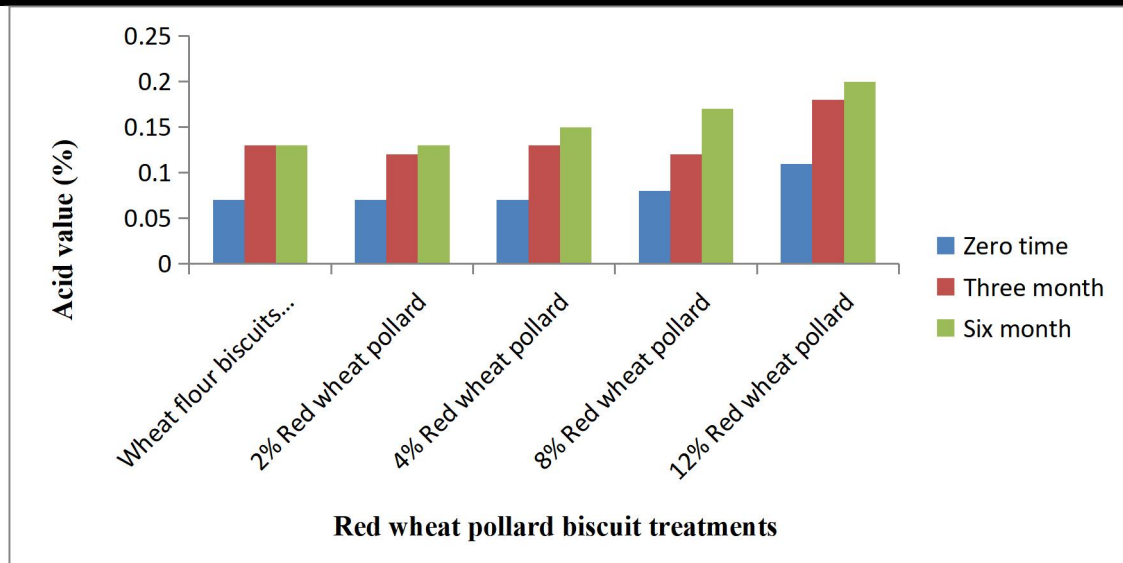


Figure 3. Changes in acid value (AV) levels of biscuits affected by addition of different levels of red wheat pollard during storage at room temperature up to six months.

CONCLUSION:

From this study can be summarized as follows:

- 1- The possibility of the production of high-fiber biscuits by using high fiber plant wastes, by-products and composite flour at 2, 4, 8 and 12% by using orange peels powder, red wheat pollard and whole oat flour.
- 2- Most chemical composition components contents of biscuits were increased by adding the red wheat pollard and the whole oat flour to it.
- 3- The red wheat pollard biscuits had the highest score in the sensory evaluation, followed by oat flour biscuits, while orange peel powder biscuits recorded the lowest values.
- 4- The acidity of biscuits increased with increasing the addition rate of additives and with increased storage period up to 6 months.

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الملخص العربي

أثير استخدام مخلفات نباتية عالية الألياف ومنتجات ثانوية ودقيق مركب على جودة البسكويت

في هذا البحث تم الإحلال الجزئي لدقيق القمح ذو نسبة إستخلاص 72٪ بدقيق الشوفان ومسحوق قشور البرتقال وسن القمح الأحمر عند إنتاج البسكويت من أجل رفع مستوى الألياف به وكانت نسبة الإحلال لهذه الإضافات 2 ، 4 ، 8 ، 12٪ بالنسبة لدقيق القمح المستخدم في وصفات البسكويت المنتج . تتبعت الدراسة التغيرات التي حدثت في المكونات الكيميائية للبسكويت من الرطوبة والرماد والدهون الخام والألياف الخام والبروتين الخام والكربوهيدرات الكلية نتيجة هذا الإستبدال. وأشارت النتائج إلى وجود فروق معنوية لجميع مكونات التركيب الكيميائي بين البسكويت (الكنترول) والمنتج من دقيق القمح مقارنة ببسكويت الشوفان , بسكويت سن القمح الأحمر وبسكويت مسحوق قشور البرتقال ، بإستثناء المحتوى الرطوبي الذي لا يظهر فروق معنوية له . كما أوضحت النتائج زيادة محتوى الرماد والدهون والألياف الخام للبسكويت مع إضافة سن القمح الأحمر، كما أدت إضافة دقيق الشوفان الكامل إلى زيادة محتوى البروتين في عينات البسكويت المنتج . كذلك تم تتبع التقييم الحسي للبسكويت وأظهرت نتائج التحليل الإحصائي إلى وجود فروق معنوية بين معظم معاملات البسكويت للخصائص الحسية المقيمة، ما عدا حجم القطع والتناسق والطعم والتي لم تظهر فروق معنوية. وبينت النتائج أن بسكويت سن القمح الأحمر سجل أعلى درجة للتقييم الحسي ، يليه بسكويت دقيق الشوفان ، بينما سجل بسكويت مسحوق قشور البرتقال أقل الدرجات . تم تتبع رقم الحموضة (AV) لعينات البسكويت وأوضحت النتائج زيادة رقم الحموضة بجميع العينات مع زيادة معدل الإضافات المستخدمة ومع إمتداد فترة التخزين حتى 6 أشهر .

الكلمات الدالة :

بسكويت، دقيق الشوفان، مسحوق قشور البرتقال، سن القمح الأحمر، التركيب الكيميائي، التقييم الحسي، رقم الحموضة .