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Utilization of Food by Products in Preparing Low-Calorie Biscuits

Asma A. E. Elgindy*

Faculty of Education, Najran University, P.O .BOX(1988) KSA

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ABSTRACT

This research aims to utilization of food processing by products such as orange peels and apple pomace in some low-calorie bakery products, where this research was to explore the possibility of using of why protein concentration and some food processing by products (i.e. orange peels and apple pomace) as a fat replacers in biscuits . Impacts on physical, chemical, sensory and nutritional characteristics biscuits samples were prepared by replacing butter up to 75 by whey protein concentrate, orange peels and apple pomace, which were comparable to their full-fat biscuits. Obtained results showed an observed. decreases in fat content and caloric value in biscuits sample, beside the increase amount in protein content in biscuits prepared with whey protein concentrate and also increased in crude fiber in prepared biscuits sample orange peels and apple pomace. Sensory characteristics of biscuits prepared with fat replacers showed that color, taste, flavor and overall acceptability of biscuits prepared using different fat replacement (whey protein concentrate) at levels of 25, 50 and 75% of butter was increased by the increasing replacement levels, but overall acceptability value of biscuits prepared using (orange peels and apple pomace) was accepted at level of 50% and 25%, respectively.

Keywords: Fat replacers, Whey protein concentrate, Orange peels, Apple pomace, Biscuit

INTRODUCTION

Foods that serve three fundamental roles as sources of essential fatty acids, fat-soluble vitamin carriers, and energy sources (Mela, 1990 and Papadima and Bloukas 1999). The obvious link between dietary fat and the development of cardiovascular disease and hypertension has caused consumers to be more conscious of the amount of fat in their diet and to be more concerned about it. (O'Neil, 1993).

The processing of many fruit and vegetable products generate a large amount of waste. Unused waste not only adds to the issue of disposal, but also aggravates environmental pollution. (Kaur *et al*., 2005).

Industrial waste issues are becoming more difficult to resolve and a great deal of effort will be needed to improve the nutritional and industrial value of by-products and waste.. Recently, more attention has been focused on the use of by-products and waste for food production. Obviously, such utilization this will contribute to optimizing the resources available and lead to the production of different foods.. (Khed *et al*., 2016) .

Dietary fibers and pectin are known to be very strong hypocholesterolemic agents. These ingredients decreased total serum cholesterol, total lipids, low-density lipoprotein (LDLc) cholesterol, and decreased serum triglyceride (sGPT) as reported. El-Zoghbi and Sitohy (2001).

The primary use of apple pomace is currently livestock feed. Some efforts have been made, such as producing pectin, to increase the value-added use of apple pomace. (Garna *et al*. 2007) .And the addition of bakery products of various kinds (Sivam *et al*. 2011).

The addition of up to 10 percent orange and apple peels as fat replacers in beef burgers resulted in sensory and physical qualities comparable to high fat level regulation without the addition of ingredients and reduced fatty acids, suggesting that these fibers (orange peels and apple peels) can be considered good fat replacers in meat production (Bessar, 2008).

The primary by-product of the production of apple juice is apple pomace. (Lu and Yeap Foo 2000) Generating more than 300 g of pomace for each liter of juice with conventional juice processing (Kaushal *et al*. 2002). ,

Despite being a by-product, apple pomace produces a large degree of bioactive compounds, such as dietary fiber and polyphenols, which can have a high value for its food and other value-added products applications, such as enzymes, single-cell protein, flavouring compounds, ethanol, organic acids, polysaccharides, and mushrooms (Vendruscolo *et al.* 2008) .

A fat replacement is an ingredient that can be used to provide some or all of the fat functions, containing less calories than fat. (Jonnalagadda and Jones,2005). In general, fat replacers are divided into two groups: fat substitutes and fat mimetics. Ingredients that have a chemical composition very identical to fats and have similar physiochemical properties are fat substitutes. ((Lipp, 1998 Kosmark, 1996; Peters 1997)). Usually, they are either indigestible or have lower calories on a per gram basis. Ingredients that have distinctly different chemical structures from fat are fat mimetics. They are typically based on carbohydrates and/or protein. They have various functional properties that mimic some of the characteristic physiochemical characteristics and attractive fat viscosity, mouthfeel and appearance characteristics of eating. (Johnson, 2002; Duflot, 1996; Harrigan, 1989) .

Whey protein concentrate has been used in the preparation of many food products and is an ideal functional ingredient that can tackle hunger and obesity. (Pinto *et al*., 2007,Rai and Jayaprakasha, 2004). Fat replacers based on carbohydrates are the most common and can be completely digestible, partially digestible or non-digestible with a yield of 0-4 kcal/g (Drewnowski,1992). Increased dietary fiber levels are

* **Corresponding author.**
E-mail address: asmaelgindy@yahoo.com
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believed to decrease the risk of colon cancer, obesity, cardiovascular disease and many other conditions. (Anon,2001).

The objective of this work was to evaluate the effect of using why protein concentration and some food processing by products (i.e. orange peels and apple pomace) as a fat replacers in biscuits on the characteristics of physical, chemical, sensory and nutrition properties

MATERIALS AND METHODS

Materials

Orange peels(Citrus sinensis 'Valenciaand), apple pomace (*malus domestica gala*): Orange peels and apple pomace were obtained from najran, Dairy and Juice Company (Najran), kingdom Saudi Arabia.

Wheat flour (72% extraction), butter, sugar powder, milk, Sodium bicarbonate, Ammonium bicarbonate, Vanilla and salt came from the local market, at najran kingdom Saudi Arabia.

Whey protein concentrate: The percentage of whey protein concentrate was obtained from The Egyptian Co. for Advanced Foodstuff Industries Alexandria, Egypt (Farage Group).

Methods

Preparation of orange peels:

The peels were washed and dried at 50 + 2 C^0 dried in a forced hot air oven (WT-binder, type F115, Germany) for 2 days, then ground into a fine powder and processed, packed in polyethylene bags and stored until used. According to methods by Zaker *et al* . (2017)**.**

Dried apple pomace was prepared according to the method described by Jooyeoun *et al*.,(2015)

Preparation of biscuits: biscuits were prepared according to the methods described by Laguna *et al*., (2014).and the formula were mentioned in table

Table 1. Low calorie biscuits formula

biscuit Formula		Ingredients (g)									
		wheat flour	Butter	whey protein concentrate	orange peels	Apple pomace	Sugar	Sodium bicarbonate	Baking powder	Ammonium bicarbonate	Milk, ml
control		100	50	0	0	0	50	0.5	0.5	0.25	10
Whey protein Concentrate	25%	100	37.5	12.5			50	0.5	0.5	0.25	10
	50%	100	25	25			50	0.5	0.5	0.25	10
	75%	100	12.5	37.5			50	0.5	0.5	0.25	10
Dried orange peels	25%	100	37.5		12.5		50	0.5	0.5	0.25	10
	50%	100	25		25		50	0.5	0.5	0.25	10
	75%	100	12.5		37.5		50	0.5	0.5	0.25	10
Dried apple pomace	25%	100	37.5			12.5	50	0.5	0.5	0.25	10
	50%	100	25			25	50	0.5	0.5	0.25	10
	75%	100	12.5			37.5	50	0.5	0.5	0.25	10

Fat of biscuits was replaced by deferent levels of Whey protein concentrate and some food wastes (orange peel and apple pomace).

The biscuit sample was placed at 4 ° C in the refrigerator in glass containers before further analysis was carried out.

Chemical Analysis

Moisture content, crude fat, protein, crude fiber and ash content have been calculated A.O.A.C. (2000). The measurement of total carbohydrates was based on the difference. By subtracting crude fiber content from total carbohydrates, the available carbohydrates were determined. The caloric value of raw materials and products was calculated according to the following equation:

E (caloric value) = 4(carbohydrate %+ protein %) + 9 (fat%).

Physical properties

Physical characteristics of biscuits were measured, i.e. diameter (D) and thickness (T) Five pieces of biscuits were put edge to edge from each formulation and stacked one above the other to measure the diameter (D) and thickness (T), respectively. Average values of the Diameter(D) and thickness(T) were expressed in mm, using the mentioned method.by AACC,(2000). The spread ratio of biscuits was derived from diameter and width

Sensory Evaluation

For various quality attributes and overall acceptability, prepared biscuits were organoleptically assessed. Sensory testing was done by a 9 panel testers. The ratings were done on a Hedonic 9-point scale. Average sensory ratings for attributes. Color, taste, texture, taste and overall acceptability have been reported as described by Kumar *et al* ,(2010)

Statistical analysis

With one-way ANOVA, the findings were analyzed to identify major differences between the Sample Implies. The mean ± standard deviation of three replicates was expressed in all data. Tukey test compared the mean of results with a confidence interval set at 95 percent

RESULTS AND DISCUSSION

Proximate chemical composition and caloric value (whey protein concentrate, orange peels) of fat replacers and apple pomace) as compared to butter

Results of table (2) As they were used for various biscuit formulations, the gross chemical composition of fat replacers showed lower moisture content value, ether extract (fat content) and caloric value in compared to butter, but protein content, dietary fiber, ash and carbohydrates were higher than those of butter. Fat substitutes were found to have much lower caloric values than butter, based on chemical composition. It could be concluded from the results obtained that the higher carbohydrates were mentioned by Siljestrom and Bjorck, (1992). They reported that the higher carbohydrate content of legume paste provides their capacity to act as fat replacers In addition to high protein and fiber content which lead to enrichment of nutritional value of products made with these fat replacers. Also high protein and fiber content, resulting in the nutritional value of products produced with these fat replacers being enriched. In previous studies (Ognean *et al*., 2010) It was concluded that (35-60 percent) apple pomace is rich in dietary fiber.

Table 2. Gross chemical composition and caloric value (g/100 g on a dry weight basis) of butter and fat replacers

	Chemical constitutes							
row material	**Moisture,**	**Protein**	**Crude fat**	**Ash**	**Total Dietary Fiber,**	**Total* carbo-hydrates**	**Available Carbo-hydrates**	**Caloric Value (cal/100g)**
Butter	15.1±1.00	1.29±0.13	97.21±2.30	.44±0.04	0.0	1.06±0.03	1.06±0.04	884.29±5.33
Whey protein concentrate	4.51±0.33	66.73±1.40	3.49±0. 20	5.4±0.40	0.0	24.38±2.13	24.38±1.31	395.85±3.32
Dried orange peels	11.1±0.50	2.72±0.12	5.55±.60	4.81±0.22	13.49±1.09	86.92±1.43	73.43±2.74	354.55±4.54
Dried apple pomace	10.25±1.50	4.9±0.45	3.2± 0..15	2.8±0.10	61.9±3.12	89.1±1.50	27.2±1.76	157.2±2.43

Values are means of three replicates ±SD

Proximate chemical composition and caloric value of fat replacer-based biscuits

The findings in Table (3) showed that the chemical composition of the prepared biscuits was influenced by the substitution of butter with whey protein. The increasing amount of fat replacement was associated with a steady increase in protein content and ash, this was higher than that of control biscuits samples , this increase may be attributed to their higher whey protein content, which improved their consistency. Reduced and usable carbohydrates for crude fat lipids (fat content) were increased by increasing fat content. Regarding to it was noted that biscuits processed with fat replacement at levels of 25, 50 and 75% by whey protein concentrate, Orange peels and apple pomace have lower caloric value from 382.86(75% apple pomace) to 487.69 (cal/100g)(25% whey protein concentrate) than those control of biscuits sample 518.42(cal/100g). Total Dietary Fiber content was affected by fat replacement of orange peels and apple pomace, the high content of Total dietary fiber in biscuits was observed in biscuits samples prepared with apple pomace.

Shehata *et al*,(2011) found that cakes processed with fat replacement at levels of 30, 40, 50 and 70% by whey protein concentrate had lower caloric value by 7.14, 9.51,11.85 and 16.65% in average than the control cake, respectively. The increase in these compounds was due to their higher whey protein concentrate content, which improved their consistency. Fat replacement has not changed crude fiber quality.

Table 3. Proximate chemical composition and caloric value for biscuits prepared on a dry weight basis with different fat replacers (g/100 g).

Constituents Biscuits		**Moisture**	**Protein**	**Crude fat lipids**	**Ash**	**Total Dietary Fiber,**	**Total* carbo-hydrates**	**Available Carbo-hydrates**	**Caloric Value (cal/100g)**
control		5.0±0.21	6.5±0.78	24.1±1.1	0.29±0.09	0.23±0.02	69.11.3±3.21	68.88±1.33	518.42±4.43
Whey protein Concentrate	25%	4.99±0.50	9.89±1.21	18.21±2.00	0.57±0.05	0.27±0.06	71.33±2.22	71.06±2.03	487.69±2.32
	50%	4.85±0.22	13.91±2.32	12.42±2.54	0.88±0.33	0.24±0.03	72.79±3.12	72.55±1.98	457.62±3.76
	75%	5.0±0.50	17.61±2.12	6.63±1.23	1.01±0.05	0.22±0.03	74.75±2.32	74.53±2.43	428.23±4.54
Dried orange peels	25%	6.02±1.03	6.02±0.43	18.28±3.21	0.55±0.03	1.13±0.34	75.15±3.98	74.02±2.65	484.68±3.67
	50%	6.89±0.73	6.01±0.50	12.7±1.65	0.81±0.08	1.90±0.10	80.48±2.75	78.58±1.43	452.66±5.22
	75%	8.07±0.65	5.78±0.85	7.54±0.65	1.00±0.02	2.72±0.21	85.68±4.12	82.96±3.54	422.82±3.38
Dried apple pomace	25%	6.05±0.31	6.15±1.11	18.18±2.12	0.41±0.01	4.25±0.56	75.26±1.32	71.01±1.33	472.26±3.76
	50%	7.38±0.53	6.28±0.55	12.35±1.54	0.53±0.06	7.95±1.32	80.84±2.12	72.89±1.55	427.83±4.34
	75%	8.11±1.12	6.18±0.65	6.58±0.74	0.71±0.04	11.80±1.54	86.53±1.76	74.73±0.87	382.86±2.55

Values are means of three replicates ±SD

Physical characteristics of biscuits prepared with fat replacers

Physical characteristics of prepared biscuits with butter while replaced by whey protein, orange peels and apple pomace are given in Table (4).

Results of physical properties show that values of diameter were decreased with addition fat replacers. Also the results indicated that spread ratio of prepared biscuits were decreased as ratio of replacement increased, the lowest spread value (11.33)was observed for prepared biscuits by 75% replacement apple pomace in compared with control(11.85), this can be due to the dilution of gluten and also to the interaction of gluten, dietary fiber components and water. Chen *et al*. (1988) have shown that these harmful effects can be partly mitigated by the hydration of apple fiber prior to the addition of wheat flour. Whereas Kohajdová, *et al* (2014) found that adding a higher volume of apple pomace (10 per cent and 15 per cent) substantially decreases the thickness, width and spread ratio of biscuits. It could be inferred that the reduction in these physical parameters could be caused by the dilution of gluten. Also all spread ratio values for prepared biscuits with whey protein concentrate were lower than those for control.

Table 4. Physical characteristics of biscuits prepared with whey protein concentrate, orange peels and apple pomace as a fat replacers

Constituents Biscuits		**Diameter, mm**	**Thickness, mm**	**Spread ratio**
control		6.52±1.31	0.55±0.05	11.85±2.32
Whey protein Concentrate	25%	6.51±1.80	0.55±0.03	11.83±1.87
	50%	6.48±0.98	0.55±0.01	11.78±0.87
	75%	6.45±0.92	0.55±0.3	11.72±1.08
Dried orange peels	25%	6.52±0.78	0.56±0.02	11.64±1.54
	50%	6.50±2.01	0.56±0.01	11.61±0.97
	75%	6.45±1.13	0.50.04	11.51±0.81
Dried apple pomace	25%	6.35±2.01	0.54±0.01	11.75±2.14
	50%	6.15±1.34	0.53±0.05	11.60±2.01
	75%	5.89±0.87	0.52±0.07	11.33±1.35

Values are means of three replicates ±SD

Sensory characteristics of biscuits prepared with different fat replacer

This research was suggested to examine the probability of utilization of whey protein concentrate and some food processing by products (i.e., orange peels and apple pomace) as a fat replacers in biscuits. Sensory characteristics of biscuits processed with fat replacers showed that color, taste, Texture, Flavour and overall acceptability of biscuits prepared using fat replaces namely whey protein concentrate at the levels 25, 50 and 75% of

butter (by weight) was increased by the increasing of replacement levels, but overall acceptability of prepared biscuits using the other fat replacement namely orange peels and apple pomace was accepted at level of 50% and 25%, respectively. Biscuits samples containing apple pomace displayed lower color sensory values than the control sample. Similar findings were presented in the earlier studies of Gupta (2006), who also indicated that the brown color of apple pomace limits its use in fine bakery items to a limit of 5%.. Hardness texture of apple pomace containing biscuits increased with increasing level of apple pomace in the product. These observations are in agreement with those obtained by Masoodi and Chauhan (1998). The increase in the hardness of the biscuits may be attributed to the dilution of gluten and the lower amount of water required for gluten hydration. (Sharma *et al*., 2013). But the hardness texture of the biscuits with whey protein concentrate recorded almost identical results to the control.. Such close findings to control biscuits may be due to the fact that whey proteins are soluble and do not actively bind water unless they are strongly denatured. Color findings showed that biscuits with whey protein Concentrate had low values relative to the control biscuit sample. This is due to Maillard browning reactions between proteins and sugar reduction, which lead to the browner/darker color of the product. Caramelization would also have been a significant factor. Huyghebaert (1984) Commented on the development of brown polymers/ melanoidine as a result of browning reactions due to protein incorporation.

Table 5. Sensory characteristics of biscuits prepared with fat replacer

Sensory characteristics biscuits		Colour	Taste	Texture	Flavour	Overall acceptability
control		7.81±1.10	8.0±2.05	7.8±0.54	7.75±1.56	7.84±1.03
Whey protein Concentrate	25%	7.97±0.78	8.18±1.32	7.89±1.05	8.16±1.32	8.05±1.33
	50%	7.61±1.43	8.40±1.21	7.91±2.12	8.32±0.98	8.06±0.89
	75%	7.52±0.87	8.55±2.13	7.95±1.71	8.52±1.02	8.14±0.68
Dried orange peels	25%	7.7±1.06	8.2±0.89	7.50±0.76	8.1±0.87	7.88±2.01
	50%	7.35±.054	7.8±0.79	7.2±.76	7.80±1.03	7.54±0.55
	75%	7.2±2.01	7.5±1.09	6.90±1.04	7.2±0.98	7.20±1.09
Dried apple pomace	25%	7.5±1.32	7.8±0.82	7.2±0.87	7.1±1.22	7.40±0.99
	50%	6.80±0.76	7.0±0.91	6.5±0.91	6.7±0.54	6.75±1.02
	75%	6.5±0.76	6.70±0.67	5.90±0.87	6.2±0.87	6.58±0.76

Values are means of three replicates ±SD

CONCLUSION

From this analysis, it could be inferred that fat substitutes under investigation (i.e. whey protein concentrate, orange peel and apple pomace) can be used to replace portions of fat in biscuits up to 75% butter. The overall acceptability of biscuits prepared using fat substitutes, namely whey protein concentrate at levels 25, 50 and 75% of butter (by weight) was increased by increasing the levels of substitution, However the overall acceptability of prepared biscuits using the other fat substitute, namely orange peels and apple pomace, was agreed at 50 per cent and 25 per cent respectively. In addition, this substitute has gained many nutritional and health benefits when eating low-fat bakery products.

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الاستفادة من المنتجات الثانوية للغذاء في تحضير البسكويت منخفض السعرات الحرارية

أسمة أحمد عيسى الجندي*

كلية التربية جامعة نجران ص.ب. (1988) المملكة العربية السعودية

يهدف هذا البحث الى الاستفادة من مخلفات مصانع الأغذية كقشور البرتقال وتفل التفاح في بعض منتجات المخابز منخفضة السعرات . لذلك كانت هذه الدراسة لدراسة إمكانية الاستفادة من مركز بروتين الشرش وبعض المنتجات الثانوية للتصنيع الغذائي (مثل قشور البرتقال وثفل التفاح) كبديل للدهون في البسكويت ومدى تأثيرها على الخصائص الفيزيائية والكيميائية والحسية والجودة الغذائية. تم تحضير عينات البسكويت من خلال استبدال الزبدة حتى 75% بمركز بروتين الشرش وقشور البرتقال وثفل التفاح ، ثم مقارنتها بالبسكويت كامل الدسم. أظهرت النتائج التي تم الحصول عليها انخفاضًا ملحوظًا في محتوى الدهون وقيمة السعرات الحرارية في جميع عينات البسكويت المحضرة ، بالإضافة إلى زيادة محتوى البروتين في عينات البسكويت المصنع مع زيادة نسبة مركز بروتين الشرش وكذلك زيادة في قيم الألياف الخام في عينات البسكويت المحضرة من قشور البرتقال وثفل التفاح. أظهرت الخصائص الحسية للبسكويت المصنوع من بدائل الدهون زيادة في قيم اللون والمذاق والنكهة ودرجة التقبل العام للبسكويت المحضر باستخدام (مركز بروتين الشرش كبديل للزبد) بمستويات 25 و 50 و 75٪ ، ولكن تم الحصول على أعلى درجة تقبل عام للبسكويت المحضر باستخدام (قشر البرتقال وثفل التفاح) عند مستوى 50٪ و 25٪ على التوالي .