J. Agric. Sci. Mansoura Univ., 34 (6): 6477 - 6485, 2009

PEEL OF FRUIT AS SOURCE OF FUNCTIONAL INGREDIENTS OF FISH PRODUCTS

Ahmed, H. A.; Shadia M. Sharaf and Naglaa A. El-Senousi
Meat and Fish Technology Research Dept., Food Technology Research Institute, Agric. Res. Center, Giza.

ABSTRACT

It is known that fish is among nutritious and healthy foods. That is because fish contains great amount of protein, minerals and vitamins, and also it lowers blood pressure, lipids and cholesterol. Fish burger is easy to eat by children and elderly people. And some diseases common in civilized communities (including diabetes, gallstone, atherosclerosis, cancer and ulcer) may be prevented when consuming foods with high fiber content. At the same time, dietary fibers can be an effective tool in seafood processing for improving functional properties such as water binding, gelling, etc. And whereas fish and fish products are poor in fibers, this investigation aimed to raise the level of fiber in bolti (*Tilapia nilotica*) fish burger using a fine powdered fibers dried at (60^{o}C) prepared from orange and pomegranate pomaces. Different levels of fiber (5, 7.5 and 10%) were added in a selected formula and storage at -18^{o}C lasted for two months, based on organoleptic evaluation.

Chemical and physical studies were carried out. The results revealed that adding orange and pomegranate peel performed for decrease moisture, protein and fat and increase fiber and carbohydrate. It was found that slight differences in chemical composition after storage at -18^{o}C for two months. The results showed that adding orange and pomegranate peel to fish burger performed to perfection properties of product during storage, whereat, performed to the decrease of TBA, TVN and TMAN after storage for two months at -18^{o}C, these peel acted as antioxidants, also adding these peel performed to perfection physical and sensory quality properties.

INTRODUCTION

Dietary fiber plays an important role in human health. High dietary fiber diets are associated with the prevention, reduction and treatment of some diseases, such as diverticular and coronary heart diseases (Figuerola *et al.,* 2005).

Van Soest (1978) stated that the role of dietary fiber in the diet is related to its bulk, hydration capacity, binding properties and termetability.

In view of the fact that some diseases, particularly those common in civilized nation, may be prevented when consuming foods of high fiber content as they stimulate the different body organs activity. Some high fiber foods were developed such as the high fiber juice, foods with added bran, some canned fruits and vegetables of high fiber content and even some dairy products as yoghurt with dietary fibers or simply with some fruits and vegetables (Trowell, 1978).

In this concern, fruit and vegetable pomaces, which are common by-products in food industry, could be considered as promising rich sources of dietary fiber used successfully to produce high fiber foods as cookies and other bakery products (Morris, 1985).

Yetley and Park (1995) reported that fibers may provide protection against disorders listed. Constipation, diverticulosis, hemorrhoids, appendicitis, irritable bowl, colorectal cancer, gallstones, atherosclerosis, coronary diseases, polyps, obesity, heart disease, diabetes, hypertension and dental caries. This effect may occur at sites localized or not localized in the intestines.

High dietary fiber powders from Valencia orange and Persa lime peel were prepared and their dietary fiber composition and antioxidant capacity studied. Fiber from both peel had high total dietary fiber content (61-69%) with an appreciable amount of soluble fiber (19-22%). HPLC analysis of the polyphenols extracted from orange and lime peel fibers showed the presence of caffeic and ferulic acids, as well as naringin, hesperdin and myricetin in both fruit fibers. The different antioxidant power of these fibers could be in part explained by the presence in lime peel fiber of ellagic acid, querecetin and kaempferol which are strong antioxidant polyphenols (Larrauri *et al.,* 1996). Residues from orange juice extraction are potentially an excellent source of dietary fiber (Grigelmo-Miguel and Martin-Belloso, 1998).

Pomegranate peel is a nutritive-rich by-product whose amounts are extensively growing due to the exponential increase in the production of pomegranate juice and "ready to eat" arils. Pomegranate peel is a rich source for antioxidants and thus may serve in the prevention of cattle disease and in the improvement of beef products, making it an attractive component in beef cattle diets (Shabtay *et al.,* 2008).

Interest in the fiber content of foods has decreased in recent years as concerns about fat intake have increased. Fiber, however, remains an important component of the diet. Soluble dietary fibers including pectin substances and hydrocolloids, is found naturally in food such as fruit, vegetables, legumes and oat bran. Insoluble fiber, including cellulose and hemicellulose is found in foods such as whole grains. Fiber supplementation has been used to enhance the fiber content of variety of foods ranging from cereal-based products to meats, imitation cheeses and sauces (Mckee and Latner, 2000).

MATERIALS AND METHODS

Materials:

1. Orange and pomegranate peel were obtained from local market.
2. Bolti fish (*Tilapia nilotica*) was transferred directly after catching to the laboratory.
3. Bread crisp, starch, sodium chloride, spices, cumin, onion, and garlic were obtained from local market.

Methods :

After washing the orange peel and pomegranate peel were dried in an air oven at 60^{o}C then milled and sieved.

Fish burger was prepared using orange and pomegranate peel powder.

Orange and pomegranate peel powder were added to fish (5%, 7.5% and 10%) (Fernandez-Gines *et al.,* 2004).

The fish were scaled, eviscerated and washed with tap water to remove blood and mucous membrane lining in the gut cavity. Afterward, head,

skin and bones were removed with hands from all fish which then minced to get rid of small spines via grinding.

Ingredients of fish burger (Control) were as follows :

Fish flesh	75%
Bread crisp	5%
Starch	5%
Sodium chloride	1.8%
Spices	1%
Cumin	0.2%
Onion	5%
Water	6%
Garlic	1%

All ingredients were mixed by grinding and pounded. About 60g of the mixture was prepared in circular pieces with 10 cm-diameter. Analysis was carried out at zero time and after 1, 2 and 3 months of frozen storage (-18^{o}C).

Analytical methods :

1. Chemical composition :

Moisture, protein, fat and ash and fiber were analyzed according to **A.O.A.C. (2000)**. Carbohydrate were calculated by difference.

2. Storage stability :

Total volatile nitrogen (T.V.N.) and trimethyl amine (T.M.A.) were determined according to the method described by A.O.A.C. (2000). Thiobarbituric acid value (T.B.A.) was determined as described by the method of Pearson (1970).

3. Physical characteristics :

Water holding capacity (WHC) and plasticity were measured according to Volovinskaia and Merkolova (1958). Percent shrinkage was determined after frying in corn oil at 110^{o}C for 5 min as follows :

$$\frac{\text{(Fresh sample diameter – fried sample diameter)}}{\text{(Fresh sample diameter)}} \times 100$$

Cooking loss was determined, after frying in corn oil at 110^{o}C for 5 min. as follows :

$$\frac{\text{(Fresh sample weight – fried sample weight)}}{\text{(Fresh sample weight)}} \times 100$$

Cooking yield was determined as follows :

100 - % cooking loss

4. Organoleptic evaluation :

Organoleptic evaluation of cooked fish burger was carried out according to Watts *et al.,* (1989). Data were analyzed using ANOVA and Duncan's test at a probability level of < 0.05 according to SAS Institute (1987).

RESULTS AND DISCUSSION

Chemical composition of orange and pomegranate peel :

Chemical composition of orange and pomegranate peel powder, the results are presented in Table (1). Low differences were found between orange peel and pomegranate peel for moisture, protein and fat being (10.86, 10.53%, 10.02, 9.98% and 2.70, 2.89%, respectively. On the other hand, total fibers content and ash content of pomegranate peel recorded the lower values (65.9 and 3.30%) compared to orange peel (67.85 and 4.36%), while carbohydrate content of pomegranate peel (7.4%) was higher than orange peel (4.21%). These results are in agreement with those obtained by Larraui *et al.* (1996) who reported that high dietary fiber powders from Valencia orange and Persa lime peel, fibers from both peel had a high total dietary fiber content (61.69%).

Table (1) : Chemical composition (%) of pomegranate and orange peel powder. (% on dry weight basis)

Contents	Orange peel	Pomegranate peel
Fiber	67.85	65.90
Moisture	10.86	10.53
Protein	10.02	9.98
Fat	2.70	2.89
Ash	4.36	3.30
Carbohydrate	4.21	7.40

Chemical composition of fish burger as influenced by adding orange and pomegranate peel at zero time was determined, the results recorded in Table (2). It is clear that the addition of fiber (orange and pomegranate peel) decreased the moisture, protein and fat contents, while the ash, fibers and carbohydrate increased. This is due to the addition of the pomace powder, being poor in moisture, protein and fat with high contents of fiber and carbohydrate. The increase of fiber was remarkable as influenced by adding (10% peel) compared to control sample. These findings are in agreement with those obtained by Fouda, Zoba (1999) who reported that the addition of fiber mixture decreased the moisture, protein and fat, while the fiber and carbohydrate increased in fish sausage.

Table (2) : Chemical composition (%) of fish burger as influenced by adding orange peel and pomegranate peel at zero time (% on wet weight basis).

Samples / Contents	Control	Orange peel			Pomegranate peel		
		5%	7.5%	10%	5%	7.5%	10%
Moisture	66.49	64.79	63.99	63.49	65.53	64.99	64.49
Protein	22.12	20.9	19.95	19.35	19.86	19.49	18.91
Fat	3.12	2.80	2.72	2.67	3.05	2.91	2.85
Ash	2.53	2.60	2.66	2.70	2.86	2.92	3.09
Fiber	0.64	2.21	2.66	3.29	2.01	2.41	2.86
Carbohydrate	5.10	6.70	8.02	8.50	6.69	7.28	7.80

Data presented in Table (3) show the chemical composition of fish burger as influenced by adding orange and pomegranate peel after frozen storage at -18°C for two months. The results indicated the slight changes between chemical analysis at zero time and after frozen storage. In general, by storage, the moisture and protein were reduced, while ash, fiber and carbohydrate were increased. It might be assumed that the drip separation during thawing some losses of water and protein occurred as reported by Hsieh and Regenstein (1989). Raising percent of peel powder (orange and pomegranate) added to samples, increased percent of fiber in burger samples. Also, percent fiber in burger samples with adding orange peel was higher than that of burger prepared with adding pomegranate peel (Table, 3), this because orange peel have high value of fiber content compared to pomegranate peel (Table, 1).

Table (3) : Chemical composition of fish burger as influenced by adding orange peel and pomegranate peel after frozen storage at -18°C for two months storage (% on wet weight basis).

Samples / Constitute	Control	Orange peel			Pomegranate peel		
		5%	7.5%	10%	5%	7.5%	10%
Moisture	65.26	63.51	62.69	62.18	64.30	63.70	62.99
Protein	21.89	20.39	19.58	18.98	19.46	19.10	18.65
Fat	3.41	3.11	2.97	2.89	3.31	3.29	3.12
Ash	3.12	3.24	3.32	3.43	3.59	3.73	3.99
Fiber	0.91	2.63	2.94	3.71	2.44	2.69	3.15
Carbohydrate	5.41	7.12	8.50	8.81	6.90	7.49	8.10

From the results of Table (4) it could be noticed the TBA values, TVN and TMAN of fish burger as influenced by adding orange and pomegranate peel during frozen storage at -18°C for two months storage.

Prepared samples with orange and pomegranate peel resulted in lower values of TBA, TVN and TMAN after two months storage. Low TBA values were possibly due to the antioxidant effect of orange peel as reported by Kang *et al.,* (2006) who reported that the samples containing the aqueous solution of citrus peel powder gave significant protection to lipid oxidation as indicated by the lower TBA value. Effect of pomegranate peel was also reported by Shabtay *et al.,* (2008) who found that pomegranate peel is a rich source for antioxidants, and thus may serve in the prevention of cattle disease and in the improvement of beef products.

Table (4) : Storage stability of fish burger as influenced by adding orange peel and pomegranate peel during frozen storage at -18°C for two months storage (% on wet weight basis).

Samples / Parameters		Control	Orange peel			Pomegranate peel		
			5%	7.5%	10%	5%	7.5%	10%
TBA mg/kg	**Zero time**	0.120	0.100	0.090	0.080	0.086	0.080	0.077
	After 2-months	0.780	0.720	0.510	0.490	0.420	0.400	0.380
TVN mg/100g	**Zero time**	3.97	3.80	3.77	3.70	3.70	3.65	3.60
	After 2-months	7.45	6.10	5.97	5.95	5.93	5.90	5.85
TMAN mg/100g	**Zero time**	0.50	0.45	0.42	0.39	0.37	0.33	0.30
	After 2-months	1.90	1.30	1.22	1.09	1.01	1.00	0.99

From the results in Table (5), it could be noticed the physical characteristics of fish burger as influenced by adding orange and pomegranate peel during frozen storage at -18°C for two months storage. The results showed that plasticity (zero time) for samples prepared by adding orange peel was higher than that prepared by adding pomegranate peel. After two months, plasticity was decreased for both samples processed by adding orange peel and pomegranate peel. Water holding capacity (WHC) at zero time and after two months better for samples by adding orange peel than samples by adding pomegranate peel. Plant fiber show some functional properties, such as water holding capacity (WHC), swelling capacity (SWC) and viscosity. Grinding the dry fibrous material to fine powder may adversely affect both its WHC and SWC the effect is attributed not only to particle size reduction, but also to the altering the fiber matrix structure. The literature concerned with the effects of treatments for fiber extraction on its physicochemical properties is scarce and sometimes contradictory Figuerola *et al.,* (2005).

The shrinkage and cooking loss for samples with orange peel were lower than that prepared by adding pomegranate peel at zero time and after two months. However, adding orange and pomegranate peel at different percentages decreased shrinkage and cooking loss for all samples compared to control.

Table (5) : Physical characteristics of fish burger as influenced by adding orange peel and pomegranate peel during frozen storage at -18°C for two months storage (% on wet weight basis).

Parameters \ Samples		Control	Orange peel			Pomegranate peel		
			5%	7.5%	10%	5%	7.5%	10%
Plasticity (cm^2/0.3g)	Zero time	2.31	2.50	2.60	2.61	2.40	2.51	2.58
	After 2-months	2.20	2.31	2.38	2.40	2.20	2.30	2.35
WHC (cm^2/0.3g)	Zero time	1.20	4.00	1.90	1.80	3.60	3.40	3.30
	After 2-months	1.80	4.50	2.62	2.50	4.10	3.99	3.91
% Shrinkage	Zero time	10.98	9.78	6.30	6.12	10.52	7.40	6.20
	After 2-months	11.50	10.82	7.42	7.30	11.73	8.32	7.50
% Cooking loss	Zero time	10.45	10.26	7.67	5.50	11.38	9.31	7.63
	After 2-months	13.31	12.98	9.82	7.61	14.12	12.22	9.54
% Cooking yield	Zero time	89.55	89.74	92.33	94.50	88.62	90.69	92.37
	After 2-months	86.69	87.02	90.18	92.39	85.88	87.78	90.46

Concerning cooking yield, it was higher for samples by adding orange peel than those adding by pomegranate peel compared to control at zero time and after two months.

Organoleptic properties of cooked fish burger as influenced by adding different levels of orange and pomegranate peel during frozen storage at -18°C for two months are presented in Table (6).

Table (6) : Average of organoleptic properties of cooked fish burger as influenced by adding orange peel and pomegranate peel during frozen storage at -18°C for two months

Samples / Factors		Control	Orange peel			Pomegranate peel		
			5%	7.5%	10%	5%	7.5%	10%
Taste	Zero time	9^{a}	9^{a}	9^{a}	8^{ab}	8.5^{ab}	8^{ab}	7^{b}
	After 2-months	8.5^{a}	8.5^{a}	8.5^{a}	7.5^{ab}	8.0^{ab}	7.5^{ab}	6.5^{b}
Colour	Zero time	8^{a}	9^{a}	9^{a}	8^{a}	6^{b}	6^{b}	6^{b}
	After 2-months	7.5^{a}	8.5^{a}	8.5^{a}	7.5^{a}	5.8^{b}	5.8^{b}	5.8^{b}
Odour	Zero time	8^{a}	9^{a}	8^{a}	8^{a}	9^{a}	8^{a}	8^{a}
	After 2-months	7.5^{a}	8.5^{a}	7.5^{a}	7.5^{a}	8.5^{a}	7.5^{a}	7.5^{a}
Texture	Zero time	9^{a}	8^{ab}	8^{ab}	7^{b}	8^{ab}	8^{ab}	7^{b}
	After 2-months	8.5^{a}	7.5^{ab}	7.5^{ab}	6.5^{b}	7.5^{ab}	7.5^{ab}	6.5^{b}
Appearance	Zero time	8^{a}	9^{a}	9^{a}	9^{a}	7^{b}	7^{b}	7^{b}
	After 2-months	7.5^{a}	8.5^{a}	8.5^{a}	8.5^{a}	6.5^{b}	6.5^{b}	6.5^{b}
Overall accept-ability	Zero time	8.4^{a}	8.8^{a}	8.6^{a}	8^{a}	7.7^{a}	7.4^{a}	7^{b}
	After 2-months	7.9^{a}	8.3^{a}	8.1^{a}	7.5^{a}	7.3^{a}	6.96^{a}	6.76^{b}

Means with the same letters in the same column are not significantly different (p>0.05) using ANOVA.

The results indicated that slight changes between sensory evaluation at zero time and after frozen storage. From the results, it could be observed the nonsignificant differences in taste, odour and texture for all samples except sample prepared by adding pomegranate peel 10% percentage.

Concerning colour and appearance a significant decrease for samples prepared by adding pomegranate peel were recorded. In general, nonsignificant differences between all samples were noticed for overall acceptability compared to control, except for sample by adding pomegranate peel 10% percentage.

REFERENCES

A.O.A.C. (2000). Official Methods of Analysis of Association of Official Analytical Chemists, 17th Ed. Published by A.O.A.C. In Gaithersburg, Maryland 20877-2414, U.S.A.

Fernandez-Gines, J.M.; Fernandez-Lopez, J.; Sayas-Barbera, E.; Sendra, E. and Perez-Alvarez, J.A. (2004). Lemon albedo as a new source of dietary fiber : Application to bologna sausages. Meat Science, 67; 7-13.

Figuerola, F.; Hurtado, M.; Estevez, A.; Chiffelle, I. and Asenjo, F. (2005). Fiber concentrates from apple pomace and citrus peel as potential fiber sources for food enrichment. Food Chemistry, 91: 395-401.

Fouda, Zoba, M.A. (1999). Quality attributes of fish sausage as affected by adding dietary fibers. Annals of Agric. Sci., Moshtohor, 37 (2) : 1287-1299.

Grigelmo-Miguel, N. and Martin-Belloso, O. (1998). Characterization of dietary fiber from orange juice extraction. Food Research International, 31 (5) : 355-361.

Hsieh, Y.L. and Regenstein, T.M. (1989). Texture changes of frozen stored cod and ocean-perch minces. J. Food Sci., 54 (4) : 824.

Kang, H.J.; Chawla, S.P.; Kwon, J.H. and Byun, M.W. (2006). Studies on the development of functional powder from citrus peel. Bioresource Technology, 97 : 614-620.

Larrauri, J.; Ruperez, P.; Bravo, L. and Sauracalixto, F. (1996). High dietary fiber powders from orange and lime peel : Associated polyphenols and antioxidant capacity. Food Research International, 29 (8) : 757-762.

Mckee, L.H. and Latner, T.A. (2000). Underutilized sources of dietary fiber. A review. J. Plant Foods for Human Nutrition, 55 (4) : 285-304.

Morris, G. (1985). Apple and Fiber. Chlton's Food Eng., Vol. 1 : 72.

Pearson, D. (1970). The Chemical Analysis of Food. National College of Food Technology, Univ. of Reading, Weybridges, Surry, T. and Churchill, A.

SAS Institute (1987). SAS/STAT Series Guide Release 6.03 Ed., SAS Institute Int., Cary MC, U.S.A.

Shabtay, A.; Eitam, H.; Tadmor, Y.; Orlov, A.; Meir, A. and Chen, Y. (2008). Nutritive and antioxidative ponential of fresh and stored pomegranate industrial by-products as novel beef cattle feed. J. Agric. Food Chem., 56 (21) : 10063-10070.

Trowell, H. (1978). The development of the concept of dietary fiber in human nutrition, Am. J. Clin. Nutr., 10 : 3-11.

Van Soest, P.J. (1978). Dietary fibers : Their definition and nutritional properties. J. Clin. Nutr., 31: 512.

Volovinskaia, V.P. and Merkolova, V.K. (1958). Methods for The Determination of Water Holding Capacity of Meat.

Watts, B.M.; Yamaki, G.L.; Jeffrey, L.E. and Elias, L.G. (1989). Basic sensory methods for food evaluation. 1st Ed., International Development Research Center Pub., Ottawa, Canada.

Yetley, E. and Park, Y. (1995). Diet and heart disease, health claims. J. Nutrition, 125 (3) : 679-685.

قشور الفاكهة كمصدر لمكونات وظيفية في منتجات الأسماك

هشام أحمد أحمد ، شادية محمود شرف و نجلاء عبد الوهاب السنوسي
قسم بحوث اللحوم والأسماك – معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – الجيزة.

من المعروف أن الأسماك من الأغذية المرتفعة القيمة الغذائية والصحية فهو بالإضافة لإحتوائه علي نسبة عالية من البروتينات المرتفعة القيمة الحيوية والعناصر المعدنية والفيتامينات فهو مفيد صحياً حيث يؤدي إلي تقليل ضغط الدم وتقليل مستوي الليبيدات والكوليسترول بالدم. هذا وأن برجر السمك محبباً للأطفال ولكبار السن لسهولة تناوله وقد تحدث بعض الأمراض في الجهاز الهضمي والدوري نتيجة لنقص الألياف الطبيعية بالأغذية مثل مرض السكر والسرطان والقرح والحصوات المرارية وغيرها وهذه الأمراض يمكن تجنبها بإستهلاك الأغذية المحتوية علي ألياف ، وفي نفس الوقت الألياف الغذائية قد يكون لها دور فعال في تحسين الخواص في صناعة الأغذية البحرية مثل ربط الماء أو الخواص الجيلية. وحيث أن الأسماك ومنتجاتها فقيرة في إحتوائها علي الألياف فإن هذا البحث يهدف إلي تدعيم برجر سمك البلطي بإستخدام مسحوق ألياف مجفف علي درجة حرارة (٦٠°م) ومنتج من مخلفات البرتقال والرمان وإضافتها إلي برجر السمك بنسب ٥٪ ، ٧,٥ ، ١٠٪ والتخزين علي -١٨°م لمدة شهرين. شملت الدراسة الإختبارات الحسية والكيماوية والطبيعية لبرجر السمك وقد أوضحت النتائج أن إضافة قشور البرتقال والرمان أدت إلي تقليل نسبة الرطوبة والبروتين والدهن وزيادة نسبة الألياف والكربوهيدرات ، ووجد إختلافات طفيفة في التركيب الكيماوي بعد التخزين لمدة شهرين علي -١٨°م. أوضحت النتائج أن إضافة قشور البرتقال والرمان إلي برجر السمك أدي إلي تحسين خصائص المنتج أثناء التخزين ، كذلك أدي إلي تقليل قيم TBA ، TVN ، TMAN بعد التخزين لمدة شهرين علي -١٨°م وأن هذه القشور لها تأثير كمضادات أكسدة ، كما أن إضافة هذه القشور أدي إلي تحسين خصائص الجودة الطبيعية والحسية.