
**DETERMINATION OF TOTAL ANTIOXIDANTS AND
CAROTENOIDS IN FORTIFIED WHITE BREAD WITH DIFFERENT
LEVELS OF DRIED POTATO PEELS**

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DETERMINATION OF TOTAL ANTIOXIDANTS AND CAROTENOIDS IN FORTIFIED WHITE BREAD WITH DIFFERENT LEVELS OF DRIED POTATO PEELS

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Abstract

Antioxidants and carotenoids are considered good sources and necessary for human health. The aim of this work was to determinate of the total antioxidants and carotenoids in fortified bread with different levels of dried potato peels (5%, 10% and 15%). It is used wheat flour (72% extraction) and dried potato peels in oven at temperature (180 o C for 15 minutes) to raise nutritional value of antioxidants and carotenoids in bread. The bread was divided into two main groups, the first group (non- fortified) consisted of bread, and the second group consisted of fortified bread with potato peels and divided into three sub-groups they are as follows: fortified bread with (5%, 10% and 15%) respectively potato peels. The obtained results revealed that sensory evaluation of bread was acceptable sensory until level (15%) dried potato peels compared to the control group and there were significant different with increasing potato peels, but the best result appeared in fortified bread with the (5%),also there were significant differences (significant increasing) in the rats of vitamins and minerals with increasing potato peels compared to control group of bread . on the other hand the content of antioxidants and carotenoids in fortified bread were revealed that with increasing the level of dried potato peels increased of antioxidants and carotenoids (17.22, 35.13 and 55.86) respectively and carotenoids (74.9, 121.23 and 151.58) respectively as compared to control bread (0.00 and 27.4).It can be recommended that its necessary to utilization of potato peels in bakery products for important of nutritional values and healthy bread.

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Key words: Antioxidants, Carotenoids, potato peels, wheat flour , sensory and chemical evaluation .

1. INTRODUCTION:

Carbohydrates are considered important and necessary nutrients for human health according to food agricultural organization [FAO, 1997]. Bread is one of the basic products for human diet. It is a source of energy and rich in carbohydrates, [Bowles and Demiate, 2006]. A dietary supplement is providing human body with enough essential nutrients such as vitamins, minerals and fiber, especially people consume insufficient quantities. [Food and drug administration, 2014 and Crésio Alves and Renata Villas Boas Lima, 2009.]. And this is shown deficiency in micronutrients [Guallar et al., 2013].

Fruits and vegetables are considered of the foods with high content of potassium which helps maintain lean body mass and bone mineral density. [Dawson-Hughes et al., 2008]. Vegetables and fruits peels are characterized as the best herbal extracts, it is rich in bioactive compounds and it has been biological properties [Parmar and Kar, 2009 & Hamendra et al., 2010]. Among these vegetables are potatoes, it is one of the popular vegetables and important in the United States. [Lin and Yen, 2004 and Faostat, 2009]. Potatoes became basic foods in human nutrition, which it is considered natural source of phenolics and antioxidants, these compounds are found heavily in the peel, so potato peels is considered a natural source of strong antioxidants properties , high in the content of polyphenols and other phenolic compounds such as chlorogenic acid (50.31%) ,glucaric acid. Gallic acid (41.67%), protocatechuic (7.81%) and caffeic acid (0.21%). [Brown, et al 2005 & Fischer and Bipp, 2005]. The role of antioxidants are decrease the risk of coronary heart diseases [Venketeshwer, 2012 & Lachman *et al*, 2008]. One medium potato with peel is contains two grams of fiber of the daily value, which it has health benefits in improving blood lipid levels, regulating blood glucose, and help weight loss, also potatoes are riches in vitamin C, it is provide with 45 % of vitamin C and this makes potatoes in the top 5 of vitamin C for Americans , Potato peels are provide the body with important minerals such as potassium (620 mg of potassium) more than high foods in the content of potassium such as

bananas, oranges, mushrooms which it reduce the risk of hypertension , stroke and heart diseases Also it is contain of magnesium, phosphorous, iron, and zinc and vitamins for example 10 % of vitamin B6, thiamin, riboflavin, folate, and no fat.The water soluble vitamins acts as an antioxidant, and help to prevent cellular damage and vitamin C assists with the absorption of iron and help support the body's immune system [Gropper *et al.*, 2009 & FDA, 2002 & Cotton *et al*, 2004 & Food and Nutrition Board, 2004 & Cook *et al*, 2009 and Nowson *et al*, 2004].

More than 50% of the nutrients found in the potato peels such as total dietary fiber, so Potato peels (PP) is considered a source of dietary fiber for human health [Stushnoff *et al.*, 2007 & Mabrouk and El Ahwany., 2008 & Ballesteros *et al.*, 2001]. [Nara *et al.*, 2006] studied that physical and chemical properties of potato peels and reported that potato peels is containing a high rate of dietary fiber more than wheat bran. [Sello, 2011] Evaluated the content phenolic of potato and apple peels, the results showed that potato peel has high levels of copper (0.826), calcium (39.2), copper (0.68) and calcium (26.03) ppm. And the content of total phenols in potato peel was higher than apple peel (3.2 vr 2.5) respectively and the compounds of phenolic are distributed between the potato cortex and peel tissues, also 50% of the phenolic compounds are found in the potato peel a nearby tissues [Friedman, 1997 & Hasegawa *et al*, 1966]. Compared between sesame cake, sugar beet pulp and potato peels, the results were showed that potato peels was superior in the content of Polyphenolic and antioxidant, these compounds have a role in human health [Mohdaly *et al*, 2010 & Al-Weshahy and Rao, 2012]. [Rasha and Nareman, 2013] compared between potato and eggplant peels and they reported that potato peels are better than eggplant peels in levels of chlorogenic acid. And the content of total Polyphenolic in potato peels was (3.93 mg/g) [Singh and Rajini, 2008]. Although potato peels is used for feeding livestock, on other hand it is used as a source for natural antimicrobial compounds [Prasad and Pushpa, 2007]. [Abdel-Magied, 1994] studied using potato peels in other applications such as biscuit product with levels (5% and 10% w/w) replaced wheat flour. [Arora A and Camire, 1994 & Singh and Rajini, 2004] Studied the effect of addition potato peels with level (25%) on muffins, also using it in food applications.

[Fadel, 2002] reported that Potato peels contribute in field the products of biotechnology and industrial such as wheat bran, rice bran, molasses bran, barley bran, maize meal, and soybean meal. [Singh and Rajini, 2004] measure the antioxidant activity of potato peels extract is strong activity and this make potato peels as effective element in health or functional food. So this study was carried out to determine total antioxidants and carotenoids in fortified bread with different levels of dried potato peels powder compared to control bread. So the aim of this study was investigate the effect of addition different levels of potato peels with wheat flour to produce some bakery products such as bread rich with antioxidants and carotenoids. On anther hand this paper aimed to raise and improve the antioxidants and carotenoids content of bread by adding different levels of dried potato peels, also the importance of this research was obtained in awareness some people of healthy benefits of vegetable peels especially potato peels.

2. MATERIAL AND METHODS

2.1 Material:

- Sample of white flour (72% extraction) was obtained from local market of Cairo – Egypt.
- Sample of dried Potato peels were obtained from fresh Potato tubers Purchased from local market of Cairo – Egypt in November 2015.

2.1.1 Methods:

2.1.2 Sensory evaluation:

Sensory evaluation of fortified bread with different levels of dried potato peels was included (taste, color, flavour, textures, pores and overall acceptability) compared to control bread according to the method of [Fairdi and Rulenthaler, 1984].

2.1.3 Preparation of potato peels:

Fresh potato tubers were washed well by water and remove the peels by using kitchen vegetable peeler. Potato peels was dried by different methods by sun drying or oven drying (hot air oven at 180 °C for 1 h) or solar drying methods according to [Kiremire, *et al*, 2010]. Then it was grinded in the blender to get soft powder, it was saved in plastic bags and stored in freeze until used.

2.1.4 Preparation of wheat flour with potato peels and bread groups:

Adding different levels of dried potato peels (5%, 10% and 15%) to (100 gm) wheat flour (72% extraction) and mix well with little of water, then adding other contents (salt, yeast, sugar and little of oil) to make bread product, it was leaved for a period of time for fermentation, then it was beaked in oven at temperature 200 oC for 20 minutes. Bread samples was divided into two main groups, the first main group was contained control bread (non fortified) and the second main group was contained fortified bread with different levels of potato peels (5 %, 10% and 15%), this group was divided into three subgroups are as followed, the first subgroup was consisted of fortified bread with (5%) dried potato peels, the second subgroup was consisted of fortified bread with (10%) dried potato peels and the third subgroup was consisted of fortified bread with (15%) dried potato peels. The samples were evaluated sensory evaluation compared to the control bread. Also these samples were dried in the oven at 200 oC and grinded in blender to get soft powder and preparation for chemical analysis.

2.1.5 Proximate Chemical Composition:

Chemical analysis of macronutrients (proteins, fats, carbohydrates, Ash, Moisture and crude Fiber) and micronutrients (Vitamins and minerals):

Determination of nutritional value of raw material (flour and dried potato peels) and food product (fortified white bread with different levels of potato peels (5%, 10% and 15%) to study the chemical composition of Proteins, Fats, Carbohydrates, Ash, Moisture, Crude Fiber ,Vitamins and rare compounds such as Total antioxidants and Carotenoids .Proteins, Fats, Carbohydrates, Ash, Moisture, Crude Fiber content was determined according to the method described by [Anderson and Shirley, 2007, Brand Williams *et al* .1995 and Ranganna, 1979].

2.1.6 Chemical analysis of micronutrients (Minerals and Vitamins):

minerals such as (Zn, Cu, Ca, Fe and Se) in wheat flour and potato peels were determined according to the methods outlined in [A.O.A.C., 2007].The content of vitamin B complex (B1, B2, B3, B6, B9 and B12) were determined according to the methods of [Stephane Castan *et al*, 2005]

and vitamin C contents were determined according to the methods of [Sanchez-Machado *et al*, 2006].

2.1.7 Chemical analysis of rare compounds:

The content of rare compounds (Total antioxidants and Carotenoids) in fortified bread was carried out according to the methods of [Anderson and Shirley, 2007, Brand Williams *et al*, 1995 and Ranganna, 1979].

3. Statistical analysis:

The obtained data were Statistical analyzed using Analysis of Variance (ANOVA). The results were expressed as mean \pm standard deviation "SD" at least significant difference "LSD" tests at a probability $P < 0.05$, according to [Armitage and Berry, 1987].

4. Result and discussion:

Data in Table (1) .Showed mean and least significant different (LSD) at (0.05) of sensory evaluation of control and fortified samples of bread with different levels of dried potato peels (5%, 10% and 15%).The results revealed that ,the mean values of sensory evaluation (taste, color, flavour, pores , textures and overall acceptability) were decreased gradually with increasing the level of dried potato peels from (9.7 to 7.8) taste, (9.6 to 7.4) colure, (9.5 to 6.6) flavor, (9.7to 7.2) pores, (9.6 to 7.2) textures. This showed that there are significant differences with increasing level of potato peels. In the end the best results in sensory evaluation were obtained in fortified sample with (5%), it were (9, 9, 9, 8.2 and 8.2) respectively as compared to control sample (9.7, 9.6, 9.5, 9.7and 9.6).

Table (1): Mean and least significant different (LSD) of sensory evaluation of control and fortified white bread with different levels of dried potato peels.

Mean of Sensory Evaluation Samples(Bread)	Taste	Color	flavour	Pores	textures	Overall acceptability
Control	9.7 \pm 0.21	9.6 \pm 0.031	9.5 \pm 0.12	9.7 \pm 0.012	9.6 \pm 0.02	48.1
5%	9 \pm 0.01	9 \pm 0.64	9 \pm 0.41	8.2 \pm 0.74	8.2 \pm 0.75	41.4
10%	8.4 \pm 0.49	8.8 \pm 0.41	7.4 \pm 0.76	7.2 \pm 0.75	7.2 \pm 0.74	41.00
15%	7.8 \pm 0.98	7.4 \pm 0.99	6.6 \pm 1.2	7.2 \pm 0.76	7.2 \pm 0.76	36.2
LSD at 5%	0.281	0.320	0.382	0.337	0.337	1.015

Data in Table (2). Illustrated Chemical composition of Macronutrients of control and fortified bread with different levels of dried potato peels (5%, 10% and 15%), the rates of protein, crude fiber, and Ash were significant increased with increasing the level of potato peels compared to control bread (8.130 , 10.403 , 10.450 , 11.845), (0.351 , 1.39 , 1.85 , 2.61) , (0.515 , 1.265 , 1.322 , 1.996) respectively, This could be due to substitution effect caused by the high levels of protein, fiber and ash in potato peels (17.572 , 3.472 , 4.998) respectively according to [Nara et al., 2006] studied that physical and chemical properties of potato peels and he reported that potato peels is containing a high rate of dietary fiber more than wheat bran. but the rats of carbohydrates, fats and moisture were significant decreased with increasing the level of dried potato peels (98.15 , 82.307 , 79.706 , 72.006),(3.781 , 3.232 , 3.083 , 1.109), (11.987 , 1.722 , 0.501 , 0.001) respectively and the best results were showed in the fortified bread with (5%) of potato peels as compared to the control. These results agree with the results [Sharoba et al., 2009] who analyzed wheat flour extraction (72%) from where (protein, carbohydrate, fat, crude fiber, moisture and Ash) and micronutrient (minerals), [United States Department of Agriculture, National Nutrient Database. International Year of the Potato, 2008] mentioned that Potato is considered of foods rich in carbohydrate, it contains about 80 % water and 20 % dried matter, the protein that found in potato is similar to that found in cereals. In addition, the potato is low in fat, [Mabrouk and El Ahwany, 2008] reported that Potato peels (PP) was as a source of dietary fiber. Which (50%) of potato peels (w/w) is considered dietary fibers.

Table (2): Chemical composition of Macronutrients of control and fortified bread with different levels of dried potatoes peels (5%, 10% and 15%).

Samples Macronutrients	Raw materials		Control Bread	Fortified bread with dried potato peel		
	White flour extraction (72%)	Dried potato peels		5%	10%	15%
Protein	11.845	17.572	8.130	10.403	10.450	11.845
Carbohydrate	74.193	69.973	98.15	82.307	79.706	72.006
fat	1.109	0.988	3.781	3.232	3.083	1.109
Moisture	11.987	4.776	11.987	1.722	0.501	0.001
Fiber	0.351	3.472	0.351	1.39	1.85	2.61
Ash	0.515	4.998	0.515	1.265	1.322	1.996

Table (3). Demonstrated Chemical composition of vitamins of control and fortified bread with different levels of dried potato peels (5%, 10% and 15%). This data revealed that, the mean values of vitamin B complex and vitamin C increased gradually with increasing the level of potato peels as compared to the control, There was significantly increase in the vitamin B complex content with increased level of supplementation from (12.01 to 250.96) B1,(0.76 to 16.87) B2, (42.29 to 465.72) B5, (19.60 to 154.96) B6, (6.02 to 67.53) B9, (1.38 to 364.83) B12, because of increasing the content of vitamins in dried potato peels, also There was significantly increase in the content of vitamin C with increased level of supplementation from (8.45 to 386.59) and the best results were obtained in fortified bread with (15%) of dried potato peels. These results agree with [Gropper et al., 2009] whose said that One medium potato with the peels contains 45 % of the daily value for vitamin C, potassium (620 mg), 10 % of the daily value of B6, vitamin thiamin, riboflavin, folate, magnesium, phosphorous, iron, and zinc, and [Stushnoff et al., 2007] pointed to that more than 50% of the nutrients found in the peel more than potato itself. So Vitamins are very important in food because it help to regulate body processes specialty vitamin B complex are particularly essential in carbohydrate, fat and protein metabolism. Thiamine plays a central role in the generation of energy from carbohydrates, riboflavin is involved in the energy production for the electron transport chain and the catabolism of fatty acids. Niacin plays an important role in energy transfer reactions in the metabolism of glucose, fat and alcohol [Gropper et al, 2009].

Table (3): vitamins composition of control and fortified bread with different levels of dried potato peels (5%, 10% and 15%).

Samples vitamins	Raw materials		Control Bread	Fortified bread with dried potato peel		
	White flour extraction (72%)	Dried potato peels		5%	10%	15%
Vit.B1	0.00	40.521	12.01	68.22	80.30	250.96
Vit.B2	1.94	20.870	0.76	7.24	9.89	16.87
Vit.B5	41.03	581.821	42.29	205.08	232.88	465.72
Vit.B6	5.08	204.391	19.60	35.12	48.17	154.96
Vit.B9	8.31	64.413	6.02	29.50	47.81	67.53
Vit.B12	1.34	461.112	1.38	73.21	89.96	364.83
Vit.C	21.71	443.041	8.45	9.59	23.19	386.59

Data in Table (4): Illustrated the comparison between content of minerals (Zn, Cu, Ca, Fe and Se) in White flour (72% extraction) and dried potato peels. It was resulted significant increasing of minerals (Zn, Cu, Ca, Fe and Se) in potato peels (0.515, 0.797, 39.213, 17.998 and 0.565) respectively compared to wheat flour; it was (0.457, 0.312, 12.942, 0.726 and 0.015) respectively. This could be due to the fact that potato peels are rich source of minerals as reported by [Sello, 2011] in evaluating the content of minerals and phenolic in potato and apple peels. The results showed that potato peels has high levels of copper, calcium, copper and phenolic. So minerals are playing an important and vital role in the functional processes of the body including the nervous system, the structural system also the process of water balance.

Table (4): minerals composition of wheat flour and dried potato peels.

Raw materials Minerals	White flour (72% extraction)	Dried potato peels
Zn	0.457	0.515
Cu	0.312	0.797
Ca	12.942	39.213
Fe	0.726	17.998
Se	0.015	0.565

Data in Table (5): explained chemical composition of antioxidants and Carotenoids “of control and fortified bread with different levels (5%, 10% and 15%) of dried potato peels. There is significant increasing in the rate of antioxidants with increasing the level of dried potato peels from (17.22 to 55.86) as compared to the control (0.00). Also increasing the rate of carotenoids from (74.9 to 151.587) as compared to the control (27.4) This could be due to substitution effect caused by the high levels of antioxidants and carotenoids in potato peels (87.07 and 59.6) respectively. In the end, the best results were obtained in the high level of potato peels (15%) because of increasing the content of antioxidants and carotenoids in dried potato peels, also samples were acceptable sensory. These results in line [Mohdaly *et al.*, 2010 & Al-Weshahy and Rao., 2012] whose compared between sesame cake, sugar beet pulp and potato peels, the results showed that potato peels was superior in the content of Polyphenolic, antioxidant and Their role in human health and [Rasha and Nareman., 2013] compared between potato

peel and eggplant peels, they reported that potato peels were better than eggplant peels in levels of chlorogenic acid. And the content of total Polyphenolic in potato peels was (3.93 mg/g) and dry weight based [Singh and Rajini, 2008]. So antioxidants are considered very important nutrients for human health according to [Singh and Rajini, 2004] reported that antioxidants in potato peels is considered strong activity and this make potato peels as effective element in health or functional food.

Table (5): Total antioxidants and carotenoids of control and fortified bread.

Samples Rare components	Raw materials		Control group (bread)	fortified bread with dried potato peels groups		
	White flour extraction (72%)	Dried potato peels	Sample of bread	5%	10%	15%
Total antioxidants	21.45	87.07	0.00	17.22	35.13	55.86
Carotenoids	2.2	59.6	27.4	74.9	121.23	151.58

Recommendations:

According to the obtained results, it could be recommended that:

- 1- Educate individuals about the available nutrients in vegetables peels such as antioxidants and carotenoids also its health benefits for human body.
- 2-Patients whose are suffering from Deficiency of vitamins and minerals could be recommended eating vegetables with peels.
- 3-people suffering from anemia, blood pressure, high cholesterol, heart disease and Arteriosclerosis should be eating potato with peels.
- 4- Could be making Potato with peels some applications such as fried potato or Stuffed Potato with peels.
- 5-Vitamins, minerals and rare compounds were very useful for human health so, should be eating vegetables with peels because of it is high in these contents.
- 6- Can be increasing the nutrient value of some foods by supplemented with vegetable peels or eating vegetables with peels.
- 7-Should be using vegetables peels in some bakery products such as (bread, Patton salee, pizza and pies).

Conclusion:

vegetable peels are rich in important and useful nutrient for human health such as antioxidant and carotenoids, so the aim of this work was to determinate of the total antioxidants and carotenoids in fortified bread with dried potato peels. The results of sensory evaluation were obtained that, fortified bread was acceptable until level (15%) dried potato peels as compared to control bread, and the best results showed in low level of dried potato peels (5%) more than the two levels (10% and 15%). Fortified bread was recorded gradually increasing in vitamin B complex, vitamin C, minerals and rare compounds (Total antioxidants and Carotenoids) with increasing the level of dried potato peels. So it should be eating potatoes tubers with peel or after washing well because of it is contain useful nutrients for human health such as antioxidants and carotenoids, also vitamins and minerals.

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التقدير الكلى لمضادات الأكسدة والكاروتينات فى الخبز الأبيض المدعم بمستويات مختلفة من قشر البطاطس المجفف

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الملخص العربي

مضادات الأكسدة والكاروتينات مصدراً جيداً وضرورياً لصحة الانسان. لذا هدف هذا البحث الى التقدير الكلى لمضادات الأكسدة والكاروتينات فى الخبز الأبيض المدعم بمستويات مختلفة من قشر البطاطس المجفف. حيث تم استخدام دقيق قمح استخلاص (٧٢٪) و قشر البطاطس المجفف فى الفرن على درجة حرارة (١٨٠ درجة مئوية لمدة ١٥ دقيقة) بمستويات مختلفة (٥ و ١٠ و ١٥٪) فى الخبز بهدف رفع قيمة مضادات الأكسدة والكاروتينات. حيث تم عمل منتج خبز وتقسيمه الى مجموعتين رئيسيتين، المجموعة الرئيسية الأولى تضمنت الخبز الكنترول، المجموعة الرئيسية الثانية تضمنت الخبز المدعم بقشر البطاطس المجفف، وقسمت المجموعة الرئيسية الثانية الى ثلاثة مجموعات فرعية وهى كالتالى: المجموعة الفرعية الأولى والثانية والثالثة والتي تم تدعيمهم بمستويات (٥٪، ١٠٪، ١٥٪) من قشور البطاطس المجففة على التوالي، حيث أجرى التقييم الحسى للمنتجات ومقارنتها بالخبز الكنترول، فأوضحت نتائج التقييم الحسى أن الخبز المدعم كان مقبول حسيًا حتى مستوى (١٥٪) قشر بطاطس مجفف مقارنته بالكنترول، بينما كانت أفضل النتائج فى عينة الخبز المدعم بمستوى (٥٪) قشر بطاطس، كذلك نتائج التحليل الكيمياءى للعينة الكنترول والعينات المدعمة اثبتت أنه بزيادة مستوى قشر البطاطس زاد كلاً من البروتينات وكانت معدلاتها (٨.١٣٠ و ١٠.٤٠٣)، الألياف (٠.٣٥١ و ١.٣٩)، الرماد (٠.٥١٥ و ١.٢٦٥)، الفيتامينات منها فيتامين ج (٨.٤٥ و ٩.٥٩)، مضادات الأكسدة (٠.٠٠ و ١٧.٢٢ و ٣٥.١٣ و ٥٥.٨٦) والكاروتينات (٢٧.٤ و ٧٤.٩ و ١٢١.٢٣ و ١٥١.٥٨)، بينما كان هناك انخفاض معنوى فى كلاً من الكربوهيدرات وكانت معدلاتها كالتالى (٩٨.١٥ و ٨٢.٣٠٧)، الدهون (٣.٧٨١ و ٣.٢٣٢) والرطوبة (١١.٩٨٧ و ١.٧٢٢) مقارنته بالعينة الكنترول (الضابطة).

الخلاصة:

وأخيراً، توصى الدراسة بضرورة الاستفادة من قشور البطاطس المجففة بإضافتها الى منتجات المخابز لما لها من قيمة غذائية واحتوائها على مواد مضادة للأكسدة وكاروتينات تعمل على زيادة القيمة الغذائية والصحية للخبز.

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