Nutritional content of pies fortified with potato and eggplant peels

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Abstract

The core objective of this research to determine the chemical and mineral composition and caloric value of wheat pies (control) and fortified wheat pies with potato and eggplant peels powders, without beer yeast (blends 1,2) but with beer yeast (blends 3,4). The data indicated that there was a slight variation in crude protein between the control and blends. Besides, the blends (3,4) had higher levels of the crude protein and fiber (12.32, 12.38 protein and 0.26, 0.29 fiber g/100g respectively) than that of blends (1,2) (10.92, 10.94 protein and 0.21, 0.25 fiber g/100g respectively). Level of crude fat was higher in blends (1,2,3,4) (9.09, 9.16, 9.01, 9.05 respectively) than control (1,2) (7.44, 7.33g/100g). The carbohydrate content of blends (1,2) without beer yeast was markedly higher than that of blends (3,4) with beer yeast (48.92, 52.97 vs. 37.03, 37.14g/100g). The blends (3,4) recorded lower value of caloric than that of blends (1,2) (278.49, 279.53 vs. 321.17, 338.08 k.cal/100g). While blends (3,4) recorded high value of moisture than that of blends (1,2). Levels of Fe, Mn, Cu, Ca, Mg, Na, K and P was higher in blends than control. Also, there was a slight variation in mineral content between blend samples.

Conclusion: Pies fortified with potato and eggplant peels with beer yeast had higher levels of protein, fiber, and moisture than pies fortified with potato and eggplant peels without beer yeast. In contrast, pies fortified with potato and eggplant peels with beer yeast had lower levels of carbohydrate and caloric than pies fortified with potato and eggplant peels without beer yeast. Therefore, potato or eggplant peels could be used as nutritive partial replacers in wheat biscuits leading to reduce the consumption of wheat grains.

Keywords: Potato peels, Eggplant peels, Chemical composition, Mineral composition, Caloric value.

1. Introduction

Vegetable and fruit peels have advantages over other herbal extracts, as they are easily identifiable, commonly used by people rich in various bioactive compounds, and some of their compounds have been characterized in terms of their chemical structures and biological properties through use of structure-activity relationship. Additionally, peels are usually considered waste, so they are obviously cost-effective (Parmar& Kar, 2009 and Hamendra et al. 2010).

Potato (Solanum tuberosum L.) is one of the major world crops with world annual production of 180 million tones on 2009 according to the Food and Agriculture Organization (FAO, 2009). Potato vegetation is dated back to South America around 500 B.C (Bradshaw et al. 2009) and over centuries, it becomes a cornerstone in human nutrition in which nutritional quality was well established and documented and considers a source for many nutrients (Venketeshwara, 2012).

Of over 30 MT of annual production, tenth goes to industry to produce variable products including French fries and potato chips while the rest consumes freshly (FAO, 2009). By-products from potato processing, as like as any other food processing industry, are principally organic materials thus management and disposal are crucial toward a clean industry. Potato peel (PP) was introduced as a promising source of dietary fiber. Since approximately 50% of potato peels (w/w) is dietary fibers (Mabrouk & El Ahwany, 2008). Nara et al. (2006) studied the physical and chemical characteristics of PP and reported PP as being superior to wheat bran in its content of total dietary fiber, water holding capacity, and low quantities of starchy components. Potato peel used as a low-cost agroindustrial medium in production of both alpha-amylase and alkaline protease enzymes and several extracellular hydrolytic enzymes (Mukherjee et al. 2008)[23].

Potato peel also has acquired attention as a natural antioxidant in food system due to its high content of polyphenols, which was reported to be 10 times higher than their levels in the flesh accounting for approximately 50% of all polyphenols in potato tuber. Therefore, the effective
If you want to absorb the nutrition completely, just eat it raw (Matsubara et al. 2005). The nutrient content of eggplant is not very exciting (per 100 g portion-cooked, boiled, drained). It is low in fat 0.23g and protein 0.83 g but does contain some fiber 2.5g, sugars 3.20g and give energy 35kcal. A search of the scientific literature shows that most interest has centred on the peels of purple eggplant. The skin gets its colour from a chemical called nasunin or more correctly delphinidin-3-(p-coumarylrutinoside)-5-glucoside. Nasunin has been shown to have both antioxidant and antiangiogenic activities. In the field of cancer research, antiangiogenesis agents were heralded as a new way of preventing cancer cells from growing and spreading by stopping the development of new blood vessels (Matsubara, et al. 2014).

The present investigation was carried out to assess the chemical and mineral composition and caloric value of wheat pies (control) and fortified wheat pies with potato and eggplant peels powders (blends).

2. Materials and Methods

2.1 Potato peels

Fresh potato or eggplant tubers were obtained from local market of Assuit in October 2014. The tubers were washed by water and peeled using kitchen vegetable peeler. The peels were dried in a hot air oven (VEBMLW Medizinische, Gerete, Berlin, Germany) at 200 °C for 1 h. The dried peels were ground into a fine powder in laboratory mill (120 Perten, USA). The ground powder that passed through an 80 mesh sieve was packed into polyethylene dark bags and was stored at -18 °C until used.

2.2 Preparation of potato or eggplant peel blends in the presence of wheat flour:

Two blends were prepared by mixing potato peel powder (blend 1) or eggplant peel powder (blend 2) with wheat flour at ratio 10:90 (w/w g/100g) as cited in Table 1. Then, the blends were mixed with 2 table spoons extra virgin sunflower oil and half cup of water. The ingredients were kneaded for five minutes and then were rolled out onto white plastic surface until about 1/8 inch thick. On other greased cookie sheets, the blends were baked in a preheated 200°C oven for 20 minutes and then they were kept in dark bags at -18°C until used.

2.3 Preparation of potato or eggplant peel blends in the presence of wheat flour and Beer yeast:

Two blends were obtained by mixing potato peel powder (blend 3) or eggplant peel powder (blend 4) with wheat flour in the presence of Beer yeast at ratio 10:89:1 w/w g/100g as explained in Table 1. The blends were prepared in mixture containing 10 g peel powder and 89 g flour with 2 table spoons of extra virgin sunflower oil. One gram of Beer yeast was dissolved in a few volume of water and then was added to the prepared mixtures. The ingredients were stirred after the addition of a half cup of water and then were put dough onto white plastic surface as described in the previous section. Finally, the blends were baked in a preheated 200°C oven for 20 minutes and afterthat they were kept in dark bags at -18°C until used.

2.4 Preparation of wheat flour blends

These blends were prepared as described in the upper two sections in the absence of peels powder. One blend was...
prepared in the absence of Beer yeast (control 1) and another one in the presence of Beer yeast (control 2). Both blends were used as placebo for the blends under study.

2.5 Proximate Chemical Composition
Moisture, protein, crude fibers and ash contents were determined according to the method described in the AOAC (1997). Fat content was determined as the ether extract according to AOCS (1994). Total carbohydrates were calculated by difference according to Pellet and Sossy (1970). All determinations were performed in triplicates and the means were reported. The caloric value was calculated using values of 4 k.cal/g. of protein, 4 k.cal/g. of carbohydrate and 9 k.cal/g. of fat according to Livesy (1995).

2.6 Determination of Minerals Contents
The minerals contents i.e. (sodium, potassium, magnesium, calcium, iron, copper, manganese and phosphorus of wheat pies and fortified wheat pies with Potato and Eggplant Peels powders were determined according to the methods described in AOAC (1997). The samples were wet acid digested using a nitric acid and perchloric acid mixture (HNO3:HClO4, 2:1 v/v). The amounts of iron, copper, and manganese in the digested sample were determined using an Atomic Absorption as described in AOAC (1997). Sodium and potassium were determined by flame photometer. Calcium and magnesium were determined using Double Beam Atomic Absorption. Phosphorus was determined according to the method described in AOAC (1997).

Table 2. Gross chemical composition and caloric value of wheat pies and fortified wheat pies with potato and eggplant peels powders (on dry weight basis)*

<table>
<thead>
<tr>
<th>Sample</th>
<th>Crude protein (g/100g)</th>
<th>Crude fat (g/100g)</th>
<th>Ash (g/100g)</th>
<th>Crude fiber (g/100g)</th>
<th>Carbohydrate** (g/100g)</th>
<th>Caloric value (kcal/100g)</th>
<th>Moisture (g/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control(1)</td>
<td>10.24</td>
<td>7.44</td>
<td>1.15</td>
<td>1.19</td>
<td>57.38</td>
<td>337.44</td>
<td>22.60</td>
</tr>
<tr>
<td>Control(2)</td>
<td>11.61</td>
<td>7.33</td>
<td>1.17</td>
<td>1.21</td>
<td>50.63</td>
<td>314.93</td>
<td>28.05</td>
</tr>
<tr>
<td>Blend (1)</td>
<td>10.92</td>
<td>9.09</td>
<td>1.81</td>
<td>0.21</td>
<td>48.92</td>
<td>321.17</td>
<td>29.05</td>
</tr>
<tr>
<td>Blend (2)</td>
<td>10.94</td>
<td>9.16</td>
<td>1.96</td>
<td>0.25</td>
<td>52.97</td>
<td>338.08</td>
<td>24.72</td>
</tr>
<tr>
<td>Blend (3)</td>
<td>12.32</td>
<td>9.01</td>
<td>1.90</td>
<td>0.26</td>
<td>37.03</td>
<td>278.49</td>
<td>39.48</td>
</tr>
<tr>
<td>Blend (4)</td>
<td>12.38</td>
<td>9.05</td>
<td>1.99</td>
<td>0.29</td>
<td>37.14</td>
<td>279.53</td>
<td>39.15</td>
</tr>
</tbody>
</table>

* Mean of three replicates.
**Calculated by difference.

These results were in line with the results of Devinder, (2012) who reported that dried potato peel contained 14.04 % protein, similar to the blend (1, 3). Potato peel has high level of protein than apple peel (Sello, 2011). According with blends of eggplant peels, such data are in disagree with Matsubara et al. (2005) who reported that the nutrient content of eggplant is not very exciting. It is low in protein. (per 100 g portion), protein 0.83g.

The crude fat of the four blends was higher than the two controls which might be due to containing the potato and eggplant peels as reported by Devinder, (2012) that the dried potato peel contained 1.17 % fat and (0.99g/100g) by Sello, (2011). The data about control (1, 2) are in general agreement with Yousaf et al. (2013), Vreck et al. (2013), and USDA/USDHHS, (2010) for wheat flour. Fat ratios in the current study was higher than the fat found in the peel potatoes, eggplant, wheat flour ratios. This is due to the virgin sunflower oil present in pies (The Culinary Institute of America, 2011) and (The USDA National Nutrient Database, 2011). National Sunflower Association, (2013) stated that two most common types of sunflower oil are linoleic and high oleic. Linoleic sunflower oil is a common cooking oil that has high levels of polyunsaturated fat. High oleic sunflower oils are classified as having monounsaturated levels of 80% and above. Sunflower oil can be used for low-to-extremely-high-temperature cooking (e.g. frying). It may also help food stay fresher and healthier for longer periods of time (Bath et al. 2012 and Roberta et al. 2008). Also, intake of this oil improves performance of physical exercise (at different states) reduced affect plasma levels of triacylglycerols, total cholesterol, and fatty acid profile in rats (Jose, 2003).

The data in table (2) revealed that all control and blend samples had similar levels of ash. Such data are in agreement with Moein, (2012) and Devinder, (2012) who concluded that the dried potato peel contained 5.31 % ash. Sello, (2011) reported that potato peel has high level of ash (5.3g) than apple peel has 2.5g. Yousaf et al. (2013) coincided in rats that the supplementation resulted in a significant increase in protein, fat, crude fiber and ash contents of the cookies with wheat flour.

Concerning the crude fiber, it was a slight height in control than blends samples. This is attributed to wheat flour which contains (per100g) 2.70% total dietary fiber. These data are

3. Results and Discussion
3.1 Potatoe and eggplant peels blends
The data of fortified pies with potatoe and eggplant peels which consists of wheat flour, peels powder, water, oil, with or no yeast are given in table (1).

Table 1: The formula of potato peel blends and eggplant peel blends.

<table>
<thead>
<tr>
<th>Item</th>
<th>Potato peel blends</th>
<th>Eggplant peel blends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blend 1</td>
<td>10 g</td>
<td>10 g</td>
</tr>
<tr>
<td>Blend 2</td>
<td>90 g</td>
<td>90 g</td>
</tr>
<tr>
<td>Blend 3</td>
<td>10 g</td>
<td>10 g</td>
</tr>
<tr>
<td>Blend 4</td>
<td>1 g</td>
<td>1 g</td>
</tr>
<tr>
<td>Virgin sunflower oil</td>
<td>2table spoons</td>
<td>2table spoons</td>
</tr>
<tr>
<td>Water</td>
<td>Half cup</td>
<td>Half cup</td>
</tr>
</tbody>
</table>

The data about control (1, 2) are in general agreement with Moein, (2012) and Devinder, (2012) who concluded that the dried potato peel contained 5.31 % ash. Sello, (2011) reported that potato peel has high level of ash (5.3g) than apple peel has 2.5g. Yousaf et al. (2013) coincided in rats that the supplementation resulted in a significant increase in protein, fat, crude fiber and ash contents of the cookies with wheat flour.

Concerning the crude fiber, it was a slight height in control than blends samples. This is attributed to wheat flour which contains (per100g) 2.70% total dietary fiber. These data are
in good with USDA/USDHHS, (2010), and Yousaf et al. (2013) who reported that whole wheat flour is an excellent source of insoluble fiber which is vital for preventing the formation of gallstones, especially in women. Potato peels are a potential source of dietary fiber (Shaobo et al. 2014). Gallaher et al. (2001) reported that Potato peels (PP) fibers are primarily insoluble, and can bind bile acids in-vitro. It is believed that binding of bile acids is one of the mechanisms whereby certain sources of dietary fibers lower plasma cholesterol. Also, Ballesteros et al. (2001) studied the hypcholesterolemic effect of dietary fiber from PP and found that after four weeks of feeding on potato peels, rats showed 40% reduction in plasma cholesterol content and 30% of hepatic fat cholesterol levels were reduced as compared with animals fed only with cellulose supplemented diet. Al-Weshahy & Rao, (2012) stated that different sources of dietary fibers have been used to replace wheat flour in the preparation of bakery products. Potato peel was introduced as a promising source of dietary fiber. Since approximately 50% of potato peels (w/w) is dietary fibers (Bradshaw et al. 2009). (Prasad & Pushpa, 2007) studied the physical and chemical characteristics of PP and reported PP as being superior to wheat bran in its content of total dietary fiber, water holding capacity, and low quantities of starchy components. Wheat flour was also substituted with PP in the production of white bread, but it increased crumb darkening and reduced the loaf volume. (Bradshaw et al. 2009) suggested the possible effect of potato peel as a good source of dietary fiber to be acting as anticarcinogenic material. The method of peeling was found to be a key factor influencing the chemical composition of peels and its suitability for further utilization. Kashyap et al. (2003) reported that eggplants provide dietary fiber in abundance which is essential for regulating and facilitating smooth bowel movements. They aid digestion and promote cardiovascular health. Additionally, they also help to lower the level of cholesterol in your body. One cup serving of eggplant would contain approximately 10% of the recommended dietary fiber. The skin, especially, is loaded with fiber, so it is essential that you consume an unpeeled eggplant to reap its benefits. Matsubara et al. (2005) stated that nutrient content of eggplant is not very exciting. It is low in fat and protein but does contain some fiber. (Per 100 g portion) fiber (total dietary) 2.5g.

In the current study, the control and blends sample had levels of carbohydrate, caloric value and moisture. The carbohydrate content in control and blends (1, 2) was markedly higher than that of blends (3, 4). While a slight increase in moisture blend samples compared with control. These results are due to the wheat flour contains (per100g), 78.31% total carbohydrate, 12% moisture USDA/USDHHS, (2010). Also, may be due to the dried potato peel contained 7.85% moisture Devinder, (2012). Sello, (2011) reported that potatoe peels had high level of moisture 4.84g and carbohydrates content was (69.97g) per 100g on dry weight basis. On the other hand these results may due to the nutrient content of eggplant is 4.7g carbohydrates. One cup of chopped eggplant provides 35 calories, 8 grams of carbohydrates, 2.5 grams of fiber and 0.83 gram of protein (Matsubara et al. 2005).

### Table 3. Mineral composition of wheat pies and fortified wheat pies with Potato and Eggplant Peels powders (on dry weight basis)*

<table>
<thead>
<tr>
<th>Sample</th>
<th>Fe</th>
<th>Mn</th>
<th>Cu</th>
<th>Ca</th>
<th>Mg</th>
<th>Na</th>
<th>K</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ppm</td>
<td>g/100g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control(1)</td>
<td>29.85</td>
<td>1.66</td>
<td>3.77</td>
<td>0.04</td>
<td>0.04</td>
<td>0.31</td>
<td>0.13</td>
<td>0.18</td>
</tr>
<tr>
<td>Control(2)</td>
<td>27.49</td>
<td>1.11</td>
<td>3.69</td>
<td>0.10</td>
<td>0.06</td>
<td>0.43</td>
<td>0.25</td>
<td>0.22</td>
</tr>
<tr>
<td>Blend(1)</td>
<td>31.94</td>
<td>1.73</td>
<td>3.89</td>
<td>0.87</td>
<td>0.07</td>
<td>0.39</td>
<td>0.21</td>
<td>0.18</td>
</tr>
<tr>
<td>Blend(2)</td>
<td>30.12</td>
<td>1.86</td>
<td>3.89</td>
<td>1.08</td>
<td>0.29</td>
<td>0.48</td>
<td>0.25</td>
<td>0.17</td>
</tr>
<tr>
<td>Blend(3)</td>
<td>31.88</td>
<td>1.82</td>
<td>3.61</td>
<td>0.94</td>
<td>0.09</td>
<td>0.43</td>
<td>0.41</td>
<td>0.21</td>
</tr>
<tr>
<td>Blend(4)</td>
<td>31.01</td>
<td>1.90</td>
<td>3.75</td>
<td>1.14</td>
<td>0.31</td>
<td>0.40</td>
<td>0.38</td>
<td>0.23</td>
</tr>
</tbody>
</table>

* Mean of three replicates.

Such data are in good agreement with USDA/USDHHS, (2010) for wheat flour reported that refined wheat flour contains (per100g) 50% minerals, calcium 41 mg iron 4.3 mg magnesium 164 mg phosphorus 428 mg, potassium 436 mg sodium 2.4 mg zinc 3.1 mg copper 492 mcg and manganese 4.9 mg. Szira et al. (2014) estimate the nutritional value of 13 commercial wheat flour products, and the white flour and revealed significant variation was in the case of all mineral elements in the different brands of wheat flours. Generally, the white flour enriched with germ showed higher mineral contents than the average values of normal white flours. Furthermore, the wholemeal has higher Cu, Fe, Mn and Zn, than the white flours. The milling process- as it was expected- reduces the concentrations of four elements (Fe 33%, Mn 88%, Zn 71%, Cu 44%). Also, Vrcek et al. (2013) showed that nutritional content of wheat flours originating from organic and conventional production systems had significantly lower protein content and lower levels of Ca, Mn and Fe compared to conventional samples. Protein digestibility and levels of K, Zn and Mo were significantly higher in organic than in conventional wheat flours. Demirkesen et al. (2010) stated that flour contains potassium, phosphorous and magnesium. Enriched with the magnesium, whole wheat flour is linked to lowering the risk of Type 2 diabetes. Daily consumption of these foods has shown a decline in the increasing blood sugar, by about 19%.

On the other hand, the blends (1, 2, 3, 4) had high levels of mineral content. Such data are in agreement with Sello, (2011) & Moein et al. (2012) for potatoe peels, and Matsubara et al. (2005) and USDA, (2010) for eggplant peels.
4. In conclusion, on the basis of the above-mentioned data, both potato and eggplant peels are considered as two among newer sources of good protein, fiber, moisture and minerals on account of their important roles in human nutrition and health, but the pies fortified with potato and eggplant peels with beer yeast had higher levels of protein, fiber, and moisture than pies fortified with potato and eggplant peels without beer yeast. In contrast, they had lower levels of carbohydrate and caloric than pies fortified with potato and eggplant peels without beer yeast. Therefore, potato or eggplant peels could be used as nutritious partial replacers in wheat biscuits leading to reduce the consumption of wheat grains.

5. References

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