Potential of raw banana peel as a source of polyphenol in muffins

Chaitali Chakraborty, Kakali Bandyopadhyay, Shairee Ganguly, Bornini Banerjee and Shubham Mukherjee

Abstract
Fresh banana contains about 40% (w/w) peels. Banana peels are a good source of dietary fibres, polyphenols and some bioactive compounds. But in our society banana peels are considered as waste products. Even in banana processing industries banana peels are not utilized. As a waste material these peels can be hazardous to the environment as they can act as a medium of some harmful microorganisms. In the present study the nutraceutical properties of banana peels are utilized by using them in muffin production. Here banana peels are used as wheat flour substitute and it is added in different proportions (10%, 20%, and 30%) on the wet weight basis of the dough. The muffins were produced in microwave oven at different wattage (360W, 540W, 720W and 900W) as well as in baking oven at 110 °C temperature for 20 minutes. The polyphenol contents of all types of banana peel fortified muffins (10, 20 and 30% BPM) and control muffins, prepared in microwave oven and baking oven are determined in gm GAE/100 gm GAE by using Folin-Ciocalteu method and 2,2′-azino-bis (3-ethylbenzothiazoline) -6-sulfonic acid (ABTS•+) free radicals (González-Montelongo et al., 2010; Bedare and Singh, 2011) [4, 6]. Moreover, the extraction of antioxidants from banana peels is a great way for waste management because the main by-product from banana processing industry is its peel (Anjum et al., 2014) [2]. Sundaram et al., 2011 [12], reported that the unripe banana peel sample had higher antioxidant potency than ripe and leaky ripe. Banana peel extract is classified as non-toxic to normal human cells criteria established by the National Cancer Standard Institute. (Anjum, et al. 2015), therefore, it can be safely utilized as a natural source of antioxidants and enzyme to cure disease. Banana is a highly perishable and bulky fruit, which requires processing into a more stable and convenient form.
Drying brings about a substantial reduction in weight and volume; thereby minimizing packaging, storage and transportation cost and also enable storability of the product under ambient temperature especially in developing countries (Senadeera et al., 2005) [9]. Dried fruits are unique, tasty and nutritious. They are easy to handle and can be easily incorporated during food formulation and preparation. Dried fruit can be eaten as a snack or added to cereals, muffins or ice cream (Etsey et al., 2007) [3].

Therefore, the principal objectives of this study is to develop muffins by utilizing banana peel, a common banana byproduct, and to evaluate its sensory and polyphenol content.

2. Materials and methods
2.1 Muffin Preparation: Flowchart for the production of microwave processed and baking oven processed control muffin and banana peel muffin.

2.2 Determination of Polyphenol Content
The polyphenol contents of all the prepared muffins were determined by using spectrophotometer method and expressed in terms of gallic acid equivalent (Mcdonald et al., 2001) [7].

2.3 Sensory Analysis of Muffins
Sensory analysis was done for all the prepared muffins by eight trained panel members of food technology department by using 9 point hedonic scale (Hooda and Jood, 2005) [5].

3. Result and Discussion
3.1 Polyphenol Content of Banana Peel Fortified Muffins
Polyphone content of BPMs (100:0, 90:10, 80:20 and 70:30) prepared in microwave oven and in baking oven are represented in table 1 and table 2 respectively. The samples of muffins showed a considerable change in retention of polyphenolic content in different extracting solvents. The highest polyphenol content of both microwave processed and baking oven processed BPMs is found in methanolic extract and lowest extraction power is observed in petroleum ether. Microwave processed BPM (70:30) showed maximum polyphenol content of 7.92±0.028 gm GAE/100gm compared to baking oven processed BPM (70:30) 7.77±0.078 gm GAE/100gm. The prolonged heat treatment in baking oven is might be the cause of reduction in polyphenol content compared to microwave treatment. Polyphenol extraction power by different solvents is observed as Methanol > Acetone > Ethanol > Butanol > Petroleum Ether. This finding is also supported by Stahl et al., (2009) [11] who estimated the total phenolics of chocolate cake.

3.3 Sensory Analysis of Muffins
Results of sensory analysis of both microwave oven processed and baking oven processed muffins are shown in figure 1 and figure 2 respectively. Sensory evaluation of all types of muffins constituting of different compositions is done by 9 point hedonic scale. Among all microwave processed BPMs, the best result is found for 70:30 BPM variety with an average overall acceptance value of 8.5. In case of baking oven processed muffin the best result is obtained for 80:20 varieties with an average overall acceptance value of to be 8.4. From the body and textural point of view the microwave processed BPMs are preferred more as the baking oven processed BPMs produced a harder texture. This observation is quite similar to that of the findings of Rudrawar et al., (2015) [8].
4. Conclusion
Therefore it can be concluded that incorporation of banana peel in refined wheat flour with appropriate proportions will not only enhance the overall acceptability of final product of muffins but also increase its nutritional value in respect of polyphenol content which may increase up to 1.35 times than control muffin.

![Sensory Analysis of Microwave Processed Banana Peel Muffins](image1)

Fig 1: Sensory Analysis of Microwave Processed Banana Peel Muffins by 9 Point Hedonic Scale

![Sensory Analysis of Baking Oven Processed Banana Peel Muffins](image2)

Fig 2: Sensory Analysis of Baking Oven Processed Banana Peel Muffins by 9 Point Hedonic Scale

**Table 1:** Polyphenol content of banana peel fortified muffins prepared in microwave oven

<table>
<thead>
<tr>
<th>Extraction Medium</th>
<th>Polyphenol Content (gm GAE/100gm sample) (Avg±S.D)</th>
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<tbody>
<tr>
<td></td>
<td>Control (100:0)</td>
</tr>
<tr>
<td>Acetone</td>
<td>4.91±0.062</td>
</tr>
<tr>
<td>Methanol</td>
<td>5.91±0.045</td>
</tr>
<tr>
<td>Ethanol</td>
<td>3.15±0.013</td>
</tr>
<tr>
<td>Butanol</td>
<td>2.96±0.017</td>
</tr>
<tr>
<td>P.E</td>
<td>1.48±0.015</td>
</tr>
</tbody>
</table>

**Table 2:** Polyphenol content of banana peel fortified muffins prepared in baking oven

<table>
<thead>
<tr>
<th>Extraction Medium</th>
<th>Polyphenol Content (gm GAE/100gm sample) (Avg±S.D)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control (100:0)</td>
</tr>
<tr>
<td>Acetone</td>
<td>4.56±0.026</td>
</tr>
<tr>
<td>Methanol</td>
<td>5.76±0.046</td>
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<tr>
<td>Ethanol</td>
<td>3.44±0.025</td>
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<tr>
<td>Butanol</td>
<td>2.86±0.017</td>
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<tr>
<td>P.E</td>
<td>1.28±0.015</td>
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5. Acknowledgement
The authors are hereby acknowledging the Honorable Managing Director of JIS Group for financial support and inspiration.

6. References
2. Anal AK, Jaisanti S, Noomhorm A. Enhanced yield of phenolic extracts from banana peels (Musa acuminata Colla AAA) and cinnamon barks (Cinnamomum varum) and their antioxidative potentials in fish oil. J Food Science and Technology. 2014; 51(10):2632-2639.