Assessment of yield potential of insoluble dietary fibre from banana peel

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Abstract

Banana peels are the byproducts produced during the processing of banana. The peel is usually thrown away into the municipal waste causing environmental pollution. The peel is rich source of fiber and other vital components like carbohydrates, fats, vitamins, minerals and phytochemicals which gives it a potential value for its utilization. The present study was undertaken to prepare banana peel powder by three methods viz., wet milling (WM), dry milling (DM) and wet-milling and tap water washing (WMTWW). The yield potential of insoluble dietary fiber was assessed. The banana peel powder was evaluated for physicochemical parameters by all the three extraction techniques. The banana peel powder prepared by DM had significantly higher yield (16.20±0.05%) than other methods. The protein (7.02±0.39%), starch (7.88±0.42%) and fat (5.73±0.20) content was observed higher in WM but the higher quality of IDF was obtained by WMTWW. Thus it can be concluded that banana peel can be utilized for the extraction of IDF and can be used as a component for the preparation of functional foods.

Key words: Banana peel, dietary fibers, milling, Insoluble dietary fibers, physicochemical parameters.

1. Introduction

Fruits and vegetables are high fibre foods having low levels of digestible complex carbohydrates. The history lies in 1953, when Hipsley coined the term dietary fibre which resists the enzymes present in the digestive track (Dhingra et al 2012). In 1970’s, a great development in nutritional and medical scientists occurred in their thinking which greatly impacted the scientific communities. Fibre also was not only unimportant and non-nutritive but played an important physiological role and was considered as an important part of healthy diet. It has been defined as organic compounds which has a beneficial health effects on human health. It mainly consists of
cellulose, hemicellulose, oligosaccharides, lignins, pectins etc (Benkeblia et al., 2014). They can’t be digested by humans but are digested by ruminants due to the presence of microbes which have the capability to produce enzymes which act on them causing their hydrolysis. A high dietary fiber content of banana peel about (30-40g/100g) is indicative of a good source of dietary fibre (Emaga et al., 2007). The banana peel waste is normally disposed in municipal landfills, which contribute to the existing environmental problems. This problem can be minimized by utilizing its high value compounds like dietary fibre fraction and phytochemicals including its proteins, fats, starch and minerals in the preparation of functional foods (Basra is variety of banana is a popular commercial cultivar grown extensively for table and processing purpose in the states Maharashtra, Gujarat, Bihar and West Bengal. The average bunch weight, with 6-7 hands and with about 13 fruits per hand is about 15-25 kg. The thick rind of the fruits retains to some extent the greenish color even when the fruits are ripe and can therefore possess high amount of dietary fibers. Therefore the present study was designed to assess the yield percentage and to give the potential value of banana peel as a source of dietary fibre by different extraction procedures.

2. Materials and methods

2.1 Procurement of raw material

The raw material was procured from the local market and taken to the fruit and vegetable lab. The raw materials was washed and cleaned by using cleaned water. The raw material was assessed for proximate analysis and treated with disinfectants. The present study was conducted on an Investigation of the banana for the extraction of insoluble dietary.

2.2 Extraction of dietary fibre

The extraction of dietary fibers was conducted according to the method of Emaga et al., (2007). Banana peel powder was prepared by three methods: (I) Dry Milling (II) Wet Milling and (III) Wet milling and Tap Water Washing.

2.2.1 Dry Milling
In the dry milling method, banana peels were cut into small pieces (approx. 2×2 cm) and dried at 55°C for 10 hours using a hot air dryer. After cooling at room temperature, the material was weighed, milled and passed through a 0.50 and 0.60 mm sieve and stored at 4°C.

2.2.2 Wet milling

In wet milling method, banana peels were cut and made into paste with the help of mixer and dried at 55°C for 12 hours using a hot air dryer. After cooling at room temperature, the material was again weighed, milled and passed through a 0.50 and 0.60 mm sieve before keeping in a plastic sample pouch and stored in the refrigerator at 4°C.

2.2.3 Wet milling and tap water washing (WMTWW)

In wet milling and tap water washing method, banana peels were cut and made into paste with the help of mixer and washed three times with tap water for the purpose of removal of some starch, water soluble sugars etc., and dried at 55°C for 12 hours using a hot air dryer. After cooling at room temperature, the material was weighed, milled and passed through a 0.50 and 0.60 mm sieve before keeping in a plastic sample pouch and stored in the refrigerator at 4°C.

After the preparation of BPP, the extraction of insoluble dietary fibre was extracted by Emaga et al. (2007). Banana peel powder (BPP) (20g) was taken in conical flasks and added 200 ml of 90% ethanol at the ratio of 1:10 (w/v) and mixed properly. It was then held in water bath at 50°C for 16 hours. The peel powder was washed three times with distilled water and filtered through Whatman filter paper No-4. The defatted banana peel powder from each sample method of extraction was soaked in sodium hydroxide (1:10 w/v) at pH 12 for 24 hours in a water bath at 50°C. The defatted banana peel powder was soaked in Hydrogen Peroxide solution (15%) for 3 hours. The precipitated samples were then washed 3 times with distilled water. After washing the sample was filtered through Whatman filter paper No-4 and dried at 60°C for 10 hours. Insoluble dietary fibre was obtained and stored.

2.3 Yield
The percentage of BPP after each method of extraction was calculated by dividing the weight of banana peel after drying by initial weight of banana peel×100 and the percentage of Insoluble Dietary fiber (IDF) was calculated by dividing the weight of IDF after extraction/ weight of sample taken×100.

2.4 Proximate analysis

Banana peel and its powder were evaluated for ash, crude protein, moisture, crude fat, crude protein and crude fiber according to the standard methods of the Association of Analytical Communities (AOAC 2010). The moisture content was determined by the oven drying method.

2.5 Statistical analyses

The data was analysed for analysis of variance (ANOVA) using SAS 9.4. The means were compared using ducan’s multiple range test (DMRT) (p < 0.05).

3. Results and discussions

3.1 Percentage yield of banana peel powder

The bananas was peeled and dried and the peel obtained was utilized for the preparation of banana peel powder by three methods (Dry Milling, Wet Milling and Wet milling and Tap Water Washing). Yields after the removal of sugar, protein, starch, and fat from banana peel powder prepared by the different banana peel preparation methods were shown in Figure 1. A significant difference (p<0.05) between the methods of extraction was observed. The banana peel powder prepared by DM had significantly higher yield than those prepared by the other methods. The banana peel powder obtained by Dry milling process was found to be 16.20±0.05%. In this method, water was not used for washing therefore; there was no loss of undesired components associated to dietary fibre. This result was in accordance with the results of the orange peel dietary fibre preparation reported by Larrauri (1999). The percentage of the BPP obtained in the wet milling process was found to be 12.24%. The less amount of BPP than the drying milling was due to the washing away of water soluble components associated with the fiber and hence reducing its concentration. Tap water washing caused significantly loss than wet milling (WM) due to the additional loss soluble sugar, starch and protein.

3.2 Physicochemical composition of the banana peel powder
The main chemical components in all banana peel powder samples used for extraction of insoluble dietary fibre are given in Table 1. The sugar, starch, proteins and fats was found to be less in the sample III, because it caused significantly (p<0.05) higher loss than wet milling due to the loss of soluble components. The sugar and starch contents were found maximum in sample II because the addition of water and the blending process causing the cells to break and liberated the starch granules and sugar components out from the other cell components, resulting increase in its concentration. The results are in according to the Emaga et al. (2008) The banana peels had higher fat, ash, and total dietary fiber content, but lower protein and starch content than those of the banana peels at stage of ripeness reported by Emaga et al. (2007) (4.2, 12.8, 37.3, 3.6 and 9.5 g/100 g dry matter, respectively). This might be due to the differences in varieties and due to geographical factors. In comparison with the peels of other fruits, the protein and fat content of the banana peel were greater than those of lemon peel (7 and 2.5 g/100 g dry matter, respectively) and sweet orange peel (9.1 and 2.6 g/100 g dry matter, respectively). On the other hand, it had lower total dietary fibre content than fibre obtained from different sources of fruit industrial by-products (60-78 g/100 g dry matter) as reported by Figuerola et al. (2005). Therefore the removal of the fraction of fat, protein, and starch from the banana peel powders prepared by the different preparation methods was performed in this study in order to enhance the content of the dietary fibre and lower the content of fat, starch, and protein to obtain the low caloric value products. Moreover, fat and protein trapped inside the fibre matrix have the evidence to retard the water hydration properties of dietary fibres (Raghvendra et al., 2004; Yamazaki et al., 2005; (Wachirasiri et al., 2009)

Table 1- Physicochemical Parameters of banana peel powder

<table>
<thead>
<tr>
<th>Parameters (g/100g)</th>
<th>DM</th>
<th>WM</th>
<th>WMTWW</th>
</tr>
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<tbody>
<tr>
<td><strong>Sugar (water soluble)</strong></td>
<td>11.76±0.61b</td>
<td>12.82±0.68a</td>
<td>6.58±0.33c</td>
</tr>
<tr>
<td><strong>Starch (water soluble)</strong></td>
<td>7.88±0.42b</td>
<td>8.77±0.47a</td>
<td>6.23±0.30c</td>
</tr>
<tr>
<td><strong>Protein</strong></td>
<td>7.02±0.39b</td>
<td>9.09±0.45a</td>
<td>6.23±0.35c</td>
</tr>
<tr>
<td><strong>Moisture</strong></td>
<td>5.23±0.22b</td>
<td>6.05±0.30a</td>
<td>4.20±0.25c</td>
</tr>
<tr>
<td><strong>Dry matter</strong></td>
<td>95.80±0.05c</td>
<td>98.08±0.02b</td>
<td>98.54±0.07a</td>
</tr>
<tr>
<td><strong>Fat</strong></td>
<td>7.13±0.20a</td>
<td>5.73±0.20b</td>
<td>3.70±0.22c</td>
</tr>
<tr>
<td><strong>Crude fibre</strong></td>
<td>25.19±0.22b</td>
<td>27.68±0.01a</td>
<td>22.46±0.07c</td>
</tr>
<tr>
<td><strong>Ash</strong></td>
<td>13.94±0.80a</td>
<td>14.32±0.77a</td>
<td>8.03±0.42b</td>
</tr>
</tbody>
</table>

Data sharing similar letters in a row are statistically non-significant (p > 0.05).
All values represent the mean of three replications ± standard error (n = 3).

3.3 Percentage yield of Insoluble Dietary Fiber
The different banana peel powder samples prepared by three techniques were evaluated for the yield potential of insoluble dietary fiber (Figure 2). A significant difference (p<0.05) between the methods of extraction was observed. The banana peel powder prepared by DMTWW had significantly higher yield than those prepared by the other methods. The Insoluble dietary fiber banana peel powder obtained by Dry milling process was found to be 12.8±0.01% and in wet milling process the yield percentage was 12.60±0.05%. WMWWT was observed to have higher content as compared to other three techniques. The higher yield was due to the tap water washing of water soluble components like starch, proteins and other forms of sugars which might have caused hindrance due to the binding with fibers like cellulose. Baanan peel rich in dietary fibre (50 g/100 g) is an symbolic for good source of fibre (Emaga et al., 2007). Emaga et al. (2008) found that the maturation of banana fruits has shown to impact the dietary fibre compositions of banana peels. Banana peels possess high content of soluble dietary fibers like pectin as compared to insoluble viz., Cellulose, lignin, and hemicelluloses (Singanusong et al., 2014). The concentrations of hydrogen cyanide, an extremely poisonous substance, and oxalate contents in banana peels were found to be 1.33 mg/g and 0.51 mg/g, respectively, falling within the safety limits (Anhwange, 2008). These results indicated that banana peels were safe and valuable functional ingredients for human consumption. Among the three different methods of sample preparation, wet milling & tap water washing recorded the highest insoluble dietary fibre yield with good physical appearance from banana peel (Figure 2).

![Figure 2- Percentage yield of banana peel powder and insoluble dietary fiber](image)

Where; I, depicts the weight of the banana taken for individual extraction processes; ii, as the weight of the peeled banana obtained; iii as the weight of the peel; iv, as the percentage of banana peel obtained; v, as the percentage of banana peel powder obtained in each method of extraction and vi as the percentage of IDF obtained.
Values are presented as mean ± standard error of triplicate analyses. Data with different letters denote significant difference at p < 0.05.

Figure 2- Extraction of dietary fibers from banana peel

4. Conclusion

The processing of banana generates waste in the form of peels which is usually through into the landfills causing environmental pollution. It also attracts the microbes and can also become hub for the pathogenic microbes. The peels are the richest sources of proteins, carbohydrates and fibers. The present research was aimed for extracting insoluble dietary fibers from banana peels by three methods DM, WM, and WMTWW and to give the waste banana (peel) a potential value. The dietary fibers extracted by WMTWW from banana peel was found to have good physical appearance and of good quality and can be utilized for the preparation of functional foods.

References


