Extraction of Dietary Fibre from Selected Food Plants Grown In Adamawa and Gombe States North – Eastern Nigeria

Gaila.Nami1*, Barmins JeffreyTsware2, Onwuka Jude Chinedu3 and Tarfa, F D4

1Dept of Science Laboratory Tech., Federal Polytechnic Mubi, Adamawa State, Nigeria
3Department of Chemistry, Federal University Lafia, Nasarawa State, Nigeria
4Department of Medicinal Chemistry and Quality Control, National Institute for Pharmaceutical Research and Development, Abuja Nigeria

*Corresponding author: nmgaila@gmail.com

Received 16 March 2018; accepted 28 May 2018, published online 20 July 2018

ABSTRACT

The concept of body cleaning and healthy living has been with us for centuries. Dietary fiber (DF) is the edible parts of plants or analogous carbohydrates that are resistant to digestion and absorption in the human small intestine, with complete or partial fermentation in the large intestine. They passes relatively intact through your stomach, small intestine, colon and out of your body. In this research, commonly grown and consumed plant food samples in the north east of Nigeria, were selected under classification as fruits, leaf and seed samples. Soluble dietary fiber (SDF) and insoluble dietary fiber (IDF) were extracted using the enzymatic-gravimetric method. The result showed that the fruit, leaf and seed samples were richer in IDF than SDF. The percentage IDF yield ranged from 44.95 – 62.95 %, 63.00 – 84.05 % and 39.85 – 93.76 % for fruit, leaf and seed samples respectively. The percentage SDF yield for the fruit, leaf and plant samples ranged from 9.12 – 17.85 %, 3.73 – 25.86 % and 21.07 – 42.64 % respectively. It was observed that the leaf samples were better source of IDF than the seed and fruit samples. The result also revealed that the seed samples were better source of SDF than the leaf and fruit samples. Thus, the selected fruit samples were found to be the poorest source IDF and SDF when compared to the selected leaf and seed samples.

KEYWORDS: Soluble Dietary Fiber; Insoluble Dietary Fiber; Enzymatic-Gravimetric Method; Fruits; Seeds; Leaf

INTRODUCTION

Dietary fibre (DF) can be referred as that portion of food which is derived from cellular walls of plants which are digested very poorly by human beings (De Vriest et al., 1999). DF has been known and investigated for a very long time from being considered as waste to being described as a ‘universal remedy’ that improves any physiological problem within human organism (Asp, 2004; Rodriguez et al., 2006). Fiber is found only in fruits and plants. It is an indigestible carbohydrate and therefore add few if any calories to the diet. There are two types of fiber, water soluble and insoluble. Both types of fiber are required in the diet, in recommended ratio of 3:1 insoluble fiber to water soluble fiber (Suikany, 2000). Water soluble fiber dissolves in water and is found in oat bran, legumes, psyllium, nuts, beans, pectins and various fruits and vegetables. It forms a bulky gel in the intestine that regulates the flow of waste materials through the digestive tract (Perrin et al., 2001). Water soluble fiber may lower cholesterol by preventing the re-absorption of bile acids. Bile acids are made of cholesterol, and aid fat digestion, fiber binds with them as escorts them out of the body. The liver then has to pull more cholesterol from the blood. In a meta – analysis of b7 control trials, it is found that some water soluble fiber lowers the total cholesterol and the bad cholesterol (LDL) without affecting the good cholesterol (HDL). (Brown et al., 1999). A similar double-blind study found that psyllium lowered LDL cholesterol without affecting HDL cholesterol. Water soluble fiber may also stabilize blood sugar by slowing down absorption of
carbohydrates into the blood (Boerjanet al., 2003).

Insoluble fiber cannot be dissolved in water, meaning that our body cannot digest it. This fiber include the dissolvable part of plant walls and vegetables. Greatest amount in cereals, brans and vegetables (Andersonet al., 2009). The primary function of insoluble fiber is to collect water that increases stool bulk in the large intestine. Water that promotes bowel movement and as the bulk works through the intestine, it scours the intestinal walls of waste matter, reducing the risk of colon related problem. In 2000, food and nutrition board of the institution of medicine established an adequate intake (AI) recommendation for daily fiber intake. For adults over 50 years of age the recommendation is 30g/day for men and 22g/day for women (Liu et al., 1999; Wolket et al., 1999).

Studies have shown that in populations with high fiber diet, The incidence of colon cancer, appendicitis and diverticulosis are very low, but industrialized countries which have diets high in fats and low in fiber have high incidence of these diseases. The low calory contents of fiber provide great feeling in the satiety when added to diet without significantly increasing your caloric intake. The fiber found in fruits and plant serve as source of complex carbohydrate which most nutritionist consider to be a healthy choice. In addition to fiber’s ability to stabilize blood sugar; it may also curb or reduced the desire to snack intake. In other words, you may find yourself eating less and this is beneficial in weight – loss program (Cummings and Macfarlane, 2002).

Today many health practitioners recognize the importance of keeping the body in harmony to prevent sickness; it is often referred to as cleansing or detoxification. Many health practitioners believe that as our world becomes increasingly polluted with toxins found in the environment and in the foods we eat, cleansing becomes more important. A body loaded with toxins can result in a number of symptoms. These includes constipation, stomach bloat, poor digestion, gas, fatigue, weight gain, excessive mucus, poor concentration, headaches, poor skin, poor memory, depression, body odour and bad breath. Some health practitioner relates toxins to specific diseases. They believe that chronic fatigue syndrome. Multiple chemical sensitively and fibromyalgia (Muscular and joint pain may be related to toxin exposure. The body does have a system in place for detoxifying harmful toxins. The most important cleansing organ is the liver. Eliminative channels includes the bowels (the digestive system) kidney, skin, lung and lymphatic system ( Guillonet al., 1998; McCleary and Prosky, 2001).

Today many health practitioners recognize the importance of keeping the body in harmony to prevent sickness; it is often referred to as cleansing or detoxification. Many health practitioners believe that as our world becomes increasingly polluted with toxins found in the environment and in the foods we eat, cleansing becomes more important. A body loaded with toxins can result in a number of symptoms. These includes constipation, stomach bloat, poor digestion, gas, fatigue, weight gain, excessive mucus, poor concentration, headaches, poor skin, poor memory, depression, body odour and bad breath. Some health practitioner relates toxins to specific diseases

The concept of body cleaning has been with us for centuries. Populated with toxins found in the environment and in the foods we eat, cleansing becomes more important the increase popularity of high-practiced diet further promote the need to detoxify. The relationships of particular health benefits to the insoluble and soluble fractions of dietary fiber have established researchers not only update the definition of dietary fiber, but also update the methodologies that support this definition (Carnovale et al., 1995).

Dietary fiber found mainly in fruits, vegetables, whole grains and legumes is probably best known for its ability to prevent or relieve constipation. But foods containing fiber can provide other health benefits as well, such as helping to maintain a healthy weight and lowering your risk of diabetes and heart disease. Dietary fiber, also known as roughage or bulk, includes all parts of plant foods that your body can't digest or absorb. Unlike other food components, such as fats, proteins or carbohydrates which your body breaks down
and absorbs fiber isn’t digested by your body. Most nutritionists encourage getting fiber from whole foods that we eat because they contain many other healthful plant compounds. But if you don’t get enough fiber in your diet -- 25 grams daily for women and 38 grams for men ages 50 and younger-- added functional fibers can help fill in the gap (Institute of Medicine, 2012).

The typical intake for fiber is just 15 grams. Eating a wide variety of fibers is the ideal solution to gaining all the health benefits (Bessadok, et al., 2008).

The aim of this research is to extract dietary fibers from selected local fruits, herbs and seeds, with a view to recommend them as part of our daily food intake in order to improve our general health as we get older.

MATERIALS AND METHODS

Sample Collection

The fruit samples of Azanzagarkena (FA), Balanite aegyptiaca (FB), Deuterium senegalense (FC), Ziziphusspini Christi (FD) and cucurbitaspp squash gaurd (FE); leaf samples of Spinous amaranthus(LF), Senna aceidental(LG), Phyllanthusniruri(LH), Hisbiscus sabdarifff (LI), Lebtadenia hastata(LJ) and seed samples of Pakiabiglobasa(SK), Citrullus vulgaris (SL), Moringaoleifera(SM), Phaseolus vulgaris (SN) and Spondiuspurpure (SO); were collected from various sites of Adamawa and Gombe States of Nigeria. The collected samples were identified by a taxonomist in the Department of Botany, Modibbo Adama University of Technology, Yola, Adamawa State, and later attested at National Institute for Pharmaceutical Research and Development (NIPRD) Idu Abuja Nigeria. The voucher numbers were given as follows; Azanzagarkena(FA) (NIPRD/H/7069), Balanite aegyptiaca (FB) (NIPRD/H/7070), Deuterium senegalense (FC) (NIPRD/H/7071), Ziziphusspini Christi (FD) (NIPRD/H/7072), and cucurbitaspp squash gaurd (FE) (NIPRD/H/7073); leaf samples of Spinous amaranthus(LF), (NIPRD/H/7074) Senna aceidental(LG), (NIPRD/H/7075) Phyllanthusniruri(LH) (NIPRD/H/7076), Hisbiscus sabdariff (LI) (NIPRD/H/7077), Lebtadenia hastata(LJ) (NIPRD/H/7078) and seed samples of Pakiabiglobasa(SK) (NIPRD/H/7079), Citrullus vulgaris (SL) (NIPRD/H/7080), Moringaoleifera(SM) (NIPRD/H/7081), Phaseolus vulgaris (SN)(NIPRD/H/7083) and Spondius purpure (SO) (NIPRD/H/7082);

The samples were dried, ground and sieved to a homogenous size. Chemicals used as solvents and reagents were of analytical grade.

Extraction of Dietary Fiber

The insoluble dietary fibers (IDF) and soluble dietary fibers (SDF) were extracted based on the digestion of the samples (20 g) with enzymes, as determined by AOAC enzymatic-gravimetric method described by Lee et al (1992) with little modifications. Dry sample was suspended in sodium phosphate buffer (pH 6.0) and incubated with different enzymes, including alpha amylase (pH 1.5), pepsin (pH 6.8) and pancreatin (pH 4.5), for 1 h to remove starch and protein. The enzyme digestate was then filtered using ashless filter paper whatman, the remaining residue was the IDF and the filtrate was the SDF.

The IDF was further washed with ethanol and acetone and finally incinerated and weighed. Soluble dietary fiber was estimated by precipitating the filtrate using ethanol. The precipitate was washed with ethanol and acetone, dried, incinerated and finally weighed.

RESULTS

The percentage yield of the soluble dietary fiber (SDF) and insoluble dietary fiber (IDF) in the fruit, leaf and seed samples are presented in Tables 1, 2 and 3 respectively.

The selected food samples were considered sources of dietary fiber that contained various proportionsof soluble and insoluble fibers. The results showed that the insoluble dietary fibers (IDF) are significantly higher than the soluble dietary fibers (SDF) in all the samples studied. This was similarly reported by Li et al (2002), Bouazizet et al (2014) and Ng et al (2010) for
legumes, *Agave americana* L. and coconut residue respectively. The percentage yield of IDF in the fruit, leaf and seed samples ranged from 44.95 – 62.95 %, 63.00 – 84.05 % and 39.85 – 93.76 % respectively. Thus, it can be observed that the leaf samples are better sources of IDF than the fruit and seed samples. Ng *et al* (2002) reported similar result when they investigated the dietary fiber contents of 70 high consumed foods. They reported that the IDF of raw vegetable was found to be higher than that of cereal grains and pasta, cooked vegetables, baked products, boiled white potatoes and cooked lima beans. The result obtained in this study was higher than the results obtained by Li *et al* (2002), Bouaziz *et al* (2014) and Ng *et al* (2010) for legumes, *Agave americana* L. and coconut residue respectively. It was also observed that averagely, the seed samples studied were better source of IDF than the selected fruit samples. However, the highest and lowest percentage IDF yield were in seeds samples of SN and SL respectively. The IDF result showed that leaf samples should be recommended for any illness or health challenges that will be solved by consumption of a lot of IDF.

Unlike IDF, the SDF result showed that the seed samples were better sources of SDF than the leaf and fruit samples. Although the SDF result for all the samples were found to be within the range of results reported by Bouaziz*et al* (2014) and Ng *et al* (2010) for *Agave americana* L. and coconut residue respectively but higher than the SDF result reported by Li *et al* (2002) for legume, cooked vegetables and raw vegetables. The percentage yield of SDF for the fruit, leaf and plant samples ranged from 9.12 – 17.85 %, 3.73 – 25.86 % and 21.07 – 42.64 % respectively. The lowest SDF yield of 3.73 %, was found in the leaf sample LJ while the highest SDF yield (42.64 %) was obtained in the seed sample SM. It can also be observed that the leaf samples were averagely better source of SDF than the fruit samples. This result suggest that seed samples should be recommended for any illness or health challenge such control of blood sugar level, that requires consumption of SDF for its remedy.

**Table 1: Percentage (%) Yield of Soluble and Insoluble Dietary Fiber in Selected Fruit Samples**

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Weight of Sample Taken (g)</th>
<th>Weight of IDF Obtained After Extraction (g)</th>
<th>Weight of SDF Obtained After Extraction (g)</th>
<th>% Yield IDF</th>
<th>% Yield SDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>FA</td>
<td>20.00±0.02</td>
<td>8.99±0.01</td>
<td>3.57±0.10</td>
<td>44.95</td>
<td>17.85</td>
</tr>
<tr>
<td>FB</td>
<td>20.00±0.02</td>
<td>9.73±0.09</td>
<td>3.45±0.08</td>
<td>48.65</td>
<td>17.25</td>
</tr>
<tr>
<td>FC</td>
<td>20.00±0.02</td>
<td>12.59±0.28</td>
<td>2.18±0.01</td>
<td>62.95</td>
<td>10.89</td>
</tr>
<tr>
<td>FD</td>
<td>20.00±0.02</td>
<td>11.26±0.36</td>
<td>1.82±0.01</td>
<td>56.30</td>
<td>09.12</td>
</tr>
<tr>
<td>FE</td>
<td>20.00±0.02</td>
<td>10.69±0.17</td>
<td>2.23±0.03</td>
<td>53.45</td>
<td>11.15</td>
</tr>
</tbody>
</table>

IDF= Insoluble dietary fiber  
SDF= Soluble Dietary Fiber

**Table 2: Percentage (%) Yield of Soluble and Insoluble Dietary Fiber in Selected Leaf Samples**

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Weight of Sample Taken (g)</th>
<th>Weight of IDF Obtained After Extraction (g)</th>
<th>Weight of SDF Obtained After Extraction (g)</th>
<th>% Yield IDF</th>
<th>% Yield SDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>LF</td>
<td>20.00±0.02</td>
<td>16.81±0.22</td>
<td>3.12±0.03</td>
<td>84.05</td>
<td>15.63</td>
</tr>
<tr>
<td>LG</td>
<td>20.00±0.02</td>
<td>15.08±0.31</td>
<td>5.07±0.07</td>
<td>75.40</td>
<td>25.36</td>
</tr>
<tr>
<td>LH</td>
<td>20.00±0.02</td>
<td>18.00±0.39</td>
<td>4.38±0.16</td>
<td>90.00</td>
<td>21.88</td>
</tr>
<tr>
<td>LI</td>
<td>20.00±0.02</td>
<td>12.78±0.12</td>
<td>4.80±0.02</td>
<td>63.90</td>
<td>24.00</td>
</tr>
<tr>
<td>LJ</td>
<td>20.00±0.02</td>
<td>12.60±0.01</td>
<td>0.75±0.01</td>
<td>63.00</td>
<td>03.73</td>
</tr>
</tbody>
</table>
Table 3: Percentage (%) Yield of Soluble and Insoluble Dietary Fiber in Selected Seed Samples

<table>
<thead>
<tr>
<th>Sample Code</th>
<th>Weight of Sample Taken (g)</th>
<th>Weight of IDF Obtained After Extraction (g)</th>
<th>Weight of SDF Obtained After Extraction (g)</th>
<th>% Yield IDF</th>
<th>% Yield SDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>SK</td>
<td>20.00±0.02</td>
<td>15.88±0.08</td>
<td>6.64±0.31</td>
<td>79.40</td>
<td>39.85</td>
</tr>
<tr>
<td>SL</td>
<td>20.00±0.02</td>
<td>7.97±0.00</td>
<td>7.75±0.01</td>
<td>39.85</td>
<td>38.76</td>
</tr>
<tr>
<td>SM</td>
<td>20.00±0.02</td>
<td>11.43±0.15</td>
<td>8.53±0.21</td>
<td>57.14</td>
<td>42.64</td>
</tr>
<tr>
<td>SN</td>
<td>20.00±0.02</td>
<td>18.75±0.94</td>
<td>5.12±0.06</td>
<td>93.76</td>
<td>25.59</td>
</tr>
<tr>
<td>SO</td>
<td>20.00±0.02</td>
<td>15.05±0.41</td>
<td>4.21±0.09</td>
<td>75.26</td>
<td>21.07</td>
</tr>
</tbody>
</table>

CONCLUSION

The selected fruits, leaf and seed samples have been investigated as sources of insoluble dietary fiber (IDF) and soluble dietary fiber (SDF). All the samples studied were found to be better sources of IDF than SDF. However, the leaf samples were better sources of IDF than the seed and fruit samples. The seed samples were better sources of SDF than the leaf and fruit samples. Thus, the selected fruit samples were the poorest source of IDF and SDF compared to the selected seeds and leaf samples. The leaf and seeds samples can be recommended as good source of IDF and SDF respectively.

ACKNOWLEDGEMENT

The authors wishes to thank the Director General, Staff and Management of National Institute for Pharmaceutical Research and Development, Abuja, Nigeria; for providing the technical support and laboratory space for the research.

REFERENCES


