COMPARATIVE STUDY OF THE PROXIMATE VALUE AND MINERAL COMPOSITION OF HEALTHY AND BLACK ROT INFECTED RAPHIA HOOKERI FRUITS

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ABSTRACT

Preliminary determination of the proximate value and mineral composition of Raphia hookeri healthy fruits and black rot infected ones - caused by Chalara pardoxa - was carried out in order to ascertain effects of the disease on the fruit content. It was observed that the fruits contain ash, moisture, fibre, protein, fat, zinc, potassium and other minerals. There was general reduction in the proximate and mineral contents of the infected fruits compared to the healthy fruits, except the ash content which increased by 0.19% in the infected fruits. The difference between values for experimental and control for calcium, phosphate, manganese and magnesium was highly significant (P < 0.05). There was also a significant decrease in the phosphate, zinc and magnesium content which dropped from 1165.6 ppm to 52.63, 10.45 ppm to 0.55 ppm and 395.6 ppm to 27.95 ppm, respectively. Chalara pardoxa, a major pathogen of R. hookeri, caused high reduction in food value of infected fruits. Raphia hookeri fruit contains high amounts of mineral elements which are essential for the several physiological/metabolic processes that occur in man.

Keywords: Biodeterioration, black rot, food value, fungus, nutrient loss, Raphia.

INTRODUCTION

Raphia hookeri Mann and Wendle is one of the eight species of Raphia indigenous to Nigeria. It grows wild in the lowland forest region and swamps of the south as well as river courses of the savannah region of the north (Tomlinson, 1962). Economic products from Raphia palm include building materials such as bamboo, raphia fibre, thatch, pissava and palm wine (Otedoh, 1975). Most of the species are tapped for wine from the young terminal inflorescence (Otedoh, 1982). Palm wine tapped from Raphia is becoming more and more popular among Nigerians. The wine is now
successfully bottled for commercial purposes at the Nigerian Institute for Oil Palm Research (NIFOR) Benin-City. The palm wine is also used in distilling local dry gin (Ndoh, 2003). The trunk of Raphia palm is strongly recommended for pulp and paper as well as production of soft tissue paper (Odeyemi, 1985). Its exploration as a source of raw material for the above economic purposes has been advocated and cultivation of Raphia palm is now receiving greater attention in Nigeria (Ndon, 2003).

The seed is the only means of propagation of the plant. Black rot disease caused by Chalara paradoxa is a major disease of Raphia which speedily brings about decay of the fruit mesocarp thus damaging the embryo of the seed and making it unsuitable for planting (Oruade-Dimaro, 1989). A survey of uses of Raphia in the south-south geopolitical zone of Nigeria revealed that the fruit is a food source, which is usually boiled before eating. However, there have been reports of stomach upset after its consumption. The ripe mesocarp of the fruit contains a layer of oil which can be utilized for soap making, lubrication, laxative and source of vitamin A (Otedoh, 1975).

In view of the several nutritive benefits, this work was carried out to determine the effect of Chalara paradoxa infection on the food value of Raphia hookeri fruit.

MATERIALS AND METHODS

Source of Plant Materials

Raphia fruits were obtained from the gene pool harvested from wild grooves plantation in Bayelsa and Delta States of Nigeria. The species examined was R. hookeri Man and Wendle. The samples were washed with distilled water to remove sand particles before analysis.

Proximate Analysis

Proximate composition of the fruits was determined by the official method of the Association of Official Analytical Chemists (AOAC, 2005) as follows;

Analysis of Mineral Content

The method of AOAC (2005) was also used for the analysis of mineral content of Raphia fruits. The ash of each sample obtained was digested by adding 5ml of 2M hydrochloric acid (HCl) to the ash in the crucible and heating to dryness on a heating mantle. Then 5ml of 2M HCl was added again, heated to boiling and filtered through a Whatman No. 1 filter paper into a 100ml volumetric flask. The filtrate was made up to mark with distilled water stoppered and made ready for reading of concentration of calcium, potassium and sodium on the Jenway Digital Flame Photometer (PFP7 Model) using the filter corresponding to each mineral element. Magnesium was read in a Perkinhelmer Atomic Absorption Spectrophotometer (AAS) model 2300AA. The concentration of each of the element was calculated using the formula:
% Ca or % K or % Na = Meter Reading (MR) x Slope x Dilution factor
\[ \frac{1000}{1000} \]

NB: MR x slope x dilution factor gives the concentration in part per million (ppm or mg/g).
When this value is divided by 1000, it gives the concentration in %.

Phosphorus was determined routinely by the vanado-molybdate colorimetric or spectrophotometric method. The ash of each sample obtained was treated with 2 M HCl solution as described above for calcium determination. Then 10ml of the filtrate solution was pipetted into 50ml standard flask and 10ml of vanadate yellow colour solution was added. The flask was made up to mark with distilled water, stoppered and left for 10 minutes for full yellow colour development. The concentration of phosphorus was obtained by taking the optical density (OD) or absorbance of the solution on a Spectronic 20 spectrophotometer or colorimeter at a wavelength of 470nm. The percentage phosphorus was calculated using the formula:

% Phosphorus =
\[ \frac{\text{Absorbance} \times \text{Slope} \times \text{Dilution factor}}{1000} \]

Data Analysis
Data were analyzed using student t-test and significance determined at 0.05% probability.

RESULTS AND DISCUSSION
Table 1 shows the proximate value and mineral constituents of ripe healthy mesocarp and black rot infected mesocarp of *R. hookeri* (Plates 1 and 2). There were decreases in all the food and mineral components except from ash which increased from 4.33% to 4.52%. There was also a significant decrease in the phosphorus, zinc and magnesium contents which decreased from 1165.6pp to 52.63ppm, 10.45ppm to 0.55ppm and 395.6ppm to 27.95ppm, respectively. The decrease in the moisture, fat, protein, energy and mineral contents indicates the utilization of these components by the organisms.

The digest of the ash of each sample above as obtained in calcium and potassium determination was washed into 100 ml volumetric flask with deionised or distilled water and made up to mark. This diluent was aspirated into the Buck 200 Atomic Absorption Spectrophotometer (AAS) through the suction tube. Each of the trace mineral elements (magnesium and zinc) was read at their respective wavelengths with their respective hollow cathode lamps using appropriate fuel and oxidant combination.
The stability and susceptibility to microbial contamination (Scott 1980). The moisture content of the ripe mesocarp of *R. hookeri* fruit is 9.87%. Molds are generally able to grow on foods with low moisture content. Reduction in the moisture, crude fibre and carbohydrate contents in fungal infected samples may be attributed to the fact that the fungi utilized the water and carbohydrate for metabolic activities (Burnett 1976). Previous studies have indicated that pathogenic infection affects the overall level of nutritional components in a plant (Mba and Akueshi, 2001). The fibre content of the healthy fruit in current study was 56.15%, which reduced to 45.14%. Consumption of fruits with high crude fibre content may contribute to a reduction in the incidence of certain diseases like colon cancer, coronary heart diseases, diabetes, high blood pressure, obesity and other digestive disorders (Igboh et al., 2009).

Fungi have been reported to increase the protein content of samples on which they grow Rodolfo, 2000). However there was decrease in the protein content in this study from 0.95ppm to 0.3ppm which indicates that the protein content was utilized by the organisms associated with black rot disease. There was also a decrease in the fat content (8.2% to 3.96%) which indicates that the black rot organisms are able to utilize the fatty component in the fruit sample. However, increase in the amount of fat in fungi infected samples which may be due to the possible transformation of carbohydrates to fat, has been reported by Akindumila and Glatz (1998).

Similarly, mineral contents of fruits have been shown to vary tremendously with changes in infectivity caused by microbial organisms (Pathak, 1997). The results from this study shows decreases in the Ca, Na, K, P, Zn, Mn and Mg content of fruit mesocarp. This is in agreement with the findings of Lawal (2011) and Lawal et al., (2012) who reported decreases in the Na, K, Ca, Mg, Zn Fe and Cu contents of water melon seeds infected with fungi after two weeks of storage and sundried millet seeds, respectively. Moreover, Fagbohun et al (2011) also reported decrease in Na, Ca, Mg, Zn, Fe and Cu in freshly prepared melon seeds when compared to sundried samples stored for twenty weeks which were infected by fungi. Zinc is an essential metal for proper body functions such as normal growth and development in human beings (Divrikli et al., 2006). The amount of zinc detected in the healthy fruit sample was 10.45ppm which decreased to 0.55ppm in the infected fruit sample. The maximum tolerable daily intake of Zn is 0.3–1 mg/ kg (FAO/WHO, 1982). The uptake and accumulation of Mn in the healthy fruit sample was 623.18ppm (623.18 mg/kg) which was reduced to 224.95ppm (224.95mg/kg) in the infected fruit sample. The WHO recommended 2–9 mg per day for an adult (WHO, 1994).
Table: 1. Proximate and mineral constituents of mesocarp of ripe *R. hookeri* fruits.

<table>
<thead>
<tr>
<th>S/N</th>
<th>Component</th>
<th>Amount detected *</th>
<th>Healthy fresh fruit</th>
<th>Black rot infected fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ash (%)</td>
<td>4.33</td>
<td>4.52</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Moisture (%)</td>
<td>9.87</td>
<td>8.40</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Fibre (%)</td>
<td>56.15</td>
<td>45.14</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Fat (%)</td>
<td>8.2(^a)</td>
<td>3.96(^b)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Protein (ppm)</td>
<td>0.95</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Energy (J)</td>
<td>20.45</td>
<td>18.01</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Calcium (ppm)</td>
<td>7891.1(^a)</td>
<td>4709.85(^b)</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Sodium (ppm)</td>
<td>264(^a)</td>
<td>125(^b)</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Potassium (ppm)</td>
<td>4861.2(^a)</td>
<td>2200(^b)</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Phosphorus (ppm)</td>
<td>1165.6(^a)</td>
<td>52.63(^b)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Zinc (ppm)</td>
<td>10.45(^a)</td>
<td>0.55(^b)</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Manganese (ppm)</td>
<td>623.18(^a)</td>
<td>224.95(^b)</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Magnesium (ppm)</td>
<td>395.6(^a)</td>
<td>27.95(^b)</td>
<td></td>
</tr>
</tbody>
</table>

*Values with different superscript letters along the same column are significantly different (p = 0.05).

**Plate 1:** Healthy *R. hookeri* fruits

**Plate 2:** *Raphia hookeri* fruits showing symptoms of black rot caused by *C. paradoxa.*
CONCLUSION

*Raphia. hookeri* fruit contains high amounts of mineral elements. These minerals are required in major or minor quantities for the biochemical reactions that occur daily which contribute to good health and fitness in human beings. *Raphia. hookeri* fruit also contains nutritional compounds which are beneficial to man. However, adequate and proper care of the fruit during processing and storage will ensure the conservation of its nutritional potentials. There is also the need to provide adequate cost-effective control measures for the preservation and storage of the fruits against *C. paradoxa*. The effect of this fungus on *R. hookeri* seeds is presently under investigation.

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