Abstract: Introduction
Vegetables are particularly rich source of antioxidants, which are substances that may protect the body’s cells against the oxidative damaging effects of free radicals

Objective
The aim of this study was to determine the chemical composition of Sorghum bicolor, Carica papaya and Hibiscus sabdariffa leaves

Methodology
Fresh leaves of Sorghum bicolor, Carica papaya and Hibiscus sabdariffa were identified at the Herbarium unit of the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka, Enugu State. Chemical compositions of the leaf samples were also determined using standard procedures.

Result
Sorghum b. had the highest percentage of carbohydrate content (64.01%) and Sorghum bicolor leaves had the highest amount of carbohydrate (64.01%), fat (2.33%), moisture (9.25%), fiber (9.35%) and ash (8.48%). Carica papaya had the highest amount of protein (12.87%). Sorghum bicolor had the highest content of zinc (7.46mg/100g), magnesium (23.23mg/g), manganese (33.34mg/g), and phosphorus (155.58mg/100g). Hibiscus sabdariffa had the highest content of iron (13.36mg/g), Vit B12 (0.27mg/100g). Hibiscus sabdariffa has the highest Value for Vitamin C 13.07mg/100g). Sorghum b. had the highest value in Zinc, Manganese, Phosphorus, Magnesium and least value in Iron. Hibiscus s. had the least value in Zinc, Manganese, Phosphorus Magnesium and highest value in Iron, meanwhile Carica papayawas second in all the tested minerals.

Conclusion
In conclusion, the studied leaves had shown to be a good source of crude fibre, protein, carbohydrate. Sorghum b. had the highest percentage of carbohydrate content (64.01%) and Hibiscus sabdariffa has the highest Value for Vitamin C. Sorghum b. had the highest value in Zinc, Manganese, Phosphorus, Magnesium and least value in Iron.

Keywords: vegetables, carbohydrate, vitamin C, folic acid, Zinc, protein

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I. Introduction
Vegetables are particularly rich source of antioxidants, which are substances that may protect the body’s cells against the oxidative damaging effects of free radicals. Leafy vegetables are important items of diet in many Nigerian homes. Apart from the variety which they add to the main menu (Mepha, Eboh & Banigo, 2007), they are valuable sources of nutrients especially in rural areas where they contribute substantially to protein, minerals, vitamins, fibres and other nutrients which are usually in short supply in daily diets (Mohammed & Sharif, 2011). It is worthwhile to note that consumption of numerous types of edible plants as source of food could be beneficial to nutritionally marginal population especially in developing countries where poverty and climate is causing havoc to the rural populace. In many developing countries, the supply of minerals is inadequate to meet the mineral requirements of farm animals and rapidly growing population. Vegetables, if consumed in sufficient amount would contribute greatly towards meeting human nutritional requirement for normal growth and adequate protection against diseases arising from malnutrition (Adefemi, Asadu, Oyakilome, Ajibulu & Asaolu, 2012).
Natural antioxidants in vegetables and fruits, such as vitamins and polyphenols have been associated with the prevention of degenerative disease such as cancer and cardiovascular diseases (Liu, 2004). The production of superoxide occurs continuously during normal aerobic metabolism (Ou, Huang, Hampsch, Flanagan & Deemer, 2002). There is an increasing interest in the antioxidant activity presents in the diet, since they play important roles in organism’s defense system against ROS (Leite et al., 2012). Vegetables are particularly rich source of antioxidants, which are substances that may protect the body’s cells against the oxidative damaging effects of free radicals. Leafy vegetables are important items of diet in many Nigerian homes. Apart from the variety which they add to the main menu (Mepha, Eboh & Banigo, 2007), they are valuable sources of nutrients especially in rural areas where they contribute substantially to protein, minerals, vitamins, fibres and other nutrients which are usually in short supply in daily diets (Mohammed & Sharif, 2011). In Africa and in most of the developing countries, plants or herbs has been in use to treat different ailment like diabetes, hypertension, diarrhea and anaemia but not much work has been done using Sorghum bicolor leaves, Carica papaya and Hibiscus sabdariffa leaves to treat anaemia. Despite these traditional health care methods, African medicine is used by 80% of the rural populations and appears sure means of eradication of diseases. In the search of fighting against anaemia disorder, the chemical composition of Sorghum bicolor leaves, Carica papaya leaves and Hibiscus sabdariffa leaves were investigated in this study.

II. Materials And Methods

Materials
The vegetables that were used for this study were the fresh leaves of Sorghum bicolor, Carica papaya and Hibiscus sabdariffa. The leaves were collected in the zoological garden of University of Nigeria, Nsukka and identified at the Herbarium unit of the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka, Enugu state.

Preparation of samples for chemical analysis
Five kilograms (5kg) of each of the fresh leaves of Sorghum bicolor, Carica papaya and Hibiscus sabdariffa were weighed out using a digital balance scale. The leaves were sorted by removing extraneous materials, washed with tap water for five minutes and drained with the use of plastic sieve then spread evenly on trays and place in an open space under the shade which allowed for cross ventilation for seven days at room temperature. Then the dried leaves were pulverized to a fine powder, separately using Warburg laboratory blender. It was packaged in labeled polyethylene bags and stored in desiccators.

Proximate Analysis
The proximate composition of the three dried leaves were analysed with respect to its moisture content, ash, crude fiber, crude protein and fat content were determined using the Association of Official Analytical Chemists, A.O.A.C (2005) method. The total carbohydrate content was determined by difference. Carbohydrate = 100% - (%Crude fiber + %Crude protein + %Ash + %Fat + %Moisture)

Mineral Analysis
Magnesium (Mg), iron (Fe), zinc (Zn), phosphorous (P) and Manganese (Mn) content of each sample were estimated using the method of AOAC (2000). Two grams of each sample were ashes in muffle furnace at 550°C for 6 to 8 hours. The ash was dissolved with HCl. The samples were analyzed for minerals – Mg, Fe, Zn, P, and Mn using atomic absorption spectrophotometer (AAS) (Mode 303 Perkin Elmer, Norwalk, USA).

Vitamin Analysis
Pro-vitamin A (β-carotene) was determined using the method adopted from International Vitamin A Consultative Group (IVACG) (1992), Vitamin B2, B3, B6, Folic acid and vitamin C were determined using AOAC (2000) method while Vitamin E was determined according to AOAC (2000) method.

Statistical analysis
The chemical composition data collected were analyzed by using Statistical Product and Service Solution (SPSS) version 21.0. Means and Standard deviations of the data were obtained. One-way analysis of variance (ANOVA) and Duncan Studentised New Multiple Range Test were used to separate and compare means (Steel & Torrie, 1960). The differences in means were considered significant at 5% probability.

III. Results

Proximate composition of Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves
The proximate compositions of the samples were presented in table (1). The moisture contents of the Hibiscus s., Carica p. and Sorghum b. leaves obtained were 8.45%, 8.58% and 9.25% respectively. Sorghum b.
had the highest percentage, followed by Carica p. while Hibiscus s. had the least value with difference of 0.67 between Sorghum b. and Carica p. The between Carica p. and Hibiscus s. the value of their difference was 0.13. In the case of Ash values 7.34%, 7.58% and 8.48% were obtained respectively. Sorghum b. had the highest percentage followed by Carica p. while Hibiscus s. had the least value with difference of 0.90 between Sorghum b. and Carica p. The difference in value between Carica p. and Hibiscus s. was 0.13. Coming to protein, 11.75%, 12.87% and 6.58% were the values obtained respectively in which Carica p. had the highest value followed by Hibiscus s. While Sorghum b. had the highest value with differences of 1.12 between Carica p. and Hibiscus s. The difference between Hibiscus s. and Sorghum b. was 5.17 in value. Crude fat values obtained were 7.35%, 7.45% and 9.35% respectively. Sorghum b. had the highest percentage followed by Carica p. while Hibiscus s. had the least value with differences of 6.26mg/100g, 8.96mg/100g, 0.27mg/100g, 0.05mg/100g, 13.07mg/100g and 0.07mg/100g respectively. The folate, Beta carotene, Vitamin C and Vitamin E of Hibiscus s. had the least value in Zinc, Manganese, Phosphorus and Magnesium and highest value in Iron. Meanwhile Carica papaya was second in all the tested minerals.

### Table 1: Proximate composition of Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves (%)

<table>
<thead>
<tr>
<th>Samples</th>
<th>Moisture</th>
<th>Ash</th>
<th>Protein</th>
<th>Crude fibre</th>
<th>Fat</th>
<th>Carbohydrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>8.45±0.02(^{a})</td>
<td>7.34±0.01(^{a})</td>
<td>11.75±0.01(^{b})</td>
<td>7.35±0.01(^{b})</td>
<td>2.09±0.01 (^{a})</td>
<td>63.02±0.03(^{b})</td>
</tr>
<tr>
<td>CP</td>
<td>8.54±0.01(^{b})</td>
<td>7.58±0.01(^{b})</td>
<td>12.87±0.01(^{b})</td>
<td>7.45±0.01(^{b})</td>
<td>2.24±0.01 (^{b})</td>
<td>61.28±0.02(^{b})</td>
</tr>
<tr>
<td>SE</td>
<td>9.25±0.40(^{c})</td>
<td>8.49±0.01(^{a})</td>
<td>6.58±0.01(^{a})</td>
<td>9.35±0.01(^{a})</td>
<td>2.33±0.01 (^{a})</td>
<td>64.01±0.02(^{a})</td>
</tr>
</tbody>
</table>

### Table 2: Mineral composition of Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves (mg/100g)

<table>
<thead>
<tr>
<th>Samples</th>
<th>Zinc (mg/100g)</th>
<th>Iron (mg/100g)</th>
<th>Manganese (mg/100g)</th>
<th>Phosphorus (mg/100g)</th>
<th>Magnesium (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>6.30±0.01(^{b})</td>
<td>13.08±0.01(^{b})</td>
<td>25.56±0.01(^{b})</td>
<td>125.58±0.01(^{b})</td>
<td>12.28±0.03(^{b})</td>
</tr>
<tr>
<td>CP</td>
<td>6.56±0.01(^{a})</td>
<td>12.55±0.01(^{a})</td>
<td>28.43±0.01(^{a})</td>
<td>133.35±0.01(^{a})</td>
<td>13.56±0.01(^{a})</td>
</tr>
<tr>
<td>SE</td>
<td>7.47±0.02(^{a})</td>
<td>11.25±0.01(^{a})</td>
<td>33.34±0.01(^{a})</td>
<td>155.58±0.01(^{a})</td>
<td>23.23±0.01(^{a})</td>
</tr>
</tbody>
</table>

Means±Standard deviation of triplicate determination: Mean values of different superscripts in the same column were differed significantly at (P<0.05) Key: HB: Hibiscus sabdariffa, CP: Carica papaya, SE: Sorghum bicolor

### Vitamin composition of Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves

The folate, Beta Carotene, Vitamin B\(_{2}\), Vitamin B\(_{3}\), Vitamin B\(_{6}\), Vitamin C and Vitamin E of *Hibiscus sabdariffa* obtained were 6.26mg/100g, 8.96mg/100g, 0.27mg/100g, 0.05mg/100g, 13.07mg/100g and 0.07mg/100g respectively. The folate, Beta Carotene, Vitamin B\(_{2}\), Vitamin B\(_{3}\), Vitamin B\(_{6}\), Vitamin C and Vitamin E of *Carica papaya* obtained were 8.76mg/100g, 9.35mg/100g, 0.26mg/100g, 0.05mg/100g, 0.85mg/100g, 12.26mg/100g and 0.09mg/100g respectively while the folate, Beta Carotene, Vitamin B\(_{2}\), Vitamin B\(_{3}\), Vitamin B\(_{6}\), Vitamin C and Vitamin E of *Sorghum bicolor* obtained were 2.51mg/100g, 5.59mg/100g, 0.18mg/100g, 0.02mg/100g, 0.69mg/100g, 9.58mg/100g and 0.11mg/100g respectively.

### Table 3: Phytochemical composition of Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves

<table>
<thead>
<tr>
<th>Sample</th>
<th>Folate (mg/100g)</th>
<th>Beta carotene (mg/100g)</th>
<th>Vitamin B(_{2}) (mg/100g)</th>
<th>Vitamin B(_{3}) (mg/100g)</th>
<th>Vitamin B(_{6}) (mg/100g)</th>
<th>Vitamin C (mg/100g)</th>
<th>Vitamin E (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HB</td>
<td>6.26±0.03(^{a})</td>
<td>8.96±0.01(^{b})</td>
<td>0.27±0.03 (^{b})</td>
<td>0.05±0.00 (^{a})</td>
<td>0.80±0.01 (^{b})</td>
<td>13.07±0.01 (^{b})</td>
<td>0.07±0.01 (^{b})</td>
</tr>
<tr>
<td>CP</td>
<td>8.76±0.01(^{a})</td>
<td>9.35±0.01(^{a})</td>
<td>0.26±0.03 (^{a})</td>
<td>0.05±0.00 (^{a})</td>
<td>0.85±0.00 (^{a})</td>
<td>12.26±0.01 (^{a})</td>
<td>0.09±0.01 (^{a})</td>
</tr>
<tr>
<td>SE</td>
<td>2.51±0.01(^{a})</td>
<td>5.59±0.01(^{a})</td>
<td>0.18±0.01 (^{a})</td>
<td>0.02±0.13 (^{a})</td>
<td>0.09±0.00 (^{a})</td>
<td>9.38±0.01 (^{a})</td>
<td>0.11±0.01 (^{a})</td>
</tr>
</tbody>
</table>

Means±Standard deviation of triplicate determination: Mean values of different superscripts in the same column were differed significantly at (P<0.05) Key: HB: Hibiscus sabdariffa, CP: Carica papaya, SE: Sorghum bicolor
IV. Discussion

Moisture content is a widely used parameter in the processing and testing of food. It is an index of water activity on foods. An appreciable amount of moisture was observed in these leaves. A high value of moisture in these vegetables will make them susceptible to deterioration. Sorghum bicolor leaves had higher (9.25%). The observed presence of moisture implies that these leaves may have short shelf life because microorganisms that cause food spoilage thrive in foods with high moisture content (Adepoju et al., 2006). Moderate value of ash content was observed in the leaf samples with Hibiscus sabdariffa leaves ranking highest (8.48%) but was found to be low when compared with other leafy vegetables like Talinum triangulare (20.05%), Ipomea batatas (11.10%), Vernonia colorata (15.86%) and Moringa oleifera (15.09%) (Lockeet, Calvert & Grivet, 2000), Ocimum gratissium (18.00% DW), Hibiscus esculutns (8.00% DW) (Akindahunsi & Salawu, 2005) which are known rich sources of essential minerals. There was a moderate crude protein content in the leaf samples. Carica papaya was found to contain highest (12.87%) amount of crude protein but was found to be lower when compared to the findings of Maisarah et al. (2014) who recorded 33.4% crude protein in Carica papaya leaf. When these leaves are consumed it could contribute appreciable amount of protein to an individual’s daily protein requirement which is beneficial for growth and development in the body systems. The crude fat content of Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves were low. These suggest that these leaves may not be good sources of dietary fat. This also supported by Ene-Obong (2001) who stated that fats are generally low in extract of green leafy vegetables. Consuming foods low in dietary fat will be beneficial in weight management and treatment of cardiovascular diseases. Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves contain moderate amount of crude fibre when compared to other green leafy vegetables like Oha” (Pterocarpus soyausitii) 13.1%, “Nuturukpa” (Pterocarpusus talinoides) 10.55%, “Okazi” (Gnetum africanaum) 24.6% (Ekwmankama, 2008) and pigweed (Amaranthus hybridus) 8.61% (Akubugwo, Obasi, Chinyere & Ugbo, 2007). Sorghum bicolor ranked higher (9.35%) in crude fibre content. High fibre content in foods help in digestion and prevention of colon cancer (UICC, WHO, 2005). Non-starchy vegetables are the richest sources of dietary fibre (Agostoni, Riva & Giovannini, 1995) and according to Saldanha (1995) are employed in the treatment of diseases such as obesity, diabetes and gastro-intestinal disorders. The carbohydrate content of Hibiscus sabdariffa, Carica papaya and Sorghum bicolor leaves were 63.02%, 61.28% and 64.01% respectively. These leaves were found to contain high content of carbohydrate when compared to some other vegetables such as Amaranthus hybridus (52.18%) fresh samples (Akubugwo, 2007). The result of this study shows that Hibiscus sabdariffa, and Sorghum bicolor leaves contain appreciable amount of essential minerals. Iron is important in the diet especially for pregnant and nursing mothers as well as infants. It is also needed in the convalescents and the elderly to reduce cases of diseases associated with iron such as anemia (D'Mello, 2003). The highest (13.36mg/100g) content of iron was found in Hibiscus sabdariffa leaves. According to Barminas, Charles & Emmanuel (1998), an average culinary preparation contains about 300g of vegetables and this would result in the intake of 30g dry weight leaves per serving portion. In this study, the manganese in the analysed sampled varied between 33.34mg/100g to 25.56mg/100g with Sorghum bicolor leaves had the highest (33.34mg/100g) and Hibiscus sabdariffa with the least (25.56mg/100g) manganese concentrations. From Table (2) it can be seen that Sorghum bicolor contained the highest amount of zinc (7.46mg/100g). Also it’s observed that Sorghum bicolor contained the highest amount of phosphorus (155.58mg/100g) and magnesium (23.23mg/100g) Zinc is important for nerve function and male fertility (Ayoola, Adeyeye & Onawumi, 2010) and healthy functioning of the heart and normal growth (Elizabeth, 1994). Phosphorus is associated with growth and maintenance of bones, teeth and muscles. Magnesium is known to prevent cardiomyopathy, muscle degeneration, growth retardation, alopecia, dermatitis, immunologic dysfunction, gonadal atrophy and bleeding disorders. Carica papaya leaves were found to have the highest (8.76mg/100g) folate content followed by Hibiscus sabdariffa leaves. It was observed that the leaf samples had moderate Beta Carotene content. Carica papaya leaf had the highest (9.35mg/100g) Beta carotene content. Pro-vitamin A is a vitamin that protects the body cells from damaging the effects of free radicals, they act as good source of Vitamin A and enhancing the functioning of the immune system. Similarly, pro-vitamin A also helps the reproductive system to function properly. Deficiency of ascorbic acid is associated with pains in the joint and defect in skeletal calcification, anemia, manifestation of scurvy haemorrhage from mucus membrane of the mouth and gastrointestinal tract (Hunt, Goff & Holbrook, 1980). Ascorbic acid functions as an antioxidant, to prevent or at least minimize the function of carcinogenic substances from dietary material

V. Conclusion

The three leaves were found to contain high amount of carbohydrate, moisture, considerable amount of crude fiber, protein, fat and ash. Sorghum b. had the highest percentage of carbohydrate content (64.01%) and Hibiscus sabdariffa has the highest Value for Vitamin C (13.07mg/100g). Sorghum b. had the highest value in Zinc, Manganese, Phosphorus, Magnesium and least value in Iron. Hibiscus s. had the least value in Zinc, Manganese, Phosphorus Magnesium and highest value in Iron, meanwhile Carica papaya was second in all the tested minerals.
Reference


