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Nutritional and biochemical properties of Malaysian okra variety

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ABSTRACT

The nutritional and biochemical contents of Malaysian okra fruits and leaves were studied by analysing the nutritional contents in the fruits and leaves such as protein, carbohydrate, moisture, oil, ash and fibre, while the biochemical contents in the fruits and leaves such as chlorophyll, phenolics and flavonoids were also analysed. The result of the proximate analysis revealed a significant difference ($p < 0.05$) among the fruits and leaves with highest percentage of crude protein (4.81%) and ash (2.44%) were present in the leaf. Mature fruits contain highest percentage of fiber (2.44%), oil (0.4%) and carbohydrate (11.7%) respectively, while the young fruits showed highest moisture contents of 88.47%. The results of the biochemical analysis showed significant differences ($p < 0.05$) among the fruits and leaves with the highest total chlorophyll content in mature leaves (32.99 mg/1 g). The total highest phenolics content was found in young leaves (0.99 mgTNE/1 g) and the total flavonoid was highest in mature leaves (0.79 mgQE/1 g). This paper showed that nutritional and the biochemical contents of okra were higher in the leaves than in the fruits.

Keywords: Biochemical, chlorophyll, phenolics, flavonoids, nutritional.

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INTRODUCTION

The study of the nutritional and biochemical contents of okra parts became necessary due to the continuous increase in consumption of okra. The knowledge about the fruits as well as the leaves could encourage the consumption of okra leaves as well. As a good vegetable, the young pods are used for preparing soup in Nigeria. The enormous nutritional and other biological activities in the pods and seeds were reported by Agbo et al. (2008), Arapitsas (2008) and Kumar et al. (2010). The okra pods were reported to have viscous fiber and lower cholesterol content (Kumar et al., 2010; Kendall and Jenkins, 2004). Okra seeds were determined to have appreciable protein content according to Akingbala et al. (2003). The variations in polysaccharides found in the mucilage are higher in okra pods according to Hirose et al. (2004), Sengkhamparn et al. (2009) and Woolfe et al. (1977). Green vegetables contain valuable chlorophyll (Ebermann et al., 1996). Chlorophyllin as an important component of chlorophyll was reported for enormous health benefits (Whong et al., 1988). The physiological and biochemical activities of phenolic compounds as antioxidant, anti-inflammatory and anti-microbial were also reported by Ali and Deokule (2008), Manach and Mazur (2005) and Middleton (2000). Marinova et al. (2005) proved the higher values of phenolic and flavonoid values, ratios and distributions in some Bulgarian vegetables and fruits. Generally, fruits and vegetables have shown the basic useful properties especially in providing an excellent health and nutritional qualities in the area of prevention and delay in the onset of chronic diseases and the provision of vitamins and enzymes necessary for proper body function (Aman et al., 2005).

MATERIALS AND METHODS

Okra seeds

Malaysia okra seeds variety were purchased from Ymwoo Corporation Sdn Bhd and planted in soil, which served as the source of young leaves. While the fruits and mature leaves were

Table 1. Showing the nutritional contents of fresh okra fruits and leaf (100 g).

Plant parts	Moisture (%)	Protein (%)	Fiber (%)	Oil (%)	Ash (%)	Carbohydrate (%)
Leaf	82.60	4.81	1.13	0.19	2.44	8.83
Young fruits	88.47	2.56	0.37	0.18	1.38	7.05
Mature fruits	82.25	2.51	2.44	0.46	1.17	11.16

obtained from vegetable research department, Universiti Putra Malaysia. The fruits and leaves were subjected to nutritional and biochemical analysis.

Proximate analyses

Proximate analysis of young and mature okra fruits and leaves were carried out to determine the percentage of crude protein, oil, ash, fibre, moisture and carbohydrate. The protein content was determined by micro kjeldahl method by using nitrogen value which is a precursor of protein according to Pearson (1976) through digestion of sample in acid, distillation and titration. Finally, the nitrogen was converted to protein by multiplying with a factor of 6.25. The percentage of oil was determined using the method recommended by AOCS (2000). The moisture carbohydrate and ash were determined by method of weighing the differences according to AOAC (1984).

Biochemical analysis

Total chlorophyll assay

The chlorophyll content in fresh fruits and leaves of okra were estimated on four okra samples namely, young leaf, mature leaf, young fruit and mature fruit. The okra 0.1 g of each of the samples was weighed and inserted in a test tube containing 1 ml of 80% ethanol and heated for 20 min at a temperature range of 65 to 70°C. The supernatant was transferred into a new appendorff tubes, cool and stored in -20°C temperature. The experiment was repeated for 1 to 2 more times till all the ethanol in the tubes turned green and the volumes were brought to 4 ml per test tube. The chlorophyll was measured using spectrophotometer at absorbance of 665, 649 and 470 nm and thereafter chlorophyll a, b, c and total chlorophyll were calculated.

Total phenolics

Total phenolics in okra were determined from the above samples by using Folin-Ciocalteau method (Harborne, 1989). This was estimated by adding 5 µl of extract from leaves and fruits with 120 µl of deionised distilled water, 12.0 µl of folin-Ciocalteau reagent and 47 µl of saturated Na_2CO_3 solution (20 g Na_2CO_3 in 100 ml distilled water) in 1.5 ml eppendorff tubes shaken and mixed, after incubation for 1 h at room temperature. The total phenolics were measured at 760 nm. A blank sample was prepared by mixing 5 µl of deionized distilled water with the same volume of the above mentioned reagents. The absorbance against prepared reagent blanks was determined at 760 nm with UV-Vis Spectrophotometer lambda 5. Total phenolics content of the fruits and leaves (young and mature) were expressed in mg of tannic acid equivalent (TNE)/0.1 g of fresh okra weight.

Total flavonoid

Total flavonoid was determined using aluminium chloride colorimetric assay (Zhishen et al., 1999). 2 ml of 2% $ALCl_3$ in ethanol was added to 2 ml of the okra leaves and fruits test samples as above, mixed well and left in dark at room temperature for 1 h. The UV absorption was measured against prepared reagent blank at 420 nm. The total flavonoid content in fresh okra leaves and fruits (young and mature) were expressed as mg quercetin equivalent QE/0.1 g fresh weight.

RESULTS AND DISCUSSION

The proximate analysis of protein content in 100 g of okra fruits and leaves showed percentage of mean variation with mature fruit (2.51%), young fruit (2.57%) and leaves (4.81%) respectively. The highest protein content (4.81%) is found in the leaves which proved that protein is more available in the leaves than the fruits as shown in Table 1. The 4.81% protein content is in agreement with 4.4% in 100 g of protein content in pods as reported by Benchasri (2012), Falusi et al. (2012), Varmudy (2011) and Gopalan et al. (2007). In this study, the protein content showed significantly higher content in leaves than in the fruits.

The oil content in Malaysian fresh okra variety per 100 g is very negligible in all the different parts analyzed with a mean range of mature fruit (0.46%), young fruit (0.18%) and leaves (0.19%). This clearly showed okra has a low fat content. The percentage of oil in okra parts found in this result with a range of 0.178 to 0.457% per 100 g fresh state disagrees with the oil content range of 9.22 to 10.57% per 100 g fresh state as reported by Adetuyi et al. (2011). However, percentage of oil content is lower in the leaves compared with the fruits.

The percentage of moisture content revealed that the young fruit with 88.47% as the highest moisture content, mature fruit with lowest (82.25%) and leaves with 82.60% moisture content. The high moisture content in okra leaves and fruits is in agreement with high moisture content in okra pods at 89 g/100 g as reported by Goplana et al. (2007). The percentage of ash in the leaves dominates at 2.44% which is higher than mature fruit and young fruit at 1.18 and 1.34%, respectively. The carbohydrate content was highest in the mature fruit (11.17%), followed by leaf at 8.83% and young fruit (7.05%) with the lowest carbohydrate content as shown in Table 1. The result agrees with Benchasri (2012) and El-Nahry et al. (1978) which showed the percentage of carbohydrate in okra pods at 8.20 g. The most striking interest thing to be noted is the high content of protein in the leaves of okra compared with the fruits hence, consumption of the leaves should be encouraged.

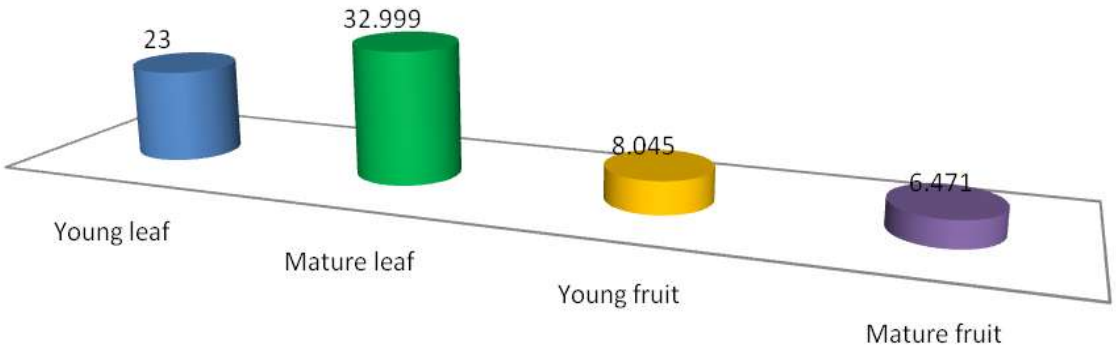

Figure 1. Total chlorophyll content in the young and mature fruits and leaves of okra.

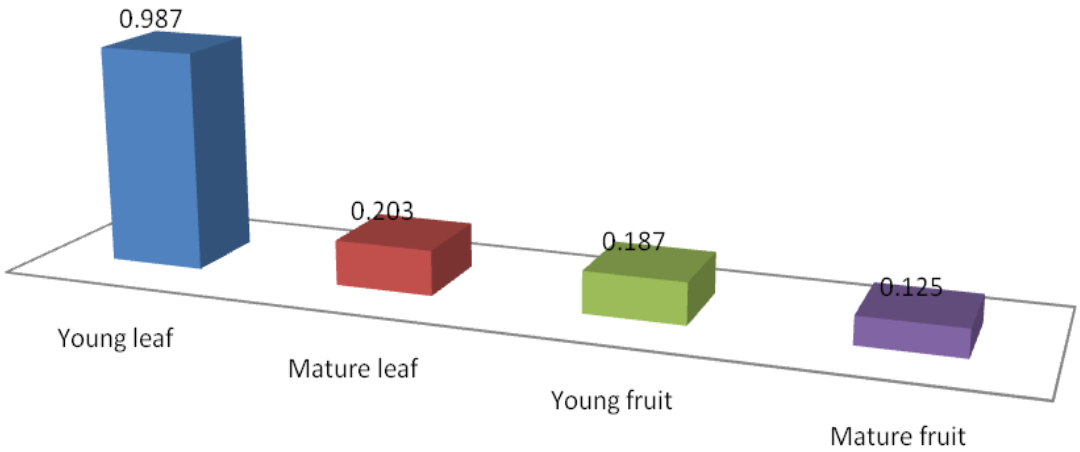

Figure 2. Total phenolics content in the young and mature fruits and leaves of okra.

The biochemical analysis of Malaysian okra variety using different parts also revealed total chlorophyll dominating in mature leaves with 1.56 mg/0.1 g and lowest in mature fruit at 0.11 mg/0.1 g as shown in Figure 1. The total chlorophyll found in this study is higher than the total chlorophyll content of *Cichorium intybus* (0.22) (Ashari) and (0.197) (Chail) according to Jan et al. (2010) and Naczk and Shahidi (2006). The total phenolics were investigated in young leaves, mature leaves, young fruit and mature leaves, young leaves with 0.99 mgTNE/0.1 g mean gave the highest content in phenolics and the lowest was recorded in 0.13 mgTNE/0.1 g found in mature fruit (Figure 2). The total phenolics is comparable to total phenolics of 87 mg/100 g *Alocacia indica* ch as found by Ali and Deokule (2008).

For the total flavonoids, mature leaves showed a distinct highest flavoniods content mean percentage of 0.8 mgQE/0.1 g while mature fruit recorded a negligible mean value of 0.007 mgQE/0.1 g as shown in Figure 3. Marinova et al. (2005) also revealed the presence of flavonoids in vegetables and the result of 49.1 mgCE/100 g in fresh okra pod is similar to 0.796 mg/0.1 g as found in this present study. The biochemical content overview divulged that chlorophyll content is more than double of the phenolics and flavonoids in all the parts tested. The analyses also showed that chlorophyll, phenolics and flavonoid dominated in the leaves compared to the fruits. There is a decrease from young fruits to mature fruits in the biochemical contents tested which maybe due to aging and ripening.

CONCLUSION

The proximate analysis result showed that okra leaves and fruits contain valuable protein, low fat and required carbohydrate with more protein in the leaves than fruits and lower fat content in the leaves than fruits. The results on total chlorophyll, total phenolics and total flavonoids proved appreciable antioxidants are present in okra leaves and fruits. Therefore, consumption of okra leaves and fruits will provide the necessary energy to the body and important antioxidants that could boast immune body system and prevent diseases. In some countries, the young leaves are used in preparing yam soup which serves as the major source of energy.

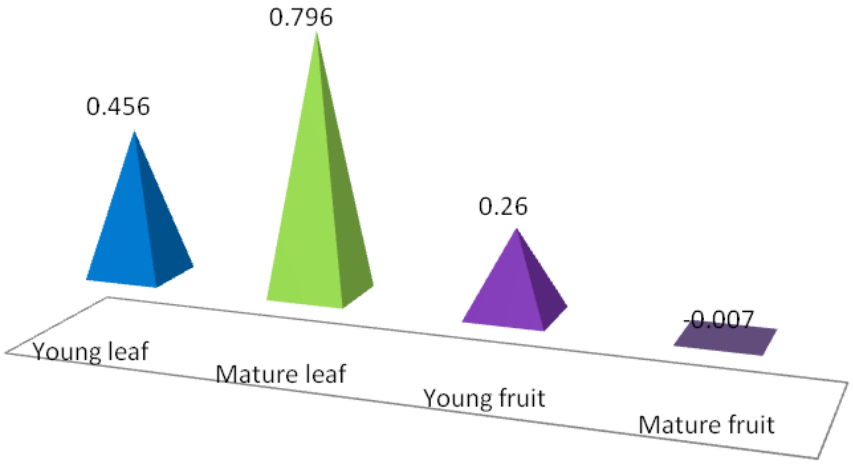

Figure 3. Total flavonoids content in the young and mature fruits and leaves of okra.

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