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Proximate Composition of Raw and Heat-treated *Seriales* [*Flacourtia jangomas* (Lour) Raeusch] Fruit

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ABSTRACT

Seriales fruit is an underutilized wild fruit in the Philippines with promising food production potential, however the usual drawback of processing is the change in the composition or properties of the crop or product. Hence, the study aimed to determine and compare the proximate composition of raw and heat-treated *seriales* fruits. Heat-treatment involves blanching, steaming, boiling and microwave-cooking, which were analyzed for its moisture content, ash content, crude fat, crude fiber and crude protein following standard methods. Results revealed that heat-treatment employed cause a significant difference ($p<0.05$) on proximate composition of the fruit except for ash and crude fat. High moisture content was identified to boiled and steamed fruits, and the lowest was observed in microwave-cooked *seriales*. Crude protein and fiber were revealed as having increased values in comparison with the raw *seriales* fruit.

Keywords: Seriales, Flacourtia jangomas, proximate composition, heat-treatment methods

INTRODUCTION

Flacourtia jangomas belongs to the Flacourtiaceae family with varying names such as coffee plum, East Indian plum, Indian plum, and Manila cherry among others (Lim 2013), depending on the place where it is wildly distributed. It is one of the wild fruits in the Philippines and is known as Seriales/ Ceriales in the Visayan and Mindanao regions. It is considered one among other less-known commodities in the Philippines. It is an important fruit crop in some parts of Southeast Asia, since it is known for food and medicine purposes (Neeharika and Pandey, 2013). The medicinal capability has been attributed to the significantly important components of the commodity. Studies made by Parvin et al. (2011) have shown that Flacourtiaceae contains bioactive compounds. Ripe fruit specifically contain alkaloids, flavonoid, phenolic compounds and tannins which proves its antioxidant potential (Neeharika and Pandey, 2013). Ara et al. (2014) reported that the fruit contains protein (0.69±0.05 gm/100 gm edible potion), fat (0.42±0.03 gm/100 gm edible portion) and fiber (0.92±0.10 gm/100 gm edible portion) which may be contributory to human need of these significantly important components. Moreover, a 100 gram edible portion of the fruit may contribute a total of 128.1 Kcal of energy (Ara et al. (2014). If unutilized, these biologically and nutritionally important compounds will just be put to waste. In order to maximize the utilization of these important compounds, processing is the best option.

There are few studies on processed seriales. Cimafranca and Dizon (2018) reported the potential of the fruit in wine production. In terms of processing methods, one among the factors affecting the sensory quality of the seriales ready-to-drink beverage is blanching time (Cimafranca and Dizon 2017). This is because processing, specifically with the use of heat not only influences the sensory quality of processed products, often than not it leads to degradation and losses of nutritionally valuable components of the fruit. Microwave heating for example reduced dietary fiber of apple, oat bran and corn (Chang and Morris, 1990). Blanching on the other hand decreases the protein and fat content of ripe banana (Musa acuminata colla)(Taiwo and Adeyemi, 2009). Results on some commodities increase instead such as in artichoke, specifically the protein and lipids content. Mepba et al. (2007) reported that sun-drying on amaranths (Amaranthus hybridus), fluted pumpkin (Talfaria accidentalis), gnectum vegetable (Gnectum africana), vine spinach (Basella alba), bush okro (Corchorus olitorus), slippery vine (Asystacia gangetica)

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and cocoyam leaves (Colocasia esculenta) resulted in moisture loss (35.6%) with insignificant ($p>0.05$) increases of protein, lipid, crude fiber and total ash. Generally, the composition or properties of the crop or product changes after heat exposure. Hence, the study aimed to determine and compare the proximate composition of raw and heat-treated seriales fruits.

METHODS

Experimental Materials

Seriales fruits were obtained from the rural areas of Baybay City, Leyte. Good quality fruits were sorted and chosen. Only the good quality ripe fruits were used, where ripeness was characterized by the purplish-red color of the skin. The sorted good quality fruits were then washed thoroughly and then drained.

Heat treatments

Heat treatment methods were adopted from the report of Ahmed and Ali (2013) as follows:

Blanching. Distilled water (1000 mL) was poured into a stainless steel vessel and heated at boiling temperature (100˚C). Pre-weighed whole seriales fruits of approximately 200 grams were immersed in the boiling water for three (3) minutes. The fruits were then drained on a stainless sieve until cold (air cooling) for approximately 22-30 minutes.

Steaming. Distilled water (1000 mL) was heated to boiling temperature using a stainless steel steamer. Meanwhile, pre-weighed whole seriales fruits of approximately 200 g were placed in the steamer basket. Then, the steam basket with seriales was placed on top of the boiling water, covered with a lid, and steam for six (6) minutes. After heating, the steamer basket was taken out from the heat and allowed to cool down similar with blanching.

Boiling. Into a stainless steel vessel, 1000 mL of water (distilled) was poured, which was then covered with a lid and heated to boiling. Upon boiling, the vessel was opened and the seriales (200g whole) fruits were submerged into the boiling water. The lid was replaced back into the cooking vessel, and the fruits were boiled for six (6) minutes. The samples were then taken out quickly from the heat and drained on a stainless sieve, air cooled for approximately 22-30 minutes.

Microwave-cooking. Whole seriales fruits (200g) were placed in a glass beaker (Pyrex 1000mL capacity), and 10 mL of distilled water was added to prevent the fruit from being burned during cooking. The fruits were then heated using the microwave oven for three (3) minutes and 30 seconds. Then, the samples were drained on a stainless sieve until cold, similar to blanching.

Proximate Analysis

Heat-treated samples were analyzed for its moisture content, crude ash, crude fat, crude fiber and crude protein (based on dry weight) at the Analytical Service Laboratory, Animal and Dairy Science Cluster, University of the Philippines at Los Banos, Laguna. The analyses were carried out in triplicate following the method of AOAC (2000). The nitrogen-free extract (%NFE) was computed based on equation (1).

$$\% NFE = \% DM - (\% CL + \% CP + \% Ash + \% CF) \quad \text{(Eq. 1)}$$

Where:

DM = dry matter
CL = crude lipid
CP = crude protein
CF = crude fiber

Statistical analysis

Data were statistically analyzed by analysis of variance (ANOVA) using Statistica version 10, and those that came out significant were analyzed using Tukey's with multiple range significant difference (LSD) test ($p<0.05$).

RESULTS AND DISCUSSION

The results of the proximate analysis revealed a significant difference among values except for the ash and fat contents (Table 1).

% Moisture content (% MC). The moisture content of all *seriales* samples that have undergone different cooking processes are significantly varied ($p<0.01$). Initially, the % MC of raw fruit was 72.13%. This amount is a little higher compared to F. jangomas fruit from other countries, e.g. 66.86 % MC gathered from Indian plum of Bangladesh (Ara et al. 2014), and 65.27 % from Soh mlum of India (Seal et al. 2014). Among the fruits treated, high moisture content was characteristically identified to boiled and steamed fruits, and the lowest %MC were observed in microwaved-cooked seriales. The significant increases in moisture content in steaming and boiling processes, with respective percent increments of 1.96 and 2.48 (relative to raw fruit), was due to the leaching of water-soluble nutrients during the process (Rickman et al. 2007 as cited by Ahmed and

Ali 2013).

Ash content (%). The ash content is the residue after ignition of a sample and is taken to represent the inorganic constituents of the food (Dublecz 2011). In the study, the different cooking condition employed did not significantly affect the ash content (%), which ranges from 0.77 to 0.85 (Table 1). The result obtained is in agreement with the findings of Ara et al. (2014) on Bangladesh Indian plum (0.72 %). Both, however, were found to be in disagreement with the results gathered by Dubey and Pandey (2013) as well as with Seal et al. (2014), where the result of the aforesaid authors were higher (2 % and 1.20 %, respectively).

Crude protein content (%). The statistical analysis for crude protein (%) content has shown to be significant at p<0.05 (Table 1). The range of values within treatments is 0.86 to 1.31 % which is more or less the same with chico, pomelo and papaya from Batangas (Untalan et al. 2015). The lowest value of 0.86 % crude protein was obtained from untreated seriales fruit and the rest of the treatments have considerably higher protein content than the raw, thereby establishing the fact that heat treatment causes an increase in protein content of the commodity. The increase in protein content after cooking observed in this study was in disagreement with the findings of Alajaji and El-Adawy (2006) and Chukwu et al. (2015). These authors discussed instead of the reduction of amino acids after cooking. The reduction results from the leaching of free amino acids. They further stated that boiling specifically has deleterious effects on protein content of the R. vomitoria leaves. The study made by Lewu et al. (2009), and Wang et al. (2010) on taro cocoyam leaves, and beans and chickpeas, respectively, were in line with the experimental result on crude protein content enhancement of this study. Lewu et al. (2009) cited an explanation from Onu et al. (2001) stating that increase in levels of protein after cooking is probably due to the breakdown of tannin that forms complexes with protein, making the latter unavailable.

The available protein determined in this study was of the same quantity with mango (0.979 % dry matter), and a little lower in banana (2.2 %) (Mohapatra et al. 2010). The data suggest that seriales fruit is not an excellent source of protein. In comparison with other studies on F. jangomas, it was determined that the crude protein content (raw) is known to be of lower amount as compared to the findings of Kermasha et al. (1987) and Hosain et al. (2011), who gathered values of 3.9 and 6.16 %, respectively. On the other hand, the findings of this study are in concurrent with the data gathered for Bangladesh Indian plum in the study made by Ara et al. (2014). The multiple comparison difference test following Tukey's

Table 1.
Proximate composition of ripe seriales (F. jangomas) fruit as affected by different heat treatment methods

TREATMENTS	PROXIMATE COMPOSITION					
	Moisture content (%)	Ash content (%)	Crude Protein (%)	Crude Fiber (%)	Crude Fat content (%)	Nitrogen-free extract (%)
Raw	72.13 ± 0.16^{a}	0.81± 0.02^{a}	0.86 ± 0.01^{a}	1.02 ± 0.07^{b}	0.06 ± 0.03^{a}	25.12 ± 0.18^{a}
Blanched	72.51 ± 0.42^{a}	0.78± 0.06^{a}	0.91 ± 0.09^{a}	5.76 ± 0.69^{a}	0.14 ± 0.02^{a}	19.90 ± 0.82^{b}
Steamed	74.09 ± 0.26^{ab}	0.85± 0.04^{a}	1.08 ± 0.09^{ab}	4.49 ± 0.43^{a}	0.15 ± 0.01^{a}	19.34 ± 0.77^{bc}
Boiled	74.61 ± 1.00^{b}	0.77± 0.01^{a}	1.31 ± 0.11^{b}	6.67 ± 0.76^{a}	0.15 ± 0.03^{a}	16.49 ± 0.41^{c}
Microwaved	69.85 ± 0.57^{a}	0.91± 0.05^{a}	1.09 ± 0.09^{ab}	6.63 ± 0.63^{a}	0.11 ± 0.01^{a}	21.41 ± 1.04^{b}

Values are means of triplicate determination ± standard error (SE) (% w/w)
Mean values followed by different letter superscripts in the same column are significantly ($p<0.05$) different according to Tukeys (HSD) test.

HSD for the aforesaid variable revealed that the different cooking conditions employed does not make the blanched, steamed and boiled seriales different with that of the untreated (raw) seriales (Table 1).

Crude fiber (%). The crude fiber content analysis was likewise statistically significant at $p<0.05$. Puupponen-Pimia et al. (2013) cited that thermal processes such as steaming and cooking might change the properties of dietary fiber in many ways. She reported that the results of dietary fiber content she reviewed from various studies could either increase or decrease. In this experiment, the heat treatment caused an increase in the crude fiber content. This result was in agreement with the study on chickpea seeds (Alajaji and El-Adawy 2006) and some vegetables (Puupponen-Pimia et al. 2013). The latter discussed that the reason for the increase in dietary fiber content was most probably due to the washing out of soluble components and small molecules, such as free sugars, leading to the concentration of fiber components in the processed material. Moreover, the said author added that processing might disrupt the cells resulting in better extraction of fiber components. Furthermore, enzymatic action was also mentioned as another factor that might have caused the release of fiber components from the insoluble cell wall matrix leading to increasing the soluble fiber contents of the sample.

Although the effect of heat treatment may be significant on other properties, Tukey's test revealed that these variables except for microwaved-cooked fruit, aren't significantly different from each other in terms of its fiber content. The maximum amount of fiber (6.673±% crude) was found in the seriales fruit that has been microwaved-cooked, while the least was found on the raw fruit (Table 1). The comparison of the raw fruit with the other fruits revealed that seriales fruit has more or less similar crude fiber content with avocado, jackfruit, Malay apple, tangerine, longan, and Java apple. In comparison with F. jangomas fruit studied from previous studies, it was found out that the data gathered in this study are higher than the results on paniala (as it is locally known) in Bangladesh according to Ara et al. 2014 (0.92 %), and lower (9.6 %) than the results obtained by Dubey and Pandey (2013). Also, it was gathered that the fruit was of lower fiber content (1.02 %) in comparison with mango (3.70 %) (Mamiro et al. 2007) and papaya (1.88 %) (Oloyede 2015), but this plainly suggests that the fruit can input to the dietary fiber requirement for consumption.

Fat content (%). Fat content analyses of the samples were not statistically significant ($p \geq 0.05$) (Table 1). The % crude fat ranges from 0.06 to 0.15 (Table 1), which reveals that these values are not different from each other. It is noticeable though that the fat content of the seriales fruit was low, and are even lower as compared with the values obtained from previous studies that gathered ranges of 0.42 to 0.8 % (Ara et al. 2014 and Dubey and Pandey 2013). The 0.06 % (dry weight basis) crude fat of raw seriales is too low and can be comparable with other tropical fruits with almost no fat content (less than 1 %) such as mangosteen, tamarind, balimbin, pomelo and java apple among others (Jahan et al. 2014).

Nitrogen Free Extract (NFE)(%). The second largest component in seriales fruit is nitrogen-free extracts (NFE), which mainly consists of a heterogeneous mixture of all components such as sugars, fructans, starch, pectins, organic acids and pigments (Dublecz, 2011). In fruits, variations are observed as a result of geographic, climatic and seasonal variations (Adepoju et al, 2012, Iorgyer et al., 2009). In this study on the other hand where seriales fruits were pre-treatment with heat, it was observed that pre-treatments cause significant variation in the NFE of the fruit. Table 1 reveals that the % NFE of fresh seriales was 25.12, while heat treated samples range from 16.49 to 21.41, the latter being significantly lower than the raw. Among the heat treatments applied, steaming and boiling caused the highest reduction of NFE. Similarly, Ndidi et al. (2014) observed that boiling significantly reduced NFE in Bambara groundnuts. Iorgyer et al. (2009) further observed that the reductions in NFE increased with an increase in boiling period. The decrease in proximate components with boiling could be due to the leaching of nutrients into the boiling water. Meanwhile, blanched, steamed and microwave-cooked seriales fruits were revealed not significantly different from each other, but are significantly different from the raw fruit.

CONCLUSION

The proximate analysis revealed that heat treatment caused a significant difference in the aforementioned parameters, except ash content and crude fat.

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