

Physico-chemical and functional properties of fresh pulps jackfruit (*Artocarpus heterophyllus* Lam.) varieties in Eastern Visayas, Philippines

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ABSTRACT

Quality is a wide-ranging concept determined by many factors. It is a composite of those physical and chemical properties of the material which govern its acceptability and processing suitability. This study aimed to determine the physico-chemical and functional properties of the two jackfruit varieties (EVIARC Sweet and AES-2) grown in Eastern Visayas, Philippines. Fresh ripe jackfruit varieties were subjected to physico-chemical properties and functional component analyses following standard protocols. The two jackfruit varieties were found to have the following properties: the pH were 4.80 and 5.50; total soluble solids (TSS), 24.00 and 22.60°B; total titratable acidity (TTA), 0.33% and 0.12% citric acid; moisture content (MC), 77.30% and 75.96% (wb); total phenolics (TP), 127.73 and 125.91mg CE/100g; tannin content (TC), 127.73 and 208.72 mg VE/100g; total reducing sugar (TRS), 15.43% and 14.38%; total sulfur (TS), 0.36 and 0.57ppm; and antioxidant activity (AOA), 39.55 and 52.35% LP (lipid peroxidation) for EVIARC sweet and AES-2, respectively. Variety significantly affects the pH, TSS, TTA, %MC, TC, TRS, TS and AOA. Non-significance was noted on their TP contents.

Keywords: Total phenolics, tannins, antioxidant activity, lipid peroxidation, sensory evaluation, EVIARC Sweet and AES-2

INTRODUCTION

Physico-chemical properties of raw materials can greatly affect the quality of processed food products. They affect the flavor, appearance, and nutritive value of the food products (Eskin 1990). Temperature, acidity and the like impinge on the processing and storage, these properties. Processors therefore should look the standard specifications of delivered raw materials to be assured of product's quality.

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Functional food refers to foods that provide not only basic nutritional needs, but also physiological benefits and help prevent diseases (Viuda-Martos et al 2010, Swami et al 2012).

Jackfruit is a delicious tropical composite fruit with succulent and firmly textured bulbs. It is grown extensively in several tropical countries including the Indian sub-continent, southern China, southeastern Asian countries, in middle Africa, and Latin American countries (Saxena et al 2009). Jackfruit has high amount of protein, starch, thiamine and calcium (Burkill 1997, Swami et al 2012). The ripe perianth contains 2MJ of energy per kg/wet weight (Swami et al 2012).

Widely grown in the Philippines, it is one of the tropical fruits which produce the largest edible fruit that may weigh as much as 50kg (Coronel 1983). The fruit deteriorates rapidly upon ripening like other climacteric fruits. In the Philippines, specifically in the Visayas, jackfruit is one of the priority commodities (Cruz 2002). In Eastern Visayas, Increasing efforts were undertaken to identify and propagate promising accessions to increase jackfruit production. The increasing volume of production requires processing technologies with high commercial viability so that more Filipino jackfruit products can enter local or high end markets. This can help improve the livelihood of local farmers and alleviate the Philippine's economy.

Two jackfruit varieties were highly recommended for processing into value added products, namely the EVIARC Sweet and AES-2. These two varieties are the focus for mass production in Eastern Visayas considering the varieties' sensory qualities and production performance. The physico-chemical properties of the fruits should be studied since this can affect the suitability of the fruit for processing. The growing awareness on the importance of healthy foods has made consumers conscious of the functional properties of food products as can be seen in product labels. This study was therefore conducted to fill the gaps in information on the functional properties of jackfruits that can serve as basis of choice by consumers.

MATERIALS AND METHODS

Raw Materials. Figure 1 shows two jackfruit varieties (EVIARC Sweet and AES-2) with right maturity that were analyzed at the Department of Food Science and Technology, VSU, Visca, Baybay City, Leyte.

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Figure 1. EVIARC Sweet (A) and AES-2 (B) varieties of jackfruit in Eastern Visayas, Philippines

Experimental Design. The study used 2 factorial design arranged in completely randomized design (CRD), with variety EVIARC Sweet and AES-2. The experiment was replicated three times.

Physico-chemical Analyses. The fresh pulps of the two jackfruit varieties were subjected to different physico-chemical analyses such as pH, total titratable acidity (TTA), total soluble solids (TSS), and moisture content (%MC) following AOAC (1980).

Functional components analyses. Fruits were sent to the Institute of Plant Breeding (IPB), UP Los Baños for the analysis of total phenolics (TP) adopting the protocol of Velioglu et al (1998), the tannin content (TC) using the modified vanillin method by Sun et al (1998), the total reducing sugar (TRS) adopting the dinitrosalicylic (DNS) assay protocol of Miller (1972), total sulfur (TS) employing the protocol of Sandhu et al (1974) and antioxidant activity (AOA) following the procedure of Leong and Shui (2002). Three replicates were done with the mean used in reporting results.

Statistical Analyses. The effects of variety on the physico-chemical and functional properties were analyzed by subjecting data to analysis of variance (ANOVA) at 5% level of significance employing SPSS 16. The treatment means were compared using Tukey's HSD (Honestly Significant Difference at 5% level). All the analyses were carried out in triplicate.

RESULTS AND DISCUSSION

Physico-chemical Properties

The two jackfruit varieties showed significant differences in their physico-chemical and functional properties which could be attributed to their different nature of raw material, chemical composition and or its structure (Konopacka et al 2009).

As can be seen in Table 1, EVIARC Sweet obtained a significantly higher TSS value (24°B), which means it was sweeter than AES-2 which had a TSS value of 22.60°B. The values obtained were in agreement with the findings of Shamsudin et al (2009) for threaten clusters (44 genotypes) of jackfruit which had TSS values that ranged from 15.10-25.90°B. Acedo (1992) reported TSS values of jackfruit pulps at 11.70-23.20°B.

Table 1. Mean¹ values of the physico-chemical properties of fresh pulp from two jackfruit varieties

Property	Jackfruit variety	
	EVIARC Sweet	AES-2
pH	4.80 ^b	5.47 ^a
Total Soluble Solids (°B, Brix)	24.00 ^a	22.60 ^b
Total Titratable Acidity (% citric acid)	0.33 ^a	0.12 ^b
Moisture Content (% wet basis)	77.30 ^a	75.96 ^b

¹N=3. Means followed by the same letter(s) in a row are not significantly different from each other at $p \leq 0.05$

EVIARC Sweet had significantly higher percent moisture content (77.30%) than AES-2 (75.96%), which would also imply that AES-2 had a little bit harder texture (Table 1). However, the values obtained in both varieties were higher than those obtained by Acedo (1992) who reported that moisture content of jackfruit pulp ranged from 65.60 to 73.10%. The difference in values may be attributed to varietal differences. Moisture content is associated to shelf life of the food considering that water is essential for microbial, chemical and enzymatic reactions. More water, especially free water, in the food product hastens the proliferation of microorganisms. More microorganisms means faster food product spoilage.

Functional Properties

Murano (2003) considers tannin content (TC) as phenolic compound. Table 2 shows that AES-2 had a TC values of 208.72mg VE/100g, which was significantly higher than EVIARC Sweet's 127.73mg VE/100g. On the other hand, there was no significant difference between the two varieties with respect to total phenolic content with EVIARC Sweet having 127.73mg CE/100g and AES-2 125.91mg CE/100g. This could be attributed to the presence of other kinds of phenolic compounds in EVIARC Sweet that resulted to comparable values even if AES-2 had higher tannin content. Previous studies directly linked total phenolics to antioxidant activity (Maizura et al 2011).

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Table 2. Mean¹ values of the functional properties of fresh pulp from two jackfruit varieties

Property	Jackfruit variety	
	EVIARC Sweet	AES-2
Total Phenolics (mg CE (Catechin Equivalent) / 100g)	127.75a	125.91a
Tannin Content (mg VE (Vanillin Equivalent) / 100g)	127.73b	208.72a
Antioxidant Activity (%LP, Lipid Peroxidation)	39.55a	52.35b
Total Reducing Sugar (%)	15.43a	14.38b
Total Sulfur (ppm, parts per million)	0.36b	0.56a

¹N=3. Means followed by the same letter(s) in a row are not significantly ($P \leq 0.05$) different from each other.

The % LP had an inverse relationship with antioxidant activity. This means higher %LP, the lower is the antioxidant activity. Results revealed that EVIARC Sweet had significantly higher antioxidant activity (39.55% LP) than AES-2 (52.35% LP). In this case, even if their total phenolics were comparable, and the tannin content of EVIARC Sweet was low, still EVIARC Sweet had higher AOA which could be attributed to the presence of other components in the sample which included other phenolic compounds like saponin, flavonoids, anthraquinones and tannins (Pitchaon 2011) and other components like beta carotene, ascorbic acid which have also antioxidative action.

Maizura et al (2011) mentioned that the natural presence of antioxidants in plants and a combination with other antioxidants may have an additive effect that was expected from a simple addition and synergistic effect that was greater than individual or sum of the combination. Maizura et al (2011) and Roberts and Gordon (2003) reported that plant polyphenols had a synergistic effect with other antioxidants present in plant material.

As reported by Brown (2005), antioxidants were chemical substances that prevent or repair damage to cells caused by exposure to oxidizing agents such as environmental pollutants, smoke, ozone, and oxygen or free radicals. Free radical was formed when an atom of hydrogen or oxygen lost an electron which made the atom reactive. Thus, it needed to steal an electron from a nearby atom or molecule in order to reestablish a balance between its positive and negative charges. Atoms and molecules that had lost electrons to free radicals were said to be oxidized. These oxidized substances were reactive and could damage cell membranes, DNA and other cell components. Cellular damage due to free radicals appeared to play a role in the development of some types of cancer, bronchitis, emphysema, heart disease, cataracts, and premature aging. From the results, EVIARC Sweet therefore gave higher protection against free radicals than AES-2. In addition Marshall et al (2000) mentioned that the polyphenolic composition of fruits varied in accordance with species, cultivar, degree of ripening and environmental conditions of growth and storage.

The total sulfur of AES-2 (0.56ppm) was significantly higher than EVIARC Sweet (0.36ppm) which would mean that AES-2 is composed of more sulfur containing proteins or other sulfur containing compounds than EVIARC Sweet. Ajandouz and Puigserver (1999) observed that sulfur amino acids inhibited the non-enzymatic browning of amino acid-containing glucose solutions. Added TRS of EVIARC Sweet (15.43%) was significantly higher than AES-2 (14.38%). These reducing sugars could react with amines to produce a non-enzymatic reaction

called Maillard browning. These reducing sugars were probably similar with the findings of Chowdhury et al (1997) who identified fructose and glucose, the major sugars in all parts of the jackfruit as quantified by gas liquid chromatography.

CONCLUSION

The two jackfruit varieties studied differed in their physico-chemical and functional properties, particularly in pH, TSS, TTA, %MC, TC, TRS, TS, and AOA. No significant difference was observed in their TP. These differences could affect their response to treatment, processing or storage.

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