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Studies of the Variability of Primary Metabolites in the Epicarp, Mesocarp and Seed of *Dacryodes edulis* Fruit at Taste Maturity

Etou Ossibi Grace Jokael[1,2*], Mbon Nguékou Chrichina[1,2], Ongouya Mouekouba Dalcantara Liana[2], Mpika Joseph[2], Attibayeba[2]

[1]Biology Center, Faculty of Applied Sciences (FSA), Dénis Sassou N'guesso University, Kintélé, Congo
[2]Laboratory Biotechnology and Plant Production, Faculty of Science and Technology, Marien Ngouabi University, Brazzaville, Congo
Email: *etouossibigj@gmail.com

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Abstract

The fruits of *Dacryodes edulis* are rich in biologically active substances, which makes them of great interest in terms of validation. In this study, we targeted the primary metabolites in the epicarp, the mesocarp and the seed of the fruit of *Dacryodes edulis* at taste maturity, which were selected for their nutritional quality and its appreciation throughout the Gulf of Guinea area, which is very popular because of its large size, texture and special taste. The evaluation of total carbohydrates, total lipids and soluble proteins in the epicarp, mesocarp and seed of the fruit at taste maturity was made from spectrophotometer measurements. The overall analysis of the results of the present study shows that total carbohydrates, total lipids and proteins accumulate more in the seed with respectively 251.33 ± 1.15 mg/g DM; 9.92 ± 0.201 mg/g DM and 55.075 ± 0.024 mg/g DM. Likewise, the results indicate low concentrations of total carbohydrates and total lipids in the epicarp with respectively 245 ± 1 mg/g DM and 4.77 ± 0.047 mg/g DM, on the other hand, it is the mesocarp which presents the lowest content of soluble proteins: 28.075 ± 3.231 mg/g DM. This variation could be linked to the nature of the compartment, more particularly to the storage location. This comparative study could lead to the valorization of the seed of the fruit of *Dacryodes edulis* for its richness in metabolites and arouse significant interest in nutrition.

Keywords

Dacryodes edulis, Fruit, Taste Maturity, Epicarp, Mesocarp, Seed

1. Introduction

Dacryodes edulis (G. Don) HJ Lam is an oil-bearing fruit tree of the Burseraceae family [1]. It is cultivated in Africa in equatorial zones, humid tropical and tropical high altitude, from Nigeria to Uganda in the east, and to Angola in the South [2]. It is native to the Gulf of Guinea [3]. Its fruit edible is called safou in the Republic of Congo. It is the pericarp, separated from the seed, which is eaten. This fruit can contribute to the food security of the countries where it is present and it has enormous nutritional benefits [4]. The safou pulp, taking into account its very interesting nutritional composition would thus find its place in the industry food, pharmaceutical and cosmetics [5]. Indeed, several studies have shown that safou are rich in carbohydrates, lipids and proteins [4]. But, the accumulation of these compounds in the epicarp, mesocarp and seed of the fruit at maturity taste still remains unknown. The storage of these compounds may be an indicator of the part which has an important nutritional value from the fruit of *Dacryodes edulis* (G. Don) HJ Lam. To provide a scientific basis for the valorization of the seed of this fruit, it would be important to know the variation in the contents of primary metabolites, the epicarp, the mesocarp and the seed of the fruit at taste maturity. The objective of this study is to promote the seed of safou.

2. Material and Methods

2.1. Material

African plums at taste maturity **Figure 1**, approximately homogeneous and suspected of belonging to the *edulis* species, were collected from a tree on a farm in Djiri, a district of Brazzaville, in February 2022. The fruits were authenticated as belonging to *Dacryodes edulis* (G. Don) HJ Lam by a taxonomist from the Department of Biology, Section of Plant Biology and Physiology, Faculty of Science and Technology, Marien Ngouabi University, Brazzaville, Congo.

Figure 1. African plums (Mouaragadja *et al.*) fruit of *Dacryodes edulis* (G. Don) HJ Lam. (A) Mesocarp of the African plum (Mouaragadja *et al.*) of *Dacryodes edulis*; (B) Lobed seed of the African plum (Mouaragadja *et al.*) of *Dacryodes edulis*.

2.2. Preparation of Crude Extracts

When ripe, the fruit is separated into three parts: the epicarp, the mesocarp and the seed (Figure 2). Each part was dried away from light at room temperature in the laboratory. Then, 25 g of the dried epicarp or mesocarp or seed was ground in a mortar porcelain and reduced to a homogeneous powder. The powder was kept in tinted vials dry to be used for the determination of primary metabolites.

Figure 2. African plums (Mouaragadja *et al.*) fruit of *Dacryodes edulis* (G. Don) HJ Lam. (A) Mesocarp of the African plum (Mouaragadja *et al.*) of *Dacryodes edulis*; (B) Lobed seed of the African plum (Mouaragadja *et al.*) of *Dacryodes edulis*

2.3. Methods

Determination of Total Sugars and Lipids in the Epicarp, Mesocarp and Seed

The fruit was separated into three parts: the epicarp, the mesocarp and the seed. Each part was dried away from light at room temperature in the laboratory. The powder was served to the dosages of primary metabolites.

The extraction of total sugars and lipids from the epicarp, mesocarp and seed was carried out according to a technique adapted from that described by [6]. 10 g of sample The vegetable is finely ground, then homogenized for 30 minutes in 100 ml of distilled water. After stirring, the mixture is centrifuged at 5000 rpm for 10 min. The supernatant I has been used for the determination of carbohydrates and the pellet I is added with 1 ml of an ether/chloroform (1/1, v/v). A second centrifugation at 5000 rpm for 10 min allows recovering the supernatant II which will be used for the determination of lipids.

1) Dosage of total carbohydrates

The determination of total carbohydrates was carried out according to the method of [7]. It consists The determination of total carbohydrates was carried out according to the method of [7]. It consists add 0.5 ml of sample and 4.5 ml of anthrone reagent and heat the mixture to 80˚C for 10 min. A green color develops, the intensity of which is proportional to the amount of carbohydrates present in the sample. The absorbance is read at 620 nm against a white range. The preparation of the anthrone reagent is as follows: weigh 150 mg of anthrone, add 75 ml of concentrated sulfuric acid and 25 ml of distilled water. We obtain a clear green solution which is stored in the dark. The calibration range is carried

out from a stock glucose solution (0.1 mg/ml).

2) Determination of total lipids

Total lipids were determined according to the method of [8]. using vanillin as reagent. Lipids form hot with sulfuric acid in the presence of vanillin and ortho phosphoric acid, a pink complex. The dosage is done on doses 100 ÿl aliquots of lipid extracts or calibration range to which 1ml is added concentrated sulfuric acid (96%). The tubes are closed, shaken and placed for 10 minutes in a dry bath at 100˚C. After cooling for 5 minutes, take 200 ÿl of this mixture to which 2.5 ml of sulphosphovanillic reagent is added and stirred vigorously. After 30 minutes in the dark, the absorbance is read in a spectrophotometer at 530 nm against a white range. The reagent is prepared as follows: dissolve 0.19 g of vanillin in 27.5 ml of distilled water and add 97.5 ml of 85% ortho phosphoric acid. The stock lipid solution is prepared immediately from 2.5 mg of edible oil. (99% triglycerides) dissolved in 1 ml of ether/chloroform, 1/1; V/V).

3) Total protein assay

The extraction of soluble proteins is carried out using a technique adapted from that described by [9]. 5 g of the plant sample is finely ground, then homogenized for 50 minutes in 50 ml of buffer comprising: Tris-HCl 20 mM pH 7.5; 5 mM $MgCl_2$; 50 mM KCl and 0.16% ascorbic acid. The Tris-HCl buffer at this molarity and at this pH makes it possible to combat the acidity of the vacuolar juice, Ascorbate makes it possible to prevent the oxidation of phenols to quinones; the latter causing the inactivation of proteins [10] and the manganese and potassium ions serving as cofactors reinforcing the activity protein [9]. After stirring, the mixture is centrifuged using of a HETTICH EBA 85 centrifuge at 8000 rpm for 15 minutes. The nerve is eliminated and the supernatant will be used for the determination of soluble proteins. Soluble proteins are measured according to the method of Bradford (1976). The reaction environment consists of 5 mg of Coomassie brilliant blue G 250, 50 ml of 95% ethanol, 100 ml of 85% ortho phosphoric acid, made up to 1 liter with distilled water The color reaction is started by adding to 2 ml of Bradford solution, 0.1 ml of extract protein or 0.1 ml of bovine serum albumin (BSA) solution for the standard range.

The reading is taken at 595 nm after 5 minutes using the spectrophotometer. The results are expressed in milligrams per gram of fresh material.

2.4. Data Analysis Methods

SPSS software (Statistical Package for Social Sciences), version 22.0 was used to analyze the collected data. The average concentrations were first compared using the 1-factor Anova test. Then, when the differences were detected, the comparisons were made two by two according to the Bonferroni test at the risk threshold of 5%.

3. Results

This study revealed variability between the epicarp, the mesocarp and the seed of

the fruit at taste maturity based on the analysis of biochemical characteristics.

3.1. Total Carbohydrate Content in the Three Compartments of the Fruit at Taste Maturity

The total sugar content in the epicarp, mesocarp and seed of *Dacryodes edulis* fruit at taste maturity is presented in Figure 3. A variation in the sugar content emerges totals in the three compartments of the fruit at taste maturity.

The results of the statistical analyzes revealed that the total sugar content in the epicarp, the mesocarp and the seed varied significantly (p-value = 0.001). Therefore, 2 groups of homogeneous (a and b) total sugar contents in the three compartments of the fruit can be rated according to the Bonferroni test. This is group a, represented by the carbohydrate content in the mesocarp and in the seed, which was characterized by high contents with respectively 252.67 ± 1.528 mg/g of DM and 251.33 ± 1.15 mg/g of DM. Group b, formed by the carbohydrate content in the epicarp, was marked by a low content (245 ± 1 mg/g of DM) (Table 1).

3.2. Total Lipid Content in the Three Compartments of the Fruit at Taste Maturity

The enrichment of the epicarp, mesocarp and seed of the fruit of *Dacryodes edulis* in total lipids (expressed in mg/g of dry matter) is quite marked in the

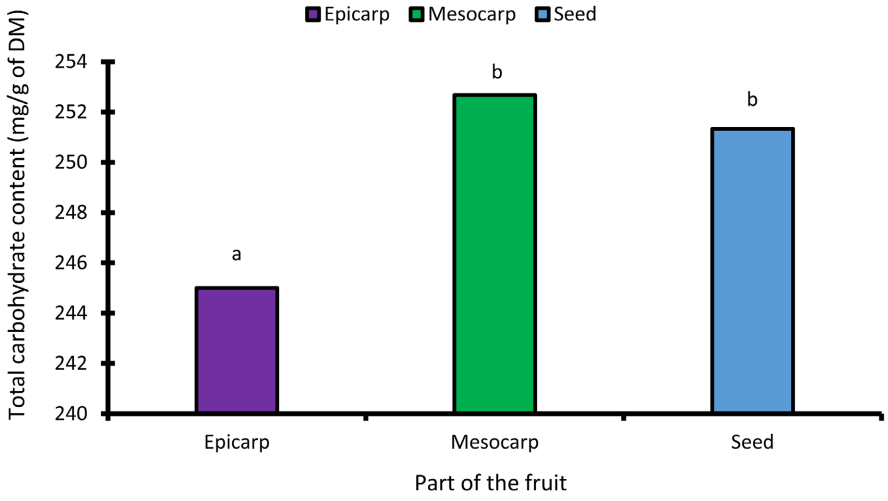

Figure 3. Variation of carbohydrate content in the three compartments of *Dacryodes edulis* fruit at taste maturity.

Table 1. Variation in the carbohydrate content in the three compartments of the fruit at taste maturity according to the 1-factor Anova test.

Compartments	Total carbohydrate content (mg/g of DM)
Epicarp	245 ± 1^{b}
Mesocarpe	252.67 ± 1.528^{a}
Seed	251.33 ± 1.15^{a}

three compartments and this enrichment is more important in the seed. This content increases gradually into the epicarp, mesocarp and seed (Figure 4).

The results of the Anova test show that the total lipid content in the epicarp, the mesocarp and the seed of the fruit of *Dacryodes edulis* increases highly significantly ($p = 0.000$). Therefore, the highest content was observed in the seed and followed in the mesocarp with respectively 9.92 ± 0.201 mg/g DM and 6.23 ± 0.10 mg/g DM. And the weak content was marked in the epicarp with 4.77 ± 0.047 mg/g of DM (Table 2).

3.3. Soluble Protein Content in the Three Compartments of the Fruit at Taste Maturity

The results in Figure 5 show the richness of safoutier fruit in soluble proteins. The Soluble protein contents in the epicarp, mesocarp and in the seed vary.

Comparative analysis of soluble protein contents in 3 compartments of the fruit of *Dacryodes edulis* at taste maturity reveal 3 homogeneous groups (a, b and c) of average soluble protein contents can be noted according to the Student-Newman-Keulsa test. This is group a, represented by the content of soluble proteins in the seed, which has been characterized by a high content with 55.07 mg/g DM. Group b, formed by the soluble protein content in the epicarp, was marked by an average content of 37.27 mg/g DM. Group c, made up by the content of soluble proteins in the mesocarp, was marked by a low content of

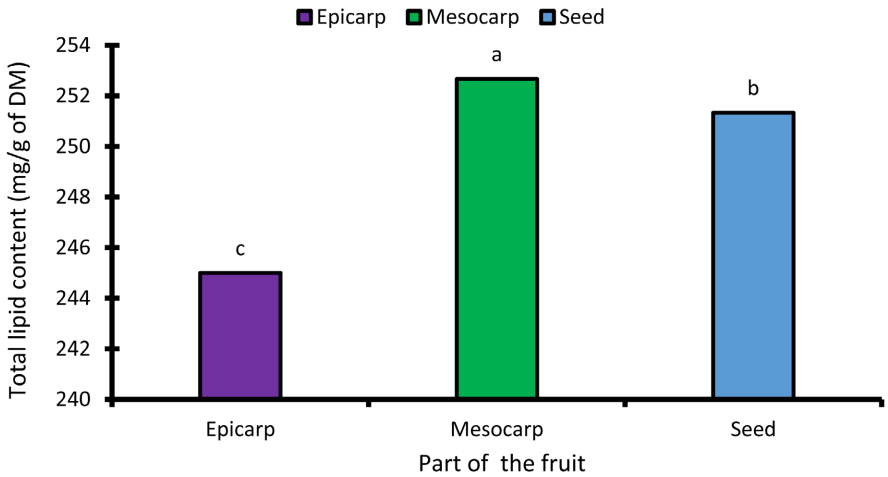

Figure 4. Variation of lipid content in the three compartments of *Dacryodes edulis* fruit at taste maturity.

Table 2. Variation in the lipid content in the three compartments of the fruit at taste maturity according to the 1-factor Anova test

Compartiments	Total lipid content (mg/g of DM)
Epicarp	4.77 ± 0.047^{c}
Mesocarpe	6.23 ± 0.10^{b}
Seed	9.92 ± 0.201^{a}

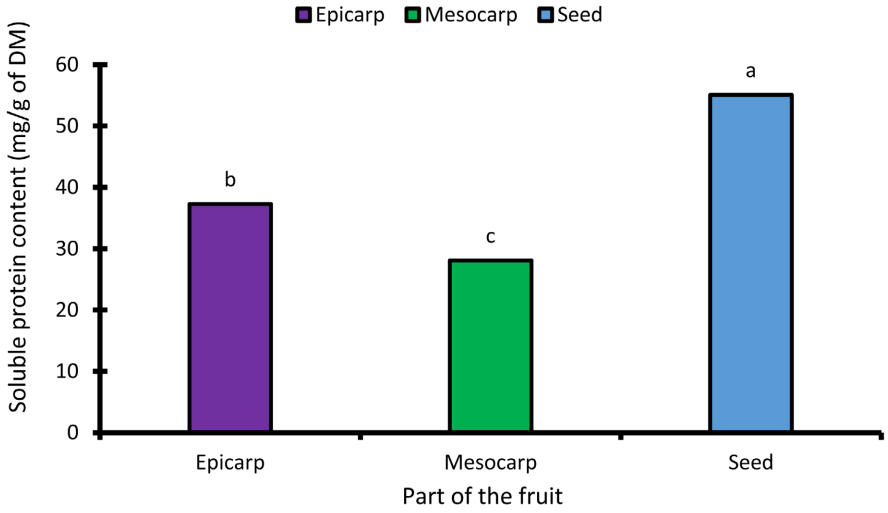

Figure 5. Variation in the soluble protein content in the three compartments of *Dacryodes edulis* fruit at taste maturity.

Table 3. Variation in the soluble protein content in the three compartments of the fruit taste maturity according to the 1-factor Anova test.

Compartments	Soluble protein content in mg/g DM
Epicarp	37.275 ± 1.023^{b}
Mesocarp	28.075 ± 3.231^{c}
Seed	55.075 ± 0.024^{a}

soluble proteins with 28.07 mg/g DM(**Table 3**).

4. Discussion

Quantitative determination by UV-visible spectrophotometer of the fruit of *Dacryodes edulis* at maturity taste revealed the presence of total carbohydrates, total lipids and soluble proteins in the epicarp, mesocarp and seed of *Dacryodes edulis* fruit at taste maturity. The total carbohydrate, total lipid and soluble protein contents vary significantly in the epicarp, the mesocarp and the seed at the taste maturity of the fruit. [4] have also reported the presence of these compounds in this same fruit. In the epicarp, mesocarp and seed, the contents of total carbohydrates, total lipids and soluble proteins vary significantly in all three parts of the fruit at maturity. Total carbohydrates, total lipids and soluble proteins accumulate much more in the seed than in the mesocarp and the epicarp. Our results are in agreement with those reported by [7] who studied the variations of secondary metabolites of *D. edulis* fruit. This accumulation can therefore be explained by the fact that the seed is a storage part of the metabolites. The Soluble proteins accumulate less in the mesocarp than in the epicarp and the seed. This decline was also observed by [4]. It can therefore be explained by the fact that the mesocarp is a transitional part of the [8]. [4] showed that the total lipid contents of the pulp and almond cakes of safou are lower than that of

deoiled palm cake (14.71%). These same authors have shown that that of safou pulp cakes is higher than that of soybean meals (9.06%) and sunflower (8.21%). Also, the protein content of meal safou is much lower than that of soya (45%).

5. Conclusion

The fruit of *Dacryodes edulis* (G. Don) HJ Lam. contains carbohydrates, lipids and proteins. In this fruit of *Dacryodes edulis* (G. Don) HJ Lam at taste maturity, the contents total carbohydrates, total lipids and soluble proteins are higher in the seed than in the epicarp and mesocarp. Our work shows that the seed of this fruit can be present and used for nutritional needs.

Author Contributions

Attibayeba designed the research project and edited the manuscript. Etou Ossibi Grace Jokael executed this project and wrote the manuscript. Etou Ossibi Grace Jokael, Mbon Nguékou Chrichina and, Ongouya Mouekouba Dalcantara Liana manipulated in the laboratory. Mpika Joseph analyzed The obtained results.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Kengue, J. (1990) The Safoutier (*Dacryodes edilis* (G, DON) H. J, Lame) First Data on Morphology and Biology. Ph.D. Thesis, University of Yaoundé, Cameroon, 144 p.

[2] Kapseu, C., Mapongmetsem, P.M., Silou, T. and Roques, M. (1998) Physico-Chemical of *Dacryodes edulis* Fruits. *Tropicultura,* **17**, 37-42.

[3] Bourdeaut, J. (1971) The Sasoutier (*Pachylobus edulis). Fruits,* **26**, 663-666.

[4] Ano, A.A.R.R., N'dri Koffi, E., Adima, A.A., N'da, P.K. and Anin, L.A. (2018) Biochemical and Phytochemical Composition of Fafoutier Fruit Cakes (*Dacryodes edulis)* from Ivory Coast. *International Journal of Biological and Chemical Sciences,* **12**, 2535-2546. https://doi.org/10.4314/ijbcs.v12i6.6

[5] Sika, A.E., Kadji, B.R.L., Dje, K.M., Koné, F.T.M., *et al.,* (2019) Nutritional, Microbiological and Organoleptic Quality of Flours Made From Corn (*Zea mays)* and Safou (*Dacryodes edulis*) Produced in Côte d'Ivoire. *International Journal of Biological and Chemical Sciences,* **13**, 325-337. https://doi.org/10.4314/ijbcs.v13i1.26

[6] Shibko, S., Koivistoinen, P., Tratyneck, C., New hall, A. and Freidman, L. (1966) A Method for the Sequential Quantitative Separation and Glycogen from a Single Rat Liver Homogenate or from a Subcellular Fraction. *Analytical Biochemistry,* **19**, 415-428. https://doi.org/10.1016/0003-2697(67)90242-4

[7] Triki, T., Guasmi, F., Ben Ali, S., Ben Mohamed, M., Drine, S., Yahya, H., *et al.,* (2016) Studies of the Biochemical Variability of Five Chenopoduim Quinoa Cultivars. *Agriculture and Biotechnology,* **25**, 1161-1166.

[8] Goldsworthy, G.J., Mordue, W. and Guthkelch, J. (1972) Studies on Insect Adipokinetic

Hormones. *General and Comparative Endocrinology,* **18**, 545-551. https://doi.org/10.1016/0016-6480(72)90034-2

[9] Attibayéba. and Hartmann, C. (1992) Polygalacturonase Activity and Ripening in Pears (*Pyrus malus*, cv *Passe crassane*). *Fruits,* **40**, 665-668.

[10] Drouet, A. (1981) Ripening and Senescence of the Passe Crassane Pear: Some Aspects of Protein Metabolism. Ph.D. Thesis, University of Orléans, Orléans, 155 p.