Variation in total sugar and soluble protein contents during ripening of *Pancovia laurentii* fruit

Abstract

The fruits of *Pancovia laurentii* are rich in biologically active substances. On the other hand, the results indicate in total sugars and soluble proteins, and is of significant interest in nutrition. spectrophotometer. The overall analysis of the results of the present study shows that the, gives great interest in terms of validation. In this study we targeted sugars total and soluble proteins in the mesocarp and kernel of the fruit of *Pancovia laurentii* in during its maturation, were selected for its nutritional quality and its appreciation across the Gulf of Guinea area, which is very popular due to its small size, its texture and particular taste. The evaluation of total sugars and soluble proteins in the mesocarp and almond of the fruit during maturation was made from the dosages at spectrophotometer. The overall analysis of the results of the present study shows that the sugars and proteins accumulate more in the mesocarp of the fruit at veraison with respectively of 11.337 mg/g MS and 2397.420 mg/g MS. On the other hand, the results indicate low levels of total sugars and soluble proteins in the ripe fruit kernel taste with respective values of 5.718 mg/g MS and 914.916 mg/g MS. This variation could be linked to the nature of the compartment, more particularly to the storage location. This comparative study could lead to valuing the fruit of *Pancovia laurentii* for its richness in total sugars and soluble proteins, and is of significant interest in nutrition.

Keywords : *Pancovia laurentii*, mesocarp, almond, primary metabolites

1. INTRODUCTION

The Republic of Congo, more than half of whose national territory is covered by forest, known for its great diversity in very rich and diverse natural flora, almost unexplored and unexploited, which is a center of life for the populations. In tropical countries, a large number of fruits grow in the wild, and sometimes throughout the year, providing abundant, inexpensive or free food rich in virtues (Normand, 2002). This is the case of Pancovia laurentii which is a species native to tropical and subtropical Africa of the Sapindaceae family (Itoua Ingoba et al., 2024). This fruit contributes to the food security of the countries where it is present and it has enormous nutritional virtues (Itoua Ingoba et al., 2024). The fruit of *Pancovia laurentii*, given its very interesting nutritional composition, would thus find its place in the food, pharmaceutical and cosmetic industries (Itoua Ingoba et al., 2024). Indeed, the nutritional value of fruits is influenced by maturation, cultural and structural factors. However, most research has not been carried out in the field of physiology and biochemistry of *Pancovia laurentii* fruits. Maturation is a coordinated series of a set of physiological and biochemical processes that result from the synthesis and degradation of pigments, proteins and the conversion of starch into simple sugar, changes in firmness and texture that are linked to macromolecules, the production of volatile substances, increased fruit respiration and possibly their senescence (Speirs and Brady, 1991). Furthermore, firmness is the predominant factor in determining the organoleptic quality of fruits ; It therefore appears that controlling fruit maturity is of certain economic importance in the production of fruit juices. However, during maturation, fruits are exposed to certain changes that affect firmness, color, but also the characteristics of sugars, lipids and proteins (Benchabane, 2007). The accumulation of primary metabolites in this fruit during its maturation remains unknown. The storage of these compounds may be an indicator of the part of the fruit that has a significant nutritional value. For a scientific contribution to the valorization of this fruit, it would be important to know the variation in the total sugar and soluble protein contents of the mesocarp and almond of the fruit of *Pancovia laurentii*. The objective of this study is to valorize the fruit of *Pancovia laurentii*.

2. MATERIALS AND METHODS

2.1. Material

The fruits of Pancovia laurentii were collected at the Lesio Louna Gorilla Nature Reserve (RNGLL) in the Pool department during maturation, on an experimental tree. The fruits were authenticated as belonging to *Pancovia laurentii* (De Wild.) Gilg ex De (Sapindaceae) by a taxonomist from the Department of Biology, Section of Biology and Physiology of Plants, Faculty of Science and Technology, Marien Ngouabi University, Brazzaville, Congo. Harvested fruits were divided into 4 batches based on visual criteria to establish the different stages of maturity (Mpika et *al*., 2022). This is the pigmentation of the epicarp of the fruit. Thus, these 4 stages of maturity are :

- Stage 1. Physiological maturity (MPH) : the fruits are green ;
- Stage 2. Veraison (VER) : the fruits are light green ;
- Stage 3. Prematurity of taste (PMG) : the color of the fruit epicarp becomes light yellow ;
- Stage 4. Taste maturity (MAG) : the epicarp of the fruit becomes dark yellow.

These fruits are grouped in clusters (Figure. 1)

Figure 1 : Fruits of *Pancovia laurentii* at different stages of maturity: physiological maturity (a); veraison (b); taste prematurity (c); taste maturity (d)

2.2. Preparation of crude extracts

The fruits of Pancovia laurentii after harvesting at different stages were washed with water and then separated into two parts using the scalpel (the mesocarp and the endocarp). Each part was dried away from sunlight and at room temperature in the laboratory (25 ± 1°C) for 30 days. The powder has was used for the dosages of total sugars and soluble proteins.

2.3. Determination of total sugars

The dosage of total carbohydrates was carried out according to the method of (Triki et al., 2016). It consists of 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 quantity of carbohydrates present in the sample. The absorbance is read at 620 nm against a range blank. 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. A clear green solution is obtained which is stored in the dark. The calibration range is carried out from a glucose stock solution (0.1 mg/ml).

2.4. Determination of soluble proteins

2.4.1. Protein extraction

The extraction of soluble proteins was carried out using a technique adapted from that described by Attibayéba and Paulet (2004), 50 g of the plant sample was finely ground, then homogenized for 50 minutes in 500 mL of buffer comprising: 20 mM Tris-HCl pH 7.5; 5 mM MgCl2; KCl 50 mM and 0.16% ascorbic acid. After shaking, the mixture was centrifuged at 5000 rpm for 15 minutes. The pellet was discarded and the supernatant was used for the determination of soluble proteins.

2.4.2. Determination of soluble proteins

Soluble proteins were measured according to the method of Etou Ossibi et al., (2024). The medium the reaction mixture consisted of 100 mg of Coomassie brilliant blue G 250, 50 ml of 95% ethanol, 100 ml of 85 % orthophosphoric acid, made up to 1 liter with distilled water.

The color reaction was initiated by adding to 2 mL of Bradford solution ; 0.1 mL of extract protein or 0.1 mL of bovine blood albumin (BSA) solution for the standard range. The reading was made at 595 nm after 5 minutes using a SECOMAN S 205 spectrophotometer. The results are expressed in micrograms per gram of fresh material. To estimate the accuracy of results 8 independent extractions were carried out on 8 fruits at each stage of maturation.

2.5. Data analysis methods

SPSS (Statistical Package for Social Sciences) software, version 22.0 was used to analyze the collected data. The means of the concentrations were first compared according to the 1-way ANOVA test. Then, when differences were detected, comparisons were made according to the test Student-Newman. The significance level was set at $p < 0.05$.

3. RESULTS

3.1. Total sugar content

Total sugar content in mesocarp and kernel during ripening of *Pancovia laurentii* fruit is presented in Figure 2. This figure shows a variation in sugar content totals in both compartments of the fruit during ripening and this enrichment is more important at veraison in the mesocarp than in the almond. This content decreases progressively to reach low levels at the pre-taste maturity stage for the mesocarp and at maturity taste in the almond.

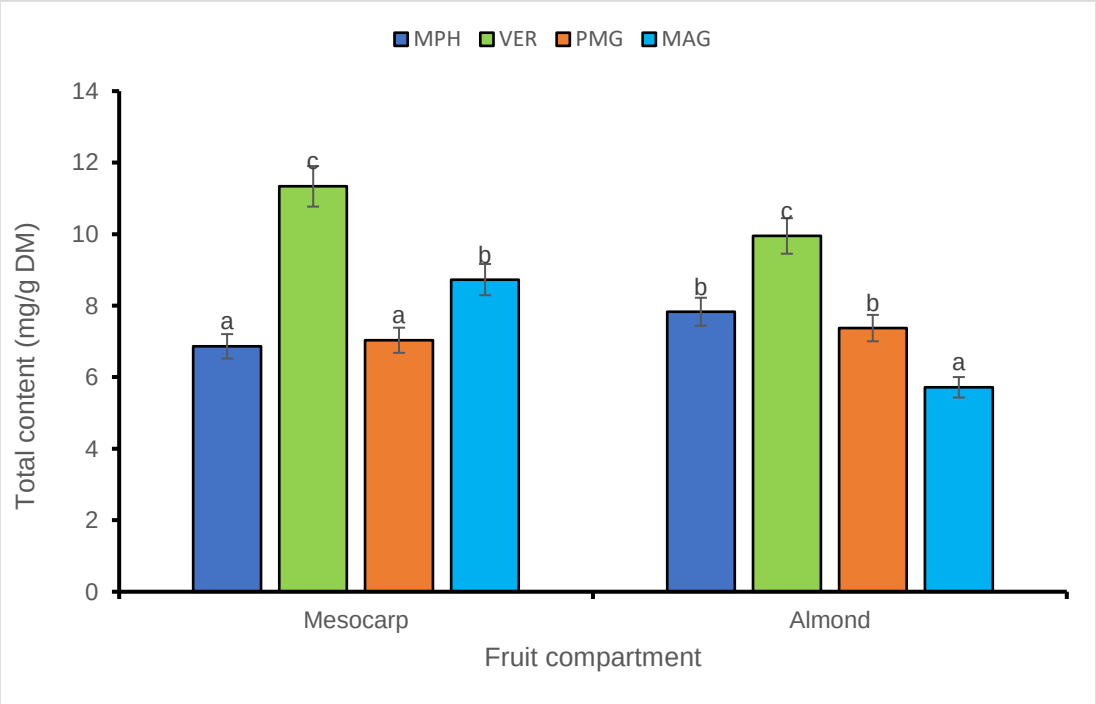

Figure 2. Variation of total sugar content in the mesocarp and kernel of *Pancovia laurentii* fruit during

At all stages of maturity, the variance analyses reveal a significant maturity stage effect at the 5% threshold according to the Student-Newman test and highlight the existence of three groups homogeneous (a, b and c) of the total sugar contents. In the mesocarp during the maturation of the fruit, the variance analyses highlight the existence of three homogeneous groups (a, b and c) total sugar contents. The high total sugar content of 11.3372 ± 1.451 mg/g DM was noted at veraison, followed by taste maturity with 8.729 ± 0.122 mg/g DM. These contents were significant at physiological maturity and pre-gustatory maturity with respectively 6.862 ± 0.381 mg/g DM and 7.033 ± 0.184 mg/g MS (Table 1). In almond, the increase was always noted total sugar contents at veraison, followed by physiological maturity and pre-taste maturity at these two stages, the total sugar content did not allow the maturity stage to be distinguished physiological and pre-taste maturity, and these contents are low at taste maturity with values respective 9.950 ± 0.435 mg/g DM ; 7.830 ± 0.203 mg/g DM ; 7.373 ± 0.324 mg/g DM and 5.718 ± 0.029 mg/g MS (Table 1).

Table 1 : Total sugar contents in the mesocarp and almond of *Pancovia laurentii* fruits during

	Maturity stage			
Compartment	**MPH**	**VER**	**PMG**	**MAG**
Mesocarp	6,862 [a]	11,3372 [c]	7,033 [a]	8,729 [b]
Almond	7,830 [b]	9,950 [c]	7,373 [b]	5,718 [a]

Legende : MPH : Physiological maturity; VER : Veraison ; PMG : Pregustatory maturity ; MAG : Maturity.
same letters are not significantly different at the 5% threshold according to the Student Newman test.

3.2. Soluble protein content

Enrichment of the mesocarp and endocarp of Pancovia laurentii fruit with soluble proteins (expressed in mg/g of dry matter) is quite marked during maturation in both compartments and this enrichment is more important in the mesocarp at veraison. This content gradually grows in the almond of the fruit to taste maturity (figure 3).

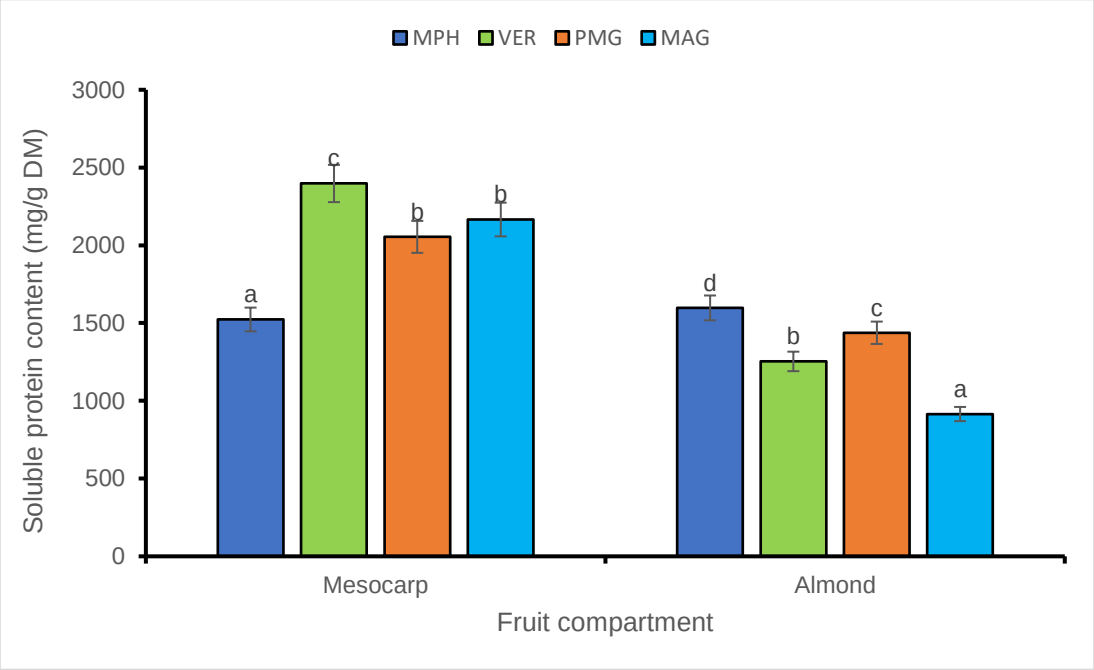

Figure 3. Variation of soluble protein content in the mesocarp and kernel of Pancovia laurentii fruit during

Comparative analysis of soluble protein contents in the fruit mesocarp of *Pancovia laurentii* during its maturation reveal three homogeneous groups (a, b and c) of average contents in soluble proteins, can be scored according to the Student-Newman test. This is group c represented by the soluble protein content at veraison, was characterized by a high content with 2397.416 mg/g DM. Group b, formed by the soluble protein content at the pre-maturity stages taste and taste maturity, was marked by respective average contents of 2054.083 mg/g DM and 2165.750 mg/g DM (Table 2). In almonds, high soluble protein contents were noted at physiological maturity (group d), followed by pre-taste maturity (group c) and at veraison (group b) with respectively 1597.416 mg/g MS ; 1437.416 mg/g DM and 1253.250 mg/g DM. The group stood out for the content of soluble proteins in the almond of the fruit at taste maturity, was marked by a low content with 914.916 mg/g MS (table 2).

Table 2 : Soluble protein contents in fruit mesocarp and almond of *Pancovia laurentii* during

	Maturity stage			
Compartment	MPH	VER	PMG	MAG
Mesocarp	1523,250 [a]	2397,416 [c]	2054,083 [b]	2165,750 [b]
Almond	1597,416 [d]	1253,250 [b]	1437,416 [c]	914,916 [a]

Legende : MPH : Physiological maturity; VER : Veraison ; PMG : Pregustatory maturity ; MAG : Maturity.
same letters are not significantly different at the 5% threshold according to the Student Newman test.

4. DISCUSSION

UV-visible spectrometry assay revealed variation in primary metabolite contents (total sugars and soluble proteins) in the mesocarp and kernel during the ripening of the fruit of Pancovia laurentii. They accumulate more in the mesocarp than in the kernel. In this sense, Etou Ossibi et *al*. (2024) report that total sugar and soluble protein contents vary in the epicarp, mesocarp and seed of the fruit of Dacryodes edulis. Etou Ossibi et *al*., (2023) showed also a variation of secondary metabolites in the mesocarp and seed of safou. These results are similar to those obtained by Benchabane et al. (2006). These authors showed that at during date development, the contents of primary metabolites vary to reach maximum contents at the veraison stage. The increase in total sugar and protein contents soluble at veraison may be due to the intense activity of invertase which degrades sucrose to provide simple sugars and protein synthesis. The decrease after veraison could also be explained by a strong presence of fibrillar structures in vesicles of the ripe fruit taste. These fibrillar structures (sugars and proteins) would constitute substrates to be digested by the pectolytic enzymes. Concerning the compartmental effect, our results clearly show that the contents of primary metabolites accumulate much more in the mesocarp (exocarp) than in almond. These results confirm on the one hand the presence of lignin in the almond would make this last hard and other by the sclerenchyma which forms the exocarp. Similar results have been obtained by Wolf et al. (2009). It should also be noted that the total sugar and protein contents solubles vary with structural changes in the fruit compartment. Furthermore, the contents in total sugars and soluble proteins decrease at taste prematurity and taste maturity in both compartments of the fruit (mesocarp and almond). Similar results were obtained by El-Zoghbi (1994) in dates. These results would confirm the degradation of sugars and proteins by softening enzymes. The action of these enzymes would facilitate and lead to the degradation primary metabolites thus leading to the softening of the fruit (Lacampagne, 2010). In this sense, It is suggested that sugars and proteins make up the membrane of fruits and play a role in rigidity. However, the work of Ketsa and Daengkanit (1999) shows that the softening of fruits requires the integrated action of pectolytic enzymes which will degrade the sugars at the wall level of the fruit. Similarly, it has been assumed that the dissolution of the middle lamella and the disintegration of the cell walls during ripening would be the cause of softening (Mbama Okadzé et *al*., 2024).

5. CONCLUSION

This study made it possible to determine the total sugar and protein contents during of the fruit of Pancovia laurentii. The analyses show a significant difference for the two parameters studied, in the fruit of Pancovia laurentii the contents of total sugars and proteins are higher in the mesocarp than in

the almond and vary depending on the stage of maturation fruits. The presence of total sugars and proteins in the fruit of Pancovia laurentii could justify its use for nutritional needs and supplement the daily intake of sugar and proteins. The protein content of the fruits of this plant would make this plant organ an important source of proteins.

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