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(Research Article)

Production and physicochemical, biochemical profile of cashew apple powder from Côte d'Ivoire

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Abstract

Côte d'Ivoire produces ten (10) times more cashew apples than the quantity of the nuts produced on a weight basis. Yet, this important production is often left to decay in the orchards. The objective of this study was to conduct a physiological and biochemical characterization of cashew apples that had fallen from the trees and were collected on the same day in order to find ways to valorize this waste material. The physicochemical and biochemical analyses were conducted on five (5) samples of cashew apple powder, including one (1) sample of 1 kg (2 x 0.5 kg) purchased on the market and four (4) samples (2 x 0.5 kg) produced in the laboratory. Results showed an acidic pH (4.10 to 4.81) and a low humidity (9.26 to 11.27%). The biochemical characterizations highlighted a marked antioxidant activity through high polyphenol (400 to 900 mg/kg) and flavonoid (160 to 640 mg/kg) contents. In addition, reducing sugars (5.60 to 7.38g/kg) and total sugars (13.32 to 18.67 g/kg) were dominant. These results suggest that cashew apple powder can be used as an ingredient in the formulation of infant or animal foods.

Keywords: Cashew Apple; Powder; Food; Côte d'Ivoire

1. Introduction

In developing countries, poverty, famine, and malnutrition remain alarming despite the ongoing efforts to address them [1], [2]. According to the Food and Agriculture Organization of the United Nations, the estimated number of undernourished people worldwide in 2022 was 735.1 millions [3]. Sub-Saharan Africa is particularly affected by this situation. In 2022, the region recorded a malnutrition rate of 22.5%, which is double the global average of 9.2% [4]. Unfortunately, Côte d'Ivoire is not exempt from these challenges, as 6 out of 19 surveyed regions were categorized as food insecure. Among these regions, Bélier, Grand-Pont, Béré, and Marahoué were classified as being in the pressure phase. This category of the population lived in an unstable financial situation; meaning, the population needed support during difficult times. In the regions of Iffou and N'zi, approximately 210,027 people were already in a food crisis. If nothing is done, the number of people in a situation of food insecurity will continue to grow in the coming years. However, Côte d'Ivoire has a wide range of fruits capable of playing a significant role in food security and fighting poverty [5], [6]. A good example is cashew apples, with over two-thirds of the production wasted in the orchards [7]. These apples can be sold or consumed fresh or processed, and they possess high nutritional value [3], [8], [9] and are known for their anti-carcinogenic, anti-tumor, and antioxidant properties [8], [10]. Unfortunately, apples are not valued due to limited knowledge of their nutritional properties, processing techniques, and benefits [7]. In this context, this

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study aims to provide a physiological and biochemical characterization of cashew apples that had fallen and were collected on the same day to promote their valorization.

2. Materials and methods

2.1. Plant material

Ripe cashew apples that had fallen from the tree were collected the same day during the 2023 and 2024 cashew nut campaigns in Yamoussoukro, Katiola, and Korhogo growers' orchards. The red and yellow apples were separated from their nuts and placed in barrels for transport to the factory laboratory of the School of Agronomy of Félix Houphouët-Boigny National Polytechnique Institute (INP-HB), Yamoussoukro, Côte d'Ivoire. Different phenotypes of apples were used for powder production in the laboratory. Additionally, a batch of powder was purchased on the local market.

2.2. Cashew apple flour production

After pressing the juice, the cakes recovered were dried under the sun on a black plastic tarpaulin and repeated for several days, from 9 a.m. to 5 p.m., until they became dry. The cake was then ground in a mixer (brand, address of the manufacturer) and sieved, and the flour obtained was packaged in plastic boxes for analysis.

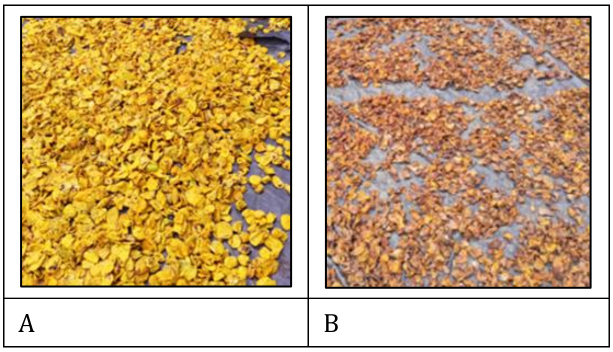

Figure 1 A) Fresh oil cake; B) Dry oil cake

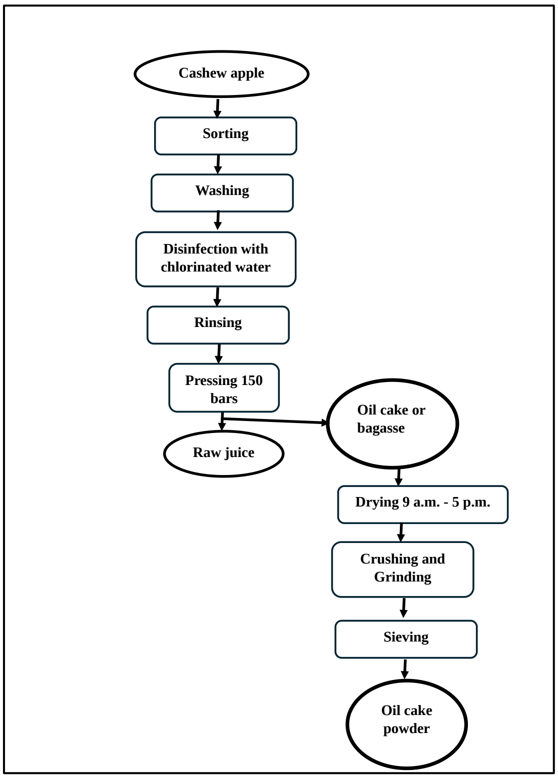

Figure 2 Flowchart of the experimental procedure for obtaining cashew apple powder

2.3. Sampling

Five samples of 1 kg (2 X 0.5 g) in total, including the batch purchased on the markets in Yamoussoukro and the four samples produced in the laboratory from cashew apples collected in Yamoussoukro, Katiola, Korhogo, were used to conduct this research.

a b

Figure 3 a) Cashew apple powder; b) Commercially purchased cashew apple

2.4. pH measurements of the juice

Ten grams of each solid sample were weighed, diluted in 90 mL of distilled water, stirred on a magnetic stirrer (manufacturer's name and address), and filtered on Whatman paper No. 4. A pH meter (manufacturer's name and address), calibrated using the buffer solutions pH = 4 and 7, was used. Its electrode was immersed in the filtrate for reading.

2.5. Determination of titratable acidity

Titratable acidity was determined from 10 mL filtrate of each sample using 0.1 N sodium hydroxide solution. The determination was carried out in the presence of phenolphthalein solution as a color indicator. The pink color of the solution ended the analysis[11].

2.6. Determination of dry matter content

The dry matter content of each sample was determined by the AOAC method [12]. Each porcelain crucible used was washed carefully and dried in an oven. The empty mass (m0) of the crucible was first recorded, and then 5 g of each cashew apple derivative was weighed. The crucible and sample (m1) were in an oven at 105°C for 24 h, after which the samples were removed from the oven and placed in a desiccator. The crucible and sample assembly was weighed in the oven (m2). The dry matter content was calculated using the following expression:

$$\text{Dry matter (\%)} = \frac{m_2 - m_0}{m_1 - m_0} \text{ X } 100$$

The moisture content of different cashew apple juices was determined using the following relationship:

$$\text{Humidity level (\%)} = \frac{m_1 - m_2}{m_1 - m_0} \text{ X } 100$$

m_0: mass of the crucible (g)
m_1: mass of crucible + sample before drying (g)
m_2: mass of crucible + sample after drying (g)

2.7. Determination of total polyphenols

The total polyphenol content of each sample of cashew apple by-products through the method described by[13] using Folin-ciocaleu. Thirty microliters of each sample were quantified using a micropipette and added to 2.5 mL of a 10% diluted Folin-Ciocalteu. The resulting mixture was placed in the dark in a cabinet at room temperature for 2 min and then 2 mL of sodium carbonate solution was added. The turn is incubated in a water bath for 15 min at 50 °C, then cooled to room temperature. Five milliliters of diluted Folin-Ciocalteu reagent were added to 4 mL of sodium solution (75g L-

[1]) and prepared under the same abovementioned conditions. Gallic acid was used as a standard, and an absorbance reading was carried out with a UV-visible spectrophotometer Jasco (V-530) at 760 nm.

2.8. Dosage of flavonoids

The method described by [14] was used for the determination of flavonoids in different by-products derived from cashew apples. Briefly, 2.5 mL of each sample was added to 0.75 mL of 5% sodium nitrite (NaNO2) in a 25 mL graduated flask. To this mixture, 0.75 mL of 10% (m/v) aluminum chloride (AlCl3) was added, and then it was incubated for 6 min in a dark room. After removal from the dark room, the volume of water was made up to the gauge mark after adding 5 mL of 1 N sodium hydroxide. The mixture was homogenized and allowed to stand before reading the absorbance using a spectrophotometer (Jasco V-530) at 510 nm.

2.9. Determination of total tannin

To 7.5 mL of distilled water contained in a test tube, 100 µl of each derivative was added, followed by an addition of 0.5 mL of Folin Ciocalteu reagent. The mixture is added with 1 mL of Ca2CO3 and then made up to 10 mL using distilled water. The solution is homogenized using a vortex and then left protected from light at room temperature for 30 min. The absorbance is read at 700 nm using a spectrophotometer. Distilled water was used as a blank [15].

2.10. Dosage of reducing sugars

The reducing sugar content was determined by the colorimetric method of [16]using 3,5-dinitro-salicyclic acid (DNS). Ten grams of each sample was weighed and then introduced into 90 mL of distilled water. The mixture was then homogenized using a magnetic stirrer and then filtered on Whatman No. 4 paper. 0.1 mL of the filtrate of the jam, flour, and cashew apple juice was introduced independently into a test tube and supplemented with 0.1 mL of DNS. The mixture was placed in a boiling water bath. 15 min later the samples were removed and supplemented with 10 of distilled water. The spectrophotometer reading was carried out against a blank at 540.

2.11. Determination of total sugars

For the determination of total sugars, 0.1 mL of each sample was introduced into a test tube using a micropipette with the addition of 0.9 mL of distilled water. To this mixture 1 mL of 5% (m/v) phenol and 5 mL of sulfuric acid. The absorbance was determined using a spectrophotometer against one prepared from a glucose concentration (1g.L-1) at 490nm [17].

2.12. Statistical analysis

All data from the various analyses were expressed as mean ± standard deviation using Excel 2019. One-way analysis of variance (ANOVA) was performed, and significant differences were determined by Duncan's test using the XLSAT software version 2016.

3. Results

3.1. Physicochemical characteristics of cashew apple powder

Physicochemical characteristics of cashew apple powder data from Yamoussoukro, Korhogo, and Katiola are shown in Table 1. All samples presented pH values ranging from 4.10 ± 0.01 to 4.81 ± 0.01, indicating their acidic character. In this context, the yellow cashew apple powder exhibited greater acidity, with a content of 4.10 ± 0.01. The commercially purchased powder has a pH similar to that of Korhogo. Also, the titratable acidity of the commercially purchased sample and samples from Katiola, Korhogo, and Yamoussoukro (red) showed no difference. In general, values were different between the tested powders, but they seemed to follow the same trend as the pH values. The highest titratable acidity was obtained in the red cashew apple powder sample from Yamoussoukro, while the lowest was detected in the yellow cashew apple powder. Results showed a high dry matter content, ranging from 88.73 ±0.10 to 90.74 ± 0.23 %, with the red cashew apple powder from Yamoussoukro recording the highest dry matter content. The humidity rate, inversely proportional to the dry matter obtained, followed the inverse distribution of the latter. Results also showed a low humidity rate, between 9.26 ±0.23 and 11.27 ± 0.10 %.

Table 1 Physicochemical characteristics of cashew apple powder

Samples	pH	Titrable acidity (%)	Dry matter (%)	Humidity (%)
PA	4.81 ± 0.01^{a}	0.54 ± 0.03^{a}	90.16 ± 0.53^{ab}	9.84 ± 0.53^{bc}
PKO	4.80 ± 0.01^{a}	0.53 ± 0.01^{a}	88.73 ± 0.10^{c}	11.27 ± 0.10^{a}
PKA	4.64 ± 0.02^{b}	0.51± 0.01^{a}	89.47 ± 0.29^{bc}	10.53 ± 0.29^{ab}
PJYA	4.10 ± 0.01^{d}	0.33± 0.06^{b}	89.75 ± 0.08^{b}	10.25 ± 0.08^{b}
PRYA	4.42 ± 0.01^{c}	0.53 ± 0.06^{a}	90.74 ± 0.23^{a}	9.26 ± 0.23^{c}

The values in the table represent means ± standard deviation of three trials for each parameter. Values sharing the same superscript letter are not statistically different at P > 0.05. PA: Commercially purchased cashew apple powder; PKO: Korhogo cashew apple powder; PKA: Katiola cashew apple powder; PJYA: Yellow cashew apple powder; PRYA: Red cashew apple powder.

3.2. Biochemical characteristics of cashew apple powder

Results of the biochemical composition of the cashew apple samples are presented in Table 2. The table reveals that the polyphenol contents of the different samples ranged from 400.00 ± 40.00 to 960.00 ±10.00 mg/L. The lowest polyphenol content was recorded in the red and yellow cashew apple samples from Yamoussoukro, which have respectively accumulated contents of 398.00±13,00mg/kg and 400.00±40.00mg/kg, respectively. In addition, these different samples show variability at the 5% threshold. As indicated in the table, the samples from Korhogo (900.00 ± 20.00mg/kg) and Katiola (960.00 ±10.00 mg/kg) contained more polyphenols, followed by the one purchased on the markets (596.67 ±11.55mg/kg). The flavonoid contents of commercially purchased powders (PA) and those from Korhogo and Katiola were not significantly different. Similarly, the red and yellow apples from Yamoussoukro were not different. However, the PA, PKA, and PKO presented a greater flavonoid content than the PJYA and PRYA samples. The Yamoussoukro samples were relatively low in flavonoids. The Korhogo and Yamoussoukro samples showed the highest total tannin contents of 878,867±3.31 and 868,233 ± 5.10 mg/kg of total tannins, respectively. while the lowest content was recorded in the samples from Yamoussoukro, with the red and yellow apple samples having 336,490 ±53.40 and 371,387±0.67 mg/kg of total tannins, respectively. Samples PYA, PRYA, PKA, and PKO are identical but different from sample PA. Reducing sugar contents varied from 5.60±0.30 to 7.60±0.03g/L, with the red cashew apple powder showing the lowest content. PKO, PA, and PJYA samples had similar values and did not present any variability, but they differed from samples PKA and PRYA. The total sugars of the powders of the different samples revealed the highest content in the PJYA sample from Yamoussoukro. In addition, PKA and PKO samples did not present any significant difference at the threshold of 5%.

Table 2 Biochemical characteristics of cashew apple powder

	Polyphenols (mg/kg)	Flavonoids (mg/kg)	Total tannins (mg/kg)	Reducing Sugars (g/kg)	Total sugars (g/kg)
PA	596.67± 11.55^{b}	640.000 ± 26.46^{a}	702.10 ± 4.91^{b}	7.38 ± 0.01^{a}	15.99 ± 0.14^{b}
PKO	900.00 ± 20.00^{a}	530.00 ± 10.00^{a}	878.87 ± 3.31^{a}	7.33 ± 0.2a	13.32 ± 0.33^{c}
PKA	960.00 ± 10.00^{a}	546.667 ± 64.29^{a}	868.23 ± 5.10^{a}	6.43 ± 0.01^{b}	13.57 ± 0.20c
PJYA	398.00 ± 13.00^{c}	160.000 ± 30.00^{b}	371.39 ± 0.67^{c}	7.60 ± 0.03^{a}	18.67 ± 0.12^{a}
PRYA	400.00 ± 40.00^{c}	200.000 ± 100.00^{b}	336.49 ± 53.40^{c}	5.60 ± 0.30^{c}	12.33 ± 0.12^{d}

The values in the table represent means ± standard deviation of three trials for each parameter. Values sharing the same superscript letter are not statistically different at P > 0.05. PPSL: Commercially purchased cashew apple powder; PKO: Korhogo cashew apple powder; PKA: Katiola cashew apple powder; PJYA: Yellow cashew apple powder; PRYA: Red cashew apple powder.

4. Discussion

The physiological characteristics of the cashew apple powder samples from Yamoussoukro, Katiola, Korhogo, and those purchased in stores suggest that cashew apple powder is an acidic food product. The acidity range reported in this study could provide great stability to the powder; meaning, the pH values could make it difficult for microorganisms to proliferate. The results obtained are close to those reported by [18]while studying the physicochemical and nutritional characterization of agricultural by-products, including cashew apple powder, mango peel, and shelled almond. These authors reported a pH of 5 for cashew apple powder. Also, the results of a study on the characterization of cashew apple powder in Nigeria are partly similar to our study. Additionally, [19]observed a similar pH range between 3.96 and 4.32, confirming the acidic nature of cashew apple powder. Likewise, an acidic pH (PH=3.9) was obtained in cashew apple residues subjected to drying in Brazil [20]. The acidic nature of the samples could be explained by the strong presence of certain organic acids (vitamin C and citric acid) contained in the raw juice of the cashew apple before extraction [21]. After extraction, the remaining organic acid is concentrated in the cake during drying, making the cashew apple powder acidic. The titratable acidity confirmed the acidic character of the samples analyzed from several locations. Similar observations were made by [22]. The variability between samples could be explained by the composition of the fruits which is influenced by agricultural practices used by different producers. Moreover, the locations of different fruits on the tree, the soil composition, the climate, the cultivar, and the light interception by the cashew trees could all influence the chemical composition of the cashew apple and that of the titratable acidity [23]. On the other hand, the acidity levels showed that the powders could be preserved without chemical preservatives and contributed to a light flavor [24]. Dry matter contents between 88.73 ±0.10 and 90.74 ±0.23%, reported in this study, are smaller than those reported by [25]when evaluating flours from three different varieties of purple corn in Côte d'Ivoire. Previous research on cashew apple powder reported similar results (89.39%) [26]. This high content could be an advantage for the valorization of the cashew apple which can be used as a substitute for fodder or grass for feeding of ruminants [27], [28]. Several studies suggested that cashew apple could also be used in the formulation of infant flour, biscuits to face certain current challenges [29].Moisture contents were comparable to the values reported by [19]for different formulations with apple powder in Togo. The observed values in the present study are relatively lower than those recommended by the Codex Alimentarius set at 15%, meaning the samples evaluated in this study could be well preserved as their low humidity levels would make it difficult for microorganisms to proliferate. Such humidity levels would slow down enzymatic activities and the deterioration of the product. Low humidity levels were previously reported in corn flour in Brazil and Côte d'Ivoire [20], [25]. This difference could be attributed to temperature, the drying medium, or climatic conditions. Polyphenols are from secondary metabolites of plants, particularly in vegetables, fruits, and spices. They are known for their antimicrobial, antimutagenic, antiallergic, anti-inflammatory, and antioxidant properties. These compounds play an active role in protecting human health. Moreover, polyphenols play a role in the nutritional and sensory quality of fruits, particularly that of the cashew apple. The levels observed during this study are lower than those that [10]reported (2012). In their study on the determination of bioactive compounds of non-traditional tropical fruits in Brazil, [30]reported a value of 8300 mg/kg of polyphenols, which is higher than the contents reported in the present study. Differences in total polyphenols in cashew powder samples reported in the literature could be due to the methods used for quantification [31]. Flavonoids are subclasses of polyphenols sharing a common structure, composed of two aromatic rings found in fruits, especially in the cashew apple. Like polyphenols, flavonoids are natural antioxidants capable of preventing the oxidation of several types of molecules (lipoproteins, nucleic acids, and free radicals) in the human body, improving our health [32]. In the present work, the flavonoid contents were lower than those [25]reported in corn (1791.6 mg to 1909.5 mg/kg). Previous research demonstrated that the injection of cashew apple powder's aqueous extract could play an important role in pharmacology through its flavonoid content [33]. This hypothesis opens the way to the formulation of food products based on cashew apples alone or in combination to ensure the proper functioning of the body. Alongside polyphenols and flavonoids are tannins, all secondary metabolites secreted by the plant. Unlike the first two, tannins are sometimes considered anti-nutrients because a high content of tannins in a food product makes it astringent. In addition, tannins are capable of reducing the bioavailability of certain nutrients during digestion after their consumption. The level of tannins in this study was similar to those obtained by[28], with a value of 845.6 mg/kg in cashew apple powder. These results indicate that cashew apple after juice extraction and cake drying can be used alone or in combination in animal or human nutrition. This statement is supported by[28], who indicated that at a content lower than 2600 mg/kg, tannins no longer influence the digestibility of energy and proteins. However, a study on the dehydration of cashew apple slices from different media showed concentrations of 2679.5 mg/kg and 2665 mg/kg, respectively, for hot and solar dryers in Tanzania [34]. This variability would be linked to the agroecological conditions of the regions. Tannin concentrations obtained in this study can be reduced by mixing cashew apple powders with spices and sugar [35]. Reducing sugars are a portion of total sugars that can reduce other chemicals through a group of free aldehydes or ketones. The reducing sugar contents of this study corroborate those obtained in the optimization of aqueous extraction of reducing sugars from cashew apple bagasse (cake powder) in India [36]. Similar trends were reported in mango peel and four varieties of mango flour grown and processed in the northern part of Côte d'Ivoire. These authors reported reducing sugar contents from 7.26 to 8.7 g/kg [37]. In contrast, in Brazil [38]and [31]reported higher reducing sugar contents of 36 g/kg and 13.32 g/kg in cashew powder, respectively. Differences in concentrations could be explained by the assay method and soil composition. The total sugars in cashew apple powder or bagasse are composed mainly of fructose and glucose [39]. In this study, although the concentration of total sugars is high, it remains relatively low compared to fresh cashew apples, as reported by several studies, including those of [40], [41]in Côte d'Ivoire. Our results are within the range (1.7 to 28.9 mg/kg) obtained in India when making the characterization of cashew apple marc [42]. Natural total sugars in powder can play a vital role in providing quick energy, enhancing the powder's flavor, and acting as a preservative.

5. Conclusion

This study aimed to characterize the physicochemical and biochemical properties of cashew apple powder. Results highlight the acidic character and the low humidity of the different samples of cashew apple powder. It should be noted that cashew apple powders are rich in polyphenols and flavonoids, which play a key role in preventing metabolic diseases and correcting nutritional deficiencies. They also contain natural sugars capable of covering human and animal calorific needs. These characteristics suggest that cashew apple powder purchased commercially or produced locally can be used as an ingredient in the formulation of infant or animal foods in the quest for the valorization of cashew apple.

Compliance with ethical standards

Disclosure of conflict of interest

Authors have declared that no competing interests exist.

References

[1] A. M. Abdullahi, R. B. Kalengyo, et A. A. Warsame, « The unmet demand of food security in East Africa: review of the triple challenges of climate change, economic crises, and conflicts », *Discov. Sustain.*, vol. 5, nº 1, p. 244, sept. 2024, doi: 10.1007/s43621-024-00381-5.

[2] J. Hickel, « The true extent of global poverty and hunger: questioning the good news narrative of the Millennium Development Goals », *Third World Q.*, mai 2016, Consulté le: 16 janvier 2025. [En ligne]. Disponible sur: https://www.tandfonline.com/doi/abs/10.1080/01436597.2015.1109439

[3] M. R. M. de Oliveira, « Hunger, undernutrition, and other forms of malnutrition from the perspective of achieving human rights: A critical essay », *Rev. Nutr.*, vol. 37, p. e230118, nov. 2024, doi: https://doi.org/10.1590/1678-9865202437e230118.

[4] C. Ding, K. A. Khan, H. K. K. AbdulKareem, S. Kumar, L. M. Minani, et S. Abbas, « Towards a healthier future for the achievement of SDGs: unveiling the effects of agricultural financing, energy poverty, human capital, and corruption on malnutrition », *Humanit. Soc. Sci. Commun.*, vol. 11, nº 1, p. 1-12, sept. 2024, doi: 10.1057/s41599-024-03628-8.

[5] C. Ackello-Ogutu, V. Okoruwa, et G. N. Bahal, « Long Term Challenges to Food Security and Rural Livelihood in Sub-Sahara Africa ».

[6] S. Shaheen, M. Ahmad, et N. Haroon, « Food Security: A Global Problem », in *Edible Wild Plants: An alternative approach to food security*, S. Shaheen, M. Ahmad, et N. Haroon, Éd., Cham: Springer International Publishing, 2017, p. 1-39. doi: 10.1007/978-3-319-63037-3_1.

[7] D. N'guessan *et al.*, « Waste Cashew Apple (Anacardium occidentale) as Feedstock for Simultaneous Production of Two Main Ecofriendly Fuels », *J. Power Energy Eng.*, vol. 11, nº 8, Art. nº 8, août 2023, doi: 10.4236/jpee.2023.118002.

[8] L. J. Cruz Reina *et al.*, « Chemical composition and bioactive compounds of cashew (Anacardium occidentale) apple juice and bagasse from Colombian varieties », *Heliyon*, vol. 8, nº 5, p. e09528, mai 2022, doi: 10.1016/j.heliyon.2022.e09528.

[9] N. N. Oliveira, C. G. Mothé, M. G. Mothé, et L. G. De Oliveira, « Cashew nut and cashew apple: a scientific and technological monitoring worldwide review », *J. Food Sci. Technol.*, vol. 57, nº 1, p. 12-21, janv. 2020, doi: 10.1007/s13197-019-04051-7.

[10] D. Soro, « Couplage de procédés membranaires pour la clarification et la concentration du jus de pomme de cajou : performances et impacts sur la qualité des produits. », *Inst. Régions Chaudes Montp. Supagro*, p. 136 p., 2012.

[11] P. Cunniff, *Official methods of analysis of AOAC international*, 16th ed. Washington, DC: Association of Official Analytical Chemists, 1995.

[12] H. Kenneth, *Official Method of Analysis of the Association of official analytical chemists*, Fifteenth Edition., vol. Volume 1. Virginia 22201 USA, 1990.

[13] J. E. Wood, S. T. Senthilmohan, et A. V. Peskin, « Antioxidant activity of procyanidin-containing plant extracts at different pHs », *Food Chem.*, vol. 77, nº 2, p. 155-161, 2002.

[14] D. Marinova, F. Ribarova, et M. Atanassova, « TOTAL PHENOLICS AND TOTAL FLAVONOIDS IN BULGARIAN FRUITS AND VEGETABLES », 2005.

[15] K. C. Ci & Indira, « Quantitative estimation of total phenolic, flavonoids, tannin and chlorophyll content of leaves of Strobilanthes Kunthiana (Neelakurinji) », *J. Med. Plants Stud.*, 2016.

[16] P. Bernfeld, « [17] Amylases, α and β », *Methods Enzymol.*, vol. 1, p. 149-158, 1955, doi: 10.1016/0076-6879(55)01021-5.

[17] Michel. DuBois, K. A. Gilles, J. K. Hamilton, P. A. Rebers, et Fred. Smith, « Colorimetric Method for Determination of Sugars and Related Substances », *Anal. Chem.*, vol. 28, nº 3, p. 350-356, mars 1956, doi: 10.1021/ac60111a017.

[18] Monnou Sophie Guehi *et al.*, « Physicochemical and nutritional characterization of flours from cashew apple, Kent mango peelings and kernel almonds collected in Korhogo city (Northern Ivory Coast », *GSC Biol. Pharm. Sci.*, vol. 22, nº 1, p. 048-055, janv. 2023, doi: 10.30574/gscbps.2023.22.1.0502.

[19] X. Dansou, B. Ouadja, et G. Baba, « Production and Characterization of Cashew Apple Powder », *Asian J. Dairy Food Res.*, nº Of, mai 2023, doi: 10.18805/ajdfr.DRF-316.

[20] J. M. C. D. Costa, É. M. D. F. Felipe, G. A. Maia, F. F. F. Hernandez, et I. M. Brasil, « Production and Characterization of the Cashew Apple (anacardium Occidentale L.) and Guava (psidium Guajava L.) Fruit Powders », *J. Food Process. Preserv.*, vol. 33, nº s1, p. 299-312, 2009, doi: 10.1111/j.1745-4549.2008.00342.x.

[21] G. O. Babarinde, F. O. Afolabi, G. B. Balogun, et Z. Lawal, « Quality Characteristics of Cashew Apple Juice as Affected by Pre-Treatment Techniques », *J. Food Agric.*, vol. 16, nº 2, p. 1-18, déc. 2023, doi: 10.4038/jfa.v16i2.5287.

[22] T. Abdoulaye, Z. A. Fabrice, T. Naka, S. Fatou, S. Y. Réné, et C. Adama, « Phytochemical and nutritive properties of by-products flours from cashew (Anacardium occidentale) and mango (Mangifera indica) for ruminants feeding in Poro region (Northern Côte d'Ivoire) », vol. 2, 2020.

[23] T. M. Gadelha *et al.*, « Comprehensive analysis of quality and bioactive compounds in umbu-cajá fruit during different ripening stages », *Sci. Hortic.*, vol. 327, p. 112886, mars 2024, doi: 10.1016/j.scienta.2024.112886.

[24] H.-D. Belitz, W. Grosch, et P. Schieberle, Éd., « Food Additives », in *Food Chemistry*, Berlin, Heidelberg: Springer, 2009, p. 429-466. doi: 10.1007/978-3-540-69934-7_9.

[25] F. A. Akaffou, D. M. Koffi, M. Cisse, et S. L. Niamké, « Physicochemical and Functional Properties of Flours from Three Purple Maize Varieties Named "Violet de Katiola" in Côte d'Ivoire », *Asian Food Sci. J.*, vol. 4, nº 4, Art. nº 4, sept. 2018, doi: 10.9734/AFSJ/2018/44034.

[26] T. Abdoulaye, Z. A. Fabrice, T. Naka, S. Fatou, et S. Y. René, « Propriétés phytochimiques et nutritives des sous-produits des farines de noix de cajou (Anacardium occidental) et mangue (Mangifera indica) pour l'alimentation des ruminants dans la région du Poro (Nord de la Côte d'Ivoire) », vol. 2, 2020.

[27] A. B. Aboh, J. T. Dougnon, G. S. T. Atchade, et A. M. Tandjiekpon, « Effet d'aliments à base de pomme cajou sur les performances pondérale et la carcasse des canetons en croissance au Bénin », *Int. J. Biol. Chem. Sci.*, vol. 5, nº 6, Art. nº 6, 2011, doi: 10.4314/ijbcs.v5i6.20.

[28] B. Rokiatou, T. Naka, et K. F. M. Thierry, « Caractéristiques biochimiques de quelques sous- produits agricoles de Côte d'Ivoire en vue d'une valorisation en alimentation de volaille », 2023.

[29] M. O. Adegunwa, B. I. Kayode, R. M. O. Kayode, S. A. Akeem, A. A. Adebowale, et H. A. Bakare, « Characterization of wheat flour enriched with cashew apple (Anacardium occidentale L.) fiber for cake production », *J. Food Meas. Charact.*, vol. 14, nº 4, p. 1998-2009, août 2020, doi: 10.1007/s11694-020-00446-9.

[30] M. do S. M. Rufino, R. E. Alves, E. S. de Brito, J. Pérez-Jiménez, F. Saura-Calixto, et J. Mancini-Filho, « Bioactive compounds and antioxidant capacities of 18 non-traditional tropical fruits from Brazil », *Food Chem.*, vol. 121, nº 4, p. 996-1002, août 2010, doi: 10.1016/j.foodchem.2010.01.037.

[31] R. A. M. de S. Andrade, M. I. S. Maciel, A. M. P. Santos, et E. de A. Melo, « Optimization of the extraction process of polyphenols from cashew apple agro-industrial residues », *Food Sci. Technol.*, vol. 35, p. 354-360, juin 2015, doi: https://doi.org/10.1590/1678-457X.6585.

[32] R. Antoni, R. M. Soniah, V. F. Rangita, et R. Razafimahefa, « Physicochemical, nutritional and functional properties, rate of polyphenols and flavonoids of the Stenochlaena tenuifolia (BLECHNACEAE) leaves », *Int. J. Sci. Adv.*, vol. 2, nº 2, avr. 2021, doi: 10.51542/ijscia.v2i2.5.

[33] M. Dosso, A. E. Koffi, D. Soro, A. Traore, et N. Diarrassouba, « Activités analgésique, antiinflammatoire et antipyrétique d'un extrait aqueux des tourteaux de la pomme de cajou (Anacardium occidentale L.): Analgesic, anti-inflammatory and antipyretic activities of an aqueous extract of cashew apple cake (Anacardium occidentale L.) », *Int. J. Biol. Chem. Sci.*, vol. 15, nº 5, p. 1842-1852, janv. 2022, doi: 10.4314/ijbcs.v15i5.12.

[34] N. Dimoso, E. Makule, et N. Kassim, « Quality Assessment of Formulated Osmotically Dehydrated Cashew Apple (Anacardium occidentale L.) Slices Dried using Hot air and Solar Driers », 2020.

[35] P. Preethi, M. Shamsudheen, S. V. R. Reddy, G. L. Veena, P. Kalal, et R. Pandiselvam, « Biochemical quality comparison of forced air dried osmo-dehydrated cashew apple products infused with spice mixture and sugar », *J. Hortic. Sci.*, vol. 18, nº 2, Art. nº 2, déc. 2023, doi: 10.24154/jhs.v18i2.2015.

[36] A. Kuila, A. Singh, M. Mukhopadhyay, et R. Banerjee, « Process optimization for aqueous extraction of reducing sugar from cashew apple bagasse: A potential, low cost substrate », *LWT - Food Sci. Technol.*, vol. 44, nº 1, p. 62-66, janv. 2011, doi: 10.1016/j.lwt.2010.06.005.

[37] M. Diomande *et al.*, « Mango Peel and Almond Flour (Mangifera indica var Amelie,Kent, Keitt, Brooks) harvested, Processed in North of Cote d'Ivoire: Biochemical Parameters and Mineral Content », *Asian Food Sci. J.*, p. 1-9, mai 2021, doi: 10.9734/afsj/2021/v20i630304.

[38] S. D. O. Sancho *et al.*, « Characterization of the Industrial Residues of Seven Fruits and Prospection of Their Potential Application as Food Supplements », *J. Chem.*, vol. 2015, p. 1-8, 2015, doi: 10.1155/2015/264284.

[39] E. D. Deenanath, K. Rumbold, M. Daramola, R. Falcon, et S. Iyuke, « Evaluation of Physicochemical Properties of South African Cashew Apple Juice as a Biofuel Feedstock », *Scientifica*, vol. 2015, p. 1-9, 2015, doi: 10.1155/2015/764196.

[40] M. Adou, Y. D. Adjouman, K. O. Kouadio, A. F. Tetchi, et N. G. Amani, « Improvement of Cashew Apple Juice (<i>Anacardium occidentale</i> L.) by Association with Passion Fruit Juice (<i>Passiflora edulis</i>) », *Food Nutr. Sci.*, vol. 12, nº 07, p. 787-804, 2021, doi: 10.4236/fns.2021.127059.

[41] L. B. C. Sahie, D. Soro, I. Cissé, E. N. Assidjo, et B. K. Yao, « Impact of Cultivation Areas and Analysis Site on the Nutritional Quality of Cashew Apples (Anacardium Occidentale L.) Grown in Côte d'Ivoire », vol. 43, nº 1, 2024.

[42] K. V. Nagaraja, S. Bhuvaneshwari, et K. R. M. Swamy, « Biochemical characterization of cashew ("Anacardium occidentale" L.) apple juice and pomace in India », *Plant Genet. Resour. Newsl. Bull. Ressour. Phytogénétiques Not. Recur. Fitogenéticos*, nº 149, p. 9-13, 2007.