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Effects of Drying Temperature on the Physicochemical Characteristics and Functional Properties of Papaya Seeds (*Carica papaya L.*)

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Abstract **- This study was conducted with the aim of valorising papaya seeds. To do this, papayas were purchased in order to extract the seeds, then these seeds were dried at different temperatures (50°C/72h; 75°C/48h and 105°C/24h) in the oven. The dried seeds were ground with a mixer to obtain a flour. The effect of temperature on the physicochemical and functional characteristics of this flour was determined. The results of the physicochemical parameters showed that the 50°C dried seeds had the best pH (67.6), fat (5%), protein (32%) and fibre (17.9%). On the other hand, the 100°C temperature recorded parameters such as dry matter (92.17%), carbohydrates (41.12%) and energy value (334.48Kcal). The best ash content was recorded at 75°C (7.80%). On the other hand, no significant difference was recorded for these three temperatures on the functional properties of the papaya seeds. Given the good physicochemical and functional characteristics of papaya seeds we can say that these seeds could be recommended to people suffering from obesity and digestive disorders.**

Keywords: Papaya, seeds, physicochemical, functional properties, temperature, drying.

I. INTRODUCTION

Papaya, from the Caricaceae family, is a tropical tree plant; native to Central and South America [1] , [2]. In 2012, the world production of papaya was around 12.4 million tonnes [3]. Mexico is the leading exporting country in the world with 74,000 tonnes per year, followed by Malaysia with 54,000 tonnes per year. Côte d'Ivoire is the 5th largest African producer after Ghana. It exports 1163 tonnes annually to the European Union [4]. In Côte d'Ivoire, the main cultivation area is in the south, more precisely in the Azaguié area, where former banana growers have now converted to papaya production [4].

Papaya is a well-known agricultural commodity in several African countries and worldwide. The pulp (flesh) of the papaya has a delicate and sweet aroma [5]. Papaya is an ingredient in many cuisines around the world. Thai and Vietnamese people use the unripe fruit as a vegetable in cooking [6]. Papaya has many qualities. Indeed, this fruit offers a wide range of consumer products. It is commonly used for dessert or processed into jam or drinks [7].

Emeruwa [8] demonstrated the pronounced efficacy of papaya fruit and seed extracts against the bacteria Staphylococcus aureus, Bacillus cereus, Escherichia coli, Pseudomonas aeruginosa, and Shigellaflexneri that cause many infections. The Dutch and Malays use leaf and young fruit extracts to eradicate intestinal worms and treat boils [9] . Traditional African medicine also uses papaya organs in its treatments. In Ghana, infusion of the dry leaves, administered as a purge, treats gastric disorders. The decoction of the same leaves is used for genitourinary problems in Côte d'Ivoire [9]. The processing of this fruit, as well as its direct consumption, results in large quantities of waste, such as the skin and seeds.

In contrast to the pulp, which is totally consumed, the seeds and pericarp are totally rejected, as they are of unknown interest to everyone.

With the exception of some farmers who use papaya pericarp for livestock feed, the seeds are part of the co-products whose technological applications and nutritional potential are still little known by the agri-food sector.

The objective of this work is therefore to valorise the by-products of papaya, more precisely the seeds of papaya in nutrition and food technology. Specifically, the aim is to (1) determine the effect of drying temperature on the physicochemical properties of papaya seeds; (2) determine the effect of Drying Temperature on the Functional Properties of Papaya Seeds.

II. MATERIALS AND METHODS

Biological Material

The biological material used in this study consists of pawpaw (*Carica papaya L.*) fruit seeds. These fruits come from the markets of the city of Daloa, in the Haut Sassandra region of Côte d'Ivoire (Figure 1).

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Figure 1: Papaya (*Carica papaya L.*) seeds

Methods

Sampling and production of pawpaw seed flour

The pawpaw fruits were purchased, at the mature stage, at the markets of the city of Daloa, in the Haut Sassandra region, Côte d'Ivoire. At the Laboratoired' Agro valorisation de l'UFR Agroforesterie, Université Jean Lorougnon Guédé, Daloa (Côte d'Ivoire), the seeds were extracted from the fruits and then placed in an oven at different temperatures (50° C for 72 hours, 75° C for 48 hours and 100° C for 24 hours). The dried seeds were crushed with a blender and then sieved with a sieve (300 µm). The flours obtained were each kept in a glass jar that had been previously washed and dried for the determination of physicochemical and functional parameters (Figure 2).

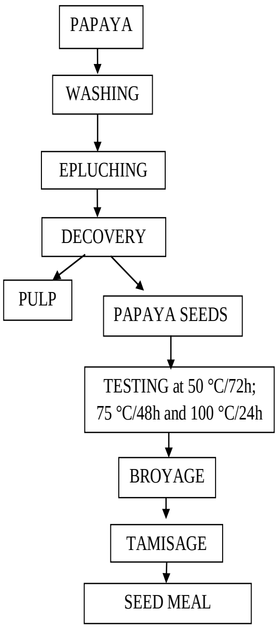

Figure 2: Manufacturing diagram of papaya seed flour

Determination of the physico-chemical properties of papaya seeds

The dry matter was determined by oven-drying the pawpaw seeds at 105°C for 24 hours [10]. The pH of the sample was measured with a digital pH meter (Consort PI07, Belgium). The titratable acidity was carried out by neutralising the total free acidity with a sodium hydroxide solution (NaOH 0.1 N). The ash content was determined after the destruction of the organic substance by incineration. The fibre content is determined according to the AOAC method [10]. The crude protein content is determined from the nitrogen content according to the Kjeldhall method. Lipids are extracted using the Soxhlet method [10].

Available carbohydrates

The available carbohydrate content was determined using the difference method described by FAO [11]. This content is obtained by the following mathematical formula:

Carbohydrate (% DM) = 100 - [% Protein+ % Fat + % Fibre + % Ash]

Energy value

The energy value was determined according to the difference method described by Atwater and Rosa [12]. This content is obtained by the following mathematical formula:

EV (Kcal/l00g DM) = 4 x (%) Protein + 9 x (%) Fat + 4 x (%) Carbohydrate

Determination of functional properties

Water absorption capacity of flour samples (WAC)

A quantity of one (1) gram of flour was weighed per sample and introduced into a centrifuge tube. Three (3) tests, for each type of flour, were performed. The tubes containing the flours were weighed and the masses noted (me). Then, ten (10) mL of water was added to each tube and the whole was shaken for 30 minutes. Finally, centrifugation was carried out for 25 minutes at 5000 rpm using a JOUAN centrifuge, (Serial No. 39707312, Ref. No. 11174301). The supernatant from each tube was poured out and the new masses noted (me'). The water absorption capacity for each sample is determined according to the following formula:

WAC = (ms' - ms) x 100 / ts

With ms: Mass of the tube containing the flour before centrifugation; ms': New mass of the tube containing the flour after centrifugation; ts: Test sample.

Oil absorption capacity of flour samples (OAC)

For each sample, a quantity of 0.5 g of flour is weighed and introduced into a centrifuge tube. Three (3) tests, for each

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type of flour, were carried out. The tubes containing the flours were weighed and the masses noted (me). Then, 6 mL of sunflower oil was added to each tube and the whole was shaken for 30 minutes. Finally, centrifugation was carried out for 25 minutes at 5000 rpm using a JOUAN centrifuge, (Serial No. 39707312, Ref. No. 11174301). The supernatant from each tube was poured off. The tubes are dried in an oven (at 50 °C) and the new masses are noted (me"). The oil absorption capacity for each sample is determined according to the formula:

$$OAC = (ms'' - ms) \times 100 / ts$$

With ms: Mass of the tube containing the flour before centrifugation; ms": New mass of the tube containing the flour after centrifugation and steaming; ts: Test sample.

Emulsifying activity (EA) and stability of emulsions (SE)

A quantity of one (1) gram of flour is weighed per sample and introduced into a centrifuge tube. Three (3) tests are performed for each type of flour. The tubes containing the flours were weighed and the masses were noted. Then, 3 mL of oil and 3 mL of water were added successively to each tube. For 30 minutes, the different tubes were shaken. Finally, centrifugation was carried out for 25 minutes at 5000 rpm using a JOUAN centrifuge, (Serial No. 39707312, Ref. No. 11174301). The tubes were removed and the heights (total height and water height) were measured and recorded. The emulsifying activity is calculated according to the following formula:

$$EA = (WH / TH) \times 100$$

With wh: Water height; th: Total height.

For the determination of emulsion stability, the centrifuge tubes were run in a boiling water bath at 100 °C for 30 minutes. At the end of this period, the tubes were removed and the new water heights were recorded (He'). The stability is calculated according to the following formula:

$$S\,E = (WH'/WH) \times 100$$

With He: water height; He': new water height.

Bulk density of flour samples (BD)

For each sample, a quantity of fifteen (15) grams of flour is weighed (m) and introduced into a graduated (plastic) test tube. The flour in each test tube is tamped and the volume is read (v). The bulk density is determined according to the following formula:

$$BD = m/v$$

With m: Mass (g) of the flour introduced into the test tube; v: Volume occupied (cm3) by the flour in the test tube.

Foaming power (FP) and stability of foam (SF)

A quantity of three (3) grams of flour is weighed per sample and placed in a beaker. Then 100 ml of water is added and the whole is shaken for a few minutes. The resulting solution is filtered. After quantifying the filtrate, the liquid is shaken in a measuring cylinder to make it foam and the height of the foam is noted. The foaming power is determined according to the following formula:

$$FP = (V2 - V1) / V1) \times 100$$

With V1: Volume of filtrate before foaming; V2: Volume of filtrate after foaming.

After shaking the test tubes containing the different solutions, the test tubes are left at room temperature for 30 minutes and the foam level is read again. The stability of the foam is determined according to the formula:

$$S\,F = (Vf / (V2 - V1)) \times 100$$

With Vf: Final volume of the foam after 30 minutes rest;
V1: Volume of filtrate before foaming;
V2: Volume of filtrate after foaming.

Statistical processing of the data

The data collected after the physicochemical and functional characterisation of the flour samples were subjected to statistical analysis. Thus, a multivariate analysis of variance was carried out in order to assess the existence of differences between the samples studied. Multiple comparison tests (Tukey HSD) were conducted when the difference was found to be significant ($p < 0.05$) in order to separate the different samples. These statistical treatments were carried out using STATISTICA 7.1 software.

III. RESULTS AND DISCUSSION

Results

Physicochemical characteristics of papaya seeds

The analysis of the physicochemical composition of papaya seeds dried at different temperatures shows a variability and illustrated on the graphs. Indeed, the pH of papaya seeds differs according to the drying temperature. The

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seeds dried at 75°C (6.21 ± 0.03) show a significant difference with the seeds dried at 50°C (6.67 ± 0.06) and 105°C (6.60 ± 0.01). The titratable acidity content of the seeds showed a significant difference. The seeds dried at 105°C (0.32 ± 0.02%) have a higher titratable acidity content than the seeds dried at 50°C (0.25 ± 0.02%) and 75°C (0.24 ± 0.02%). The fat content of seed flours dried at 50°C, 75°C and 105°C also differed significantly from each other with values of (5 ± 0.00%), (7 ± 0.00%) and (6 ± 0.00%) respectively. The protein content of the seed flours dried at different temperatures is significantly different. In particular, the protein content of seed flours dried at 50°C (32 ± 0.01%) is higher than those of seed flours dried at 75°C (28 ± 0.01%) and 105°C (29 ± 0.01%) . In addition, the dry matter, fibre, ash, carbohydrate and energy content of the seed flours dried at the different temperatures did not differ significantly ($p > 0.05$). Indeed, the dry matter content of seeds dried at 50°C is 45.10±0.051%, those at 75°C and 105°C are respectively 47.40±1.11% and 48.8± 0.42% . The values recorded for the fibre content are 17.9 ± 0.04% for the pips dried at 50°C, which is the highest, 17.6 ± 0.06% for the pips dried at 75°C and 16.2 ± 0.24% for the pips dried at 105°C, which is the lowest . The highest ash content is recorded for the 75°C drying temperature (7.80 ± 0.26%) and the lowest for the 50°C temperature (7.40 ± 0.42%) . The value recorded for carbohydrate levels in papaya seeds dried at 105°C (41.12%) is higher than that at 50°C (37.7%) and 75°C (39.6%). The seeds dried at 105°C (334.48 Kcal) also recorded the highest energy value compared to those dried at 50°C (323.80 Kcal) and 75°C (334.40 Kcal) (Table 1).

Functional properties of papaya seeds

The analysis of the functional properties of the different papaya seed flours dried at different temperatures shows a significant variability illustrated in the graphs.

The water absorption capacities of the poppy seed flours dried at different temperatures do not show significant differences. Indeed, the seeds dried at 50°C have the lowest value of 209.25±1.47 and the highest value is recorded for seeds dried at 105°C, which is 210.65±0.88.

The oil absorption capacities of the seed flour dried at different temperatures show a significant difference. Thus, the seeds dried at 50 °C show the highest value of 123.80±4.96 and the seeds dried at 105 °C (103.01±1.62) the lowest value.

The block densities of the three pawpaw seed flours dried at different temperatures do not show significant differences. However, the seeds dried at 105°C (0.62 ± 0.07) have the highest bulk density than those dried at 50°C and 75°C which have the same bulk density (0.57 ± 0.6) .

The emulsifying activities of the seed flours dried at different temperatures do not show significant differences. On the other hand, seeds dried at 50°C (35.77 ± 0.06) show the lowest emulsifying activity compared to seeds dried at 75°C (34.92 ± 0.97%) and 105°C (34.82 ± 0.89%). The stability of the emulsions of the dried seeds at different temperatures did not show significant differences. However, the seeds dried at 100°C have a higher stability rate (79.00 ± 2.00%) than the seeds dried at 50°C (76.33 ± 1.53%) and 75°C (78.67 ± 1.53%).

The foaming capacities of the seeds dried at different temperatures do not show any significant difference. However, the seeds dried at 105°C (2.03 ± 0.06%) show a higher foaming power than the seeds dried at 50°C (1.80± 0.17%) 75°C (1.90 ± 0.11%). The foam stability is completely zero for all three papaya seed flours (Table 2).

Table 1: Physicochemical characteristics and energy value of papaya seeds according to drying temperature

Temperature and drying time	Dry matter (%)	pH	Titratable acidity (eq.g/100g)	Ash content (%)	Fibre content (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Energy value (Kcal/100g)
50 ° C / 72h	91.20±1.11[a]	6.67 ± 0.06[a]	0.25 ± 0.02[a]	7.40 ± 0.42[a]	17.9 ± 0.04[a]	5.1 ± 0.30[a]	32. 6± 0.81[c]	37.7 ± 0.11[a]	323.80 ± 0.22[a]
75 °C / 48h	91.27±0.51[a]	6.21 ± 0.03[b]	0.24 ± 0.02[a]	7.80 ± 0.26[a]	17.6 ± 0.06[a]	7.3 ± 0.55[c]	28.7 ± 1.01[a]	39.6 ± 0.43[a]	333.40 ± 0.86[a]
105°C / 24h	92.17 ± 0.42[a]	6.60 ± 0.01[a]	0.32 ± 0.02[b]	7.68 ± 0.36[a]	16.2 ± 0.24[a]	6.8 ± 0.28[b]	29.9 ± 0.99[ab]	41.12 ± 0.46[a]	334.48 ± 0.86[a]

50°C / 72h: seeds dried at 50°C for 72h; 75°C / 48h: seeds dried at 75°C for 48h; 105°C / 24h: seeds dried at 105°C for 24h; Values are expressed as Mean ± Standard Deviation; Values in the same column with the same letter are not significantly different from each other according to Tukey's comparison test at the 5% threshold (P>0.05)

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Table 2: Functional characteristics of papaya seeds according to drying temperature

Temperature and drying time	Water absorption capacity (%)	Oil absorption capacity (%)	Block density (g/ml)	Emulsifying activity (%)	Emulsion stability (%)	Foaming power (%)	Foam stability (%)
50 °C/ 72h	209.25 ± 1.47[a]	123.80 ± 4.96[b]	0.57 ± 0.06[a]	35.17 ± 0.49[a]	78.67 ± 1.53[a]	1.80 ± 0.17[a]	0
75 °C/ 48h	210.56 ± 0.94[a]	107.82 ± 1.64[a]	0.57 ± 0.06[a]	34.92 ± 0.97[a]	76.33 ± 1.53[a]	1.90 ± 0.11[a]	0
105 °C/ 24h	210.65 ± 0.88[a]	103.01 ± 1.62[a]	0.62 ± 0.07[a]	34.82 ± 0.89[a]	79.00 ± 2.00[a]	2.03 ± 0.06[a]	0

50°C / 72h: seeds dried at 50°C for 72h; 75°C / 48h: seeds dried at 75°C for 48h; 105°C / 24h: seeds dried at 105°C for 24h; Values are expressed as Mean ± Standard Deviation; Values in the same column with the same letter are not significantly different from each other according to Tukey's comparison test at the 5% threshold (P>0.05)

Discussion

The physicochemical parameters of the papaya seed meal samples were determined. This study indicated that the titratable acidity of papaya seed flours dried at 105°C (0.32 ± 0.02%) is higher than those at 75°C (0.24 ± 0.02%) and 50°C (0.25 ± 0.02%). These results are higher than those of N'da et al. [13] (0.04%) in their work on the biochemical characterisation and antioxidant activity of papaya pericarp. The relative decrease in acidity in papaya pulp could be the result of the use of organic acids (citric acid and malic acid) in the pericarp as respiration substrates for the fruit [14]. The pH of the different papaya seed meals ranged from 6.21 to 6.67. These results are higher than those of N'da et al. [13] in their work on papaya pericarp, which is around 5.80. This increase in the pH of the pips would explain the beginning of the natural degradation of the pulp towards the pips of the fruit during its conservation. The fat content of papaya seeds dried at different temperatures ranged from 5% to 7%. These results are higher than those of N'da et al. [13] in their work on papaya pericarp (2.51 ± 0.13%). On the other hand, our results remain lower than those of Dossou et al. [15] and Oloyede [16]. In their work on the nutritional properties of papaya pulp which are respectively 56.66 ± 0.27% and 51.58 ± 0.04%. Fat is important in the diet because it is believed to contain fat-soluble vitamins and is also a source of energy. The protein content of papaya seeds dried at different temperatures, namely 50°C (32 ± 0.01), 75°C (28± 0.01) and 105°C (29 ± 0.01), is higher than those obtained by Dossou et al. [15] on aril harvested in Ghana and Meite et al. [17] on wheat, whose values are 11.67 ± 0.37% and 10.09 ± 0.09% respectively. This difference would be due to the effect of temperature which could denature the proteins. The dry matter content of papaya seed flour dried at different temperatures ranged from 91.20% to 92.17%. These rates are similar to those of Muhamad [18] and Meite et al. [17] in their respective work on solo papaya pulp 8 (90.18%) and wheat flour dried at 100°C (92.67 ± 0.20 g/100 g). This dry matter content is higher than that of wheat flour which is 86.2 ± 0.6% and lower than that of Blighiasapida flour harvested in Nigeria (96.05 ± 0.01%), according to Oloyede (2005) and in Ghana (95.17± 0.02%) according to Dossou et al. [15].These results suggest that the nutrients in the pulp are also present in the pawpaw seeds. The difference in material content can be explained by the fact that 105°C is the highest temperature compared to other temperatures. The higher the temperature, the greater the chance of extracting the maximum amount of water from the sample. The fibre content of papaya seeds dried at different temperatures 50°C, 75°C and 105°C ranged between 16.2g and 17.9g. These results are lower than those of N'da et al. [13] in their analysis of papaya pericarp, which is 32.5 g. However, these values are higher than the values found in papaya pulp according to the work of Muhamad [18] and Nwofia et al. [19] which is 0.5g. These results suggested that papaya seeds could be recommended for people with digestive disorders. The ash content of papaya seeds dried at 75°C (7.80±0.26%) is higher than those at 50°C (7.42±0.42%) and 105°C (7.68±0.36%). These values are higher than the ash levels of the Blighiasapida aril flour (5.49±2%) analysed by Dossou et al. [15]. On the other hand, these results remain lower than those of Oloyede [16] which is 8.68 ± 0.42%.

This high ash content of papaya seeds would mean that they are richer in minerals than the papaya pulp. The carbohydrate content of papaya seeds dried at different temperatures ranged from 45.10 ±0.46% to 48.8±0.11%. These results are still lower than those of N'da et al. [13] and Oloyede [16] on papaya pericarp, respectively 52.33% and 54.5%. On the other hand, the carbohydrate content of papaya seeds in the present study was higher than those of Dossou et al. [15] during these analyses on Blighiasapida flour harvested in Nigeria (6.86 ± 0.06%). This flour, a carbohydrate source, would find its application in diets. The energy value of papaya seeds dried at 105°C (334.48 ± 0.86 Kcal/100 g) is higher than at 75°C (333.40 ± 0.86 Kcal/100 g) and 50°C (323.80 ± 0.22 Kcal/100 g). These results are higher than those of N'da et al. [13] on papaya pericarp with an energy value of 278.59 Kcal/100 g and 35 Kcal/100 g for the pulp reported by Muhamad [18]. On the other hand the energy value of papaya seed meal is lower than that of Blighiasapida from Ghana (590.67 Kcal/100 g) according to Dossou et al. [15], and Nigeria 571.16 kcal/100 g according to Oloyede [16]. Papaya seeds provide more energy than papaya pulp and

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pericarp. For carbohydrate and energy intake, it would be better to consume the seeds of the papaya.

As a prelude to the valorisation of these papaya seed flours in food technology, the functional properties were characterised. The results revealed that the oil absorption capacities of the papaya seed flours are statistically ($p<0.05$) different. The oil absorption capacity of the seeds dried at 50°C (123.80 ± 4.96%) is higher than that at 75°C (107.82 ± 1.64%) and 105°C (103.01 ± 1.62%). These values are higher than those reported by Diomandé et al. [20] and Akpossan et al. [21] who worked respectively on fishmeal with a value of 82 ± 6% and on caterpillar (Imbrasiaoyemensis) with values between 56.71 and 78.12%. Moreover, these values are lower than those reported by Omotoso [22], which are of the order of 358 ± 0.21% on Cirinaforda larvae. These values are also lower than those of edible mushroom meals, which are between 450 and 480% according to Aremu et al. The variation in the oil absorption capacity of papaya seed meals is believed to be due to moisture levels. The high oil holding capacity of the flour implies that it would result in high palatability. Consequently, the constituents of this flour would present pleasant textures to the palate and would promote food pleasure. The oil absorption capacity (OAC) is an important property in food preservation as it prevents the development of oxidative rancidity [23].

The water absorption capacity (WAC) is an index of the maximum amount of water that a food product would absorb and hold [24]. The WAC obtained for papaya seed flours dried at 105°C (210.65 ± 0.88%) is higher than at 75°C (210.56 ± 0.94%) and 50°C (209.25 ± 1.47%). These values are lower than those of uncooked (225%) and cooked (250%) rice reported by Abulude [25] and that of the flour of the aril of Blighiasapida harvested in Ghana (565.53± 9.06%) according to Dossou et al. [15]. Indeed, according to Nelson-Quartey et al. [26] the presence of lipids in a flour reduces the binding capacity of water to particular substances. The availability of protein functional groups in flours would govern the water absorption capacity. According to this author it is an important property for flours used in baking. The emulsifying activity values of papaya seeds dried at 50°C (35.17 ± 0.49%) are higher than those at 75°C (34.92 ± 0.97%) and 105°C (34.82 ± 0.89%). These results are lower than the emulsifying activity of caterpillar meal (63.88 ± 0.92%) and fish (62.73 ± 0.23%) according to Diomandé et al. [20].

The papaya seed flours dried at 105°C (79.00 ± 2.00%) have a more stable emulsion than the 50°C (78.67 ± 1.53%) and 75°C (76.33 ± 1.53%) seeds. The emulsifying activities of the different papaya seed flours recorded in the present study are higher than those reported by Akpossan et al. [21] which range from 16.84% - 46.66%. On the other hand these values are lower than those of emulsion stability which are in the range of 79.75 - 91.22% on Imbrasiaoyemensis flour. Thus, according to Yu et al. [27] and Fekria et al. [28] and emulsion formation and stability are very important in the manufacture of dressing. So papaya seed flour can be well used in the manufacture of salad dressings. Block density (BD) determines the suitability of a flour to be easily packed, which would facilitate the transportation of a large amount of food [29]. The bulk density of papaya seed flours dried at 105°C (0.62 ± 0.07 g/cm^3) is higher than those at 75° (0.57 ± 0.06 g/cm^3) and 50°C (0.57 ± 0.06 g/cm^3). These values are close to those of caterpillar meal of the species Imbrasiaoyemensis (0.54±0.01 g/cm^3) analysed by Diomandé et al. [20]. However, these values are lower than those recorded for yam flour (0.49 to 0.63 g/cm^3) and wheat flour (0.80 g/cm^3) reported by ljorotimi [30]. According to Nelson- Quartey et al. [26], the low DB of papaya seed flour suggests that it could be used in infant food formulation. Papaya seed flours dried at different temperatures have a foaming power between 1.80 ± 0.17% and 2.03 ± 0.06%. These values are lower than the one obtained by Dossou et al. [15] on the flour of Blighiasapida aril in Ghana which is 5.67 ± 0.58%. The low foaming capacity could therefore be due to an importance of globular proteins in these flours which would resist surface tension more. Indeed, a link has been established between the high foaming capacity and the flexibility of the protein molecules which reduces the surface tension. It increases the surface area of the protein, which allows the protein to interact with its environment.

IV. CONCLUSION

The objective of this work was to determine the effect of drying temperature on the physicochemical and functional properties of papaya seeds for their valorization in food nutrition and technology.

The results revealed that for the physicochemical parameters, the seeds dried at 50°C had a better pH (6.67) which tends towards neutrality, a low fat content (5%), the highest protein content (32%) and higher fibre content (17.9%). It could therefore be said that 50°C is the appropriate temperature for parameters such as pH, fibre, protein and fat. On the other hand, the temperature of 105°C would be the most suitable for parameters such as dry matter (92.17%), carbohydrate content (41.12%) and energy value (334.60 Kcal). On the other hand, the temperature of 75 °C gave the highest ash content (7.80%).

On the other hand, the functional properties were not significantly influenced by the drying temperatures (50°C, 75°C and 105°C), only the oil absorption capacity showed

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differences in the temperatures, but the 50°C temperature (123.80%) remained the highest.

Papaya seeds are an excellent source of minerals, protein, fibre and carbohydrate and have good functional properties. These seeds could therefore be used in the manufacture of food products and medicines.

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DISCLOSURE OF CONFLICT OF INTEREST

All the author declare no conflict of interest.

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