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Research Article

Sieving Effect on the Physicochemical and Functional Properties of Taro (*Colocasia esculenta.*) Flour

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Abstract: The objective of this work was to study the influence of sieving on the physicochemical and functional properties on four samples of the flours of taro *Colocasia esculenta*. To be done, we used the tubers of taro (white variety) of Congo Brazzaville. In the first place, we produced two types of flour, one of which was derived from the slices of raw taro bulbs we named (F1) and the other from sliced taro bulbs cooked in tap water At 100°C for 10 min which we have named (F2). These two types of flour were each sieved in 100 and 180 µm mesh sieves. This led us to obtain four flour samples named F1T100, F2T100, F1T180 and F2T180. The physicochemical and functional flours were studied by determining the water content, fat, protein, ash and total carbohydrates by standard methods. The parameters of gelatinization, color, Water Absorption Capacity (WAC), Water Solubility Index (WSI), and Swelling Power (SP) flour were also investigated. The results revealed some significant differences in these physicochemical and functional properties compared to the size of taro flour (*Colocasia esculenta*). Protein and ash levels increased in F2T100 and F2T180 pre-processed flours. It is more important in sifted flour at 100 µm and 180 µm respectively for proteins and ash. These are pre-cooked flours F2T100 (72.35°C±0.49) and F2T180 (81.5°C±6.08). The transition temperature of the latter has increased considerably after use of a large mesh screen. The granulometric properties of taro flours were not influenced by the size of the sieves used.

Keywords: Effect, functional properties, physicochemical properties, sieving, taro flour

INTRODUCTION

Taro (*Colocasia esculenta*), a member of the Araceae family, is an ancient crop grown throughout the humid tropics for its edible corms and leaves, as well as for its traditional uses. Tubers are important sources of carbohydrates as an energy source and are used as staple foods in tropical and subtropical countries (Liu *et al*., 2006). Today the plant is widely used throughout the world, in Africa, Asia, the West Indies, and South America (Wilfred, 1999). Africa accounts for 92% of the annual global production of food taro around 9.5 million tons, including 1.4 million in central Africa according to FAO (2008) and Nguimbou (2012).

In Congo, taro (*Colocasia esculenta*) is cultivated almost in all regions of the north and south of the country. But it is important to remember that there are many problems, namely: It is perishable because of its high humidity and its important metabolic activities after harvesting.

This prevents the long-term preservation. To overcome these problems and to complete our studies, we planned to turn it into flour. This is the case of the work carried out in Cameroon by Njintang (2003), Nguimbou (2012), Aboubakar *et al*. (2012) and Panyoo (2014) on the production of taro flour. Today, most currently produced by the food industry are foods in powder form (Fitzpatrick and Ahrné, 2005); powder industry takes an ever-increasing importance for both ingredients producers' food and users (Nguimbou, 2012).

The previous study carried out in Cameroon by these authors emphasizes the physicochemical and functional characteristics of taro (*Colocasia esculenta*) flour. By cons, we set a goal to study the influence of screening on the physicochemical parameters and functional taro flour. Two types of 100 mesh and 180 micron mesh sieves were chosen for this study. According to the granulometry of each of the flours; the choice of the best taro flour will be made on the one

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that will have the least lost in physicochemical and functional properties. The sample chosen will be used for the continuation of our studies including those to manufacture biscuits for diabetics.

MATERIALS AND METHODS

Sampling and Taro flour production: Taro flour were produced from a white variety of taro tuber under eight or nine months in a peasant village field Kindamba (Pool area, Congo), located in southern Congo Brazzaville. The tubers was washed in tap water, peeled and calibrated to remove the defective samples in the laboratory. Peeled tubers were washed meticulously with tap water and cut into slices 0.5 cm thick using a stainless steel knife (Stainless steel). These slices were divided into two lot, a cell for the first lot and cooked in tap water during 10 min in the second batch. Each batch is disposed on aluminum trays and then placed in an electric dryer convection air forced to type for a drying operation in the course of 24 h at 50°C. After drying, the wafers from each batch were crushed using a cutter mill Saachi NL-BL-4376 (China). The two samples of milled flour obtained from the two batches were each sieved using two different sieves of 100 and 180 µm mesh. This led us to obtain four types of taro flour rated F1T100, F1T180 (Raw flours sieved at 100 and 180 µm), F2T100 and F2T180 (Precooked flour sieved at 100 and 180 µm). These flours were sealed in polythene bags and stored at 4°C in a refrigerator until used.

Physicochemical properties of taro flour sifted 100 and 180 µm: Flour samples were analyzed for moisture (oven method of air), fat (Soxhlet), crude protein (Nx6.25) and ashes (incineration method) content, as a weight per weight percentage (w/w) following (AOAC, 1990) procedures. Semi-automatic machine (GEHARDT, Paris, France), was used for analysis of crude protein.

Total carbohydrates: The total carbohydrate content "G" in g per 100 g of dry product was determined by the difference between the moisture content, ash content of total protein and total lipid content (Benkadri, 2010).

Differential Scanning Calorimetry (DSC) analysis of taro flour: DSC thermograms of taro flour were recorded on a differential scanning calorimeter model Pyris 1 controlled by the software (Perkin-Elmer Corp. Norwalk, USA). The flour was dispersed in distilled water (1: 3, w/v) in an aluminum capsule hermetically sealed. The capsule thus sealed was placed in the apparatus and kept at room temperature at 25°C for 15 min to allow good homogenization. The instrument was calibrated for temperature and measuring enthalpy with indium, heated at a rate of 5°C/min and a temperature scan of 25-100°C. An empty capsule was used as the reference. The software Pyris 1 was used to calculate the heat capacity and integrate the peaks. The onset and end temperatures of the gelatinization peaks were determined by the intersection of tangents fitted to the leading and trailing flanks of the peak with the baseline. The melting enthalpy (ΔH) were calculated by integration of the total area of the melting peak.

Color characterization of taro flour: Color measurements of flour samples were carried out using a Hunter colorimeter CR210 (Minolta France S.A.S., Carrières-sur-Seine) on the basis of L* a* and b* values as described by Himeda *et al*. (2012b). The Whiteness Index (WI) was determined according to the following equation (Saricoban and Tahsin, 2010):

$$WI = 100 - \sqrt{(100 - L)^2 + a^2 + b^2}$$

Water Absorption Capacity (WAC), Water Solubility Index (WSI) and Swelling Power (SP): The Water Absorption Capacity (WAC) and the Water Solubility Index (WSI) were determined according to the method of Phillips *et al*. (1988) and Anderson *et al*. (1969) with Slight change. We dispersed 1 g of taro flour in 10 mL of distilled water and mixed at 45 rpm for 30 min using a rotary agitator Bioblock compass type. The mixture was centrifuged at 2500 g for 10 min in a Beckman Coulter centrifuge (Firlabo, France). The wet pellet was weighed and dried at 105°C to constant weight. The excess water absorbed by the flour was expressed as the percentage water bound by 100 g sample. For the estimation of water solubility index, the supernatant was dried in an oven set at 105°C for 48 h and the soluble matter expressed per 100 g of flour. The swelling power was determined according to Lai and Cheng (2004).

Particle Size of taro flours: The particle size distribution of taro flours was measured using a laser particle size analyzer (Mastersizer S, Malvern Instruments, Orsay, France). Each sample was dispersed in 95% ethanol to the darkness of 17-20%. Six measurements were made for each of the flours. The conventional diameters (D10, D50, and D90) determined where Dx means that x% of the volume of particles has a diameter smaller than Dx.

Statistical analysis: The data reported in all tables and figures are average values determined in triplicate. They were subjected to Analysis of Variance (ANOVA) and multiple scatter tests by the Fisher method (LSD) in order to classify the samples at the significant level of 5% using the program Statgraphics XVII Centurion Version 17.1.12 (Statpoint Technologies, Inc. USA). The Excel 2007 software was used for the plotting of curves.

RESULTS AND DISCUSSION

The chemical composition of taro flours: Table 1 presents the chemical characteristics of taro flour. Protein levels fluctuate between 2.92% and 4.20%. They are comparable to those obtained by Njintang *et al*. (2007) and Aboubakar *et al*. (2008). The protein content of raw taro flours F1T100 and F1T180 (2.92% and 3.37%) is lower than that of pre-cooked taro flour F2T100 and F2T180 (4.20% and 3.45%). We can say that the pre-treatment by cooking caused the increase of the protein content in these flours. This protein increase is due to the presence of mucilages which play an important role on the viscoelastic properties of the dough. Since protein is the major component of mucilages (Aboubakar *et al*., 2012). Moreover, before cooking, the protein content of the F1T180 large particle flour was higher than that of the small particle flour F1T100. Conversely, when cooking, this content is higher in 100 µm sifted flour (F2T100). The sieving had a slightly significant effect on our flours.

The water contents of taro flour are between 5.96 and 8.91%. These levels are adequate to cover a retention period of more than six months (Sriroth *et al*., 2000).

The ash content is an indicator of the purity of the flour (Benkadri, 2010). The ash content varies between 1.8 and 4.43% related to those of most tropical tubers (Swinkles, 1985). The ash values of 3.86 pretreated flour and 4.43% (F2T100 and F2T180) are relatively higher than those of non-pretreated flour 1.8 and 2.02% F1T100 and F1T180). These high ash values reflect their mineral content as indicated by Nguimbou (2012) on an unconventional two-color taro. Pre-treatment of taro slices by cooking has contributed significantly to the accumulation of minerals in pre-cooked flours. This mineral accumulation is remarkable on large-particle flours in the order F2T180>F2T100 and F1T180>F1T100.

Lipids are counted among the least important compounds in taro flour. Their content ranges from 0.10 to 0.28%. While the total carbohydrates are the majority with a rate that varies between 88.49 and 82.73%. These results are in agreement with the literature (Payne *et al*., 1941; Jane *et al*., 1992). On the other hand, raw meal F1T100 and F1T180 have a high carbohydrate content above pre-cooked flour F2T100 and F2T180. Therefore, starch gelatinization during the precooking flour would cause the lower rate of total carbohydrates.

Physical and functional properties of taro flour: The color of the flour derived tuber is an important quality parameter that may influence their acceptability (Ndouyang *et al*., 2009). The color parameters L*, a*, b* of our flour are shown in Table 2. In general, their values range from 86.92 to 92.37 (F2T180-F1T100) for L*, from 0.17 to 1.51 (F2T100-F1T180) for a* and 5.76 to 10.13 (F1T100-F2T180) for b*. All were white flour (high values of L*) less red (low a * value) and less yellow (lower b* value). This observation goes along with that made by Aboubakar *et al*. (2008) saying that the outcome taro flour electric drying is clearer, less brown and less yellow. Some studies have assumed that the change in the b* value among the species related to their content of sugars and proteins because of their role in the non-enzymatic browning (Jamin and Flores, 1998). In our case, we see a wide variation between one of the raw meal F1T100 and another one of the pretreated flour F2T180. This variation could also be associated with the size of the flour particles. Although proteins and reducing sugars are theoretically responsible for non-enzymatic browning, in particular for the color of flours, the presence of dietary fiber could also influence the flour color. According to the studies (Panyoo, 2014), he observed a positive correlation between dietary fiber and the whiteness (L*) of the flours, as well as a negative correlation between dietary fiber and redness (a*) of flours. The results of this study are similar to those obtained by (Aboubakar, 2009) on two varieties of Cameroonian taro *Reb Ibo Coco Ekona* (*RIE*) and Ngaoundere *Country coconut* (*CN*).

The Whiteness Index (WI) represents the overall whiteness of food products and may indicate the extent of discoloration during the drying process (Nguimbou,

Table 1: Chemical characteristics of taro flours

Samples	Proteins (%)	Moisture (%)	Ash (%)	Fat (%)	Total sugar (%)
F1T100	2.92±0.5^{a}	7.74±0.9^{b}	1.8±0.1^{a}	0.12±0.03^{a}	87.4±1.53^{b}
F2T100	4.20±0.6^{b}	8.91±0,4^{b}	3.86±1.04^{b}	0.28±0.28^{a}	82.73±2.33^{a}
F1T180	3.37±0.2^{ab}	5.96±0.5^{a}	2.02±0.2^{a}	0.16±0.01^{a}	88.49±0.91^{b}
F2T180	3.45±0.1^{ab}	8.73±0.5^{b}	4.43±0.4^{ab}	0.10±0.01^{a}	83.29±1.01^{a}

Means±standard deviation; Means in the same line followed by different letters in superscript are significantly different at probability level 0.05.

Table 2: Variation in color parameters of taro flour

Samples	L*	a*	b*	WI
F1T100	92.31±0.05^{c}	1.02±0.01^{b}	5.76±0.04^{a}	90.33±0.01^{d}
F2T100	89.44±0.47^{b}	0 .17±0.03^{a}	7.27±0.14^{b}	7.18±0.47^{c}
F1T180	88.01±0.77^{a}	1.51±0.06^{c}	7.85±0.25^{c}	85.59±0.75^{b}
F2T180	86.92±0.79^{a}	0.19±0.10^{a}	10.13±0.13^{d}	83.45±0.70^{a}

Means±standard deviation; Means in the same column followed by different letters in superscript are significantly different at probability level 0.05. L*: the luminance; a*: the red-green scale; b*: the yellow-blue scale; WI: the whiteness index

Table 3: Gelatinization Parameters of taro flour

Samples	T_0 (°C)	T_p (°C)	T_e (°C)	ΔH (J/g)
F1T100	77.2±0.14^{b}	79.95±0.07^{ab}	83.15±0.77^{ab}	1.12±0.09^{a}
F2T100	68.1±0.14^{a}	72.35±0.49^{a}	77.25±0.35^{a}	1.19±0.09^{a}
F1T180	76.9±0.14^{b}	79.75±0.07^{ab}	83.15±0.21^{ab}	1.19±0.10^{a}
F2T180	75.95±5.58^{b}	81.5±6.08^{b}	84.5±4.94^{b}	1±0.08^{a}

Means±standard deviation; Means in the same column followed by different letters in superscript are significantly different at probability level 0.05; To, Tp, Tc and ΔH indicate temperature of onset, midpoint, end of gelatinization and Enthalpy of gelatinization respectively.

2012). The flours have WI values which are in the range of 83.45 à to 90.33. We noticed that all the flour sifted at 100 microns (F1T100 and F2T100) have higher whiteness indices than flour sifted at 180 µm (F1T180 and F2T180). These results on the whiteness index showed that, independently of the pretreatment or not, the flours of small particles are whiter than those of the large particles. Overall, drying had no significant effect on the whiteness of all flours. Our flours have IB values lower than those obtained by Himeda *et al*. (2012b) on taro flour (*Sosso* variety) from Chad, but more or less agree with Panyoo (2014), flour of Cameroon taro (*Lamba* variety) and by Ndangui *et al*. (2014) on sweet potatoes flour from Congo Brazzaville.

Differential scanning calorimetry of taro flour: The parameters of the thermogram from differential scanning calorific analysis (onset temperature (T_0), peak temperature (T_p), completion temperature (T_e) and enthalpy of gelatinization (ΔH)) of samples of taro flour sifted 100 and 180 µm are presented in Table 3. We found that the temperatures of the beginning of gelatinization (T_0) F1 flours are slightly greater than those of flours F2. This observation is true for temperatures of gelatinization end (Te). Starch is the main compound that has a thermal transition in the conditions of this study. It indirectly controls the properties of the flour in the study of temperature range of 20°C-100°C (Nguimbou, 2012). The less remarkable difference between the start and end temperatures of gelatinization may be related to the low variability of the thermal properties of the starch molecules. The sieving also had a remarkable impact on the process of gelatinization of cooked flour F2T100 (72.35°C±0.49) and F2T180 (81.5°C±6.08). We have noticed that the transition temperature of the latter has increased considerably after using a large mesh screen. According to our studies, the values of the gelatinization temperatures (T_0, T_P and T_e) were close to those of (Aprianita, 2010) on taro, yams, sweet potatoes and Congolese sweet potatoes (Ndangui *et al*., 2014); But below the values of the work of Himeda *et al*. (2012b). On the other hand, they were above the values of six varieties of taro (Aboubakar, 2009). These high values of gelatinization temperatures of our flour could be attributed to the length of the branched chains of amylopectin, a lipid content (which could alter the functional properties, phosphorus and the amylose/amylopectin ratio that could delay the gelatinization phenomenon flour (Nguimbou, 2012). According to Bahrani (2012), all internal lipids have the ability to form complexes with amylose, even in small amounts, modify the thermal behavior of starches. Also, one of the properties of amylopectin is to be able to gel very slowly. We can also add the presence of dietary fiber in the flour to explain the high gelatinization temperature (Moorthy *et al*., 1993). This may explain a better resistance to gelatinization of F1T100, F1T180 and F2T180 flours. Hence our flours can be used as a film in the industry. This is the case of the taro flour *Lamba* of Cameroon studied by Panyoo (2014).

The enthalpies of gelatinization (ΔH) of all flours vary 1J/g to 1.19 J/g. Despite the complexity of molecules Fat/amylose, the presence of fibers and other above-mentioned compounds which are the cause of delaying the phenomenon of gelatinization. We noticed a slight significant change in the flow of energy that could be explained by the difference in particle size close our flour (sifted flours 100 and 180 µm). This approximation leads to a smaller gap intervals between the gelatinization temperatures for these flours; resulting in variations in many low enthalpy. Our results on the enthalpy of gelatinization (ΔH) are far from being similar to the authors of results (Aprianita *et al*., 2009; Aboubakar, 2009).

Water Absorption Capacity (WAC), Water Solubility Index (WSI) and Swelling Power (SP) of taro flours: The water absorption capacity (WAC) of flours is shown in Table 4. It plays an undeniable role in food systems for flour (Nguimbou, 2012) and in the formation of the paste (Panyoo, 2014). In this study, a significant change in WAC was observed, taking into account the pretreatment and the type of screen used. The flour has undergone a cooking process including F2T100 and F2T180 showed higher values of WAC (322.79% and 400.37%) than those who did not undergo any pretreatment and F1T100 F1T180 (145.40% and 250.61%). However, the values are higher for flours sieved to 180 µm. This high water absorption capacity by F2 could be attributed to the presence of the high content of carbohydrate contained in the flours (Njintang *et al*., 2008). These results showed that pretreatment by cooking increases the WAC of the flour. Wolf (1970) has meant that water absorption capacity is an important property of flour used in pastry, since it allows pastry cooks to add a lot of water to the dough while improving its handling and maintaining Freshness in bread. Moreover, (Aboubakar *et al*., 2008) suggested that other compounds different from starch, such as mucilage, would contribute

Table 4: Water Absorption Capacity (WAC), Water Solubility Index (WSI) and of taro flour

Samples	WAC (%)	WSI (%)	SP en %
F1T100	145.40±0.92^{a}	11.23±1.42^{a}	2.17±0.04^{a}
F2T100	322.79±15.90^{bc}	14.66±4.60^{a}	3.61±0.33^{bc}
F1T180	250.61±64.05^{ab}	13.73±5.06^{a}	3.01±0.37^{b}
F2T180	400.37±48.45^{c}	12.53±2.78^{a}	4.36±0.28^{c}

Means±standard deviation; Means in the same column followed by different letters in superscript are significantly different at probability level 0.05

strongly to the absorption of water in taro flours. Absorption with water is also amplified by the size of the sieve meshes used (180 µm sieve) according to our studies. Also, the finding is such that there is a positive correlation similar to the studies of Kaptso (2008) between WAC and protein content in the sense that all flours with high protein content had a high WAC than those with a low level of protein. Then, the capacity of flour to absorb water is a characteristic parameter of its hydrophilicity, which is also provided by proteins.

The solubility index or soluble fraction reflects the extent of starch degradation in flours. In this study, the solubility of the flour in water is shown in Table 4. The non-pretreated or raw flours have WSI values between 11.23% and 13.73% (F1T100 and F1T180) with a low value for sifted flour at 100 µm. After treatment, the reverse is the case that the WSI of the flour of small particles is higher (14.66% for F2T100) than that of the large particles (12.53% for F2T180). Thus, we can say that the extent of degradation of starch is reduced by the pretreatment of large-particle meals (F2T180). Studies of Himeda (2012a) have deduced that cooking starch in water induces its gelatinization and solubilization of amylose which results in an increase in the soluble fraction of the flour. In our case, the increase of the soluble fraction in F2T100 flour would not only be related to the gelatinization of the starch in the water during the pretreatment but also to the fineness of the particle size. Overall, WSI values were low for all flours obtained after drying at 50°C. It should be noted that several authors have already demonstrated the influence of the drying temperature on the functional properties. For some authors, the solubility index of flours falls in the temperature range 50°C to 60°C (Kaptso, 2008) on cowpea flours. But (Aboubakar, 2009), in this same temperature range, the index of water solubility increases. Indeed, our studies are in agreement with the first observation made by Kaptso (2008). Nevertheless, all these authors observed values of WSI much higher compared to those obtained in our studies. This general decrease in solubility with respect to these authors could be attributed to the fine particle size of our 100 and 180 µm flours. Gelatinization of larger granules should be more difficult due to the limitation of water diffusion inside the particle (Ahmed *et al*., 2010). This limitation of the water diffusion inside the particle is observed on our 180 µm sieved precooked flour (F2T180, large particle flour).

The swelling power of the flour indicates the degree of water absorption of the starch granules (Carcea and Acquistucci, 1997). Our flours showed significant swelling power. It is higher for F2T100 and F2T180 (3.61% and 4.36%) than for raw meals F1T100 and F1T180 (2.17% and 3.01%). The increase in swelling capacity would be related to the gelatinization caused by the starches of the flour used. Starches absorb less water in their native structure, but after gelatinization, they absorb more (Himeda, 2012a). Indeed, when the swelling power is high, it would facilitate the process of gelatinization of the starch and would lead to the reduction of the mechanical energy necessary to break up the crystallized areas of the starch (Yussof *et al*., 2013). This observation is clearly confirmed in this study compared with the parameters of the differential thermal analysis where all the energy values were very low on all the meals (pre-cooked and raw). Although our studies are consistent with the hypothesis on the gelatinization of pre-cooked flours. But our values on the swelling capacity are much lower than those previously obtained by Himeda (2004) on pre-cooked flours of taro (white and yellow varieties) and (Njintang, 2003). They are rather comparable to the results of (Ndangui, 2015) on sweet potatoes flours. At least, they are comparable to the results of Njintang (2003). Indeed, when the swelling power is high, it would facilitate the process of gelatinization of the starch and cause the mechanical energy required to break up the crystallized zones of the starch (Yussof *et al*., 2013). This observation is clearly confirmed in this study compared with the parameters of the differential thermal analysis where all the energy values were very low on all the flours (pre-cooked and raw).

The Particle size of taro flours: The results presented in Fig. 1 and Table 5 show the particle size distribution of the taro flours. Figure 1 shows a bimodal distribution for all taro flours. This type of distribution was previously observed on taro flours by Himeda (2012a) and Panyoo (2014) and on sweet potatoes flours by Ndangui *et al*. (2014). On the other hand (Aprianita *et al*., 2009; Aboubakar, 2009) Obtained a monomodal distribution. The bimodal distribution is often related to the grinding method during which the large particles are the result of the agglomeration of small particles. Our flours F1T100 and F1T180 have two distinct populations with identical and confused patterns with peaks of 14.5-76 µm. For the F2T100 and F2T180 flours, identical distribution patterns are observed, where the second peaks formed are much more pronounced than those of the first two flours. The peak values are between 27.4-144 µm and 31.1-144 µm respectively for F2T100 and F2T180. These results lead

Table 5: Particle size parameters of taro flour samples

Samples	D10 (µm)	D50 (µm)	D90 (µm)
F1T100	18.3±0.42^{ab}	104.5±10.60^{a}	201±1.41^{a}
F2T100	18.15±3.74^{a}	100.65±24.53^{a}	210±7.07^{ab}
F1T180	24±1.41^{bc}	137±2.82^{a}	220.5±7.77^{b}
F2T180	24.2±1.13^{c}	132.15±0.21^{a}	240±2.82^{c}

Means±standard deviation; Means in the same column followed by different letters in superscript are significantly different at probability level 0.05

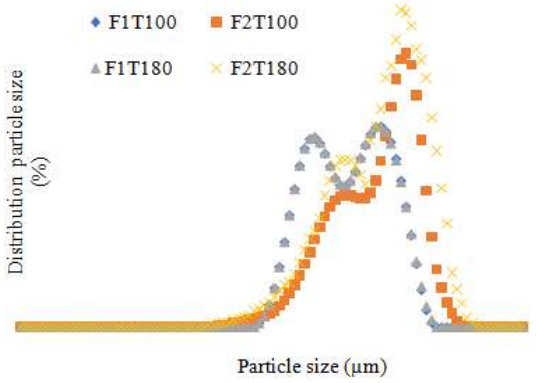

Fig. 1: Granulometric distribution of taro flour samples (*Colocasia esculenta*)

us to say that the cooking of the taro slices has had a significant effect on the size of the flour particles. By observing the peaks of its cooked flours their size doubled including particle size regardless of the diameter of the sieves used. Cooking also led to peak regularity for F2T100 and F2T180. Therefore, these F2 meals could be better used for several applications in the food industry, especially for products that require a homogeneous and smooth texture (Anuntagool *et al*., 2006). Also, there is a relationship between particle size and water absorption capacity. We note that samples with a particle size of flour doubled (F2T100 and F2T180) absorb more water than those with a low particle size (F1T100 and F1T180). It has been reported that particle size plays an important role in flour dispersion in cold water and hot water (Iwuoha and Kalu, 1995) and on the other hand, may influence properties such as swelling, Clarity of pasta, water absorption capacity and several food applications (Singh *et al*., 2003; Anuntagool *et al*., 2006; Huang *et al*., 2006). In fact, the size of the sieves used did not influence the granulometric properties of the taro flours. These properties have rather been influenced by cooking taro slices; whatever the diameter sieves used particle size peaks obtained were the same as raw flour cooked on one side and the other.

The parameters D10, D50 and D90 presented in Table 5 respectively represent the size below which is 10, 50 and 90% of the population of the particles. These parameters make it possible to better appreciate the varietal influence on the grain size distribution (Kaptso, 2008). The criterion D10 characterizes the small particles whereas D90 characterizes the large particles. The average diameter D50 of our flour is between 100.65 and 137 µm respectively for F2T100 flour and F1T180.

CONCLUSION

The influence of sieving on the physicochemical properties of taro (*Colocasia esculenta*) flours revealed some significant differences. Protein and ash levels increased in F2T100 and F2T180 pre-processed flours. They are more important in sifted flour at 100 µm and 180 µm respectively for proteins and ash. This increase in minerals is remarkable on large-particle flours in the order F2T180> F2T100 and F1T180>F1T100. All flours were white (high values of L*). The whiteness of the flours was confirmed by the values shown on the whiteness index (83.45-90.33). The flours of small particles were whiter than those of the large particles. It has been observed that the high gelatinization temperatures of our flours could be attributed to the length of the branched chain of amylopectin, lipid content, phosphorus, amylose/amylopectin ratio and dietary fiber contained in Taro flours which could delay the phenomenon of gelatinization. The sieving also had a remarkable impact on the gelatinization process of F2T100 (72.35°C±0.49) and F2T180 (81.5°C±6.08) precooked flour. The transition temperature of the latter has increased considerably after use of a large mesh screen. The presence of a lot of quantity of carbohydrates and other compounds different from starch, such as mucilages, has greatly contributed to the absorption of water in taro flours. This study also noted the protein hydrophilicity of flours. The situation is such that each taro flour with a high protein had high WAC that with low levels of protein. In general, the SP flour in this study is high, it would facilitate the starch pasting process and generate the decline of the mechanical energy required to break the crystallized areas of starch. This observation shows that all the energy values shown by the differential thermal analysis were very low on all flours (prebaked and flooded). The granulometric properties of taro flours were not influenced by the size of the sieves used, but rather by the baking of the taro slices; whatever the diameter sieves used particle size peaks obtained were the same for raw flour cooked on one side and the other. The peaks of the precooked flour F2T100 and F2T180 were regular and had doubled whatever the diameter of the sieves used. Therefore, these F2 flours could be better used for several applications in the food industry, especially for products that require a homogeneous and smooth texture.

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