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ORIGINAL ARTICLE

Evaluation of the Impact of Pre-Drying and Blanching Treatments on the Acceptability of Crisps from Sweet Cassava Roots (*Manihot esculenta* Crantz)

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Abstract

Fresh sweet cassava is highly perishable due to its high-water content. In order to reduce its postharvest losses, a new consumption form was proposed through crisps production. Red sweet cassava roots were sliced, and divided into two batches. One batch was pre-dried and another was blanched at different times and finally fried to obtained cassava crisps. The pre-drying treatments were carried out at 60±2°C for 0, 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 min whereas blanching was done at 90±2°C for 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 min. Pretreated samples were fried at 160°C for 6 min to obtain crisps. The sensorial and physicochemical analyses of the produced crisps were evaluated using standard methods. The produced pre-dried and blanched cassava crisps were generally accepted in terms of their sensory characteristics namely color, texture and overall acceptability. Among the preferred pre-dried and blanched crisps, sample made by blanching 2 min had the best sensory scores for all sensory quality attributes. The results of the physicochemical analyses of the preferred sample revealed that, the average moisture content of the accepted pre-dried and blanched crisps was in the range of 2.39-4.44 % and 6.89-8.43 % respectively. There was a significant loss of mineral for the blanched samples and this was illustrated by the drop of ash content (up to 9.26%) compared to the control sample. With respect to the texture analysis, pre-dried samples were friable than blanched samples. The hardness values ranged from 93.79-159.65 N and 42.79-74.36 N respectively for pre-dried and blanched samples. Color analyses of preferred crisps revealed that those blanched were lighter compared to pre-dried and the control crisps.

Key words: Blanching, crisps, drying, frying, root, sweet cassava

1. Introduction

Cassava scientifically known as *Manihot esculenta* Crantz, with about 80% household's consumption in the rural and urban areas, is the main starchy staple food in West and Central Africa (Djoudji & Dorothy, 2021). Among the existing staple foods, cassava lodges at the head in the developing countries with over half a billion people in Africa, Asia and Latin America depending on it for their basic diet or source of income (Jackson *et al.*, 2020). Cassava is consumed by about 500 million of Africans every day and 80% of urban households in Cameroon use cassava on a daily basis (Sanyang *et al.*, 2014). According to the same authors, the share of urban consumption of cassava was 42% in 2009.

Cassava is the second most important source of carbohydrate in sub-Saharan Africa after maize

(Lebot, 2008). Sub-Saharan Africa produces more than 50% of the world's cassava output, mainly for subsistence usage. Cassava and its products feed more than 5 hundred million individuals in Africa (Ndjouenkeu *et al.,* 2021). In Cameroun, cassava constitutes the first source of starchy foods in all the Southern part of the country (Eyenga *et al.*, 2018). With an annual production of 5 million tons, cassava is the major crop produced in Cameroon (Ndjouenkeu *et al.*, 2021). It constitutes one of the basic food of the population with more than 40 culinary receipts and various uses (Eyenga *et al.*, 2018).

Freshly harvested cassava roots quickly deteriorate due to their higher water content and excess heat generated by the high respiration rate (Ikujenlola & Opawale, 2007). The degradation starts 40 to 48 hours after harvesting if no minimal processing is done to preserve them (Djoudji & Dorothy, 2021). According to Oluwatusin (2017), the post-harvest losses are significant and account for 30% of the production of cassava roots. To alleviate these losses, the roots are transformed into various products (*sun-dried crisps, starch, flour, water-fufu, gari, bobolo, miondo etc…*) to reduce moisture content and increase the shelf-live (Djoudji & Dorothy, 2021; Kayode et al., 2021). The transformation of cassava roots into cassava crisps could be an alternative way of preservation.

Crisps are popularly consumed as snacks away from homes and in-between meals. Potato and plantain crisps are some of the popular snack foods in many countries of the world. Potato and plantain crisps are low-fat foods and are commonly served as an appetizer, side dish or snack. The basic crisps are cooked and salted; additional varieties are manufactured using various flavors and ingredients including seasonings, herbs, spices, cheeses, and artificial additives. Despite its higher productivity and its main rule as staple food in many houses, cassava crisps are not well known in Cameroon. Cassava crisps are increasingly popular in Kenya's urban areas (Abong *et al.*, 2011).

In Cameroon, potato and plantain crisps are the most popular nibbling products in local markets and restaurants. As the working population grows, the busy schedule of high-street workers has resulted in most people snacking during the day when there is usually no time to enjoy a proper meal. Recently, a research carried out in Cameroon developed fried cassava chips as one innovative product from sweet cassava variety (Eyenga *et al.,* 2018). The same authors reported the greatest appreciation of consumers for the cassava crisps. The population interest to this new product is also growing exponentially. However, the production of these crisps faces a real challenge which is to maintain some physicochemical characteristics such as the original color before frying. The color changing here is mostly due to enzymatic browning. This effect can be reduced or avoided by pre-drying or blanching of the sliced cassava roots prior to crisps production. In fact, Quayson *et al.* (2021) reported that pre-treatment such as blanching, roasting significantly decreased enzymatic browning reactions. The objective of this work was therefore, to evaluate the effect of drying and blanching as pre-treatments on some physicochemical characteristics and sensorial properties of cassava crisps production.

2. Materials and Methods

2.1. Materials

Sweet red cassava roots were harvested from a farm in Suza (4° 14' 32" North, 9° 36' 32" East), Littoral region of Cameroon in the month of December 2022. The refined palm oil used for frying was bought from a supermarket in Douala, Littoral Region, Cameroon.

2.2. Methods

2.2.1. Cassava crisps production

Cassava crisps samples were produced following the different steps as shown in figure 1.

was done in order to remove the inedible outer parts of the roots consisting of the corky periderm and the cortex. The peeled cassava tubers were then washed thoroughly with tap water to remove adhering soil particles and other foreign debris (pictures 1 and 2). The clean cassava roots were wiped dried with clean tissue and sorted to remove small and injured roots.

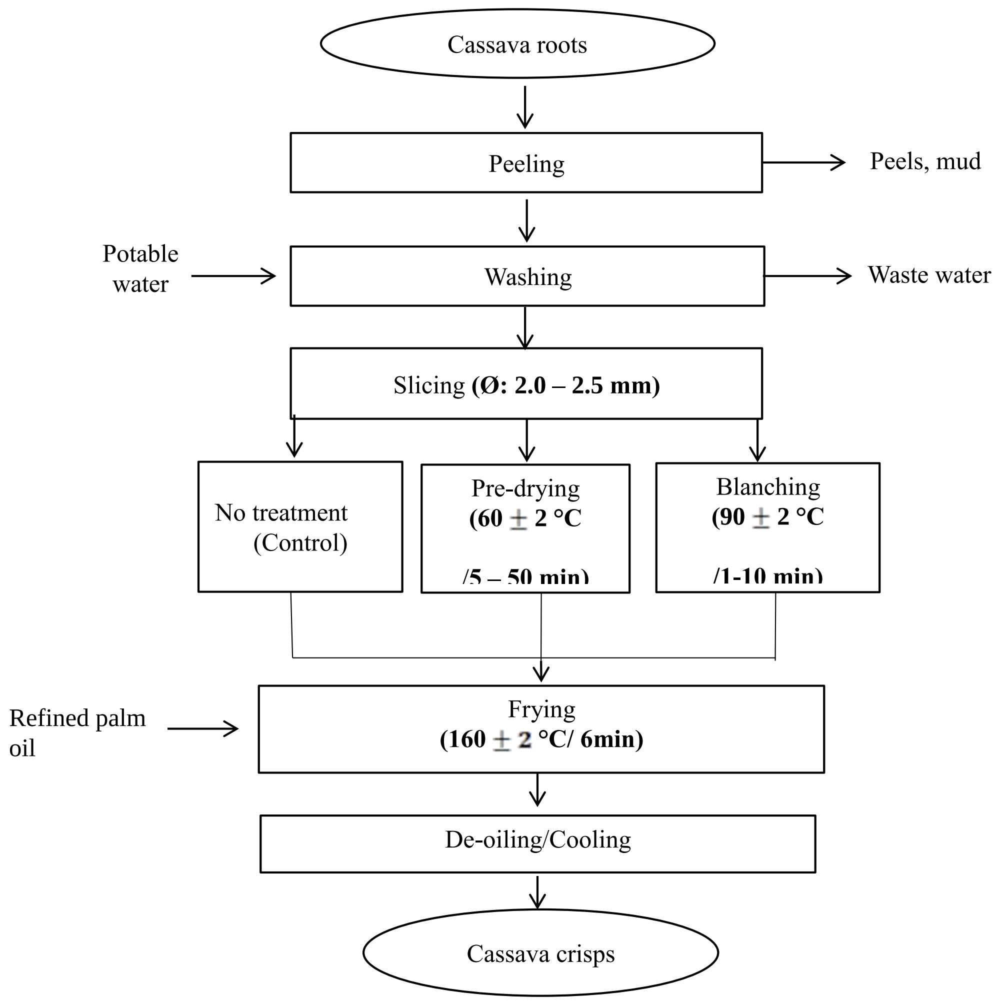

Figure 1: Flow diagram for cassava crisps samples production

2.2.1.1. Peeling and washing

Cassava tubers were peeled manually with a stainless-steel knife to remove the bark and expose the fleshy parenchyma. This operation

2.2.1.2. Slicing

In order to obtain desirable size and shape of cassava slice, cassava roots were cut manually into slices of 2.0-2.5 mm thick (pictures 3 and 4) with the help of crisps plastic cutter.

Picture 1 : Cassava roots before peeling

Picture 2 : Cassava roots after peeling

Picture 3: Peeled cassava roots

Picture 4 : Sliced cassava roots

2.2.1.3. Pre-treatment methods

Blanching

The sliced cassava was divided into portions of 200g and each of them was blanched in 1000 mL of boiling water at 90±2°C for 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10 min respectively. After blanching, each portion was collected in a plastic basket for spin-drying before frying.

Pre-drying

Reducing the moisture content of food in some cases is a great advantage prior to processing. Capar & Yalcin (2017) showed that pre-drying affects the quality of fried potato slices as well as the quality of oil used. The sliced cassava roots were divided into portions of 200 g each, which were pre-dried at 60±2°C for 5, 10, 15, 20, 25, 30, 35, 40, 45 and 50 min respectively in an electric dryer (CUSIMAX).

2.2.1.4. Frying

The fryer (Deep electric fryer, Moulinex, France) was filled with 2 L refined vegetable oil. The fryer was equipped with a metal mesh basket in which the samples were immersed in the oil and fried in the proportion of 1:3 (V/V). To determine the best frying time, the frying temperature was kept at 160 °C (Vitrac, 2000).

2.2.1.5. De-oiling

In order to remove the excess oil droplets on the surface of the cassava crisps samples, the fried crisps were gently blotted with absorbent tissue to remove surface oil and were put in sealed tins wrapped with aluminum foil till further analysis.

2.2.2 Sensory evaluation

After the frying, sensory evaluation was done on each of the cassava samples in order to eliminate those which were not generally accepted and choose the best sample. Ninety-five panelists constituted of naïve males and females participated in the evaluation of the color, flavor, oil taste texture and overall acceptability. The evaluation was done using a 9-point hedonic scale ranged from 0 (Dislike extremely) to 9 (like extremely) (Xia *et al.,* 2020).

2.2.3 Physicochemical analyses

2.2.3.1. Moisture, Ash and Oil contents

The moisture and ash contents of the produced cassava crisps were evaluated via the method described by Liao *et al.* (2020). Oil content was determined using the Soxhlet extraction method, according to the Russian method as described by Bourely (1982).

2.2.3.2 Texture

Cassava crisps texture was evaluated using the Brookfield LFRA Texture Analyzer. The hardness of crisps was expressed in Newton (N).

2.2.3.3. Color analysis

Cassava crisps color was analyzed as described by Abong *et al.* (2011), using the CIE Lab L*, a* and b* scale, with L* indicating lightness, a* the redness and b* the yellowness degree, with the aid of "Image J" software (using the Color Transformer 2 tool). The color intensity (C), the hue angle (h_{ab}) and the total color difference (ΔE) were calculated as follow:

$$C = \sqrt{a^{*2} + b^{*2}}$$

$$h_{ab} = \tan^{-1}(b^*/a^*)$$

2.3. Statistical analyses

All experiments were performed in triplicate. Data were subjected to the analysis of variance (ANOVA) and difference between means was statistically determined at a level of significance of 95% confidence level according to Fisher's LSD test.

3. Results and Discussion

3.1. Sensory evaluation of the cassava crisps

Sensory evaluation is a scientific method used to measure, analyze and interpret responses to products, as perceived through the senses of sight, smell, touch, taste and hearing (Sung, 2010). The sensory characterization of the various cassava crisps was evaluated and the results are presented in figure 2 and 3 respectively for pre-dried and blanched samples. These figures were made from the mean values of the perception of the panelists for each characteristic and product.

3.1.1. Pre-dried crisps

The effect of the pre-drying process was evaluated on the sensorial characteristics of the produced cassava crisps. From figure 2, the cassava crisps prepared with pre-dried samples for 5, 10, 15, 20 minutes and the control were more intense in appearance (color) with a score of 7.28, 6.81, 6.52, 6.52 and 7.23/10 respectively compared to those pre-dried for 25, 30, 35, 40, 45 and 50 min that had a respective score of 4.29, 3.76, 2.71, 1.99, 1.82 and 1.60/10. This may be due to the fact that, the pre-dried samples contained reducing sugar which during the frying process via the Maillard reactions gave them their intense color (Quayson *et al.,* 2021). In fact, during the Maillard reaction there may be production of brown polymers which tend to become dark as the temperature increases. Also, during the pre-drying process of cassava the enzymatic browning occurred and could leads to the formation of brown Maillard products proportionally to the reaction time. These brown products could contribute to the reduction of color intensity as pre-drying time increases.

As far as the flavor, crispiness and oil taste were concerned, the pre-dried (5 to 20 minutes) and control crisp samples gave identical mean readings which were higher than that of the sample pre-dried at 25 to 50 minutes.

4.34, 3.16, 2.68, 1.99 and 1.53/10 respectively). This could be due to the fact that during blanching, there are losses of soluble nutrients such as free sugars, amino acids and proteins which are substrates of non-enzymatic reactions. Similarly, the flavor, the crispiness and the oil taste of the samples blanched for 1 to 5 minutes and the control crisp sample gave identical mean readings which are higher than that of crisp samples blanched for 5 to 10 minutes.

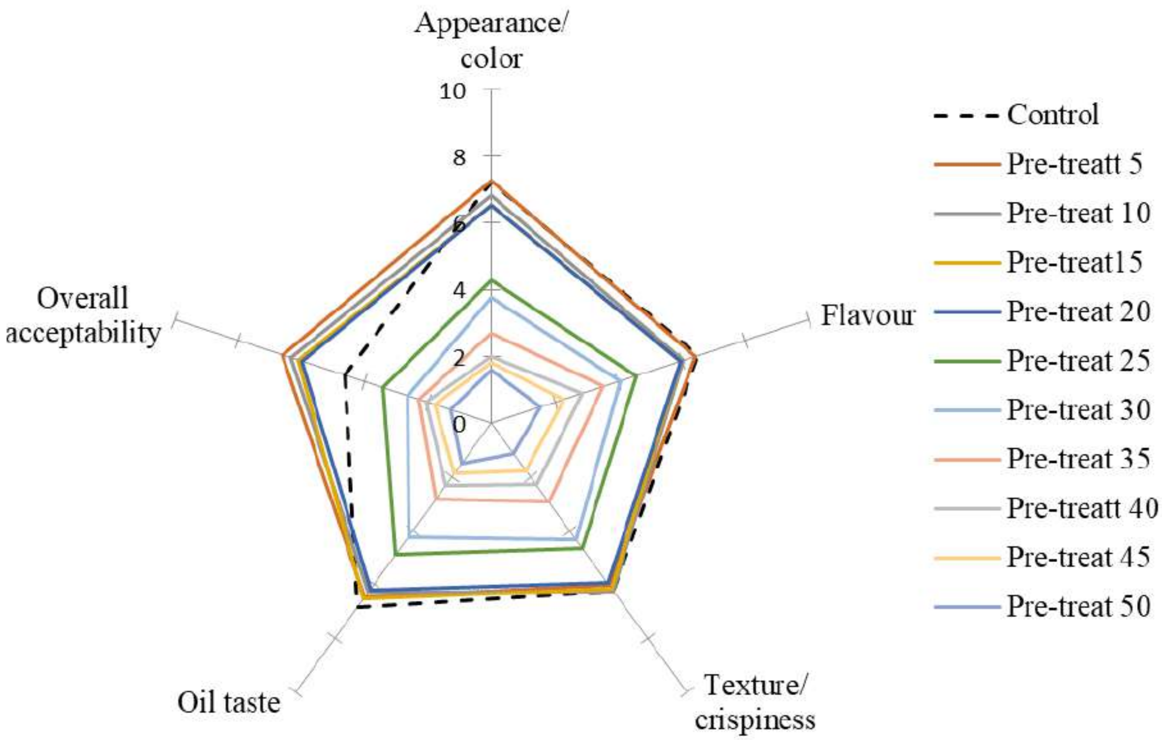

Figure 2: Sensory profile of pre-dried and control cassava crisps

3.1.2 Blanched crisps

Fresh cassava crisps were blanched to modify the starchy structure before the frying process at different times. It was noticed from figure 3 that with the score of 7.28, 8.14, 7.33 and 7.04/10 respectively, the blanched crisp samples treated at 1, 2, 3, and 4 minutes were less intense in appearance (color) than the crisp samples blanched for 5, 6, 7, 8, 9 and 10 minutes (4.88, In fact, during blanching, there is a loss of multiple nutrients and inactivation of some enzymes such as peroxidase and polyphenol oxidase which are responsible for enzymatic browning (Nascimento & Canteri, 2018). It should be underscored that the later reaction significantly ($P < 0.05$) affects the organoleptic parameter of food systems (Thakur *et al.,* 2010).

This result is in line with that of Adetoro *et al.* (2021), who found the decrease in total color difference of the Pomegranate arils (*Punica granatum* L.) during blanching.

crisps samples (pre-dried for 5 to 20 min and blanched for 1 to 5 min) as well as the control were given to panelist members for judgment in order the select the best sample.

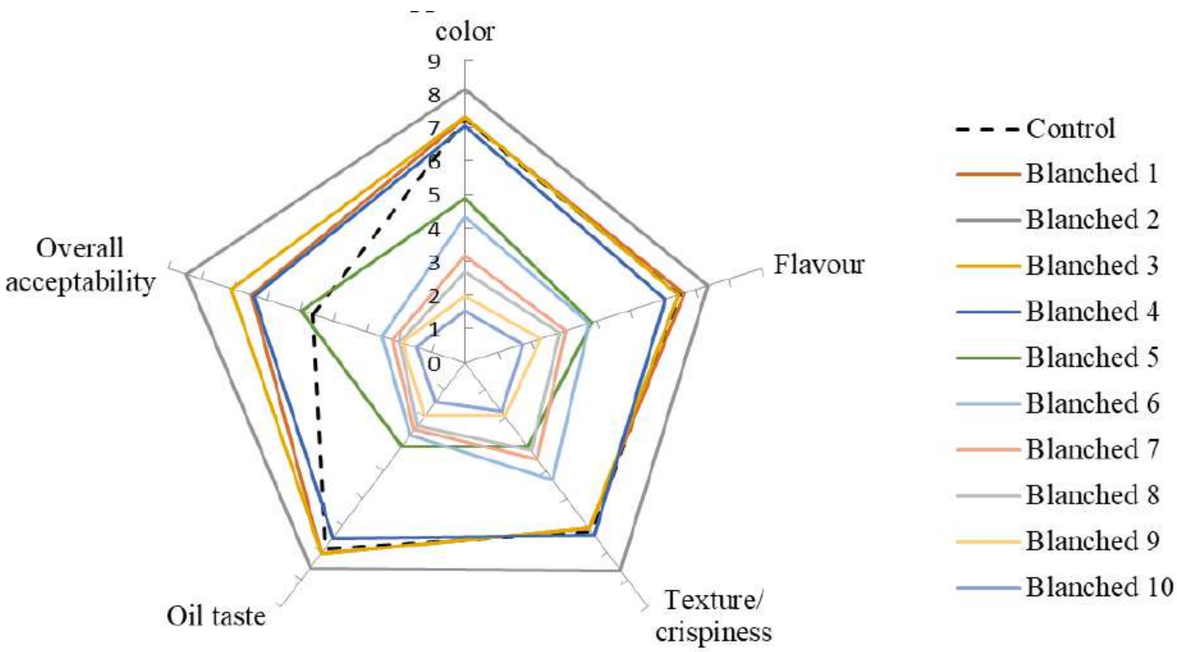

Figure 3: Sensory profile of blanched and control cassava crisps

In general, the sensory analyses showed that all pre-treatment times influenced the quality of the pre-dried and blanched cassava crisps such as the appearance, flavor, crispiness and oil taste. However, the pre-dried for 5 to 20 min and blanched for 1 to 5 min crisps samples were generally accepted by panelists. Based on these results, 12 samples namely, pre-dried at 25 to 50 crisps and blanched at 5 to 10 min were eliminated and the physicochemical characterization of the eight retained samples was evaluated.

3.1.3. Sample selection

The selection of the best sample was done based on the sensory scores of the preferred crisps samples. The previous eight accepted cassava

The recorded result of the sensory characterization permitted to draw the sensorial profile illustrated in figure 4.

The result presented in figure 4 revealed that, the blanched (2 min) crisp samples had the highest sensory characterization score of 8.14, 7.39, 7.66, 7.57 and 8.47/10 for appearance/ color, flavor, texture, crispiness, oil taste and overall acceptability respectively, compared to the control and pre-treated crisps samples. This sample was therefore, chosen as best cassava crisps among all based on its sensorial parameters.

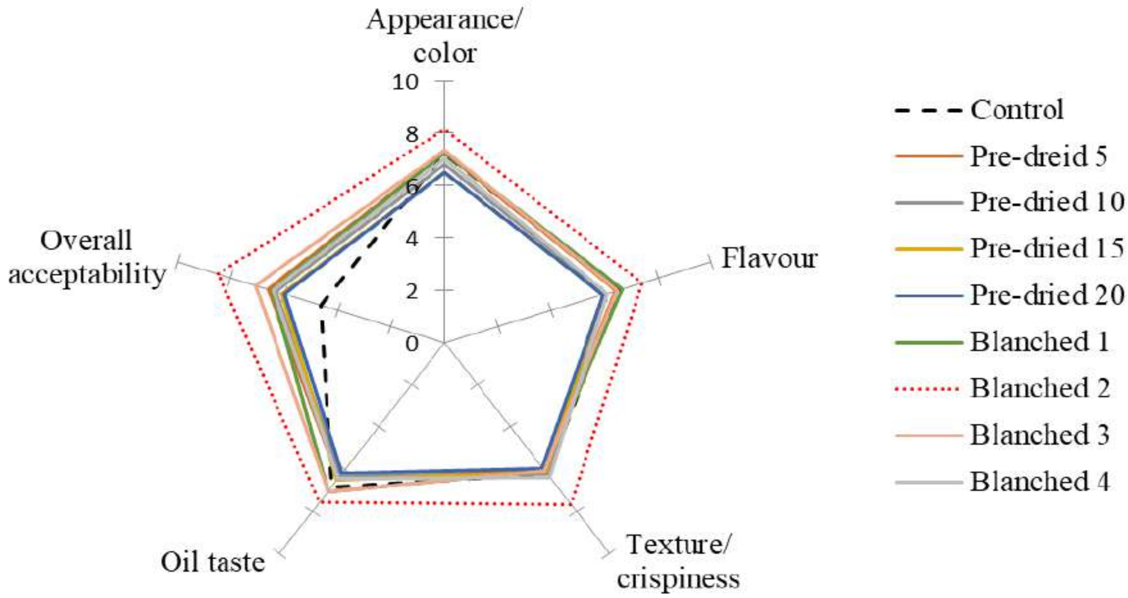

Figure 4: Sensory profile characterization of the accepted pre-dried and blanched cassava crisp samples and control

3.2. Physicochemical analyses

The moisture, ash, oil contents, the texture as well as the color of the eight preferred samples (pre-dried for 5, 10, 15, 20 min, blanched for 1, 2, 3, 4min and the control) were evaluated.

3.2.1. Moisture contents

The moisture contents of the pre-dried cassava crisps ranged from 2.39 to 4.44 % and that of the blanched cassava crisps from 6.85 to 8.47 % (figure 5). These values were significantly (P< 0.05) different from that the control 5.11 %. Only the pre-dried crisp samples had the recommended moisture levels which is less or equal to 5 % (EAS, 2010). The important moisture recorded with blanched sample could be due to the higher quantity of water absorbed during the blanching process. Also, during blanching, the starch grain absorbs water in the pre- gelatinization and significantly contributes to the overall water adsorption capacity. In general, irrespective of the pre-treatment method, the moisture content reduces with the increase of processing time. This trend could be justified by the water evaporation during the frying process. The reduction of the moisture content is of great interest for the final products. In fact, lower moisture content, contribute in increasing the shelf life of the product as this significantly affect the microbial development on the food products (Onyema, 2015).

3.2.2. Ash contents

The ash contents of the blanched, pre-dried and control cassava crisp samples were determined and the results were converted in percentage taking the value of the control as 100% (figure 6). The ash values of cassava crisps ranged from 0.46 to 0.76 % and from 0.05 to 0.37 % for the pre-dried and blanched samples respectively.

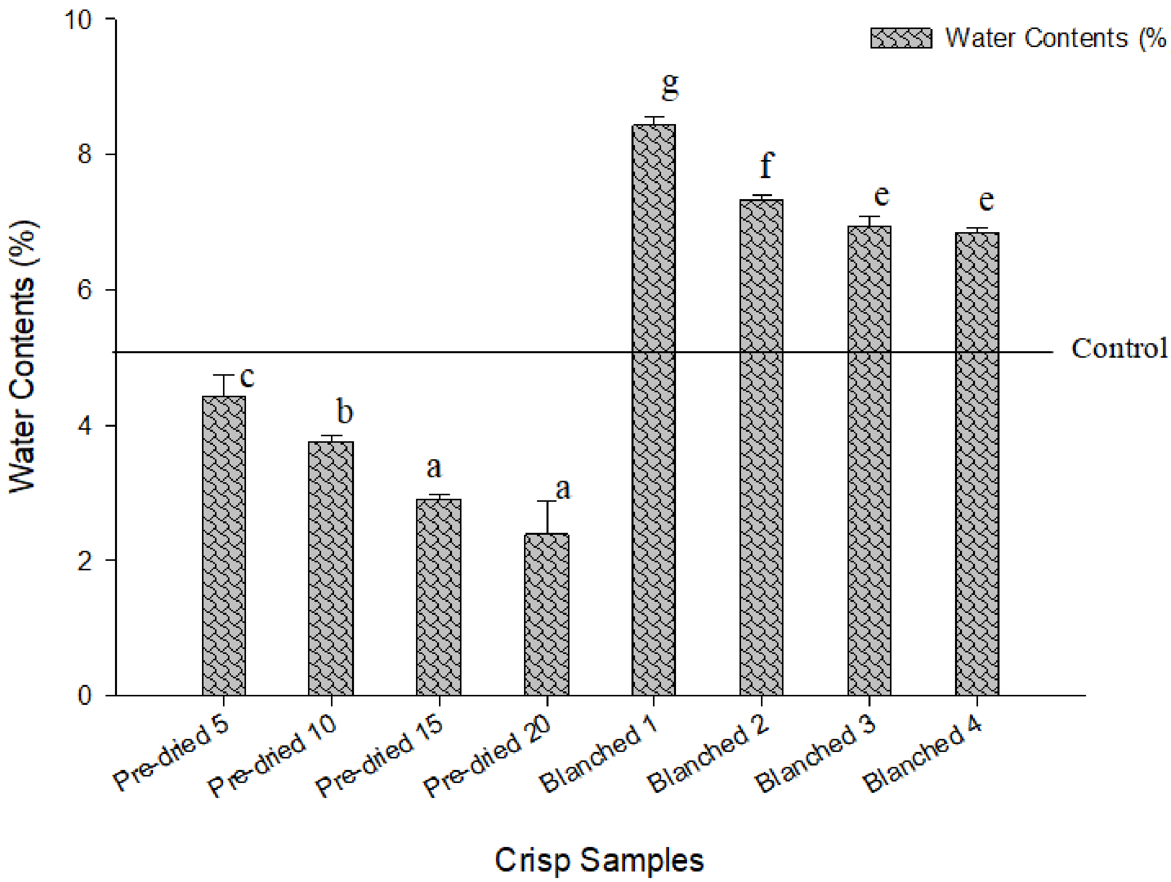

Figure 5: Water contents of the selected cassava crisps samples

These values were significantly different (P< 0.05) to that of the control sample (0.54%) which means that the pre-treatments affected the ash contents.

The ash contents of the pre-dried samples were higher compared to the blanched samples. This could be due to the hydro-solubility of minerals which leads to their loss by leaching. It was also found that ash contents abridged with the increases of blanching time. Similar result was reported by Korus (2021) who found that the ash content of kale leaves (*Brassica oleracea*) reduced up to 21% during blanching process. As far as pre-dried sample was concerned, there was a general increased of the ash content with respect to the pre-treatment time and compared to the control sample. This difference can be justified by the concentration of minerals after the evaporation of water during drying. Shonte *et al.* (2020), reported freeze dried and oven dried nettle leaves (*Urtica dioica*) as rich sources of minerals such as calcium, magnesium, iron potassium and manganese.

3.2.3. Oil contents

Oil content is a significant processing factor and its level in a food product has a number of implications as it determines some functional properties of the food. The oil contents of pre-dried and blanched cassava crisp samples were evaluated and the results are presented in table 1.

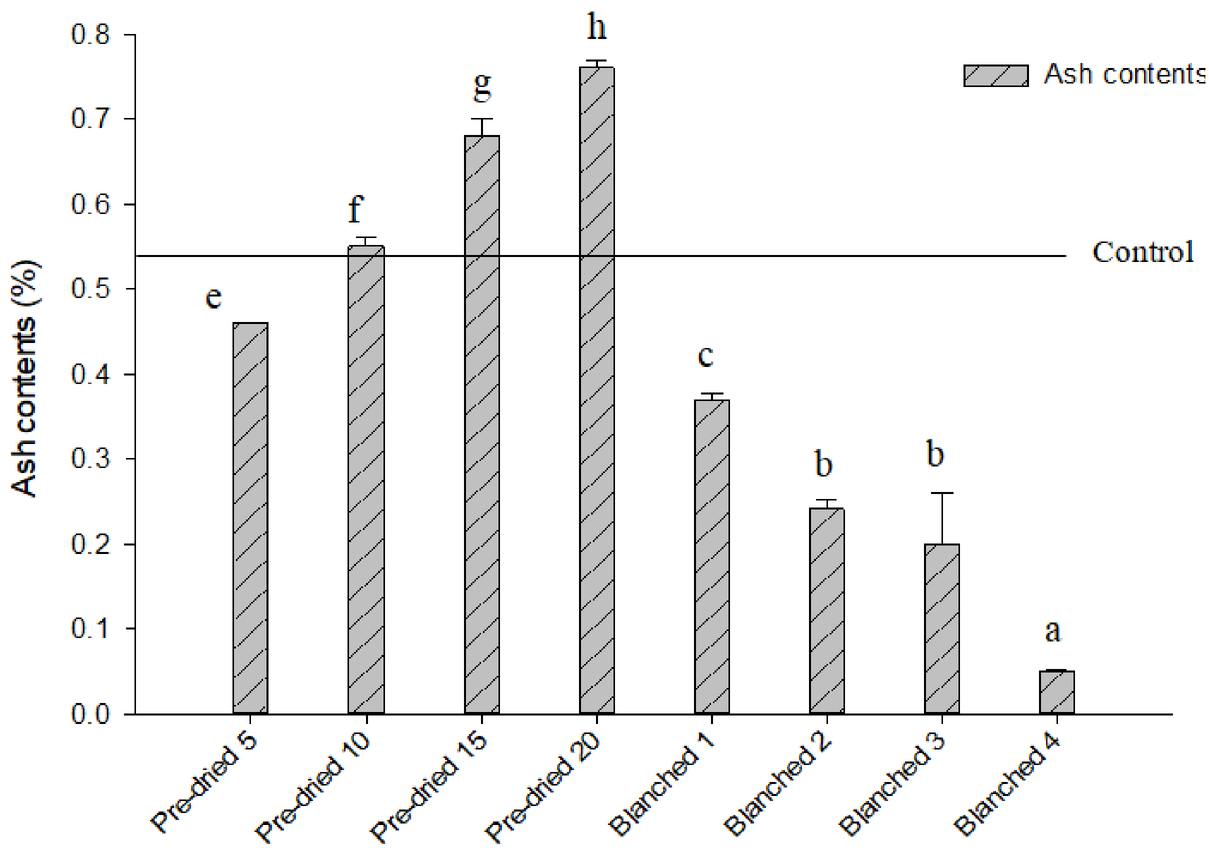

Figure 6: Ash contents of the cassava crisp samples with respect of pretreatment times

In general, the pre-dried treatment slightly impacted the oil contents. A significant ($P < 0.05$) variation was observed with blanched samples. The oil content of the later increased with the pre-treatment time.

This augmentation could be explained by the absorption of oil by cassava crisps due to the softness of the plant tissues during blanching process. In general, during the blanching process, plant cell tissues become soft due to the temperature of hot blanching water which affected the native shape of the cell. The higher oil absorption capacity (OAC) found with blanched samples could be explained by the pre-gelatinization of starch which could trap some oil molecule in the net formed by starch structure during blanching. Also, the slicing of cassava exposed some proteins which could fix oil during the blanching process and increase therefore the overall OAC of the final product. This result is similar to that of Etudaiye *et al.* (2015), who reported an increase in OAC of confectioneries made with sweet potato starches and wheat flours from 1.5 to 2.5 g/mL when the temperature of gelatinization moved from 48.0 to 65.5°C. Also, according to Wang et al. (2017), proteins have the ability to increase the OAC by fixing oil molecule through different bonds such as hydrophobic, electrostatic, and hydrogen bonding. The oil content obtained for pre-dried cassava crisps ranged from 14.05 to 16.11 % which was similar to 15.11% reported by Eyenga *et al.* (2018).

However, blanched crisp samples exhibited oil contents ranged from 24.39 to 30.70 % with the highest value being that of the sample blanched for 4min. Both the pre-dried and blanched crisp samples had the recommended oil levels of less than 35 % (EAS, 2010). Oil contents in food can be perceived in two angles. In fact, food with higher oil content can have negative aspect as oil may reduce the shelf-life of a food products through oxidation and increases the potentiality of metabolic diseases to consumers (Shetty & Kumari, 2021; Unhapipatpong et al., 2021). Additionally, very low oil percentage in food such as crisps may lead to rejection of the product due to hardness and lower test (Abong *et al.*, 2016).

3.2.4. Texture measurements of the cassava crisps

One of the main obstacles encountered with cassava crisps production is to obtain acceptable texture. Texture was measured in term of hardness. The lowest the hardness the higher is the friability of the crisp. It was reported that texture is an organoleptic attribute which affects mostly the quality of processed chips food (Kulchan *et al.*, 2010). Specifically, for dried foods such as chips, the greatest desired characteristic is crispness. The compression force (N) recorded for the pre-dried and blanched cassava crisp samples which expressed the degree of crispness is shown in figure 7.

The friability or crispness of the crisps was differently affected by the pre-treatments. There was a significant ($P < 0.05$) increase in the friability of the crisps with the rises of the pre-drying time. This result can be due to the evaporation of free water which proportionally increased with the dry matter and therefore improve the friability of the final product. Also, an increase in blanching time leads to a decrease in the friability of the crisps. This means that the higher the blanching time, the lower the resisting compressive force of the cassava crisps. In fact, increasing the blanching time proportionally increased the contact time between the crisp sample and the water which could probably cause some hydrolysis or denaturation reactions. According to Sun *et al.* (2022), the heat treatment during blanching breaks the starch chain and destroys the arrangement of the crystal zone and reduce the resistance of the grain to crack. This result is in agreement with that of Adetoro *et al.* (2021), but contrasted those pointed out by Beveridge & Weintraub (1995), who found that the hardness of red sliced apples increases after blanching process.

Table 1: Oil contents of the cassava crisps with respect of the pre-treatment times

Samples	Pre-treatment Times (min)	Oil contents (% DW)
Control	0	14.41 ± 0.12^{c}
Pre-dried	5	14.05 ± 0.21^{a}
	10	14.2 ± 0.63^{b}
	15	14.93 ± 0.03^{d}
	20	16.11 ± 0.63^{e}
Blanched	1	24.3 ± 0.83^{b}
	2	25.15 ± 0.21^{bc}
	3	26.59 ± 0.27^{bc}
	4	30.70 ± 0.59^{d}

The values carrying the same superscript letters for the same treatment are not significantly different (p<0.05).

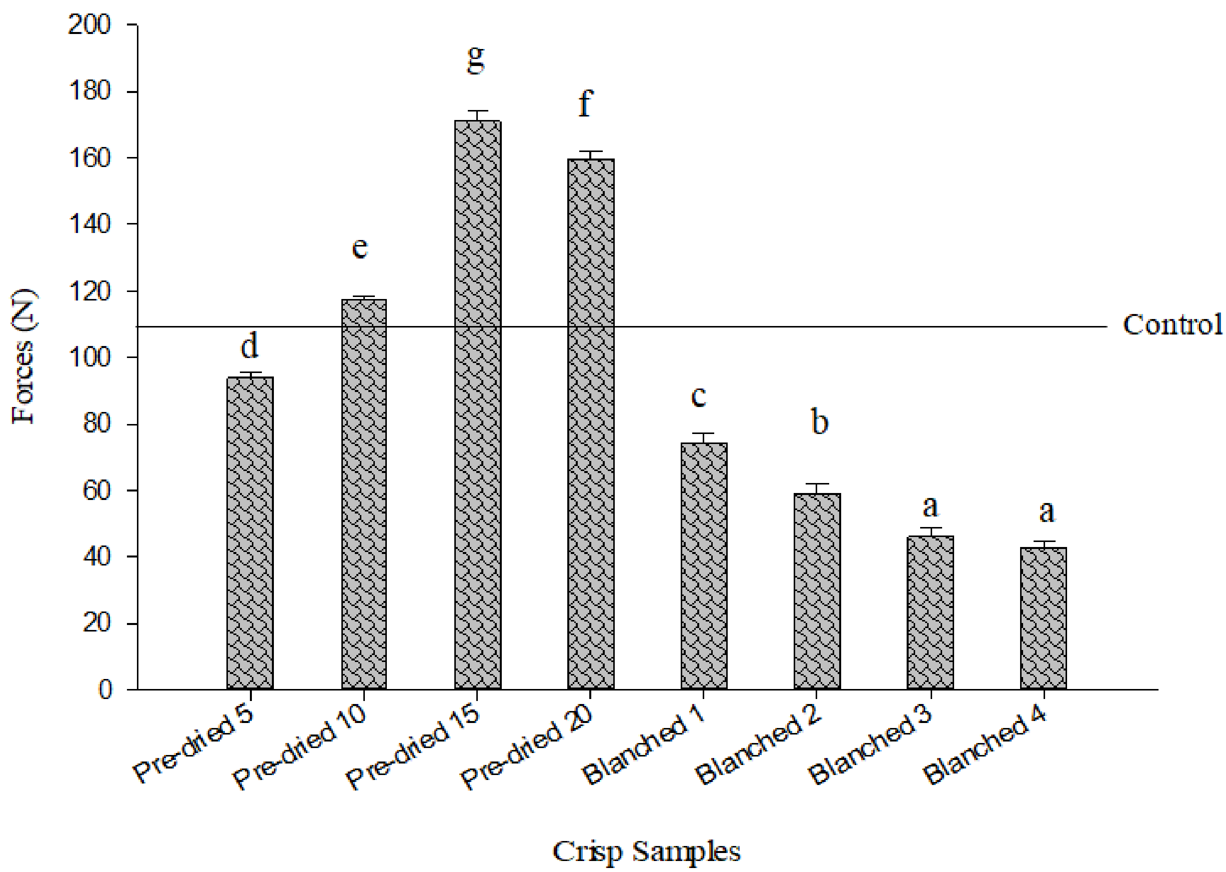

Figure 7: Friability of the cassava crisps with respect of the pre-treatments

3.6. Color analyses

According to García-Segovia *et al.* (2016) color is known as the most important attribute in the perception of the overall chips quality. The effect of blanching and pre-drying on color values of fried sweet cassava chips was estimated in terms of Lab coordinates and results are presented in table 2.

The values of the lightness (L*) changed slightly for all cassava crisps samples and were ranging from 75.38 to 87.95%. The control and blanched samples had higher L* values compared to pre-dried samples. This could be explained by the inactivation of enzymes and the solubilization of reducing sugars during pre-treatment processes and especially those responsible of browning. The pre-drying process also reduces water content which affect the water activity and therefore leads to the reduction of biochemical changes. However, although the L* values were significantly different ($P < 0.05$) from one to another, they were all above 50 for cassava crisps, indicating that products were lighter in color. This lightness result is very important for the new produced crisps since color plays a significant role in food selection. These findings are contradictory to the report of Adetoro et al. (2021), who pointed out the decrease of L* value of pomegranate arils from 20.04 to18.4.

The redness (a*) values of the fried cassava crisps were very low, pointing out a tendency of the cassava crisps to have more of greenish color rather than red. Moreover, a higher a* value shows that more Maillard reactions had occurred (Garayo & Moreira, 2002). The samples which were pre-dried before frying have a slightly higher a* values than the control and blanched sample. This result is similar to that of Capar & Yalcin (2017) who reported a decrease of redness of fried potatoes slices after pre-drying treatments.

The yellowness of a food products is specified by the parameter b* in color measurement. The b* values augmented gradually in all crisp samples and were ranged from 13.21 to 44.73. In general, higher b* parameter values gives more yellow products, which is desirable for fried products (Krokida et al., 2001). The great difference observed in b* values between pre-treated samples and the control could be due to the oil adsorption by cassava crisps during frying. In fact, Borah & Nayak (2013), pointed out an increase in oil content in chips with the frying time. Similar result was obtained by Abong *et al.* (2011) on the crisps made with potato in Kenya.

Chroma (C) describes the vividness or dullness of a color. In other words, the intensity or saturation level of a particular hue which is defined as the distance of departure of a chromatic color from the neutral (gray) color with the same value and generally ranges from 0 to 60. The chroma values of the cassava crisp samples were ranging from 18.52 to 46.16. In general, the pre-dried samples showed higher C value than blanched samples. The value equally dropped with the pre-treatment time irrespective of the method. This implies that, the chroma value contributed to the level of redness of cassava crisps for blanched samples. Blanching therefore contributed to retain the color intensity of cassava crisps than pre-dried treatment. This result alike that of Ziabakhsh Deylami *et al.* (2016), who reported a significant retaining of the color of mangosteens (*Garcinia mangosttana*) after blanching.

Table 2: Color parameters of pre-dried and blanched cassava crisps compared to the control.

Samples	Pre-treatment times (min)	Color values				
		L*	a*	b*	C	h_{ab}
Control	0	87.73±3.00 ^{b}	-10.04±2.22 ^{d}	33.87±5.05 ^{c}	35.33±5.47 ^{c}	106.39±1.20 ^{a}
Pre-dried	5	75.39±3.76 ^{b}	-9.75±1.61 ^{bc}	42.86±0.31 ^{d}	43.97±0.59 ^{d}	102.79±2.00 ^{a}
	10	76.43±2.77 ^{b}	-11.36±1.34 ^{b}	44.73±0.02 ^{c}	46.16±0.31 ^{c}	104.25±1.62 ^{b}
	15	75.74±2.27 ^{b}	-9.73±0.61 ^{cd}	43.89±0.67 ^{b}	44.96±0.64 ^{b}	102.49±0.81 ^{b}
	20	78.23±2.60 ^{b}	-8.01±1.27 ^{a}	36.64±0.62 ^{c}	37.52±0.87 ^{cd}	102.31±1.70 ^{b}
Blanched	1	85.18±0.51 ^{a}	-13.20±0.85 ^{cd}	38.37±1.38 ^{c}	40.58±1.23 ^{b}	109.00±1.49 ^{a}
	2	85.06±4.032 ^{a}	-13.99±1.68 ^{ab}	31.57±2.17 ^{d}	34.55±2.49 ^{c}	113.87±1.93 ^{a}
	3	85.74±2.19 ^{a}	-11.50±0.59 ^{cd}	24.86±0.46 ^{cd}	27.39±0.25 ^{cd}	114.83±1.48 ^{a}
	4	87.95±0.15 ^{a}	-14.26±0.91 ^{d}	33.87±0.80 ^{b}	36.76±0.39 ^{d}	112.84±1.79 ^{a}

The means with different superscript letters in the same line are significantly different ($P < 0.05$). L = lightness, a* = redness, b* = yellowness, C = color intensity, h_{ab} = Hue angle (in degree).*

Hue angle characterizes an object through its color by measuring how a color is perceived to be red, yellow, green, blue, purple etc. and it generally ranges from 0 to 360°. White, black and gray colors possess no hue. The hue angles of the cassava crisp samples ranged from 102.31 to 134.34° (table 2). According to the hue disc, the cassava crisp samples fall within the range 90 to 119°, showing a tender green color. Hence, pre-dried and blanched crisp samples are less greenish compared to the raw cassava slice.

4. Conclusion

This study aimed to valorize sweet cassava crisps by evaluating the effect of drying and blanching as two pre-treatment methods on its overall acceptability. It is established that the blanching and pre-drying processes significantly affect the physicochemical, functional and sensorial characteristic of the cassava crisps. The cassava crisps prepared after blanching had good sensorial characteristics (appearance/color, flavor, crispiness, oil taste and overall acceptance) compared to crisp samples prepared after pre-drying. However, further studies need to be done to optimize the nutritional characteristics of the blanched sweet cassava crisps.

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None

Conflict of interest

The authors declare that they have no competing interests.

Ethics

This Study does not involve Human or Animal Testing.

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None

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