Field Scientific Report

Participatory Processing Diagnosis of Attieke in Côte d'Ivoire

Understanding the Drivers of Trait Preferences and the Development of Multi-user RTB Product Profiles, WP1, Step 3

Abidjan, Côte d'Ivoire, September 2021

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Ethics: The activities, which led to the production of this document, were assessed and approved by the CIRAD Ethics Committee (H2020 ethics self-assessment procedure). When relevant, samples were prepared according to good hygiene and manufacturing practices. When external participants were involved in an activity, they were priorly informed about the objective of the activity and explained that their participation was entirely voluntary, that they could stop the interview at any point and that their responses would be anonymous and securely stored by the research team for research purposes. Written consent (signature) was systematically sought from sensory panelists and from consumers participating in activities.

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ABSTRACT

Participatory Processing Diagnosis for Attieke in Cote d'Ivoire

Bouake

September 2021

As part of activities to understand end-users' preferences, processing demonstrations were carried out in order to understand processors' demand for quality characteristics of cassava while processing different varieties. This study was done between the 9th and 12th September 2021 in Bouake, Cote d'Ivoire. Six (6) experienced processors belonging to an Attieke production unit were selected to produce attieke using 6 varieties harvested from CNRA experimental plot. The varieties are traditional cassava and hybrids, said to be of good quality (Yace and Yavo), of intermediate quality (Bocou2 and Agbable3) and less good quality (I083774 and Bocou4). Raw material characteristics were evaluated before the processing. Interviews were conducted at each step of processing using a structured questionnaire and results were analysed using SPSS 22.0.

Bocou 2 and I083774, 2 hybrids, orange flesh cassava, had the highest morphological characteristics. Findings showed that attieke is produced following a 11-step process, including ferment preparation, peeling, washing, milling, fermentation, pressing, sieving, rolling, winnowing, drying, and cooking. During processing, Bocou and I083774, the orange flesh hybrids, presented the highest peeling yield (73%). They had along with Agbable32, the local variety, the highest peeling productivity (35.48 to 42.05kg/hour/operator), meaning that they are easier to peeling than other varieties. However, at the fermentation, pressing and cooking level, the hybrid I083774 scored low compared to other varieties. It has a low dry matter content. Consequently, it had the lowest fermentation, pressing and cooking yield (50% w.b. of peeled cassava, compared to 67% w.b. for Agbable3). The global process yield ranged from 37 to 48% w.b. Yace, the preferred variety had the highest global process yield.

During this study, it was discovered that the quality of the end-product depends more on the control of critical points, which can be adjusted for a good outcome. The mastery of the process is therefore more important than the quality of the raw product. Although processors preferred medium size white cassava, non or less fibrous, with a high dry matter content, easy to peel and to grind.

Keywords: Cassava, Attieke, process, participatory diagnosis, cassava hybrids, yield.

1 STUDY CONTEXT AND GENERAL OBJECTIVES

Attieke is a cassava couscous produced by steaming fermented cassava pulp semolina. It is an Ivorian traditional calorie-dense side dish, with a slight sour taste. It originated from the South area of Côte d'Ivoire, and has become one of the most consumed side-dish in the whole country. Its fame has exceeded the Ivorian borders. This product is now consumed, and even manufactured in West Africa and even in China and other parts of Asia. It is eaten with fish, meat and vegetables.

Although attieke is processed in different forms, its sensory quality and the suitability of a cassava variety for making high quality attieke are important factors in the acceptance of a variety by processors and farmers.

After the previous Activity 3 “Survey with processors from which some sensory characteristics of Attieke were collected, Activity 4 or “Processing diagnosis”, aims to get a better understanding of processors’ quality characteristics of cassava while preparing Attieke. The knowledge of quality crop characteristics important to end-users are necessary for the development of hybrids that will be adopted.

2 METHODOLOGY

2.1 Study area

Participatory processing demonstration was conducted from September 9th to 12th in an Attieke production unit located in Koko, a neighborhood of Bouake, center of Cote d’Ivoire. Bouake is the hub of Attieke production in the center of the country. This production unit sells several kilos of Attieke every day.

For the study, six (6) experienced processors from the unit were selected. The responsible of the unit gave her approval during a preliminary visit on August 26t^{h} 2021.

For a detailed description of the sampling and methodology, refer to Fliedel et al 2018, Activity 4 manual 2.

2.2 Raw material choice

Processing diagnostics was carried out using 6 cassava varieties: ***Yace, Agbable3, Yavo, Bocou2, Bocou4, I083774***. *Yace and Agbable3* are traditional varieties. Yace is the preferred variety nationally, and Agable3 is a local variety in the Centre of the country to produce Attieke, even though the color of its Attieke product declines some days after preparation. The 4 remaining varieties are hybrids. Yavo is a hybrid variety used for years by Attieke processors. Bocou2, Bocou4 and I083774 are CNRA hybrids. Bocou 2 and I083774 are yellow fleshed cassava roots. Bocou4 is a fibrous variety, not adopted by processors. All the roots were harvested from CNRA experimental plot in Bouake.

2.3 Product profile processing

The normal process for the production of Attieke, helped by the technical sheet of Djedji *et al*., 2019 (in the concern of harmonization), was followed. *Twenty (20) kg of each cassava variety was processed 3 times, each time by a different processor, but following the same process.*

Processing steps are shown in picture in Figure 1 and summarized in Figure 2.

Step 1: Ferment preparation

Whole cassava roots were roasted on fire embers**.** The skin of the roasted roots was removed and the flesh wrapped in polypropylene bags and stored in a tank. These bags were covered with other used bags and cotton fabrics to maintain a certain temperature and avoid air circulation. The roots were left to ferment for 3 days (first day included in the count). Fermented roots are used as ferment at the fermentation step.

Step 2: Peeling and cutting

The harvested cassava roots were peeled off the flesh using a knife. Peeled roots were cut in small pieces in order to ease washing and grinding step.

The fermented roots were also peeled to remove the black cover that has been formed by the growth of microorganisms. Roots were then cut into small pieces.

Step 3: Washing

The cassava roots and fermented roots pieces were washed separately with clean water several times in order to remove dirt.

Step 4: Grinding

The cleaned roots pieces, along with the ferment (10%of the weight of the cleaned roots) and a small quantity of oil were grinded in a professional mill. A bit of water was added to ease grinding and get most of the material out of the grinder.

Step 5: Fermentation

The ground material was wrapped in polypropylene bags and let to ferment overnight (for at least 12h) at room temperature.

Step 6. Pressing

The fermented mash was pressed in a manual press in order to remove water. This step also removes cyanide compounds and decrease the starch content of the mash.

Step 7. Sieving

This step allows the removal of fibers and lumps from the pressed cake by passing it through two sieves, resulting in fine cassava ''powder''.

Step 8: Granulation and winnowing

At this stage, the cassava powder was used to form small round grains like couscous. Depending on the feeling of the water content in the cassava powder, some quantity of water is added to facilitate the grain formation process. Grains are formed by shaking and rotating the powder in a large bowl. After rolling, fibers are removed by sprinkling the grains.

Step9: Drying

Grains were spread in a thin layer on bags and dried for few minutes.

Step 10: Cooking

Dried grains were steam-cooked. Grains were placed in a traditional steamer and closed with cotton cloths in order to trap the steam inside. After sometime, cooked grains are removed from the fire. During the cooking, grains are mixed few times in order to even the cooking.

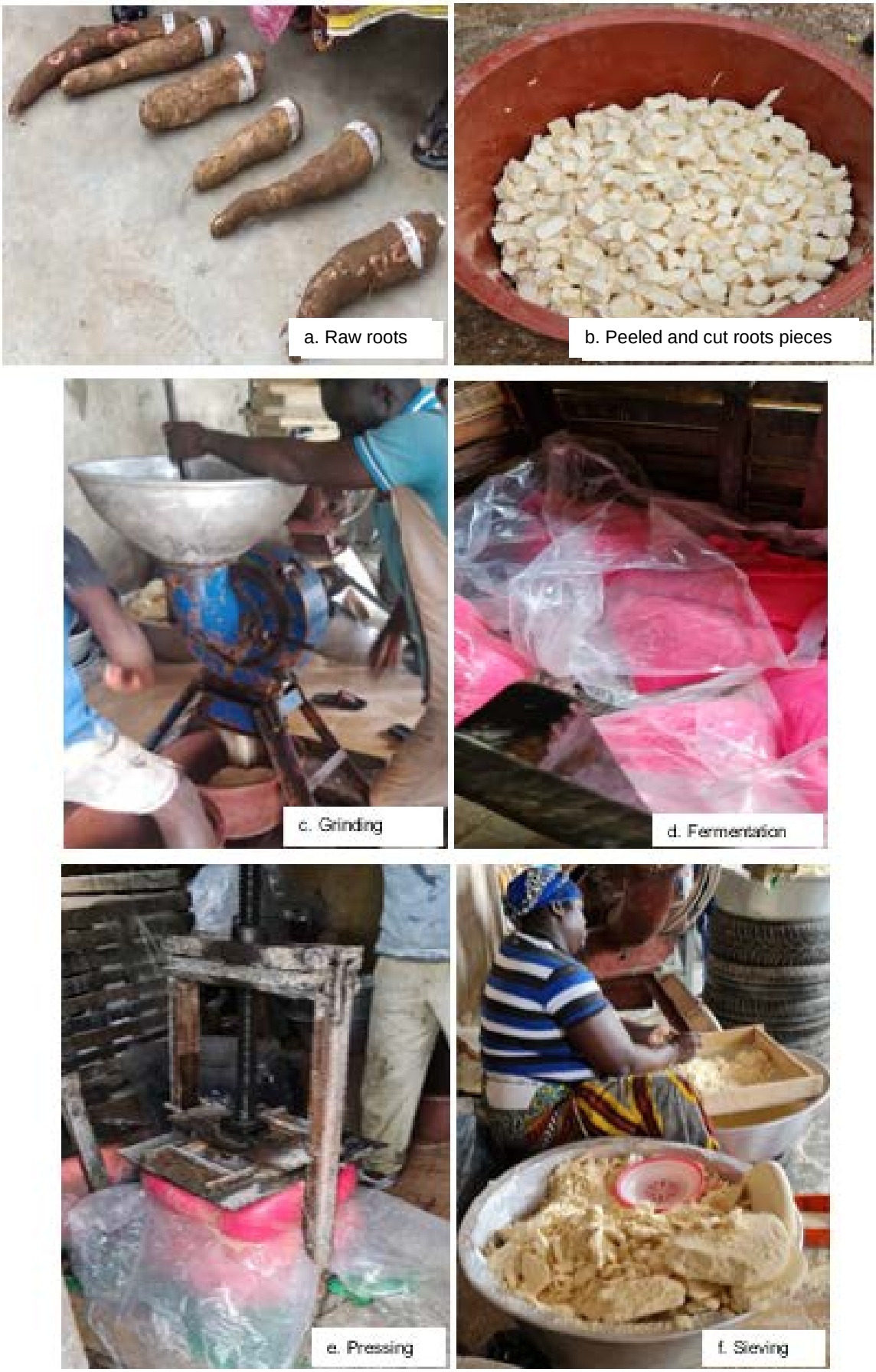

Figure 1a. Attieke production Process

Figure 1a. Attieke production Process

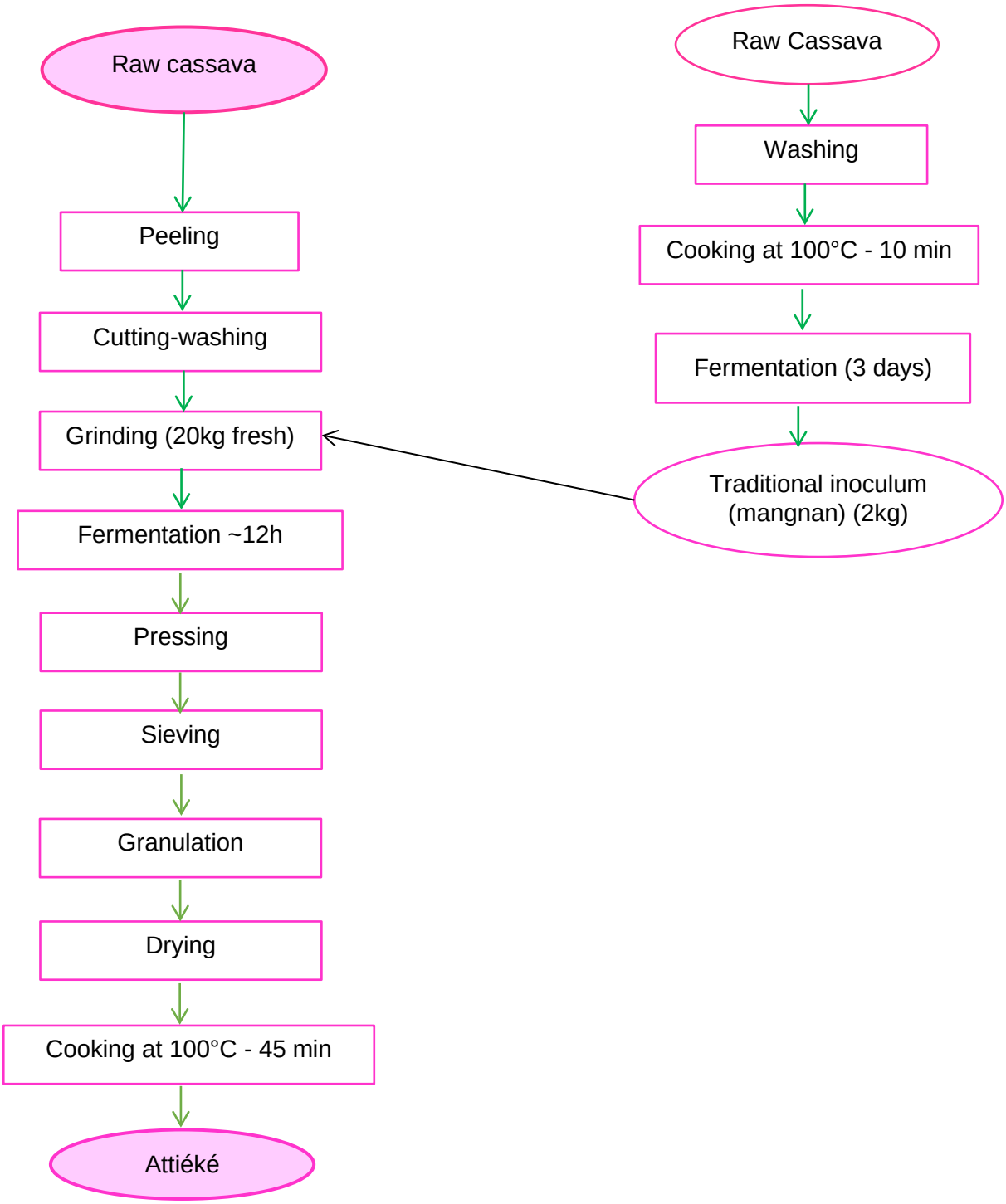

Figure 2. *Flow diagram of Attieke production process*

Table 1: Parameters measured at each operation step

Operation Step	Weights (kg)	Productivity time	Temperature recordings (°C)
Peeling	Weight of roots before and after peeling	Time recorded at each step	
Washing	Weight of washed root pieces		
Grinding	Weight of pieces to be ground		
Fermentation	Weight before and after fermentation		During fermentation
Pressing	Weight after pressing		
Sieving	Weight of debris after sieving		
Granulation (rolling)	Weight after rolling		
Drying	Weight after drying		
Cooking	Weight after cooking		During cooking

2.4 Statistical Analyses of data

XLSTAT 2014 Software was used to analyse all the data. Results are presented as means ± standard deviation. Statistical analyses were done using One-way ANOVA to determine the significant differences in the values at $P<0.05$ (Student Newman Keul's Test).

3 RESULTS

3.1 Raw material characteristics

The cassava roots used in this study were collected from the experimental plot of CNRA in Bouake. Raw material characteristics measured during processing demonstrations include root weight, root length and root circumference. Figure 2 to 4 show the results.

3.1.1 Roots Weight, circumference and length

Looking at the weight, average length varied from 1570 to 832 g, with a mean value of 1253g. Bocou 2 and I083774, the orange fleshed varieties had the highest average weight compared to white fleshed varieties. Bocou 4, a white fleshed hybrid had the lowest average weight. (Figure 2).

Bocou 2 had the highest average root length (46.77cm), as opposed to Bocou4 with 31cm as average root length (Figure4).

Average root circumference ranged from 22 cm to 26 cm, with a mean of 24cm. I083774 the highest root circumference, however there is no significance difference at the root circumference level.

It was noticed that the orange fleshed cassava have bigger and longer roots, which explained their average weight being high.

Bocou 4 had the lowest physical characteristics (root, weight, length), followed by Yace, the traditional preferred variety.

Over the 4 hybrids used, 3 have higher physical characteristics than the average mean and the traditional varieties.

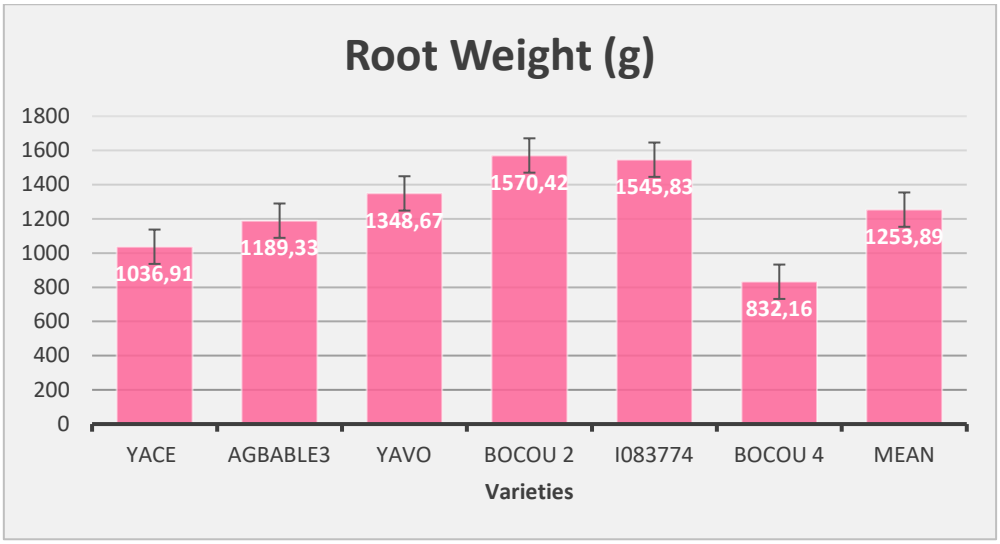

Figure 3. Average Root Weight (kg) for each variety

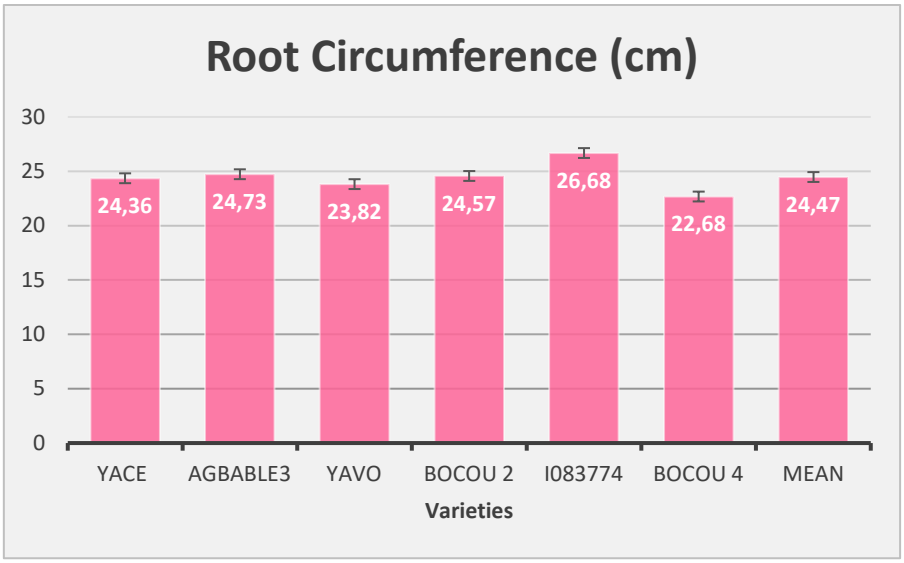

Figure 4. Average Root Circumference (cm) for each variety

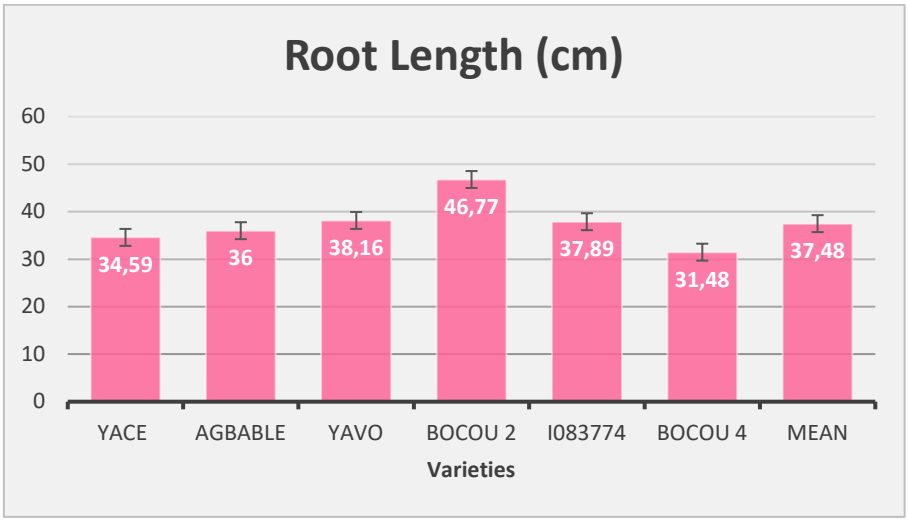

Figure 5. Average Root Length (cm) for each variety

3.1.2 Dry matter content

Dry matter content of different varieties is presented in Figure4. The dry matter content of raw pulp varied from 35.2% to 45.61%. This parameter is normally an important trait for processors because it could give an indication of the end product yield. I083774, which has the highest root weight, has the smallest dry matter.

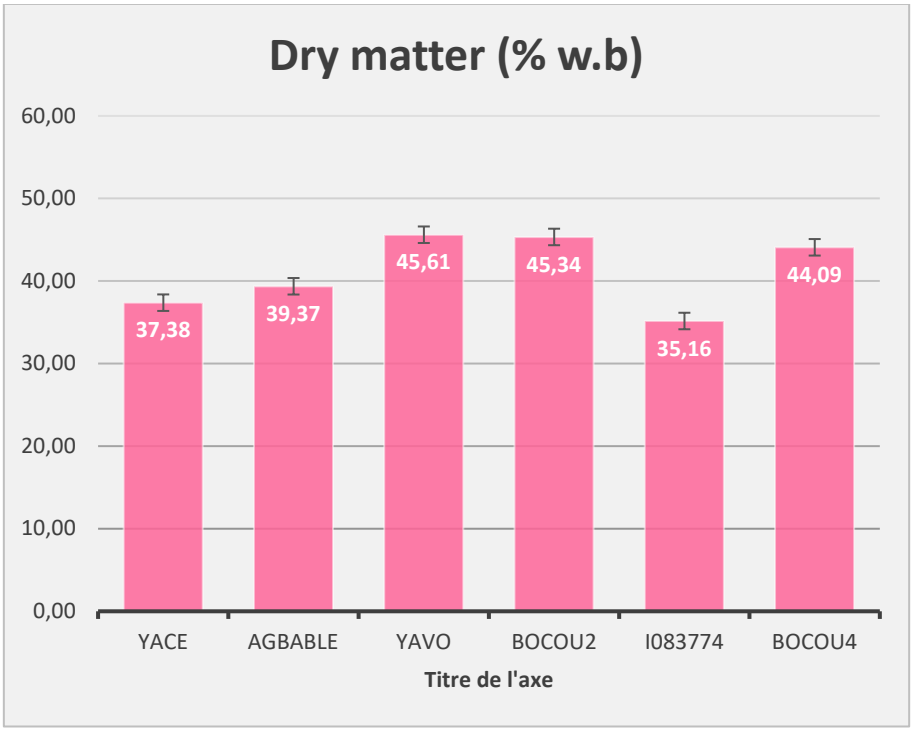

Figure6. *Dry matter content of raw varieties*

3.1.3 Qualitative information collected on the raw material

During the processing, processors identified some good characteristics they look at while buying or using cassava roots for the production of Attieke. Looking at the peel, they are encouraged by roots with dark pink color of the 2nd peel (below the 1st peel). This kind of roots might have good yield in the farm (grows well), and also cooks well. Cassava that cooks well, gives a good ferment and ferments also well. Striated peel is also a good characteristic. However, the stripes should not be poorly tangled. Roots should be of average size and heavy, indicator of good maturity and probably a high dry matter content. During the peeling process, the roots should not have big woods (fibers) in the middle or in the flesh. That type of root gives a fibrous and dull color end-product. The cassava pulp should not be too dry, because it will result in difficult peeling and cutting steps. It should not be fibrous as well, and the interior of the root should not be spongious.

According to processors, there is no really a bad cassava variety for the production of Attieke. Even though some varieties are known to be suitable, the process is a key point in the quality of the Attieke produced. The problem can come from the maturity of the cassava roots. When they are too young, the Attieke is fibrous and blackened after preparation. When they are too old, there is water inside the roots.

Qualitative information collected on the raw material are summarized in Table 2

Table 2: Raw material characteristics - qualitative information obtained from the questionnaire interview during processing

Variety	Characteristics
Yace 322	More or less easy to peel, easy to cut Looks like it will give nice attieke A bit fibrous A bit watery
Yavo 106	easy to peel, thick peel, slippery flesh makes it easy to peel, cassava similar to the usual processed variety, white flesh not watery, firm cassava flesh, easy to cut, not fibrous Looks like it will give nice attieke
Agbable 543	Striated peel Hard cassava flesh, not watery Easy to peel White pulp Not fibrous
Bocou2 207	Striated skin Difficult to peel Peel sticks on flesh Hard cassava A bit fibrous Different from usual processed varieties Yellow flesh Grains form well, but not quick
I083774 159	A bit difficult to peel Thick skin and sticky to the flesh Smooth skin firm cassava interior firm flesh, therefore good easy to cut not too much wood Yellow flesh color (end product might be weird)
Bocou 414	Good peel color Well-striated skin Easy to peel Good pulp color (white) Pulp too fibrous Watery pulp

3.2 Product profile process description

3.2.1 Unit operations of product profile process

The production of Attieke is a long and complex process, with several steps. From the ferment preparation to the cooking of the end-product, it takes 3-4 days, including ferment preparation, roots peeling, grinding, fermentation, pressing, sieving, granulation, winnowing, drying, and cooking. Despite the ferment preparation that has been done by couple processors for all the batches, and the pressing that has been performed by couple of men, each processor did every step.

3.2.2. Unit operations characterization

Peeling

Peeling involves removing the peel of cassava roots. Apart from the fermentation process, it is the first or a preliminary step during the preparation of Attieke. Peeling yield and peeling productivity yield of varieties used in this study are presented in Figures 6 and 7.

Peeling yield

Data analysis showed that the 2 yellow fleshed cassava varieties, Bocou 2 and I083774, had the highest peeling yield (73.14 and 73.93 % respectively). This means that the colored fleshed varieties might have thinner peel. The lowest peeling yield were obtained from Agbable 3, a local traditional variety, and Bocou 4, a hybrid, (67.76 and 64.20% respectively).

Peeling productivity

Peeling productivity relates to the amount in kilograms of cassava peeled in an hour by a single operator. The peeling productivity for the varieties under this study varied from 42.05kg/hour/op to 27.21kg/hour/op, with a mean value of 34.07kg/hour/op (Figure 7). Yace the preferred traditional variety, had the lowest peeling productivity of 27.21kg/hour/op, followed by Agbable and Yavo (30.89 and 31.35kg/h/op respectively).

The 2 yellow-fleshed varieties I083774 (42.05 kg/h/op) and Bocou 2 (35.48 kg/h/op), as well as the local traditional variety Agbable (37.45 kg/h/op), had the highest peeling productivity. The orange fleshed peeling productivity might be due to the big size of their roots, making it easy to peel a large quantity in less time.

Yace, Yavo and Bocou 4 are under the mean value of 34.07kg/hour/op.

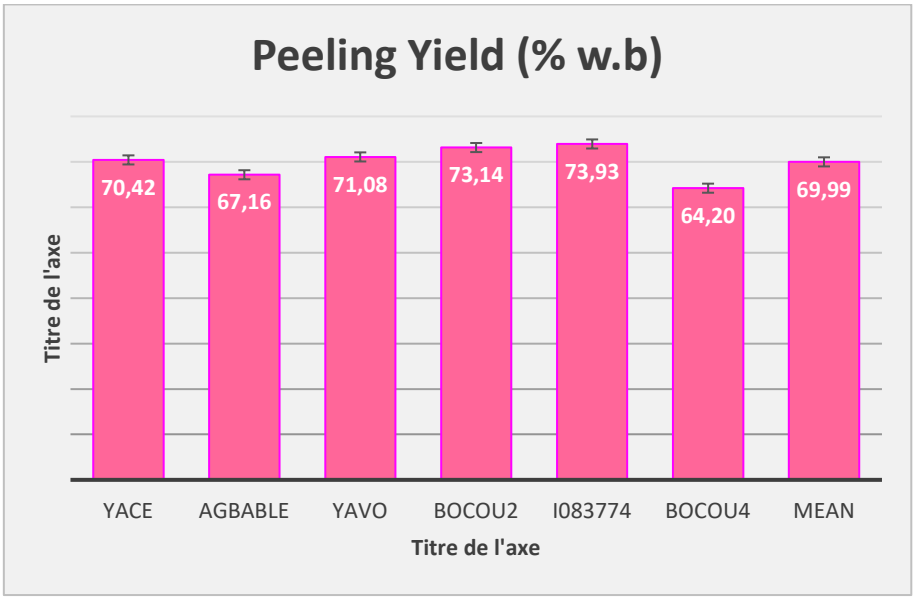

Figure6. Peeling yield (% w.b)

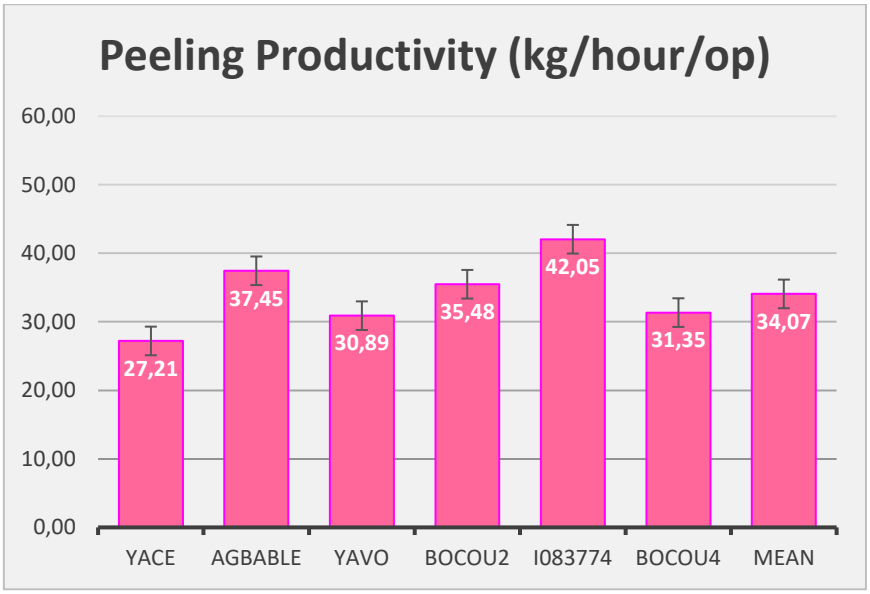

Figure7. Peeling Productivity (kg/hour/op).

Washing

Washing is meant to remove dirt from the cassava roots. This step is facilitated by the use of a big wooden spatula to ease the process. Washing productivity represents the quantity of peeled cassava that could be washed in an hour by one processor.

The washing productivity for the varieties used ranged from 205.86 kg/hour/op to 268.07kg/hour/op with mean productivity of 227.04kg/hour/op (Figure 5). Bocou 4 has the highest washing productivity (268.07 kg/hour/op), while Yavo has the lowest (205.86kg/hour/op). Yace, Agbable, Bocou2, and I083774 have the same washing productivity statistically. Only Bocou4 has a washing productivity higher than the average. Based on their washing productivity, all the varieties used are eligible by processors.

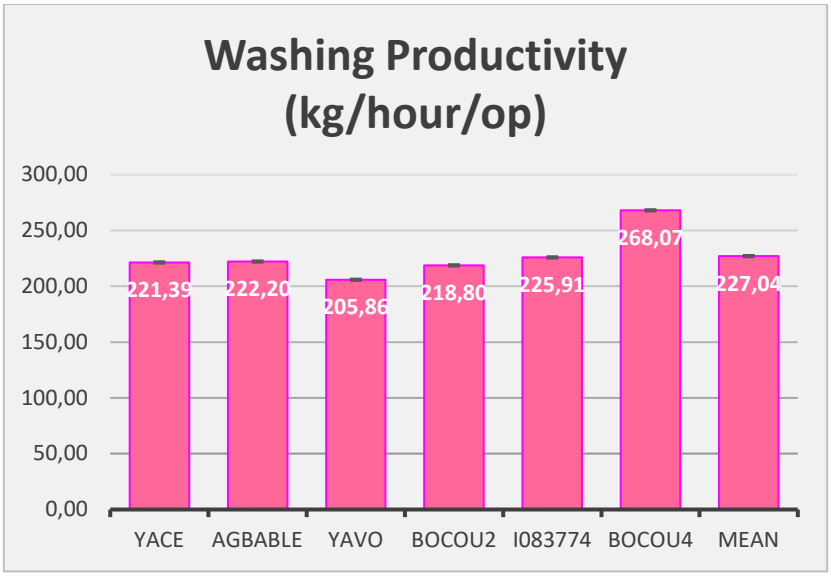

Figure 8. Washing Productivity (kg/hour/op)

Fermentation

The production of Attieke is a fermentation process. Researches has shown that the predominant microorganisms in the traditional ferment are lactic acid bacteria (LAB). During this step, there is transformation of sugars into organic acids and water. Ground roots are packaged in polypropylene bags and put in wooden bins.

Fermentation yield is reported in Figure 9. It goes from 92.31% (Yace) to 74.15% (I083774). During this step, water slowly flows out of the bags. So, the fermentation process will result in lower yield for watery cassava roots like I083774.

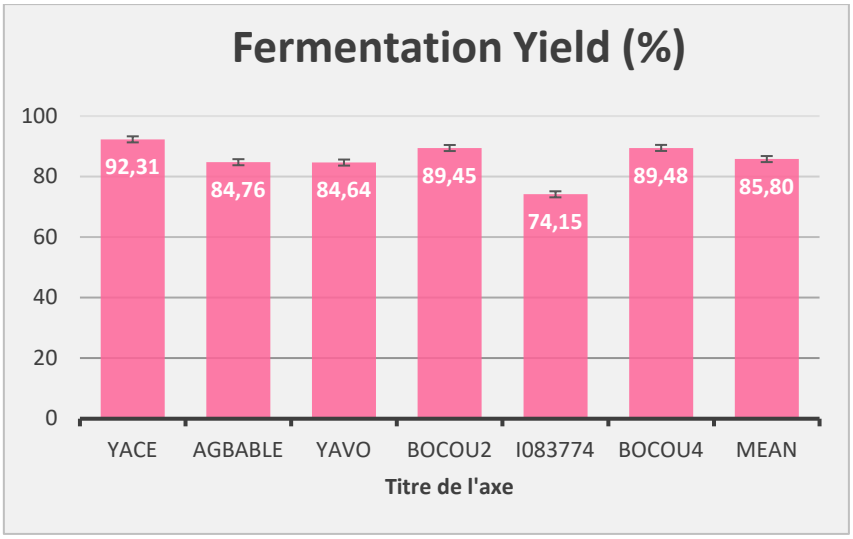

Figure 9. Fermentation Yield (%)

Pressing

Pressing consists in removing water from the fermented product using a mechanical press. At the beginning of the pressing, water removed is really milky and thick because of the starch content of the mashed product. Towards the end of the process, the water removed is more clear.

Pressing yield oscillates between 50.60% (hybrid I083774) and 66.91% (traditional local variety Agbable). All the samples have a pressing yield around the mean value 61.42%.

The pressed product yield could be an indicator of the dry matter content and the yield of the cooked product. Results here corroborates the dry matter content and the fermentation yield.

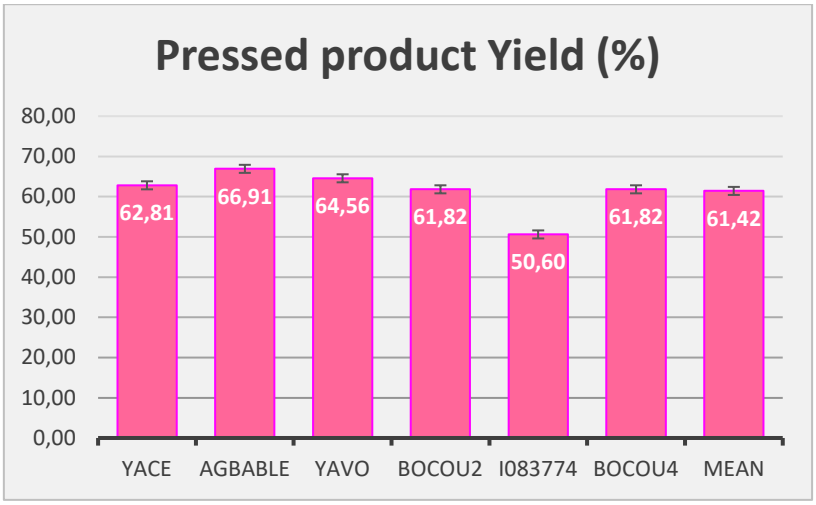

Figure10. Pressed Product Yield (%)

Sieving

Sieving consists in removing debris from the pressed product. Debris are fiber and unmilled pieces left from the grinding step. Too Hard cassava roots could have more unmilled pieces than less hard cassava roots. Fibrous cassava would have more debris than less fibrous roots.

Debris or remnant represents the leftover from the sieving process. Results show that Bocou 2 had the highest g of debris/kg of peeled raw product (81.95g/kg), followed by Bocou4 and Yace (72.80 and 71.66 respectively). The lowest values were obtained with Yavo, Agbable and I083774. (52.10 to 53.45 g of debris/kg of peeled raw product. Bocou 4 is a fibrous variety. During the peeling stage, a lot of fibers were removed from Bocou4, otherwise the percentage of its debris would have been even higher.

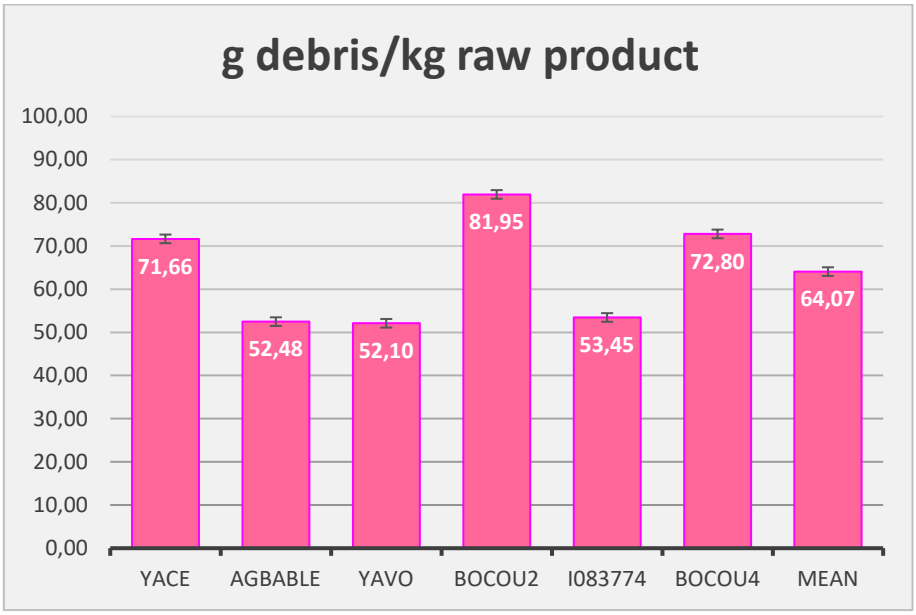

Figure11. Sieving debris of varieties

Rolling and winnowing

Attieke is a granulated product. After the sieving process, grains are formed from the sieved product. According to the processors, this step can be more or less difficult depending on roots, on varieties and on the maturity stage. Some varieties form grains easily, while others could take longer. Some form round grains, while others could form more irregular grains. The processors revealed that when a variety contains a lot of starch, the moulding is easier with that variety (grains are formed quickly). On the contrary, varieties with less starch takes longer to form grains. Also, when the cassava grist is not well fermented, the rolling step is more tedious; grains are not formed easily and are less round.

Rolling productivity is the quantity of sieved cassava completely rolled in an hour by a processor. Rolling productivity goes from 6.43 to 11.86 kg of grains rolled/hour/processor, with a mean value of 9.11kg/hour/op. Yavo, Agbable and Bocou 4 had the highest quantities rolled in an hour, compared to Yace, Bocou 2 and I083774 (7.94; 7.96, 6.43kg/hour/op). The 2 yellow fleshed cassava had the lowest quantity rolled in an hour. During the processing, our processors found I083774 not well fermented. So the rolling was difficult. The rolling productivity confirms this assertion.

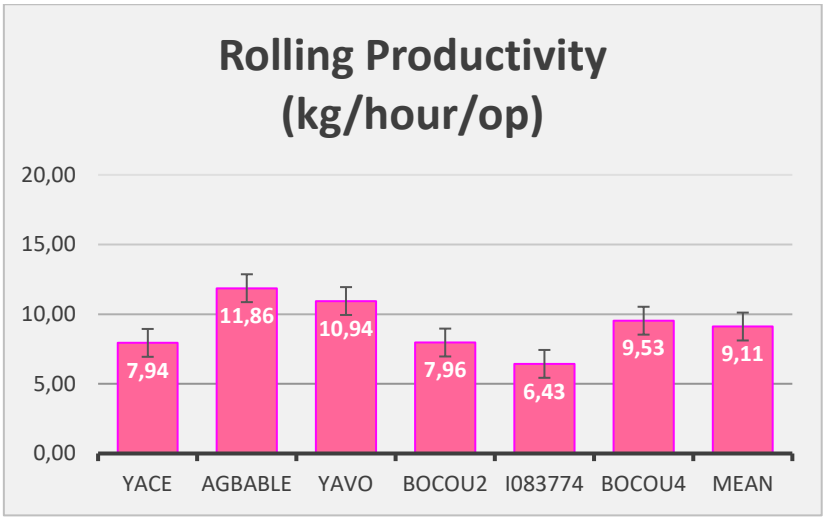

Figure12. Rolling Productivity (kg/hour/op)

Cooking

Cooking of Attieke is done by steaming of the ''dried'' semolina. Cooking yield of varieties were calculated based on the 20Kg of peeled cassava used for the fermentation.

Going from the same quantity of clean peeled raw cassava (20kg), the end-product (Attieke) yield goes from 50.05 % (I083774, hybrid) to 67.90% (Agbable, local traditional variety). The 2 orange fleshed cassava had the lowest Attieke yield. The mean value is 60.42%. The 2 traditional varieties and Yavo, an old hybrid used and adopted by processors had yields superior to the mean value; and, the 3 new hybrid had the lowest yield. I083774, the watery root cassava, had the lowest yield. These results have the same tendency as the dry matter content.

However, there is no significant difference between varieties.

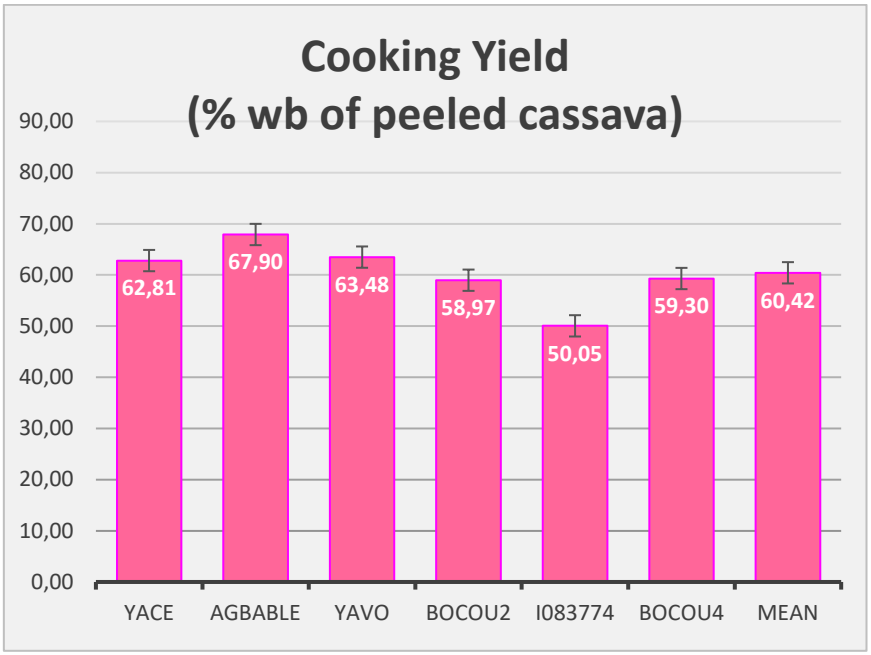

Figure13. Cooking Yield of varieties

3.3 Processors' appreciation of end-product

Attieke samples from the 6 varieties were assessed by the processors to provide attributes that describe the end-products.

3.3.1 End-products descriptors

Processors evaluated and described Attieke samples. Different attributes were given. In general, some of the desired traits of Attieke are shiny, visually appealing, moderately firm and masticable. It should have well-formed round grains, a fresh attieke smell and not be fibrous. Table 4 summarises high and low-quality sensory characteristics of Attieke.

Table 3. High and inferior sensory characteristics of Attieke

Colour Appearance		**Textural**		**Taste**		**Flavour**	
High quality	**Poor quality**	**High quality**	**Poor quality**	**High quality**	**Poor quality**	**High quality**	**Poor quality**
*Whitish *Bright color *Visually appealing *Well-formed grains *Rounded grains *Homogeneous grains	*Dull color *Not appealing *Fibrous *Not well-formed grains Non-homogeneous grains	*Firm in hand *A bit hard in the mouth *Masticable	*Too soft by touch *Dry grains	*Not sour *Good taste *Modable *Slightly sweet	*Sour *Too loose grains *Too Sticky grains *Fermented taste	*Good smell *Fresh smell	*Smell fermented *Smell old

3.3.2 Preferred and non-preferred varieties

Based on their different attributes, Attieke samples from used varieties were ranked. The most preferred and the least appreciated were chosen by each processor. The remaining rank in the middle. Processors had preference for Yace and Yavo, followed by Bocou 2, an orange fleshed hybrid. I083774 and Bocou 4 rank last. I083774 is a hybrid that did not rank well in WP5 as well.

Table 4*. Overall preference rankings of Attieke by different processors*

Varieties	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**	**Sum of individual scores (1=6, 2=5, 3=4, 4=3, 5=2, 6=1)**	**Overall score (/20)**
Yace	2	**1**	**1**	2	2	2	5+6+6+5+5+5 =32	18
Agbable	2	2	2	2	2	6	5+5+5+5+5+1 = 26	14
Yavo	**1**	**1**	2	**1**	2	2	6+6+5+6+5+5 =33	18
Bocou2	2	1	2	2	2	2	5+6+5+5+5+5 = 31	17
I083774	2	2	**6**	**6**	**1**	**1**	5+5+1+1+6+6 = 24	13
Bocou4	**6**	**6**	2	2	**6**	2	1+1+5+5+1+5 = 18	10

Varieties	Rank in order of preference
Yavo	1
Yace	1
Bocou2	3
Agbable	4
I083774	5
Bocou4	6

Table 5. *Summary Overall preference rankings of Attieke*

3.4 Global process yield (w.b.)

Global cooking yield is the proportion of Attieke relative to the initial amount of raw cassava roots used.

From the peeling yield, total raw material weight corresponding to the 20kg of peeled raw material used for the fermentation was estimated. Based on that, global process yield was calculated. Attieke yield goes from 37% to 48%, with 42.87% as mean value for all used varieties.

Yace, the preferred variety by most processors, because of its end product yield and characteristics, had the highest global process yield (48%), followed by Yavo and Agbable, 2 other used varieties in the center of Cote d'Ivoire for the production of Attieke (45% each).

Bocou 4 and I083774 had the lowest global process yield (38 and 37% respectively). The former owes its yield to its high fiber content, which had to be removed during processing to improve the quality of its attieke, and the latter owes its yield to its high-water content.

Going from the same quantity of peeled raw material, results are statistically equal, nevertheless, based on the unpeeled raw material, that there is a significance difference between varieties. It could be explained by the fact that, despite the difference in dry matter content, some critical criteria might be the weight of the peel, the easiness to remove it, and fibers in the roots. When the peel is difficult to remove, processors cut it along with some flesh. Fibers also are removed. These operations could decrease the peeling yield and impact the process in general.

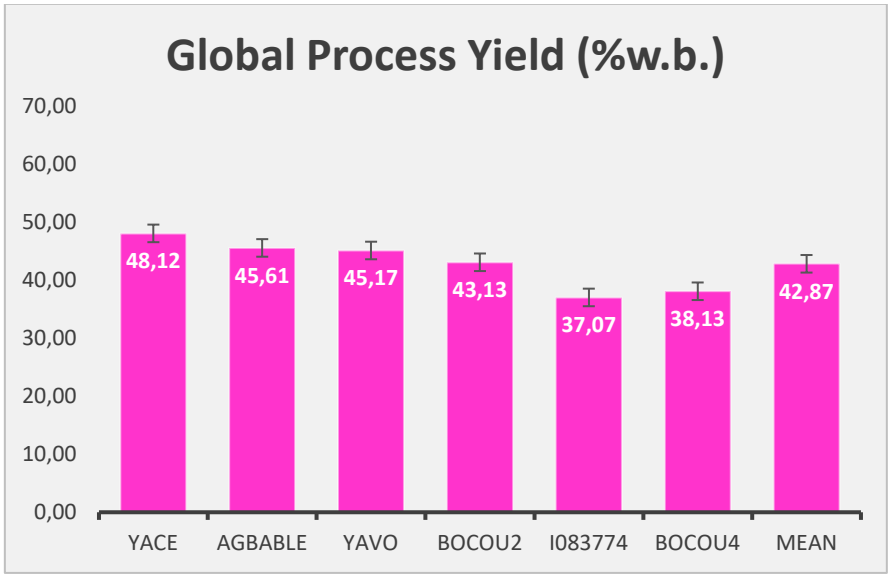

Figure14. *Global Process Yield of varieties*

4 DISCUSSION AND CONCLUSION

Attieke preparation is a long and complex process. From the findings, it is difficult to judge the suitability of a cassava variety for the preparation of Attieke, based on physical appearance The color of the skin (inner peel), cracks or streaks on the outer peel can deceive. Based on its physical aspect, the Bocou 4 variety was judged to be a good cassava for Attieke production: red skin, cracks, beautiful white color of the flesh, etc. But from the peeling, although it was easy to peel, the flesh contained many fibers (wood), which processors had to remove most, to avoid blackening of the attieke at the end. This led to a decrease in its peeling yield.

The same reasoning is true for the best or preferred variety. Yavo was not chosen by any of the processors as a preferred variety. Yace was designated by only one processor. While the end-product of these 2 varieties were the best, and Yace has the highest global cooking yield.

Processors revealed that processing is an important key in producing high quality Attieke. At the ferment preparation step, they notice the quality of the cassava variety and make adjustments of the process in order to deliver a quality end-product. For example, a sample of cooked roots indicates whether the variety will ferment well or not. Thus the amount of ferment is increased or decreased compared to the usual amount. The quantity of oil added at the milling step could be decreased or increased as well to obtain the grains to be more or less cohesive.

The process of Attieke in a producing unit is not completely fixed, but it undergoes changes according to observations made at critical points. It depends on the experience of processors.

5 APPENDICES

5.1 Annex 1: Summary table of quantitative data

	Raw material characteristics				Processing quantitative data						
					Peeling Unit Operation		Fermentation	Pressing	Cooking unit operation*		Global process yield
Varieties	Weight (g)	Root Length (cm)	Root Circumfe-rence	Dry matter (%)	Yield (%)	Productivity (kg/h/op)	Yield (%)	Yield (%)	Cooking time (min)	Yield (%)	Yield (w.b)
YACE	1036.9 b	34.59 b	24.36 a	37.38	70.42 ab	27.21 b	92.31 a	62.81 a	18.83 a	62.81 a	48.12 a
AGBABLE3	1189.3 b	36 b	24.73 a	39.37	67.16 bc	37.45 ab	84.76 ab	66.91 a	17.23 a	67.90 a	45.61 a
YAVO	1348.7 a	38.16 b	23.82 a	45.61	71.08 ab	30.89 b	84.64 ab	64.56 a	17.65 a	63.48 a	45.17 a
BOCOU2	1570.4 a	46.77 a	24.57 a	45.34	73.14 ab	35.48 ab	89.45 ab	61.82 a	17.53 a	58.97 a	43.13 a
I083774	1545.8 a	37.89 b	26.68 a	35.16	73.93 a	42.05 a	74.15 b	50.60 b	14.25 a	50.05 a	37.07 b
BOCOU4	832.2 b	31.48 b	22.68 a	44.09	64.20 c	31.35 b	89.48 ab	61.82 a	20.27 a	59.30 a	38.13 b
Mean Value	1253.9	37.48	**24.47**	*41.16*	*69.99*	*34.07*	*85.80*	*61.42*	*17.23*	60.42	*42.87*

[a,b,c,d] *indicates membership in significantly different value groups with a P value < 0.05*

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