Field Scientific Report

Participatory Processing Diagnosis of Boiled Cassava in Benin

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

Cotonou, Benin, October 2020

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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

This study is part of the RTBfoods project WP1 outputs, essentially the step 3 of the developed methodology which deals with the quality traits of boiled cassava, collected through a participatory processing diagnosis. Six local varieties with contrasting characteristics identified within the WP1 step 2 survey were processed into boiled cassava by 6 qualified processors. Completes sets of quantitative data (raw material characteristics, yield, productivity, applied conditions for each unit operation) and qualitative data (raw material and end products evaluation) were collected in two small urban centers, Bonou and Dangbo - Benin. The varieties have been classified according their phenotypic characteristics according 3 groups having significant differences according their circumferences and weights. Processors indicated that a variety could not be evaluated or selected only according its appearance. Significant differences were also identified on their dry matter content which ranged between 18.6 and 40.0 %. Regarding the cooking step, the control of the [Qwater/Qcassava] ratio is important in the quality of the boiled cassava, and in particular its textural homogeneity, its friability and the level of stickiness. No significant varietal difference were observed as far as cooking time is concerned. The texture of the boiled cassava pieces and the behaviour of the roots during cooking appear to be related to the initial dry matter content and/or to the ability of the root to lose dry matter or to absorb water during this step. The processor's end products evaluation allowed to generate a complete set of good and bad descriptors on colour, textural, taste and flavor properties, with 13 good and 18 bad descriptors that have been useful for the step 4 of the WP1's methodology.

Keywords: Cassava, boiled, flowsheet, yield, productivity, cooking, quality traits, evaluation.

1 CONTEXT AND GENERAL OBJECTIVES

This report is part of the RTBfoods project WP1 outputs, essentially the Step 3 which deals with the quality traits of boiled cassava, collected through a participatory processing preparation/demonstration. The main output from Step 3 related to cassava is to develop gendered product profile of **boiled cassava**; The outline of this activity is to i) describe the steps of the preparation, and the key processing unit operations, ii) identify the quality characteristics of cassava and boiled cassava pieces in order to select some of them for the following consumer testing. This report aims to provide information on quality traits of raw cassava, boiled cassava processing steps and final boiled cassava from six varieties.

2 METHODOLOGY

2.1 Study area

This study was carried out in two smalls urban centers: Bonou and Dangbo in the south of Benin (Ouémé Department) with respectively 44 349 hab. and 47 281 hab. INSAE, 2013 (Figure 1).

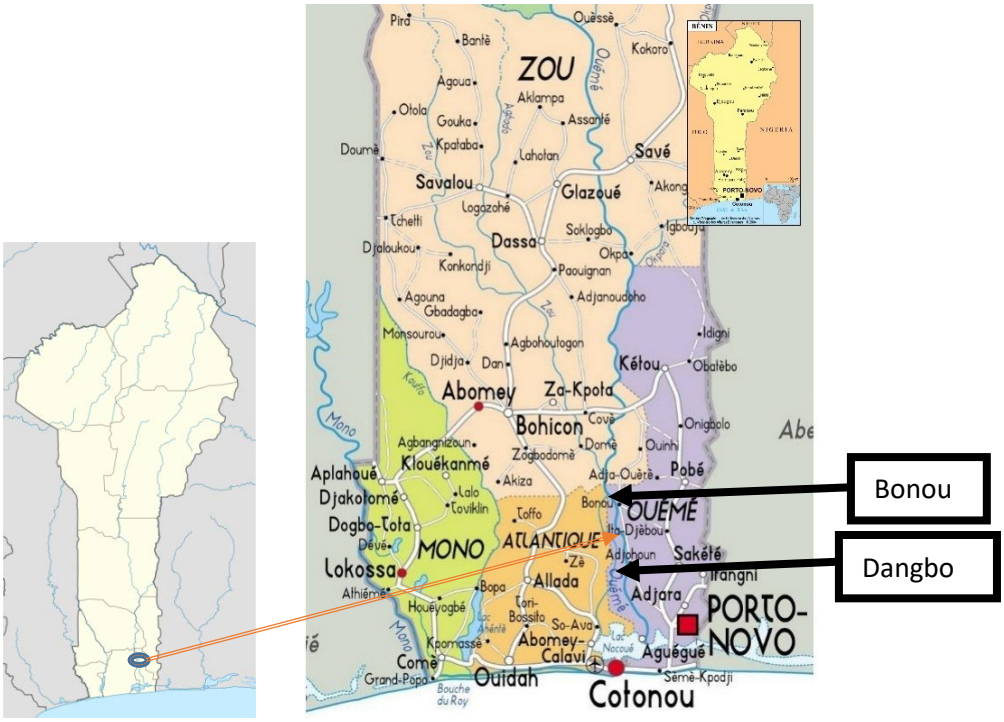

Figure 1: Map of Benin – Bonou and Dangbo – Ouémè District

2.2 Raw material

Six (6) cassava varieties with contrasting characteristics were obtained from farmers at Bonou and Dangbo. These varieties were selected based on previous surveys (Step 2 of RTBFOODS) and were locally named: *Alanmandou, Adjaha, Agric, Koleahome, Atinwewe and Dossi* (figure 2). They were harvested after respectively 9, 4.5, 4.5, 12, 9 and 4.5 months after plantating, and processed the same day.

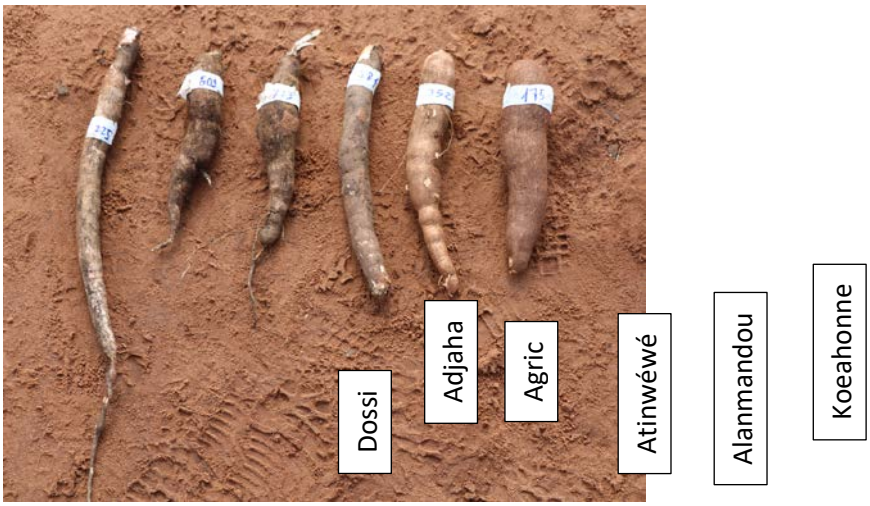

Figure 2: Variability in phenotype of the 6 varieties used; from left to right: Dossi, Adjaha, Agric, Atinwéwé, Alanmandou, Koeahonne (Photo A. Bouniol)

2.3 Boiled cassava processing and data collection

The six cassava varieties were coded with a random three-digit number. Six skilled workwomen processors were recruited to prepare boiled cassava and then, to evaluate quality characteristics of each product along the process (at each step). Cassava varieties were presented to each processor in random order. Each processor received at least two roots of each variety, which weighed between 0.7 and 1.7 kg. The cooking was carried out (by usual practice of each processor), variety after variety, consecutively in the random order previously obtained. During the preparation, the following data were collected by participatory approach:

- Raw cassava characteristics related to morphological aspects of root and boiled cassava pieces (weight, size (lengh, circumference by measuring etc)).
- Unit operations of boiled cassava preparation and some key technical data of each unit operation (mass balance, duration, temperature etc.)
- Quality characteristics of cassava at each step of preparation into boiled cassava and sensory evaluation of the final boiled cassava from each variety.

3 RESULTS

3.1 Cassava root characteristics

3.1.1 Variability in the weight and size (length and circumference) of root

The average weight of cassava roots varied between 170.3 and 1245.1 g (range of 81 to 1725 g). A tentative grouping based on the root weigh revealed that varieties can be clustered into 3 groups:

- Group 1: three varieties (*Dossi, Adjaha and Agric*) with a weight lower than 300 g, (ranging between 81,0 and 587,0 g),

- Group 2: two varieties (*Alanmandou and Atinwewe*) with a weight between 400 and 650 g
- Group 3: one variety (Koleahome) with a weight greater than 1000 g, (ranging between 478,0 and 1749,0 g),

As far as the circumference of root is concerned, mean values average ranged between 11.2 and 28.5 cm; varieties can be clustered into 4 groups:

- Group 1: one variety (*Koleahome)* with a mean circumference of 28.5 cm (with values ranging between 25,5 and 31,0 cm),
- Group 2: one variety (*Atinwewe)* with a mean circumference of 20.6 cm, (with values ranging between 12,5 and 27,0 cm),
- Group 3: three varieties (Alanmandou, Agric and Adjaha) with a mean circumference, ranging between 14.4 and 16.1 cm, (with values ranging between 9,5 and 21,0 cm)
- Group 4: one variety (*Dossi*) with a mean circumference of 11.2 cm, (with values ranging between 9,0 and 13,0 cm),

There is a significant and positive correlation between the circumference and the weight of cassava root. In addition, three distinct groups were obtained when integrating length and weigh of cassava root selected (figure 3). This tentative grouping will be improved with additional parameters.

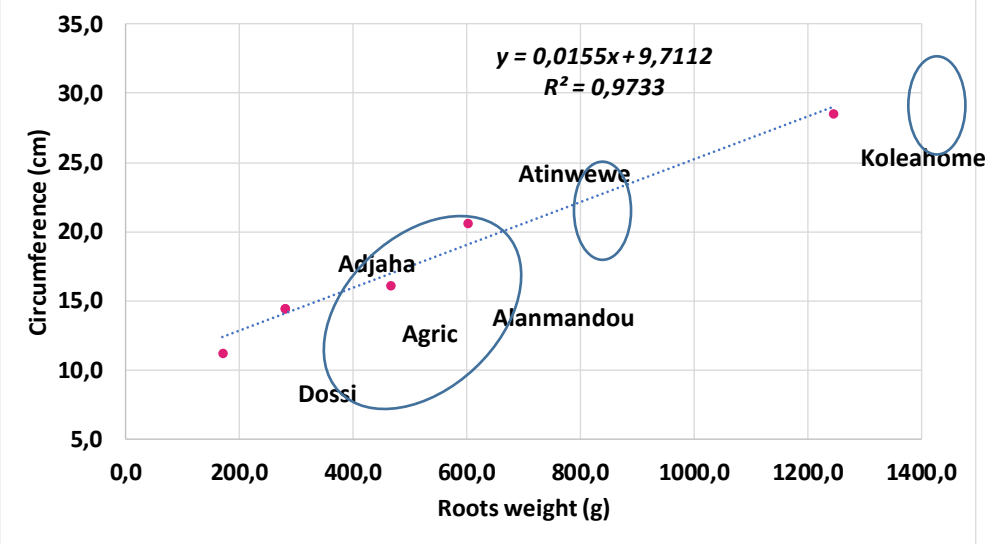

Figure 3: Position of cassava varieties by circumference (cm) versus weigh (g) of cassava root

3.1.2 Quality characteristics collected on the raw material

In order to obtain a good or bad quality of boiled cassava, the right choice of cassava root is achieved on the basis of many criteria.

The first step is an overall visual assessment of the root, even if the assessment is never 100% reliable:

- the root should preferably be long,
- the skin of the root should have thin lines on the peels.

The Variety *Dossi* was recognized to have all these characteristics.

The second step consist of removing of a small piece of skin from the root using the nail to evaluate the quality of the parenchyma and the flesh. Accordingly, for processors:

- The parenchyma should be pink,

- The flesh colour must be preferably white.
- Humidity and firmness of flesh: The flesh must have a given level of moisture and firmness, both evaluated by touching/pressing. Varieties very humid (wet) and / or too firm were considered as poor quality to produce boiled cassava.

Using these two first steps, processors are able to identify roots as close as possible; however, they unconsciously compared other varieties to the characteristics of the *Dossi* variety, which is the reference cassava variety for boiling according to their experience and empirical knowledge.

Processors indicated also that the behaviour of some cassava varieties differ according to the harvesting period (in dry or wet season). Thus, for them an important criterion is that a good variety will give a friable cassava whatever the season.

They indicated also that bitter varieties should be avoided due to a health risk ("death") for the consumer who eat boiled cassava obtained from this kind of varieties.

In the case of they are confronting to a variety that they didn't process before, processors indicate that it's not possible according to raw material aspect criteria, to evaluate her ability to give a good boiled cassava.

3.1.3 Variance in dry matter content of raw cassava

The dry matter content of cassava roots ranged between 18.6 and 40.0% (wet basis;Figure 4). Significant difference (P <0.05) was observed between cassava varieties tested, which were grouped into five (5) main groups:

- Group 1: two varieties (*Dossi* and *Alanmandou*) with a dry matter content greater than 37.0% (37.9, and 40.0%, respectively)
- Group 2: one variety (*Koleahome*) with 30.1% dry matter content,
- Group 3: one variety (*Atinwewe*) with 24.1% dry matter content,
- Group 4: one variety (*Adjaha*) with 21.2% dry matter content,
- Group 5: one variety (*Agric*) with 18.4% dry matter content.

When taking into account the position of the sample within the roots (Proximal, central and distal), there isn't any significant difference in dry matter content according to the position within the roots.

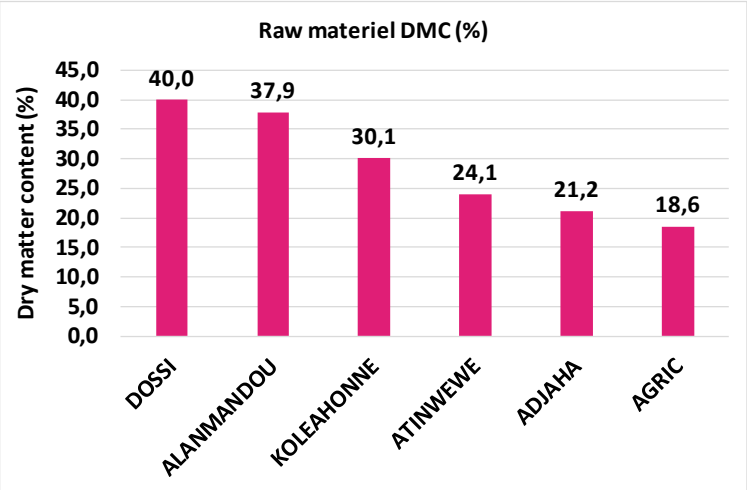

Figure 4: Raw material dry matter content (%)

3.2 Boiled cassava process description

The main unit operations of boiled cassava productions were the peeling, washing/cutting and cooking (Figure 5). Regarding cooking, cassava pieces are partially immersed in water during cooking. In our study, six processors cooked the cassava following this cooking pattern.

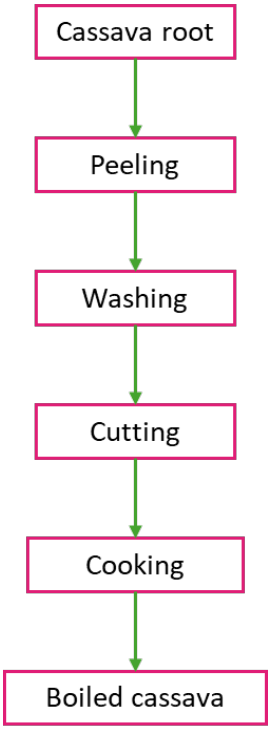

Figure 5: Flow diagram of boiled cassava process

3.2.1 Peeling

Peeling unit operation was characterized by the processing yield (%, w.b) and productivity (kg/h/processor). The peeling yield varied from 69.3 to 81.6% (w.b), with no significant difference between the 6 varieties (Figure 6).

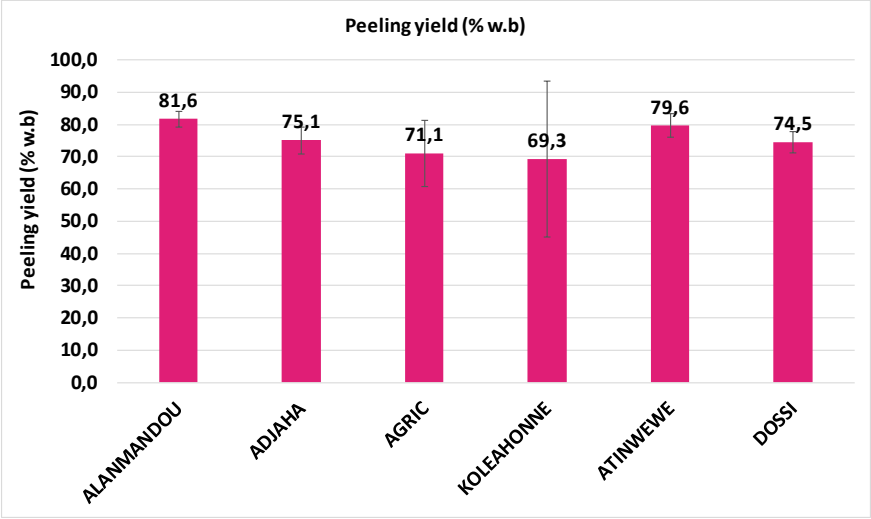

Figure 6: Peeling yield of the 6 assessed varieties

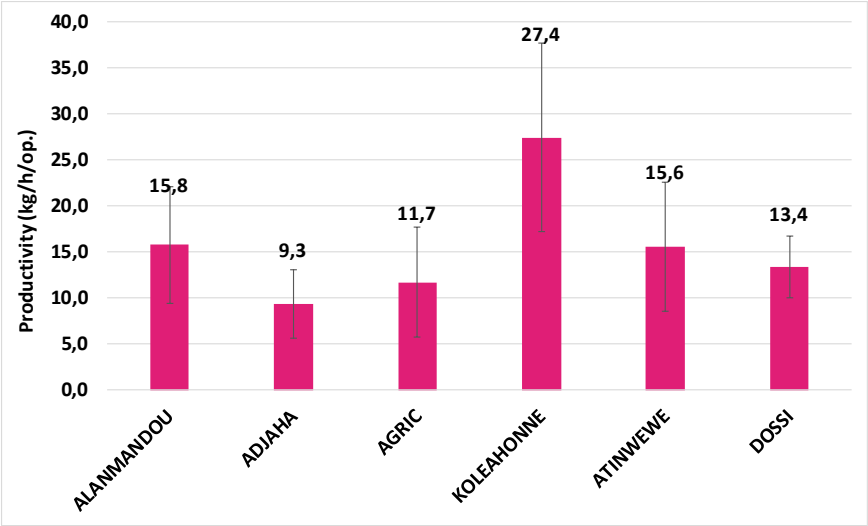

Figure 7: Peeling productivity (kg/h/operator) of the 6 assessed varieties

The productivity varied from 9.3 to 27.4 kg/h/operator, with a mean value of 36.6 kg/h/operator. Significant differences (P <0.05) were found between cassava varieties, with *Adjaha* giving the least productivity of 9.3 Kg/h/processor, and *Koleahome* the highest with 27.4 Kg/h/processor (Figure 7).

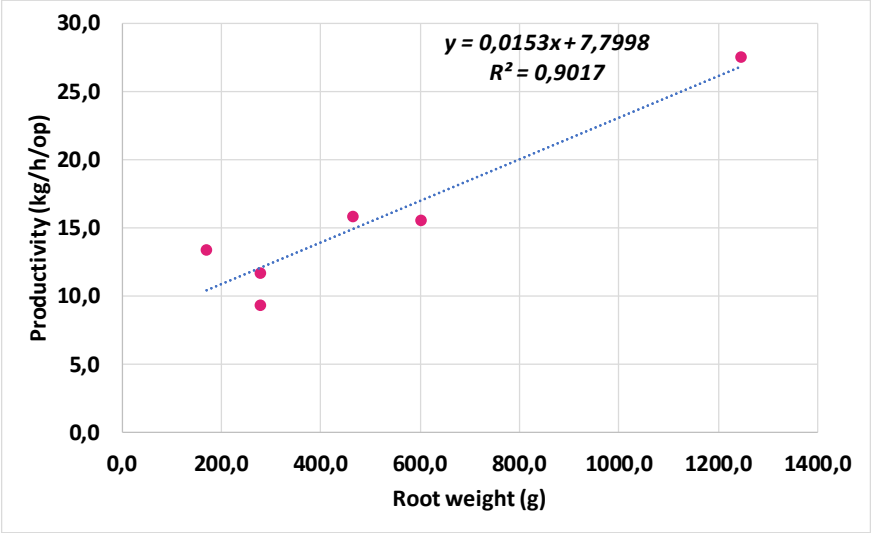

Figure 8: Productivity (kg/h/op) versus mean root weight (g) per cassava variety (% w.b)

Figure 8 show that the productivity is mainly linked to the root weight. The bigger the roots, the higher the productivity.

Figure 9: Peeling unit operation (Photo A. Bouniol)

3.2.2 Washing

This unit operation is very fast probably due to the low quantity processed; so, no data were collected. Nevertheless, it should be noted that the washing step of peeled cassava is very carefully carried out to avoid the presence of organic and/or inorganic matters.

3.2.3 Slicing/Cutting

Cutting operation was characterised by the average weigh of the cassava pieces (g). The mean average weigh of a sliced cassava pieces varied between 48.7 to 116.6 g (Figure 10) depending on the processed variety.

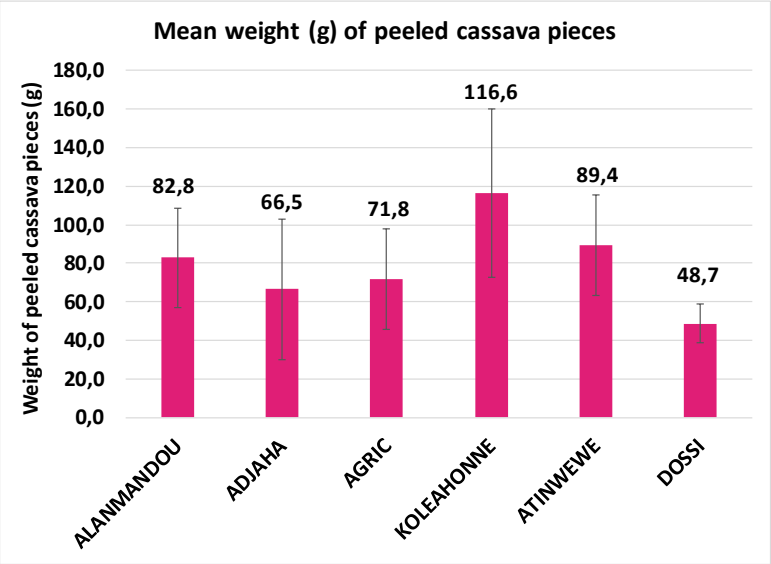

Figure 10: Mean weight (g) of peeled cassava pieces

Significant differences can be observed (Figure 11) with the variety Koleahome giving the biggest cassava pieces, and the varieties Dossi and Adjaha the smallest.

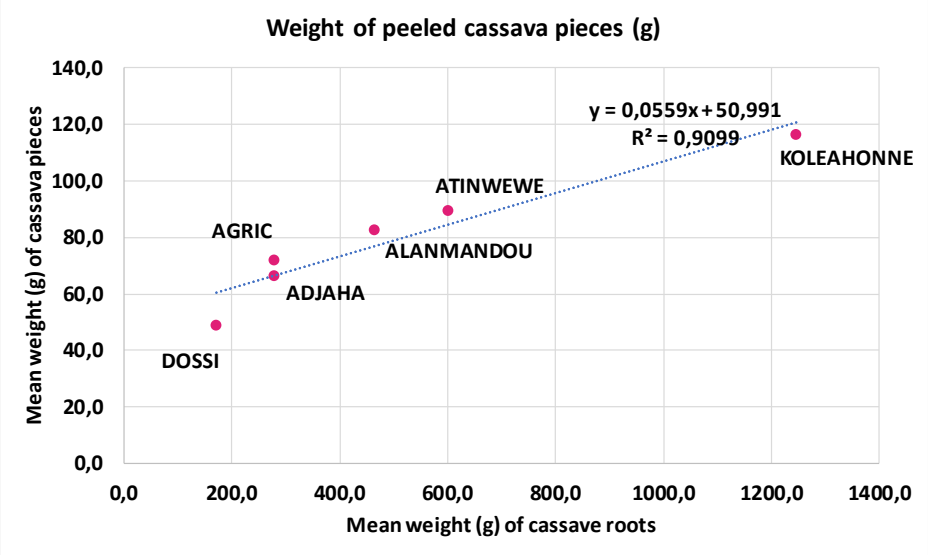

Figure 11: Correlation between the weight (g) of peeled cassava pieces and the weight (g) of cassava roots as raw material

There is a significant and positive correlation (R^2=0.91) between the weight of cassava pieces and the weight of roots as raw material. Indeed, the bigger the roots, the bigger the cassava pieces.

Figure 12: Ready to cook cassava pieces (Photo A. Bouniol)

3.2.4 Cooking

In the water-cooking procedure, processor places peeled cassava pieces into a pot while cooking, and a little salt (Figure 12) during the cooking. The pot is covered with a lid.

The following parameters were measured during cooking: ratio water/cassava, [Quantity of water introduced in the system (Qw) / Quantity of peeled cassava pieces (Qc)], duration, temperature monitoring and the yield.

Ratio Q water/Q cassava

This ratio [Qw/Qc] varied from 0.76 to 1.31 (Figure 13).

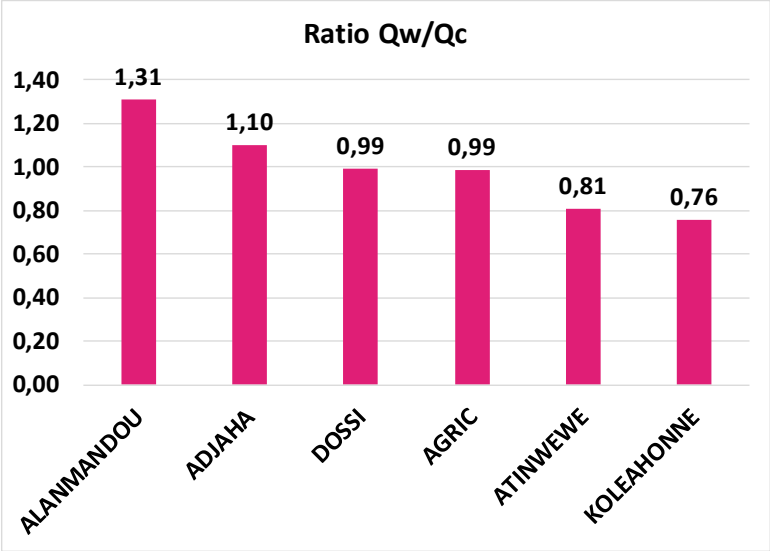

Figure 13: Ratio [Q.water/Q.cassava] during cooking unit operation

There is significant difference between varieties, which can be regrouped according 4 distinct groups:

- Group 1: one variety (*Alanmandou*) with a cooking ratio of 1.31,
- Group 2: one variety (*Adjaha*) with a cooking ratio of 1.10,
- Group 3: two varieties (*Dossi and Agric)* with for both of them a cooking ratio of 0.99,
- Group 4: two varieties (*Atinwwewe and Koleahome*) with a cooking ratio of 0.81 and 0.76, respectively.

Cooking time

The cooking time has been defined from the beginning of the fire until the end of cooking.

The cooking time varied from 27 to 37 minutes and no significant differences between varieties have been observed.

During the cooking, after a duration varying from 15 to 23 minutes, processors added 3 to 9 g of salt depending on the quantity of cassava to cook. It is not recommended to add the salt at the beginning of cooking, presumably to avoid miscooking.

Figure 14: Water-cooking system (Photo A. Bouniol)

In this cooking mode, the processor should avoid to provide too much water in order to control the texture of the product. For this, processors know-how consists in adding a first quantity of water at the beginning of the cooking. If necessary, and depending on the cassava behaviour during the cooking, they could provide a complementary quantity of water. In general, at the end of the cooking there is a little residual water in the pot. Processors indicate clearly that it's necessary to control this adding of water, otherwise the cassava pieces will absorb too much water and may become gluey, which is a criterion of rejection for consumers. This step requires the highest level of expertise and know-how.

Processors indicated also that is very important to keep the lid on the pot in order to better control the cooking and also to avoid smoke aroma in the end-product.

Processors indicated that if the cassava change colour during the cooking, it won't be friable. They also explained that it's necessary to introduce the salt only after the half of cooking time because if the salt is introduced since the beginning, the boiled cassava won't be friable.

Evaluation of the end of cooking step (cooking time)

The processors used different techniques to identify the end of cooking:

- By smelling boiled cassava odour, which should be cooked cassava odour.
- The use of fork to monitor sporadically the softness of cassava pieces. The easy to reach/penetrate the heart of cassava piece using a fork is referred to the end of cooking.
- The viscosity of the residual cooking water is also an indicator of the degree of cooking. At the end of cooking, the residual water is supposed to be slightly viscous.

Yield of the cooking unit operation

The yield (% w.b) of the cooking unit operation varied between 93.9 to 105.4 % w.b (Figure 15), with an average for all varieties of 98.8 %. Overall and concerning mass balance, some varieties absorb water during cooking while others loss material. As far as cooking step is concerned, significant differences ($P < 0.05$) between the varieties were observed, leading to four groups of cooking behaviour:

- Group 1: one variety (*Dossi*) with a yield of 105.4 % w.b,
- Group 2: one variety (*Atinwewe*) with a yield of 102.9 % w.b,

- Group 3: one variety (*Koleahome*) with a yield of 98.4 % w.b,
- Group 4: three varieties (*Alanmandou, Adjaha and Agric*) with yields respectively 97.4, 95.1 and 93.9 % w.b.

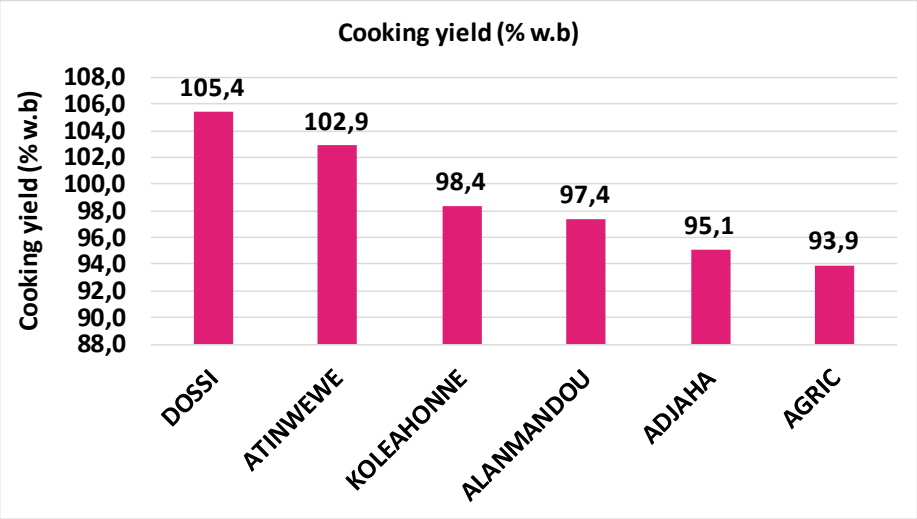

Figure 15 : Cooking yield (% w.b)

There is a trend indicating that the higher the dry matter content of the raw material, the higher the cooking yield (Figure 16). We can assume that this trend translates the capacity of the dry matter to absorb water through the starch granules gelatinisation.

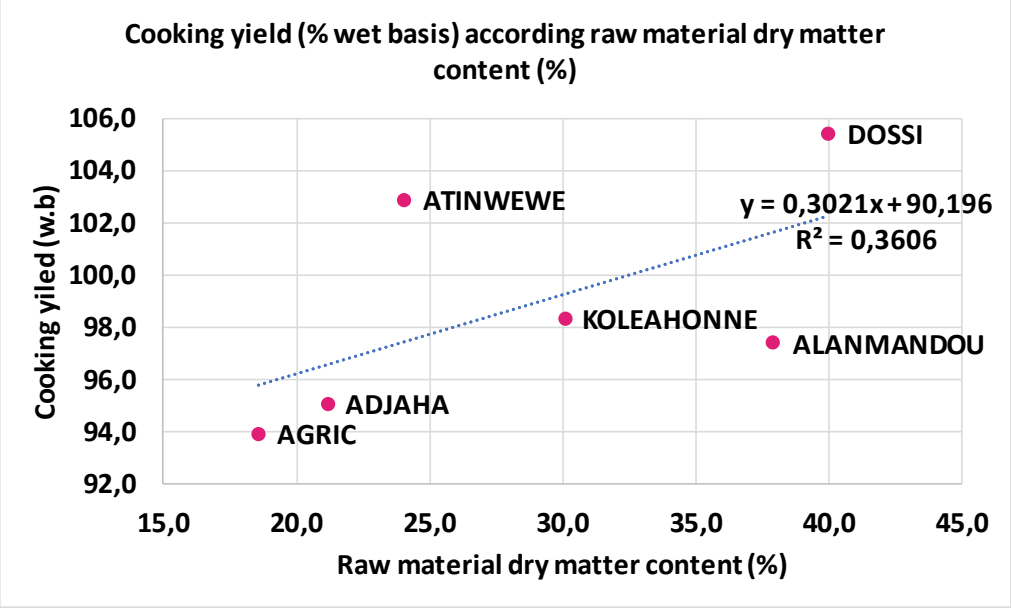

Figure 16: Relationship between cooking yield (% w.b) and raw cassava dry matter content (%)

Thus, it's observed that the variety Dossi, which is known as the best variety for boiled cassava in Benin (Rtbfoods WP1 Step 2 preliminary results), has the highest cooking yield following by the variety Atinwewe, but these two varieties have important difference in raw l dry matter content. The variety Agric has the lowest wet basis cooking yield and the lowest dry matter content. Therefore, further research works need to be undertaken to highlight the relation

between dry matter content and the cooking yield, probably the starch granules behaviour during cooking can play major role.

Interview revealed that this variety is not appreciate by the processors, who indicated that this variety is preferentially used by gari processors and not by boiled cassava processors and this because the boiled product obtained is too hard and too much bitter.

3.2.5 Change in the yield (w.b) during the boiled cassava processing

Figure 17 showed that the global yield (w.b) is mainly impacted by the peeling unit operation and the capability of the cassava root to absorb water during cooking. Indeed, Adjaha and Dossi varieties, have a very close peeling yield (respectively 75.1 and 74.5 % wet.basis), but Dossi gives a significant better global cooking yield than Adhaha, with 78.5% versus 71.4% wet basis, probably due to its ability to absorb more water (Dossi) or to lose more material as far as Adjaha is concerned.

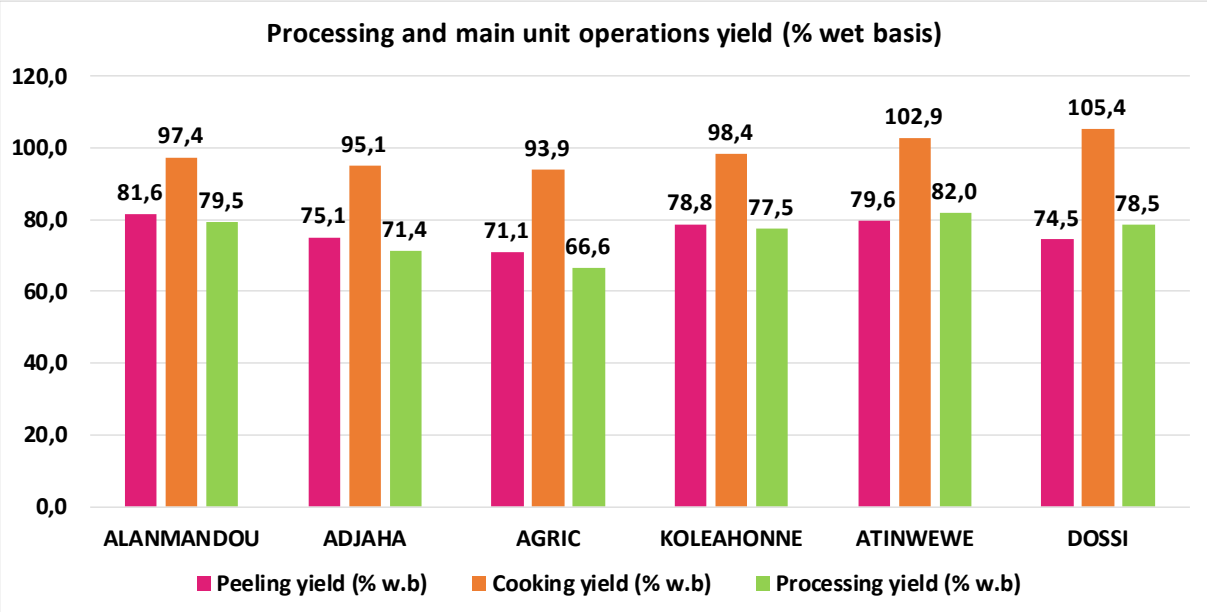

Figure 17: Processing Yield (%, w.b) of the unit operations

3.3 Processors' sensory testing of boiled cassava

The boiled cassava pieces produced from the six varieties were evaluated by the processors to provide attributes that describe the end-product, and then their preference (Figure 18 & 19). Thirty-two (32) descriptors were collected related to colour, texture, taste and aroma (Table 1). These descriptors were grouped in high and poor quality of each attributes. These descriptors were collected during the earlier survey, proving the confidence of results from both sources.

Figure 18: Samples of boiled cassava pieces for testing (Photo A. Bouniol)

Figure 19: Sensory testing of the boiled cassava pieces by the processor (Photo A. Bouniol)

Table 1: Boiled cassava descriptors collected after processing and evaluating by processors

Colour		Textural		Taste		Flavour	
High quality	Poor quality	High quality	Poor quality	High quality	Poor quality	High quality	Poor quality
White Dirty white Attractive Light yellow on the surface	Yellowish Yellow Not attractive Translucent/glassy Viscous water on the surface	Friable Easy to break No sticky in hand No fiber Tender No water Do not stick in mouth	Hard Unbreakable Sticky Gluey Elastic Fibrous Watery No tender Stick to the teeth Not friable	Sweet	Bitter Bland	Cassava odour	Unpleasant smell of boiled cassava No cassava odour

Regarding preference of boiled cassava, five out of six processors selected *Dossi* as the best variety for boiled cassava while the least preferred variety is *Koleahome*. The appearance of root (pink parenchyma, no watery flesh), the easiness of peeling, the white colour, the friability, the non-sticky cooked flesh, the sweetness, the bitterness and the viscosity of cooking water were the quality characteristics considered to select the preferred varieties or to reject the least preferred ones.

4 SYNTHESIS AND CONCLUSION

The findings from the participatory processing with well skilled processors were summarized in table 2. Concerning **the cassava root choice,** the external morphologic observation of the phenotype of roots together with flesh characteristics can't help to predict the final quality of boiled cassava.

With regard to the **peeling unit operation**, one main observation is that it is important to identify big size roots with a skin easy to separate from the flesh.

The **size of cassava pieces** intended to be cooked is correlated with the size of the roots. It could thus be interesting to ask consumers the piece size they prefer in order to define an optimal root size.

Regarding the **cooking unit operation**, the data collected revealed that:

- The control of the [Qw/Qc] ratio is important in the quality of the boiled cassava, and in particular its textural homogeneity, the friability and the level of stickiness.
- No significant varietal difference were observed as far as cooking time is concerned. This could be related to the definition of cooking time which is done in different ways. It's sometimes evaluated by the ability of fork to pick the boiled cassava or by the viscosity of cooking water, or through the boiled cassava odour.
- The texture of the boiled cassava pieces and the behaviour of the roots during cooking appear to be related to the initial dry matter content or to the ability of the root to lose dry matter or to absorb water.

In our conditions, the variety which is known as the preferred variety for boiled cassava production, is the variety *Dossi* which had the highest dry matter content and the highest processing yield, mainly due to a good capability to absorb water during cooking step. These characteristics and behaviour let appear that this variety allows processors to reach the final desired quality characteristics which should be a friable, non-sticky, white and no bitter end product. This variety gives them also a good profitability with one of the best global yield (w.b).

It seems decisive to characterize the biochemical composition of the roots (starch content and components, cell walls and fibers, starch granules microstructure etc.) in order to link it to the observations made, and ultimately to understand which biochemical elements are responsible for the textural quality of the products.

With regard to the Step 3 methodology implemented, it is important to remember that the initial choice of the variety set is decisive for obtaining good results. The choice made here proved to be relevant by providing excellent variability in root characteristics and behaviours.

Table 2: Quantitative processing data from cassava varieties

	Raw material characteristics				**Processing quantitative data**							
					Peeling unit operation		**Cutting unit operation**	**Cooking unit operation**				**Processing yield**
Varieties	Weight (g)	Length (cm)	Circumference max (cm)	Dry matter (%)	Yield (% w.b)	Productivity (kg/h/op)	Piece size (g)	Ratio [Qw/Qc]	Cooking time (min)	Yield (% w.b)	Yield (% d.b)	Yield (% w.b)
Alanmandou	464.5^{b}	35.5^{a}	16.1^{c}	37.91^{a}	81.6^{a}	15.8^{b}	82.8$^{a, b, c}$	1.31^{a}	27.8^{a}	97.4^{c}	91.4^{e}	79.5^{a}
Adjaha	277.9^{c}	29.6$^{a, b}$	14.4^{c}	21.17$^{c, d}$	75.1$^{b, c}$	9.3^{b}	66.5$^{b, c}$	1.10$^{a, b}$	30.6^{a}	95.1^{c}	155.8^{b}	71.4$^{b, c}$
Agric	279.3^{c}	27.2^{b}	14.5^{c}	18.57^{d}	71.1^{c}	11.7^{b}	71.8$^{b, c}$	0.99$^{b, c}$	37.6^{a}	93.9^{c}	166.2^{a}	66.6^{c}
Koleahome	1245.1^{a}	31.8$^{a, b}$	28.5^{a}	30.08^{b}	78.8$^{a, b}$	27.5^{a}	116.6^{a}	0.76^{c}	35.8^{a}	98.4$^{b, c}$	106.2^{d}	77.5$^{a, b}$
Atinwewe	601.1^{b}	30.6$^{a, b}$	20.6^{b}	24.05^{c}	79.6$^{a, b}$	15.6^{b}	89.4$^{a, b}$	0.81^{c}	31.6^{a}	102.9$^{a, b}$	119.8^{c}	82.0^{a}
Dossi	170.3^{c}	25.1^{b}	11.2^{d}	39.97^{a}	74.5$^{b, c}$	13.4^{b}	48.7^{c}	0.99$^{b, c}$	28.6^{a}	105.4^{a}	70.6^{f}	78.5^{a}
Mean Value	*506.4*	*30.0*	*17.6*	*28.63*	*76.8*	*15.5*	*79.3*	*0.99*	*32.0*	*98.8*	*118.3*	*75.9*

^{a,b,c,d} *indicates membership in significantly different value groups with a P value < 0.05*

Table 3: Qualitative processing data from cassava varieties

Variety	Raw cassava				Boiled cassava pieces					
	Agronomic characteristics	Processing characteristics at each step			Sensory characteristics					
		Peeling	Washing / Cuting	Cooking	When you look at	Texture when you touch	When you smell	Taste (In mouth)	Texture when you chew	After-taste
Dossi 225	The parenchyma has a pink colour. The roots are not too big. The skin has small streaks The skin does not adhere to the parenchyma The skin is a little dark	Thin skin The skin is pink Easy to peel The skin does not adhere to the parenchyma No watery	Easy to cut No "milky" No fibres	Well white Friable So friable that it's difficult to prick with a fork Cracks during cooking Good odour during cooking	Dirty white on the surface and light yellow on the inside, very white and without water, pleasant, attractive, white on the inside.	Easy to cut. No fibres. Does not stick to the fingers. Does not contain water. Soft, crumbly, sticks to the fingers.	Good cassava smell	Slightly soft, soft, crumbly, good texture in the mouth. Pleasant to eat. Glue in the mouth.		Bitter after taste
Alanmandou 352	The skin strongly adheres to the parenchyma	It's easy to peel even the skin adheres to the parenchyma No watery The peel is thin	Easy to cut No "milky water" No fibres	Became yellowish during cooking No odour of boiled cassava Not friable	Yellow, little fibres, not friable	Hard to cut. No fibres. Difficult, if not impossible to cut with the hand. Contains water. No water. Little soft, no fibres.	Good cassava smell	Sweet, slightly sweet. Not very crumbly in the mouth, hard in the mouth. Bland, neither sweet, nor bitter.		

Variety	Raw cassava				Boiled cassava pieces					
	Agronomic characteristics	Processing characteristics at each step			Sensory characteristics					
		Peeling	Washing / Cuting	Cooking	When you look at	Texture when you touch	When you smell	Taste (In mouth)	Texture when you chew	After-taste
Adjaha 609	.	Difficult to peel The skin adheres to the parenchyma (so “it won’t be friable”) The skin is very thin Watery	Easy to cut No fibres No “milky water”	Dirty white Hard Become yellowish during cooking No odour of boiled cassava	Nice dirty white colour or a little yellow, attractive, yellow, has fibres, not attractive	Very hard. Sticks to the fingers. Hard to cut. Sticks to the fingers. Contains water. Glue to fingers, not crumbly, has fibres. No fibres. Not crumbly.	Nice smell of cassava, not a good smell of boiled cassava,	Sweet, sweet, safe to eat, not tender, not safe to eat. Glue in the mouth. Elastic, not crumbly in the mouth, not soft.		
Atinwéwé 481		Easy to peel No watery	Easy to cut No watery A little fibrous	Keeps his white colour No odour of boiled cassava Cracks during cooking	Dirty white. No fibres, light yellow on the surface. It's a little yellow on the surface and white on the inside. White colour. No fibres. White on the outside, yellow on the inside. Attractive, yellow in colour, not attractive.	Easy to cut. Does not stick to the fingers. No fibres. Friable. Easily breaks. Not crumbly, without water.	Good cassava smell	Good to eat. Sweet, very good. Crumbly in the mouth, bland		

Variety	Raw cassava				Boiled cassava pieces					
	Agronomic characteristics	Processing characteristics at each step			Sensory characteristics					
		Peeling	Washing / Cuting	Cooking	When you look at	Texture when you touch	When you smell	Taste (In mouth)	Texture when you chew	After-taste
Agric 723	.	Easy to peel but the skin adheres a little to the parenchyma Watery A little fibrous	Easy to cut A little fibrous with a hard central fibres Heterogeneity of the flesh	Become yellow during cooking No odour of boiled cassava It's stays hard Heterogeneity of colour between the central and external part of the flesh	A little white, a little yellow, yellow, not attractive, not very attractive, no fibres	No fibres. Hard, hand glue (pasty), glassy (translucent). Sticks to the fingers. Difficult to cut. Contains water. Does not stick to the fingers.	Soft, no fibers, a little bitter, "hayahaya", not soft, hard in the mouth, sticky in the mouth, unpleasant to eat, does not stick in the mouth, elastic.			
Koléahonne		Easy to peel The skin is thick No watery	Difficult to cut Hard to cut Presence of milky water No fibres	Became too yellow during cooking, so won't be friable No odour of boiled cassava	Presence of fibres, pure yellow. It's translucent. Viscous water on the surface. Hard central part containing a hard fibres (edogblin), not at all attractive	No fibres. It's hard. Gooey appearance on the surface. It's sticky on the surface. Edogbin. Elastic (edè). Has fibres, contains water. Sticks to the fingers. Very difficult to cut.		It's bitter (unpleasant), very bitter, sticks to your teeth, unpleasant to eat, elastic in the mouth, a little bitter, elastic in the mouth.		

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