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1. Report on the influence of local processing on quality for bissap

Hibiscus sabdariffa L. is a herbaceous plant, cultivated largely in tropical and subtropical areas of both hemispheres. It belongs to the family of Malvaceae and is known by different names such as Guinea sorrel or bissap in Senegal, karkadé in North Africa, roselle or sorrel in Asia and flora of Jamaica in Central America (Morton & Roselle, 1987; Glew et al., 1997; Lorenzo et al., 2000 ; McClintock.& El Tahir, 2004 ; Babalola et al., 2001 ; Cisse et al., 2009a; Cisse et al., 2009b).

In Senegal, *H. sabdariffa* was introduced in the 19th century (Kerharo & Adam, 1974) and is now grown throughout the territory; mainly in the Kaolack, Fatick Thies, Ziguinchor and Louga regions. In these areas, a dozen varieties are grown including Vimto, Koor, Thai and CLT 92.

The aim of this work is to see the influence of local processing on quality for bissap. For this the functional properties considered are the levels of vitamin C, polyphenols and anthocyanins.

1.1. Sampling

Four varieties of *Hibiscus sabdariffa* were collected across Senegal (**Figure 1**) according the SOPs for sampling strategy for group 3 (D1.2.1.3). Five regions of Senegal were considered running from south to north of Senegal. This is the region of Ziguinchor in southern countries, Kaolack and Fatick located in the center of Senegal, Thies located in the west and Louga in the north.

Figure 1. Sampling area of *Hibiscus sabdariffa* calyx

According the SOPs for sampling strategy for group 3 (D1.2.1.3), the table 1 shows the location of all samples. The four varieties of *Hibiscus sabdariffa* identified during the survey (D1.1.2.3) were collected. Depending on the area, the availability of raw material, two to four varieties are considered by region.

Table 1. Location and number of samples for each varieties of *Hibiscus sabdariffa* calyx

Types of samples	**Location of samples**				
	Kaolack	Fatick	Ziguinchor	Thies	Louga
Koor	6	6	6	6	6
Vimto	6	6	6	6	6
Thai	6	6	6	-	6
Clt	6	-	6	-	-

1.2. Samples analysis

Samples collected were analysed for vitamin C, anthocyanin and polyphenol using SOP's defined on the deliverable D1.2.3.3. Analyses were undergone on the four varieties of *Hibiscus sabdariffa*

1.3. Results and discussion

Tables 2-6 give the results of functional properties of different varieties of *Hibiscus sabdariffa* for each region. These results are consistent with those of the literature (Deliverable D12.2.3) (Glew, 1987; Morton, 1987; Wong et al., 2002; D'heureux-Calix et al., 2004; Cisse et al., 2009). The calyx is characterized by their richness in polyphenols and anthocyanins. This is probably the origin of high values of antioxidant activities regardless of the measurement method used.

Anthocyanin, polyphenol, antioxidant activities content are significantly different ($p<0.05$) for all selected samples regardless of the production area. For example, for koor variety, the highest rated in anthocyanin (1.16 $g.100g^{-1}$) is observed in Fatick while the lowest (0.52 $g.100g^{-1}$) is recorded in the region of Kaolack. The observed differences in functional properties for the same variety may be due to several factors such as harvesting techniques, drying conditions and storage. The climatic conditions widely variable in these areas can also have a significant impact on the levels of vitamin C, polyphenols and anthocyanins.

1.4. Conclusion

Regarding the high level of anthocyanins and polyphenols, *Hibiscus sabdariffa calyx* appears as a reservoir of antioxidants that can be used in the fight against free radicals. The wealth of *the calyx* in these bioactive compounds can be carrying the potential use of Hibiscus sabdariffa in the fight against inflammatory diseases. So research work are undergone to evaluate the effect of traditional processing practices of *calyx* on bioactive compound, with objective to set a reengineering process in this respect and to use products from calyx of *Hibiscus sabdariffa* as natural colorant or products with high quality.

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Table 2. Results of determination of functional properties of *Hibiscus sabdariffa* from KAOLACK

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Variety/Treatment/Process/Raw material used							
			Vimto		Koor		Thai		CLT 92	
			Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	1.47[b] ± 0.02	6	1.34[b] ± 0.02	6	3.73[a] ± 0.32	6	1.03[c] ± 0.01
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	2.94[a] ± 0.06	6	2.05[c] ± 0.05	6	1.56[d] ± 0.03	6	2.18[b] ± 0.11
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	1.73[a] ± 0.04	6	0.52[b] ± 0.02	6	0.46[c] ± 0.02	6	1.48[d] ± 0.05
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	78.81[a] ± 2.68	6	75.54 [b]± 2.32	6	74.58[c] ± 2.25	6	81.21[d] ± 2.14
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	96.13[b] ±5.33	6	86.41[c] ± 4.23	6	82.67[d] ± 4.34	6	91.33[a] ± 3.23
Antioxidant capacity (TEAC) (µM Trolox/g DW)			6	135.97[a] ± 0.83	6	129.35[b] ± 0.97	6	131.25[c] ± 0.87	6	133.87[d] ± 0.78

Table 3. Results of determination of functional properties of *Hibiscus sabdariffa* from FATICK

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Variety/Treatment/Process/Raw material used					
			Vimto		Koor		Thai	
			Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	3.68[a] ± 0.03	6	3.82[a] ± 0.11	6	3.23[b] ± 0.11
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	3.10[a] ± 0.02	6	2.51[b] ± 0.01	6	1.78[c] ± 0.01
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	1.47[a] ± 0.01	6	1.16[b] ± 0.02	6	0.85[c] ± 0.01
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	93.28[a] ± 3.55	6	75.12[b]± 5.79	6	73.17[c] ± 5.15
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	76.82[a] ± 1.99	6	49.72[b] ± 1.14	6	45.78[c] ± 0.98
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	6	132.97[a]± 0.48	6	135.74[b] ± 0.63	6	133.43[b] ± 0.49

Table 4. Results of determination of functional properties of *Hibiscus sabdariffa* from ZIGUINCHOR

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Variety/Treatment/Process/Raw material used							
			Vimto		Koor		Thai		CLT 92	
			Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	28.34[c] ± 0.05	6	44.56[a] ± 0.18	6	39.78[b] ± 0.31	6	26.78[d] ± 0.31
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	2.52[b] ± 0.04	6	1.98[c] ± 0.03	6	2.03[c] ± 0.03	6	2.87[a] ± 0.04
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	1.87[b] ± 0.02	6	0.68[c] ± 0.03	6	0.73[c] ± 0.02	6	1.97[a] ± 0.03
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ ENSAI	6	103.37[a]± 4.30	6	96.64[b]± 3.02	6	95.89[b]± 2.97	6	107.47[c]± 4.15
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ ENSAI	6	66.23[b] ± 4.77	6	36.58[c] ± 2.01	6	33.24[d] ± 1.05	6	71.78[a] ± 2.14
Antioxidant capacity (TEAC) (µM Trolox/g DW)		UCAD @ ENSAI	6	140.57[a]± 1.30	6	136.68[b]± 0.84	6	138.14[c] ± 0.75	6	145.63[d]± 1.47

Table 5. Results of determination of functional properties of *Hibiscus sabdariffa* from THIES

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Variety/Treatment/Process/Raw material used			
			Vimto		Koor	
			Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	$31.45^{b} \pm 0.03$	6	$41.89^{a} \pm 0.28$
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$2.64^{a} \pm 0.02$	6	$1.67^{b} \pm 0.03$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$1.42^{a} \pm 0.02$	6	$0.78^{b} \pm 0.03$
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	$84.97^{a} \pm 5.50$	6	$80.24^{b} \pm 5.50$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	$38.51^{a} \pm 2.98$	6	$34.33^{b} \pm 1.85$
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	6	$135.74^{a} \pm 1.00$	6	$128.42^{b} \pm 2.41$

Table 6. Results of determination of functional properties of *Hibiscus sabdariffa* from LOUGA

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Variety/Treatment/Process/Raw material used					
			Vimto		Koor		Thai	
			Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD	Number of Samples	Mean +/- SD
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	3.53[c] ± 0.04	6	5.34[b] ± 0.04	6	5.83[a] ± 0.03
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	2.89[a] ± 0.02	6	2.12[c] ± 0.02	6	2.34[b] ± 0.03
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	1.65[a] ± 0.02	6	0.99[c] ± 0.02	6	1.24[b] ± 0.02
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	90.44[a] ± 3.55	6	77.22[b]± 5.79	6	73.11[c] ± 5.15
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	86.41[a] ± 2.03	6	52.72[b] ± 1.14	6	55.78[c] ± 0.94
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	6	134.14[a]± 0.78	6	130.14[b] ± 0.84	6	128.43[c] ± 0.77

2. Report on the influence of local processing on quality for baobab

2.1. Introduction

Among the numerous forest food resources available in the wild, the baobab tree (Adansonia digitata L.) is of key economic importance, being used daily by local populations in Africa (Chadare, et al. 2008; Sidibe and Williams, 2002; Diop et al., 2005; Assogbadjo et al., 2006).

The baobab is used for many purposes and represents an important source of income for the Senegalese people, but it is valorized in traditional ways. The fruit can be harvested all year round. Since years ago, the growth of small and middle enterprises makes the baobab fruit as an important food for industries. The major problems during processing of baobab pulp are linked to vitamin C loss. An understanding of the various processing parameters is necessary to produce good quality products. In addition, there is a big problem on stabilizing baobab fruit nectar and syrup as well as the dried pulp for its exportation.

In this present deliverable D4.1.1 of the AFTER (African Food Tradition Revisited by Research) project, the functional properties (vitamin C, polyphenol, antioxidant capacity) of baobab fruit (*Adansonia digitata L.*) are studied. After reminding the sampling and the local processing, the results and discussion of different analysis are presented by emphasizing the local processing on quality for baobab.

2.2. Sampling

Different samples of baobab fruit were collected across Senegal (**Figure 2**) according the SOPs for sampling strategy for group 3 (D1.2.1.3). Four regions of Senegal were considered. This is the region of Ziguinchor in southern countries, Kaolack located in the center of Senegal, Thies located in the west and Tambacounda-Kedougou in the east of Senegal.

Figure 2. Sampling area of baobab fruit

According the SOPs for sampling strategy for group 3 (D1.2.1.3), the **table 7** shows the location of all samples and the number of samples for each area. All the samples are from the specie of *Adansonia digitata*.

Table 7. Location and number of samples of baobab fruit

Tambacounda-Kedougou	Thies	Kaolack	Ziguinchor
10	5	10	5

2.3. Samples analysis

Samples collected were analysed for biochemical and nutritional analyses using SOP's defined on the deliverable D1.2.3.13.

2.4. Results and discussion

Tables 8 give the results of functional properties characterization of baobab fruit for different regions These results are consistent with those of the literature (Deliverable D12.2.3) (Haddad, 2000 ; Gebauer et al., 2002 ; Diop et al. 2005 ; Cisse et al., 2009 ; Chadare et al., 2010 ; Caluwe et al., 2010). Baobab fruit is characterized by their richness in vitamin C (340.19 to 401.59 mg.100 g^{-1}), polyphenols (3.57 to 5.93 %). This is probably the origin of high values of antioxidant activities regardless of the measurement method used. For the pulp, only the vitamin C content is significantly different ($p<0.05$) for all selected samples in different zones. Thiés and Ziguinchor have been reported to have the highest total polyphenol compared to Kaolack and Tambacounda-Kédougou which difference is not significant at $p<0.05$. Baobab fruit from Kaolack gives the highest content on vitamin C (401,59 mg.100 g^{-1}) while samples from Thies present higher value of total polyphenol (5.93 %).

Ziguinchor and Thiés have been presented to be the most important pulp production zones with high quality processing technologies (but still traditional or semi-industrial). The differences observed can be a good indication of further pulp production to reach optimal values for the nutrients in the international markets.

2.5. Conclusion

Optimizing local processing of baobab fruit for quality of byproducts can be considered as a factor of great interest because it is possible to achieve microbial safety, more bioactive compounds' retention, etc. by applying satisfied conditions at much adequate treatment parameters than what is commonly used, which would allow a better retention of nutritional compounds and physicochemical characteristics. In any case, further optimizations on the processing parameters are required to elucidate the effects of local processing parameters on quality attributes of baobab by products. In any case, we can conclude that improving the local processing by increasing the quality attributes of baobab by products has good prospects for use in baobab fruit enterprises and semi-industries as an alternative to the high techniques that the owners did not wanted to invest.

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Table 8. Results of functional properties of Baobab fruit

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Baobab pulp							
			Tambacounda-Kédougou		Thiés		Kaolack		Ziguinchor	
			Number of Samples	(Mean +/- SD)	Number of Samples	(Mean +/- SD)	Number of Samples	(Mean +/- SD)	Number of Samples	(Mean +/- SD)
Vitamin C (mg/100 g MS)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	10	340.19[d] ± 1.5	5	348.82[c] ± 0.32	10	401.59[a] ± 0.76	5	356.37[b] ± 0.52
Total polyphénols g/100g MS)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	10	3.87[c] ± 0.23	5	5.93[a] ± 0.31	10	3.57[c] ± 0.15	5	4.97[b] ± 0.12
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	10	67.50[a]± 1.76	5	89.28[b] ± 1.54	10	79.31[c] ± 4.03	5	76.43[d] ± 1.12
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	10	50.63[a] ± 1.54	5	77.67[b] ± 5.80	10	54.99[a] ± 3.51	5	64.70[c] ± 3.41
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	10	94.84[a] ± 3.99	5	95.63[b] ± 0.45	10	95.12[b] ± 0.58	5	93.84[c] ± 0.42

3. Report on the influence of local processing on quality for jaabi

3.1. Introduction

Jaabi is, in Cameroon, the local name of the fruit of jujube tree (*Ziziphus mauritiana*), a wild tree, largely spread in the savannah region of the country. The fruit is harvested dry and mainly consumed as side-dish. Its pulp is also pounded into flour which is then processed into a local cake called “Yaabande”. Though the jujube is spread in savannah regions of Africa, its fruit has not attracted significant scientific interest. It is then one of the underutilized plant species which has not received any benefit in terms of control of the cropping system or development for markets, contrary to the Asian practices where the jujube fruit is valorized in different foods and pharmaceutical products, with market, technology and quality development (Azam-Ali *et al.*, 2006).

Out of information provided by Noyé (1989) on Yaabande, no scientific study exists on *Jaabi*. It is, in fact, evident that understanding the local production and processing systems of *jaabi*, in relation with its characteristics and quality, constitutes one of the main steps to fulfill, in order to set up technology and market development of the product.

In this respect, a survey of *Jaabi* production, processing, trading and consumption systems in Northern Cameroon (Ndjouenkeu & Biyanzi, 2011) has shown that *Jaabi* fruit is harvested from November to January by field collection of mature and dry grains fallen from jujube trees. Four varieties of fruits are recognized and locally called: *jaabi lammuji*, *jaabi dakamji*, *jaabi hadinga* and *Kurnadje*. Due to their sweet taste, only *Jaabi lammuji* and *Jaabi dakamji* are the varieties consumed. The present study, related to the deliverable D4.1.1 of the AFTER (African Food Tradition Revisited by Research) project, aims at characterizing the biochemical and nutritive value of *Jaabi* fruit of the two consumed varieties, taking into consideration the potential effect of harvesting area.

3.2. Sampling of *jaabi* fruits

Jaabi fruits were collected in three villages of the Far north region (Mora, Maroua and Mokolo) and one village of the Northern region (Pitoa near Garoua) (**Figure 3**) according to Deliverable D1.2.1.3 (SOPs for sampling strategy group 3)

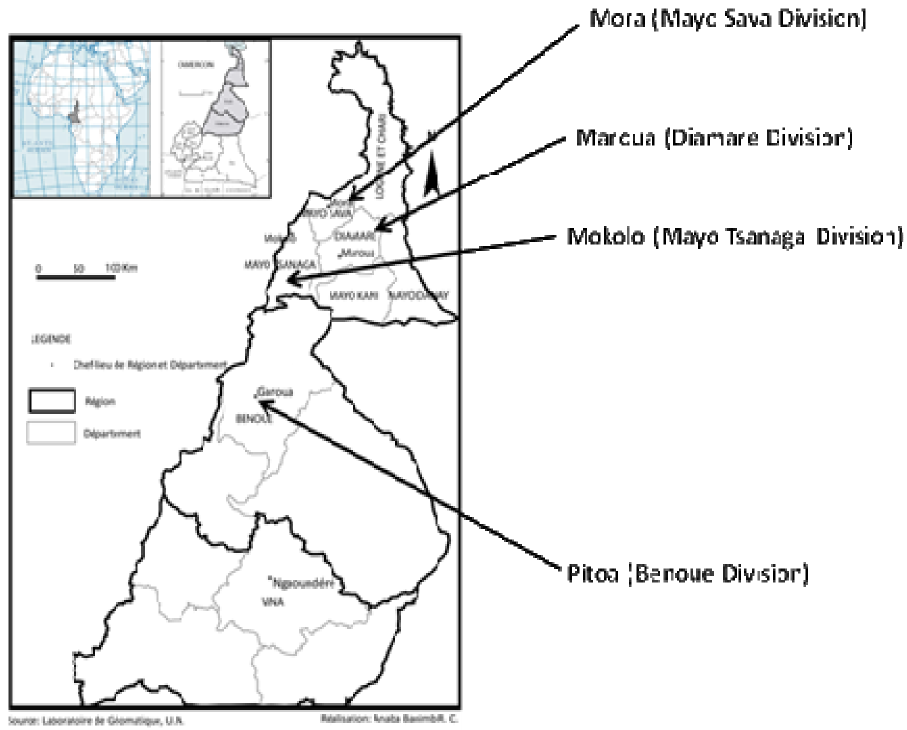

Figure 3. Sampling areas of *Jaabi* and *Yaabande*

For each sampling area, the two varieties of consumable *Jaabi* identified during survey were collected. Harvesters in each sampling area were selected and sensitized in order to guarantee the original quality of collected products. A total of 8 samples of *Jaabi* grains (2 varieties and 4 origins) were collected.

3.3 Samples analysis

Chemical analyses of collected samples were analysed according to SOPs for chemical analyses group 3 (D1.2.3.10).

3.4. Results and discussion

Since analyses are still ongoing, only results of Density, pH, Titrable acidity and crude ash are available (**Table 9**). These results indicate no significant difference among *Jaabi* samples, whatever the variety and origin. The further results on other nutrient may bring out some element of differentiation of the varieties. Meanwhile, considering the *Jaabi* varieties from Mokolo, for which more analyses have been undergone, though *Jaabi lammuji* and *Jaabi dakamji* have comparable acid pH values, the higher carbohydrates content of *dakamji* may justify the fact that this variety is sweeter than *lammuji* variety who has an acid-sweet taste. It could be hypothesised that the acid taste is hidden by carbohydrates in *dakamji*.

3.5. References

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Table 9. Quality characteristics of *Jaabi* fruits from different origin and varieties

Parameter and unit of measurement	SOP number	Origin and variety of fruits							
		Maroua		Mokolo		Mora		Garoua	
		Jaabi dakamji	*Jaabi lammuji*	*Jaabi dakamji*	*Jaabi lammuji*	*Jaabi dakamji*	*Jaabi lammuji*	*Jaabi dakamji*	*Jaabi lammuji*
Density (g/l)	**Phys-ExtPlantes-01-fr**	0.63 ± 0.01	0.65 ± 0.01	0.56 ± 0.01	0.60 ± 0.02	0.60 ± 0.02	0.61 ± 0.01	0.60 ± 0.01	0.62 ± 0.01
pH	**Chem-ExtPlantes-01-fr**	4.6 ± 0.1	4.47 ± 0.1	4.6 ± 0.1	4.4 ± 0.1	4.8 ± 0.1	4.6 ± 0.0	4.8 ± 0.0	4.3 ± 0.1
Titrable Acidity (g d'acide malique/100g poids frais)	**Chem-ExtPlantes-02-fr**	0.6 ± 0.0	0.7 ± 0.0	0.7 ± 0.0	0.7 ± 0.0	0.7 ± 0.0	0.9 ± 0.0	0.7 ± 0.0	1.3 ± 0.0
Crude Ash (%)	**Chem-ExtPlantes-004-fr**	4.5 ± 0.2	4.7 ± 0.1	5.0 ± 0.5	4.9 ± 0.7	4.6 ± 0.3	3.1 ± 0.2	4.5 ± 0.3	5.6 ± 0.2
Pectin (g/100g MS)	**Chem-ExtPlantes-05-fr**			1.9 ± 0.0	2.3 ± 0.1				
Fibers (g/100g MS)	**Chem-ExtPlantes-06-fr**			1.9 ± 0.1	1.4 ± 0.2				
Crude fat	**Chem-ExtPlantes-08-fr**			0.6 ± 0.0	0.6 ± 0.0				
Total sugar (g/100g MS)	**Chem-ExtPlantes-10-fr**			35.6 ± 0.2	28.5 ± 0.3				
Reducing sugar (g/100g MS)	**Chem-ExtPlantes-11-fr**			18.8 ± 0.1	14.4 ± 0.2				
Total protein (g/100g MS)	**Chem-ExtPlantes-12-fr**			1.2 ± 0.0	1.4 ± 0.0				