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1.1. Introduction

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 ; Nyarko et al., 2006 ; 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. Traditional processing of the *H. sabdariffa* calyx has been greatly improved by the establishment of many small enterprises.

1.2. 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. Six samples of each variety were harvested

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	-	-

1.3. Samples analysis

Samples collected were analysed for biochemical and nutritional analyses using SOP's defined on the deliverable D1.2.3.13. Analyses were undergone on the four varieties of *Hibiscus sabdariffa*

1.4. Results and discussion

1.4.1. By region

Tables **2-6** give the results of biochemical and nutritional characterization 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.

With the exception of a few elements, the varieties of *Hibiscus sabdariffa* differ significantly in terms of biochemical and nutritional characteristics regardless of the growing region. Vitamin C content of Vimto and koor varieties shows no difference in the regions of Kaolack and Fatick (Table 2-3). In the Ziguinchor region located in the south of the country (Table 4), Koor and Thai varieties show no significant differences in terms of total anthocyanin content, total polyphenol content and antioxidant capacity with the DPPH method.

1.4.2. By variety

Tables 7-10 give the results of biochemical and nutritional characterization of each variety according the growing area. These tables highlight the minimum and maximum levels of each factor for each variety based on the growing region. For example, for koor variety (Table 8), 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.

Table 2. Results of determination of biochemical and nutritional quality 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	$1.47^{b} \pm 0.02$	6	$1.34^{b} \pm 0.02$	6	$3.73^{a} \pm 0.32$	6	$1.03^{c} \pm 0.01$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$1.16^{d} \pm 0.01$	6	$2.35^{b} \pm 0.00$	6	$3.12^{a} \pm 0.02$	6	$1.33^{c} \pm 0.02$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$4.28^{c} \pm 0.26$	6	$6.97^{b} \pm 0.23$	6	$7.34^{a} \pm 0.03$	6	$3.85^{d} \pm 0.07$
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$2.94^{a} \pm 0.06$	6	$2.05^{c} \pm 0.05$	6	$1.56^{d} \pm 0.03$	6	$2.18^{b} \pm 0.11$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$1.73^{a} \pm 0.04$	6	$0.52^{b} \pm 0.02$	6	$0.46^{c} \pm 0.02$	6	$1.48^{d} \pm 0.05$
Identification of polyphenols	Bioch-ExtPlantes-07-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1	6	Annexe 1
Identification of anthocyanins	Bioch-ExtPlantes-08-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1	6	Annexe 1
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	$78.81^{a} \pm 2.68$	6	$75.54^{b} \pm 2.32$	6	$74.58^{c} \pm 2.25$	6	$81.21^{d} \pm 2.14$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	$96.13^{b} \pm 5.33$	6	$86.41^{c} \pm 4.23$	6	$82.67^{d} \pm 4.34$	6	$91.33^{a} \pm 3.23$
Antioxidant capacity (TEAC) (µM Trolox/g DW)			6	$135.97^{a} \pm 0.83$	6	$129.35^{b} \pm 0.97$	6	$131.25^{c} \pm 0.87$	6	$133.87^{d} \pm 0.78$
Aroma compounds	Bioch-ExtPlantes-12-fr	UCAD @ CIRAD	6	Annexe 2	6	Annexe 2	6	Annexe 2	6	Annexe 2

Table 3. Results of determination of biochemical and nutritional quality 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	$3.68^{a} \pm 0.03$	6	$3.82^{a} \pm 0.11$	6	$3.23^{b} \pm 0.11$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$1.21^{c} \pm 0.01$	6	$2.25^{b} \pm 0.01$	6	$2.78^{a} \pm 0.03$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$4.42^{c} \pm 0.26$	6	$6.24^{b} \pm 0.31$	6	$6.90^{a} \pm 0.12$
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$3.10^{a} \pm 0.02$	6	$2.51^{b} \pm 0.01$	6	$1.78^{c} \pm 0.01$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$1.47^{a} \pm 0.01$	6	$1.16^{b} \pm 0.02$	6	$0.85^{c} \pm 0.01$
Identification of polyphenols	Bioch-ExtPlantes-07-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1
Identification of anthocyanins	Bioch-ExtPlantes-08-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	$93.28^{a} \pm 3.55$	6	$75.12^{b} \pm 5.79$	6	$73.17^{c} \pm 5.15$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	$76.82^{a} \pm 1.99$	6	$49.72^{b} \pm 1.14$	6	$45.78^{c} \pm 0.98$
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	6	$132.97^{a} \pm 0.48$	6	$135.74^{b} \pm 0.63$	6	$133.43^{b} \pm 0.49$
Aroma compounds	Bioch-ExtPlantes-12-fr	UCAD @ CIRAD	6	Annexe 2	6	Annexe 2	6	Annexe 2

Table 4. Results of determination of biochemical and nutritional quality 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	$28.34^{c} \pm 0.05$	6	$44.56^{a} \pm 0.18$	6	$39.78^{b} \pm 0.31$	6	$26.78^{d} \pm 0.31$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$1.26^{b} \pm 0.01$	6	$2.34^{a} \pm 0.01$	6	$2.15^{c} \pm 0.02$	6	$1.08^{d} \pm 0.01$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$3.89^{d} \pm 0.05$	6	$5.02^{b} \pm 0.31$	6	$5.45^{a} \pm 0.22$	6	$4.01^{c} \pm 0.02$
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$2.52^{b} \pm 0.04$	6	$1.98^{c} \pm 0.03$	6	$2.03^{c} \pm 0.03$	6	$2.87^{a} \pm 0.04$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$1.87^{b} \pm 0.02$	6	$0.68^{c} \pm 0.03$	6	$0.73^{c} \pm 0.02$	6	$1.97^{a} \pm 0.03$
Identification of polyphenols	Bioch-ExtPlantes-07-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1	6	Annexe 1
Identification of anthocyanins	Bioch-ExtPlantes-08-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1	6	Annexe 1
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ ENSAI	6	$103.37^{a} \pm 4.30$	6	$96.64^{b} \pm 3.02$	6	$95.89^{b} \pm 2.97$	6	$107.47^{c} \pm 4.15$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ ENSAI	6	$66.23^{b} \pm 4.77$	6	$36.58^{c} \pm 2.01$	6	$33.24^{d} \pm 1.05$	6	$71.78^{a} \pm 2.14$
Antioxidant capacity (TEAC) (µM Trolox/g DW)		UCAD @ ENSAI	6	$140.57^{a} \pm 1.30$	6	$136.68^{b} \pm 0.84$	6	$138.14^{c} \pm 0.75$	6	$145.63^{d} \pm 1.47$
Aroma compounds	Bioch-ExtPlantes-12-fr	UCAD @ CIRAD	6	Annexe 2	6	Annexe 2	6	Annexe 2	6	Annexe 2

Table 5. Results of determination of biochemical and nutritional quality 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	$41.89^{a} \pm 0.28$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$1.02^{b} \pm 0.01$	6	$1.78^{a} \pm 0.01$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$3.92^{b} \pm 0.03$	6	$4.97^{a} \pm 0.31$
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	$0.78^{b} \pm 0.03$
Identification of polyphenols	Bioch-ExtPlantes-07-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1
Identification of anthocyanins	Bioch-ExtPlantes-08-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1
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	$128.42^{b} \pm 2.41$
Aroma compounds	Bioch-ExtPlantes-12-fr	UCAD @ CIRAD	6	Annexe 2	6	Annexe 2

Table 6. Results of determination of biochemical and nutritional quality 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	$3.53^{c} \pm 0.04$	6	$5.34^{b} \pm 0.04$	6	$5.83^{a} \pm 0.03$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$1.15^{c} \pm 0.01$	6	$1.34^{b} \pm 0.01$	6	$2.02^{a} \pm 0.02$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$3.57^{b} \pm 0.03$	6	$4.25^{a} \pm 0.25$	6	$5.12^{c} \pm 0.22$
Total polyphénols (g/100 DW g)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$2.89^{a} \pm 0.02$	6	$2.12^{c} \pm 0.02$	6	$2.34^{b} \pm 0.03$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$1.65^{a} \pm 0.02$	6	$0.99^{c} \pm 0.02$	6	$1.24^{b} \pm 0.02$
Identification of polyphenols	Bioch-ExtPlantes-07-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1
Identification of anthocyanins	Bioch-ExtPlantes-08-fr	UCAD @ CIRAD	6	Annexe 1	6	Annexe 1	6	Annexe 1
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	$90.44^{a} \pm 3.55$	6	$77.22^{b} \pm 5.79$	6	$73.11^{c} \pm 5.15$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	$86.41^{a} \pm 2.03$	6	$52.72^{b} \pm 1.14$	6	$55.78^{c} \pm 0.94$
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	6	$134.14^{a} \pm 0.78$	6	$130.14^{b} \pm 0.84$	6	$128.43^{c} \pm 0.77$
Aroma compounds	Bioch-ExtPlantes-12-fr	UCAD @ CIRAD	6	Annexe 2	6	Annexe 2	6	Annexe 2

Table 7. Results of determination of biochemical and nutritional quality of *Hibiscus sabdariffa*: vimto variety

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Number of Samples	Kaolack	Fatick	Ziguinchor	Thies	Louga
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	1.47^{e}± 0.02	3.68^{c} ± 0.03	28.34^{b} ± 0.05	31.45^{a} ± 0.03	3.53^{d} ± 0.04
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	1.16^{c} ± 0.01	1.21^{b} ± 0.01	1.26^{a} ± 0.01	1.02^{d} ± 0.01	1.15^{c} ± 0.01
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	4.28^{a} ± 0.26	4.42^{a} ± 0.26	3.89^{b} ± 0.05	3.92^{b} ± 0.03	3.57^{c} ± 0.03
Total polyphénols (g/100g DW)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	2.94^{b} ± 0.06	3.10^{a} ± 0.02	2.52^{d} ± 0.04	2.64^{c} ± 0.02	2.89^{b}± 0.02
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	1.73^{b} ± 0.04	1.47^{d} ± 0.01	1.87^{a} ± 0.02	1.42^{e} ± 0.02	1.65^{c} ± 0.02
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	78.81^{b} ± 2.68	93.28^{ab} ± 3.55	103.37^{a}± 4.30	84.97^{b} ± 5.50	90.44^{b} ± 3.55
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	96.13^{b} ±5.33	76.82^{a} ± 1.99	66.23± 4.77	38.51^{d} ± 2.98	86.41^{a} ± 2.03
Antioxidant capacity (TEAC) (µM Trolox/g DW)		UCAD @ CIRAD	6	135.97^{a} ± 0.83	132.97^{a}± 0.48	140.57^{a}± 1.30	135.74^{a} ± 1.00	134.14^{a}± 0.78

Table 8. Results of determination of biochemical and nutritional quality of *Hibiscus sabdariffa* : koor variety

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Number of Samples	Kaolack	Fatick	Ziguinchor	Thies	Louga
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	$1.34^{e} \pm 0.02$	$3.82^{d} \pm 0.11$	$44.56^{a} \pm 0.18$	$41.89^{b} \pm 0.28$	$5.34^{c} \pm 0.04$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$2.35^{a} \pm 0.00$	$2.25^{b} \pm 0.01$	$2.34^{a} \pm 0.01$	$1.78^{c} \pm 0.01$	$1.34^{d} \pm 0.01$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$6.97^{a} \pm 0.23$	$6.24^{b} \pm 0.31$	$5.02^{c} \pm 0.31$	$4.97^{c} \pm 0.31$	$5.25^{c} \pm 0.25$
Total polyphénols (g/100g DW)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$2.05^{c} \pm 0.05$	$2.51^{a} \pm 0.01$	$1.98^{d} \pm 0.03$	$1.67^{e} \pm 0.03$	$2.12^{b} \pm 0.02$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$0.52^{e} \pm 0.05$	$1.16^{a} \pm 0.02$	$0.68^{d} \pm 0.03$	$0.78^{c} \pm 0.03$	$0.99^{b} \pm 0.02$
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	$75.54^{b} \pm 3.32$	$75.12^{b} \pm 5.79$	$96.64^{b} \pm 3.02$	$80.24^{b} \pm 5.50$	$77.22^{b} \pm 5.79$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	$86.41^{c} \pm 4.23$	$49.72^{b} \pm 1.14$	$36.58^{c} \pm 2.01$	$34.33^{b} \pm 1.85$	$52.72^{b} \pm 1.14$
Antioxidant capacity (TEAC) (µM Trolox/g DW)		UCAD @ CIRAD	6	$133.35^{b} \pm 0.97$	$135.74^{b} \pm 0.63$	$136.68^{b} \pm 0.84$	$128.42^{b} \pm 2.41$	$130.14^{b} \pm 0.84$

Table 9. Results of determination of biochemical and nutritional quality of *Hibiscus sabdariffa*: thai variety

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Number of Samples	Kaolack	Fatick	Ziguinchor	Louga
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	$3.73^{c} \pm 0.32$	$3.23^{d} \pm 0.11$	$39.78^{a} \pm 0.31$	$5.83^{b} \pm 0.03$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$3.12^{a} \pm 0.02$	$2.78^{b} \pm 0.03$	$2.15^{c} \pm 0.02$	$2.02^{d} \pm 0.02$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$7.34^{a} \pm 0.03$	$6.90^{b} \pm 0.12$	$5.45^{c} \pm 0.22$	$5.12^{d} \pm 0.22$
Total polyphénols (g/100g DW)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$1.56^{d} \pm 0.03$	$1.78^{c} \pm 0.01$	$2.03^{b} \pm 0.03$	$2.34^{a} \pm 0.03$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$0.46^{d} \pm 0.02$	$0.85^{b} \pm 0.01$	$0.73^{c} \pm 0.02$	$1.24^{a} \pm 0.02$
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	$74.58^{b} \pm 2.25$	$74.17^{b} \pm 5.15$	$95.89^{b} \pm 2.97$	$73.11^{b} \pm 5.15$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	$82.67^{d} \pm 4.34$	$45.78^{c} \pm 0.98$	$33.24^{d} \pm 1.05$	$55.78^{c} \pm 0.94$
Antioxidant capacity (TEAC) (µM Trolox/g DW)		UCAD @ CIRAD	6	$131.25^{c} \pm 0.87$	$134.43^{b} \pm 0.58$	$138.14^{c} \pm 0.75$	$128.43^{b} \pm 1.47$

Table 10. Results of determination of biochemical and nutritional quality of *Hibiscus sabdariffa*: Clt 92 variety

Parameter and unit of measurement	SOP number	Respon-sible partner and lab	Number of Samples	Kaolack	Ziguinchor
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	UCAD @ UCAD	6	$1.03^{b} \pm 0.01$	$26.78^{a} \pm 0.31$
Free amino acids (g/100g DW)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	6	$1.33^{a} \pm 0.02$	$1.08^{b} \pm 0.01$
Total amino acids (g/100g DW)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	6	$3.85^{a} \pm 0.07$	$4.01^{a} \pm 0.02$
Total polyphénols (g/100g DW)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	6	$2.18^{b} \pm 0.11$	$2.87^{a} \pm 0.04$
Total anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	UCAD @ UCAD	6	$1.48^{b} \pm 0.05$	$1.97^{a} \pm 0.03$
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	6	$81.21^{b} \pm 2.14$	$107.47^{a} \pm 4.15$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	6	$91.33^{a} \pm 3.23$	$71.78^{a} \pm 2.14$
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	6	$136.87^{b} \pm 0.78$	$145.63^{a} \pm 1.47$

1.4.3 Identification of anthocyanins and polyphenols

Identification of anthocyanins and polyphénols are carried out by CIRAD using the SOP's Bioch-ExtPlantes-05-fr, Bioch-ExtPlantes-06-fr. The table 11 shows the compounds identified.

Table 11. Anthocyanins and polyphenols compounds identified in the four varieties of *Hibiscus sabdariffa* from Senegal

	Compounds
Major	Delpninidin of sambubioside
	Cyanidin of sambubioside
Minor	Chlorogenic acid
	Myricetine of glucoside
	Quercetine of sambubioside

The same compounds were identified in the four varieties. The major compounds are those found in the literature (Du et Francis, 1973; Degenhardt et aL; 2000; Lazze et al., 2003; Palé et al., 2004) for other varieties of *Hibiscus sabdariffa* non Senegalese

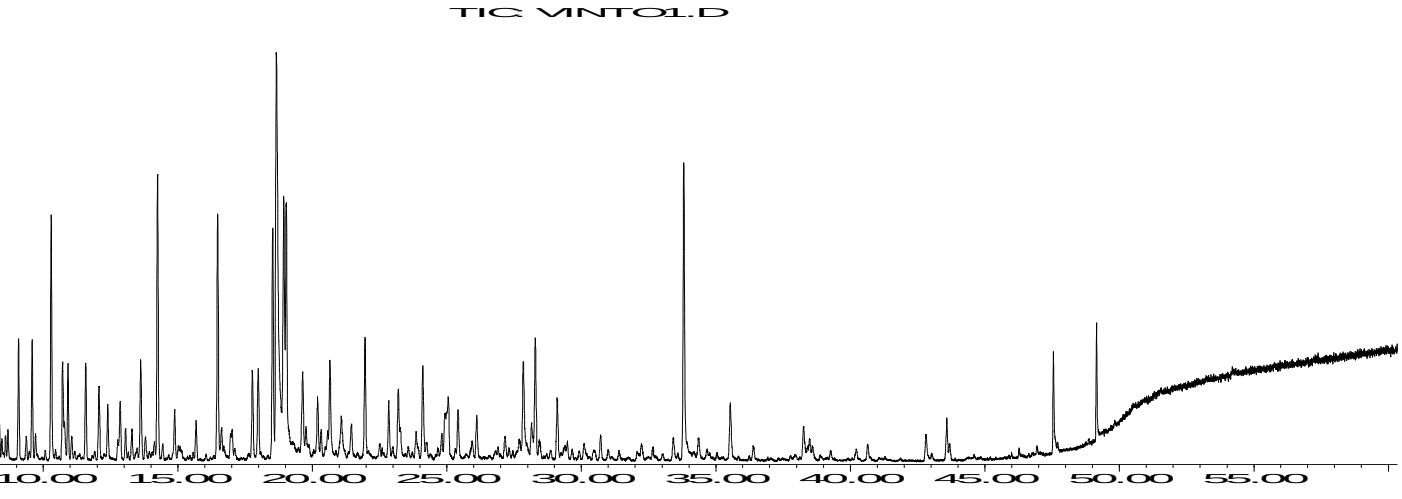
1.4.4. Identification of aroma compounds

Identification of aromas compounds are carried out by CIRAD using the SOP's Bioch-ExtPlantes-12-fr. The superposition of the chromatogram (**Figure 2**) shows the same profile for the different samples of bissap whatever the region of harvest. So, composition of the major aromas compounds is given by the **table 12**.

1.5. 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.

ult of sampling and determination of biochemical and nutritional quality for Group 3



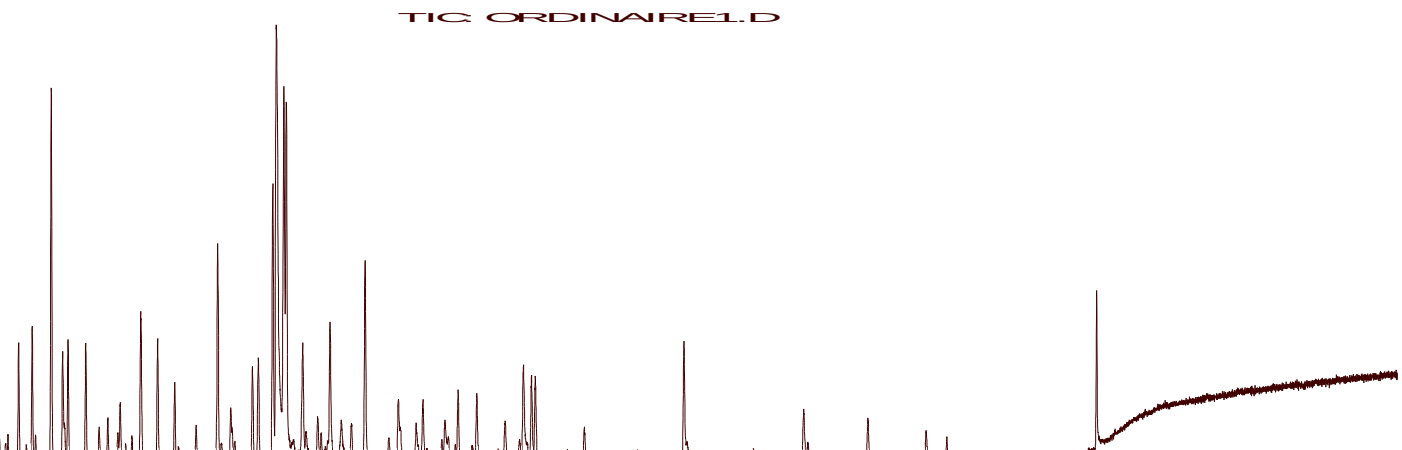


Table 12. Composition of aromas compounds of the different varieties of *Hibiscus sabdariffa* (vimto, koor, thai, clt 92)

Retention time	Compound	Match	Reverse Match
5,73	Hexanal	92,8	92,9
9,07	β-Terpinyl acetate	85,3	89,3
9,58	2,7-Octadiene-1,6-diol, 2,6-dimethyl-	78,7	78,7
10,29	Furan, 2-pentyl-	91	91,2
10,71	Limonene oxide, cis-	79,9	82,2
10,91	Octane, 1-chloro-	90	90,6
11,57	Benzene, 1-methyl-2-(1-methylethyl)-	90,7	93,3
13,61	2-Heptenal, (Z)-	86,5	93,9
14,24	5-Hepten-2-one, 6-methyl-	91,4	92,3
16,47	Nonanal	90,3	90,5
17,76	2-Octenal, (E)-	88	88,3
17,98	Benzene, 1-methyl-4-(1-methylethenyl)-	87,9	93,1
18,52	Linalyl oxide	87,2	87,9
18,66	Acetic acid	91,3	94,7
18,93	Furfural	89,1	93,4
19,03	1-Octen-3-ol	84,3	85,7
19,64	cis-Linalool Oxide	83,3	84,4
20,65	Decanal	89,6	90,2
21,95	2-Nonenal, (E)-	90,8	93,2
24,103	3,5-Heptadien-2-one, 6-methyl-, (E)-	86,4	90,9
27,84	3-Cyclohexene-1-acetaldehyde, à,4-dimethyl-	83,1	86,5
28,28	α-Terpineol	86,9	90,5
33,8	5,9-Undecadien-2-one, 6,10-dimethyl-	90,9	92,7
47,54	Diethyl Phthalate	88,8	92,2
49,15	5-(Hydroxymethyl)-2-furfural	75,4	79,1

1.6. References

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2. Result of sampling and determination of biochemical and nutritional quality for baobab

2.1. Introduction

The baobab (*Adansonia digitata L.*) is important to the livelihood and can be found in most of Sub-Sahara Africa's semi-arid and sub-humid regions as well as in western Madagascar providing food, medicine, etc. (Gebauer et al. 2002 ; Cisse et al. 2009, Caluwé et al., 2010). Baobab fruit pulp is called "Bouy" or Monkey bread is widely used by Senegalese people and it is consumed in different forms (Cisse et al., 2009). Baobab fruit pulp is a natural dried fruit pulp.

2.2. Sampling

Different samples of baobab fruit were collected across Senegal (**Figure 3)** 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 3. Sampling area of baobab fruit

According the SOPs for sampling strategy for group 3 (D1.2.1.3), the **table 13** 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 13. 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 14 give the results of biochemical and nutritional 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.

According the origin of the baobab fruit, significantly differences were noted with vitamin C ($p<0.05$) for all selected samples, polyphenol content and antioxidant capacity. Baobab fruit from Kaolack gives the highest content on vitamin C (401,59 mg.100 g^{-1}). The free amino acids and total amino did show difference from one region to another. Thiés and Ziguinchor have been reported to have the highest total polyphenol compared to Kaolack and Tambacounda-Kédougou which difference is not significant at $p<0.05$. 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).

To determine the polyphenolic profile, HPLC-MS was used. The superposition of the chromatogram (Figure 2) shows the same profile for the different samples of baobab. So, composition of the major polyphenol compounds is :

- Epicathechine M/Z- 288
- Procyanidine M/Z- 577
- Procyanidine dimer M/Z- 729
- Procyanidine trimer M/Z- 865
- Procyanidine tetra M/Z- 1153
- Procyanidine pinta M/Z- 1441

Composition of aromas compounds of the samples of baobab fruit shows also meadows with some exceptions the same profile. Contaminants are also present in all samples. This may be

due to the packaging or storage conditions of the producers. (Silicone tetramere, eco resinoide encens, bht ditertiobutyl-3, 5 hydroxy-4 toluene, etc.).

2.5. Conclusion

Regarding the high level of vitamin C, polyphenols and antioxidant capacity, baobab fruit appears as a reservoir of antioxidants that can be used in the fight against free radicals. The wealth of the fruit of baobab in these bioactive compounds can be carrying the potential use of baobab as functional foods and in the fight against inflammatory diseases. So research works are undergone to evaluate the effect of traditional processing practices on baobab bioactive compound, with objective to set a reengineering process in this respect.

2.6. References

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Table 14. Results of determination of biochemical and nutritional quality of Baobab

Parameter and unit of measurement	SOP number	Responsible 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	$340.19^{d} \pm 1.5$	5	$348.82^{c} \pm 0.32$	10	$401.59^{a} \pm 0.76$	5	$356.37^{b} \pm 0.52$
Free amino acids (g/100g MS)	Nutri-ExtPlantes-03-fr	UCAD @ CIRAD	10	$0.14^{a} \pm 0.05$	5	$0.22^{a} \pm 0.02$	10	$0.11^{a} \pm 0.06$	5	$0.36^{a} \pm 0.01$
Total amino acids g/100g MS)	Nutri-ExtPlantes-04-fr	UCAD @ CIRAD	10	$2.08^{a} \pm 0.15$	5	$2.54^{a} \pm 0.53$	10	$2.30^{a} \pm 0.40$	5	$2.28^{a} \pm 0.42$
Total polyphénols g/100g MS)	Bioch-ExtPlantes-05-fr	UCAD @ UCAD	10	$3.87^{c} \pm 0.23$	5	$5.93^{a} \pm 0.31$	10	$3.57^{c} \pm 0.15$	5	$4.97^{b} \pm 0.12$
Identification of polyphenols	Bioch-ExtPlantes-07-fr	UCAD @ CIRAD	See annexe 1							
Antioxidant capacity (DPPH) (µM Trolox/g DW)	Bioch-ExtPlantes-09-fr	UCAD @ UCAD	10	$67.50^{a} \pm 1.76$	5	$89.28^{b} \pm 1.54$	10	$79.31^{c} \pm 4.03$	5	$76.43^{d} \pm 1.12$
Antioxidant capacity (FRAP) (µM Trolox/g DW)	Bioch-ExtPlantes-10-fr	UCAD @ UCAD	10	$50.63^{a} \pm 1.54$	5	$77.67^{b} \pm 5.80$	10	$54.99^{a} \pm 3.51$	5	$64.70^{c} \pm 3.41$
Antioxidant capacity (TEAC) (µM Trolox/g DW)	Bioch-ExtPlantes-11-fr	UCAD @ CIRAD	10	$94.84^{a} \pm 3.99$	5	$95.63^{b} \pm 0.45$	10	$95.12^{b} \pm 0.58$	5	$93.84^{c} \pm 0.42$
Aroma compounds	Bioch-ExtPlantes-12-fr	UCAD @ CIRAD	See annexe 2							

3. Result of sampling and determination of biochemical and nutritional 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 D1.2.7.3 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.

3.2. Sampling of *jaabi* fruits

Jaabi fruits were collected in Mokolo, a village in the Far north region of the country (**Figure 4**) according to Deliverable D1.2.1.3 (SOPs for sampling strategy group 3)

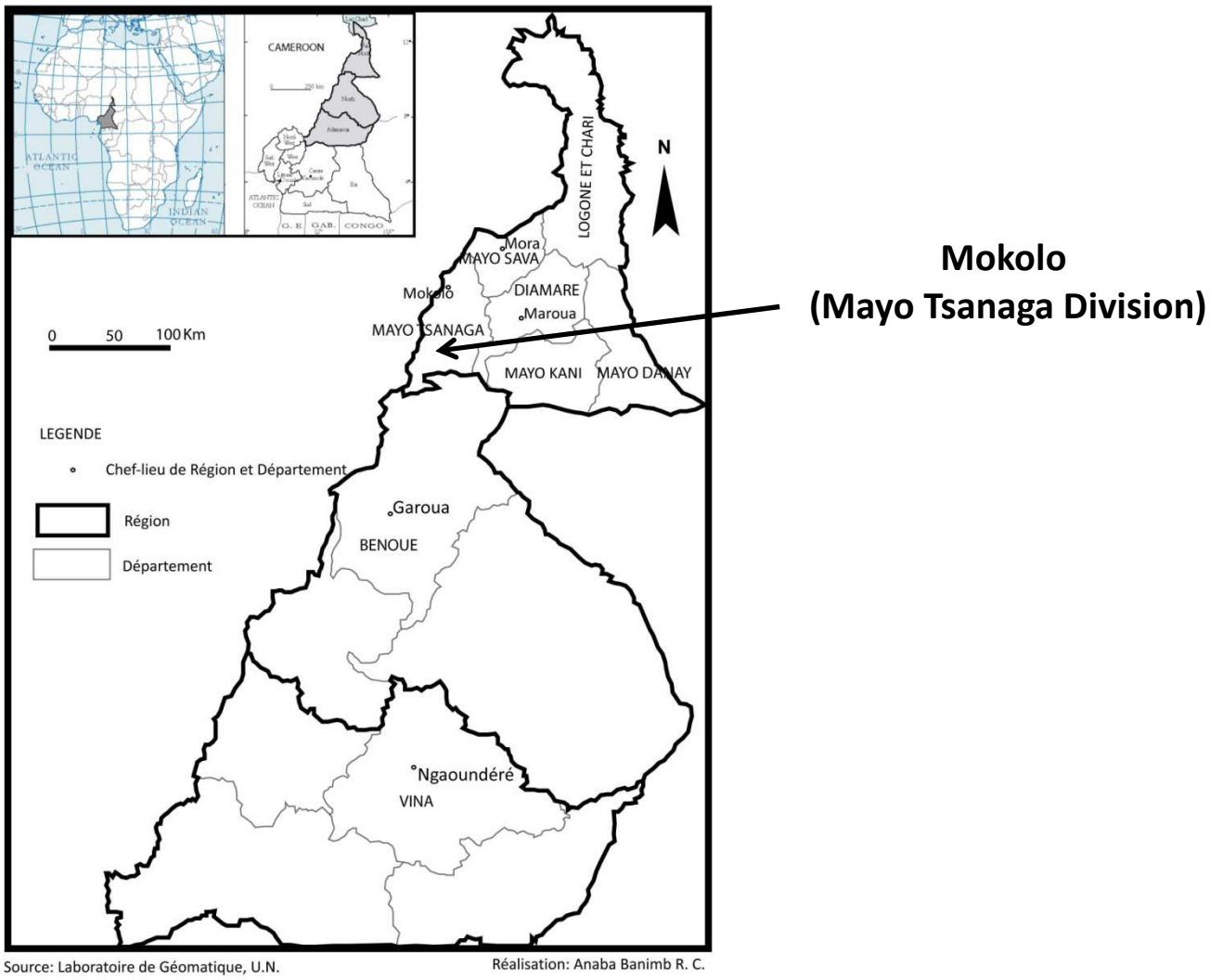

Figure 4. Sampling area of *Jaabi*

The two varieties of consumable *Jaabi* identified during survey were collected. Harvesters were selected and sensitized in order to guarantee the original quality of collected products.

3.3. Samples analysis

Samples collected from Mokolo were analysed for biochemical components: determination of polyphenols and bioactive compounds. Analyses were undergone on *Jaabi* peel and pulp in order to find how are distributed the bioactive compounds and their activity in the different parts of the fruit. This activity was measured using three methods: the DPPH (2'2 -diphényl-1'-picrylhydrazyl) method, the TEAC (Trolox Equivalent Antioxidant Capacity) and the method of reducing power FRAP (Ferric ion Reducing Antioxidant Power)

3.4. Results and Discussion

Results are shown on **tables 15** and **16.** It is noted in the analysis of polyphenols content (Table 1) that, according to our analytical method, tannins seems absent in *Jaabi*, which is an interesting observation in terms of bioavailability of *Jaabi* nutrients.

Table 15. Biochemical composition (g/100g DM) of two varieties of *Jaabi* from Mokolo

Constituents	SOP number	Varieties	
		Jaabi lammuji	***Jaabi dakamji***
Vitamin C (mg/100g DW)	Nutri-ExtPlantes-01/02-fr	81.20 ± 1.88	92.32 ± 0.98
Total carotenoids (µg/100g DW)		62.31 ± 2.61	59.75 ± 4.37
Crude ash (g/100g DW)	Chem-ExtPlantes-004-fr	0.79 ± 0.07	1.06 ± 0.06
- Fe (mg/100g DW)		1.63 ± 0.03	2.03 ± 0.02
- Ca (mg/100g DW)		62.59 ± 6.03	85.81 ± 11.58
- P (mg/100g DW)		68.94 ± 1.45	59.05 ± 5.93
Total Polyphenols (g/100g DW)	Bioch-ExtPlantes-05-fr	1.27 ± 0.07	1.65 ± 0.19[c]
-Flavonoids (g/100g DW)		0.48 ± 0.01	0.50 ± 0.16
- Anthocyanins (g/100g DW)	Bioch-ExtPlantes-06-fr	0.09 ± 0.01	0.33 ± 0.08
- Tannins (g/100g DW)		0.00 ± 0.00	0.00 ± 0.00

Taking into consideration the polyphenols content of *Jaabi* varieties and their biological activity (**Table 16**), all *Jaabi* varieties present significant and comparable antioxidant activity. This activity is mainly located in the peels. With regard to this, the traditional use of *Jaabi* as a whole for consumption and for processing of *Yaabande* appears interesting from biological point of view, since all the potential of biological compounds of the fruit is used in its consumption system

Table 16. Phenol compounds contents and antioxidant activity of peels and pulps of two varieties of *Jaabi* from Mokolo

Varieties	**Parts**	**Total polyphenols contents and antioxidant activity**			
		Total Polyphénols (g/100g DW) [Bioch-ExtPlantes-05-fr]	**TEAC (mM trolox/g DW)**	**DPPH (mM trolox/g DW)** [Bioch-ExtPlantes-09-fr]	**FRAP (mM trolox/g DW)** [Bioch-ExtPlantes-10-fr]
Jaabi lammuji	peel	1.45 ± 0.28	44.27 ± 0.86	30.69 ± 0.54	17.48 ± 0.62
	pulp	1.02 ± 0.22	35.31 ± 1.03	25.71 ± 2.88	12.63 ± 1.18
Jaabi dakamji	peel	1.96 ± 0.39	59.36 ± 0.26	43.08 ± 0.42	16.76 ± 0.67
	pulp	1.51 ± 0.28	39.32 ± 1.63	29.94 ± 1.19	11.10 ± 1.01

TEAC = Trolox equivalent activity capacity DPPH = 1.1'-diphenyl-2-picrylhydrazyl
FRAP = ferric ion reducing antioxidant power

3.5. Conclusion

Jaabi appears as a reservoir of antioxidants that can be used in the fight against free radicals. The wealth of *Jaabi* in these bioactive compounds can be carrying the potential use of these fruits in the fight against inflammatory diseases. In this respect, it should be interesting both in characterizing bioactive compounds in other *Jaabi* varieties found in the northern region of Cameroon, and in identifying the phenolic compounds responsible of this bioactive activity. Thin Layer Chromatography is actually used in our laboratory in this respect, with focus in terpenoïc acids. In addition, research work are undergone to evaluate the effect of traditional processing practices of *Jaabi* on bioactive compound, with objective to set a reengineering process in this respect and to use *Jaabi* as additive in the production of nutraceutical biscuit.

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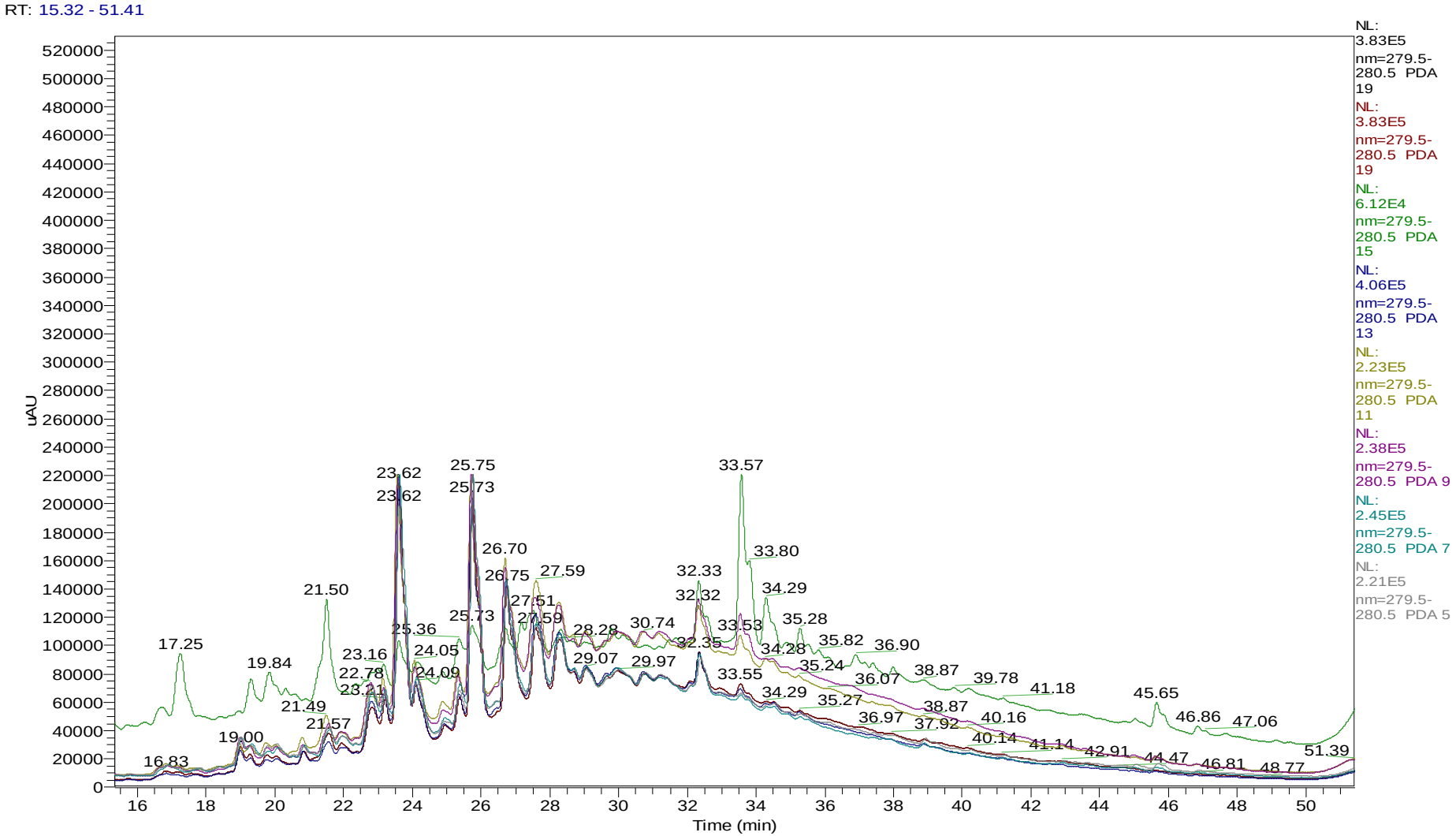
Result of sampling and determination of biochemical and nutritional quality for Group 3



Annexe 1.. Chromatogram of the different samples of baobab pulp

Annexe2. Aromas compounds of baobab

Retention time (min)	Tambacounda-Kédougou	Thiès	Kaolack	Ziguinchor
2.15		ACETONE		ACETONE
2.35	SILICONE TETRAMERE			SILICONE TETRAMERE
2.42	NONANE	NONANE	NONANE	NONANE
2.59	TETRAHYDROGERANYLE ACETATE	TETRAHYDROGERANYLE ACETATE	TETRAHYDROGERANYLE ACETATE	TETRAHYDROGERANYLE ACETATE
3.41	ECO RESINOIDE ENCENS	ECO RESINOIDE ENCENS	ECO RESINOIDE ENCENS	ECO RESINOIDE ENCENS
3.9	SILICONE TETRAMERE	SILICONE TETRAMERE	SILICONE TETRAMERE	SILICONE TETRAMERE
3.99	DECANE		DECANE	DECANE
4.27	HEPTADECANE	UNDECANE		HEPTADECANE
4.63	DODECANE	DODECANE	DODECANE	DODECANE
4.75	2-METHYLBUT-3-EN-2-OL I		N-UNDECANOL	

4.99				4-METHYL 2-PENTENAL
5.31	n-OCTANE			
5.52	1 HEXANAL	1 HEXANAL	1 HEXANAL	1 HEXANAL
5.78	UNDECANE	UNDECANE	UNDECANE	UNDECANE
6.08	4-Et-2-MetTHIAZOLE			
6.16	DIMETHYL OCTANOL(TETRAHYDRO GERANIOL)	DIMETHYL OCTANOL(TETRAHYDRO GERANIOL)	DIMETHYL OCTANOL(TETRAHYDRO GERANIOL)	DIMETHYL OCTANOL(TETRAHYDRO GERANIOL)
7.29	EPOXY-1,2 DODECANE	EPOXY-1,2 DODECANE	EPOXY-1,2 DODECANE	EPOXY-1,2 DODECANE
8.03		ROSALVA 9-DECEN-1-OL		
8.15	SILICONE TETRAMERE	SILICONE TETRAMERE	SILICONE TETRAMERE	SILICONE TETRAMERE
8.38			HEPTANAL	
8.75		LIMONENE	LIMONENE	
9.04	DODECANE	DODECANE	DODECANE	DODECANE

9.17			EUCALYPTOL	
9.67		ALCANE C14	TETRADECANE	ALCANE C14
9.81	RUMACETAL			
9.96	HEPTEN-4-OL-1 CIS	UNDECYNE	UNDECYNE	
10.26	1,2,4-TRIMetBENZENE			
10.79	PENTADECANE	PENTADECANE	STYRENE	PENTADECANE
10.89	OCTADECANE			
11.24	1 p-cymène	NONADECANE		HEPTADECANE
11.59	1,3,5 TRIMETHYL BENZENE	(,3,5 TRIMETHYL BENZENE		
12.07	1 OCTANAL		1 OCTANAL	1 OCTANAL
12.5			t2(2PENTENYL)FURANE	
12.67		TRIDECANE		
12.8	TRIDECANE	TRIDECANE	TRIDECANE	TRIDECANE

13.51	TRICOSANE	ISOPARAFFINE	ISOPARAFFINE	HENEICOSANE
13.66			TRICOSANE	TRICOSANE
13.81	ACETATE ISOTRIDECYLE / ACETATE METHYLDODECYLE	ACETATE ISOTRIDECYLE / ACETATE METHYLDODECYLE	ACETATE ISOTRIDECYLE / ACETATE METHYLDODECYLE	ACETATE ISOTRIDECYLE / ACETATE METHYLDODECYLE
13.93	6-METHYL 5HEPTEN-2ONE	TRICOSANE		6-METHYL 5HEPTEN-2ONE
14.12			Iso HEXADECYL ALCOHOL	
14.4		TRIDECANOL		
14.57				2234Met cyBUTANON
14.69	ETHYL diETHOXY ACETATE			
15.2	DECYL VINYL ETHER		3344Met cyBUTANON	
16.16	1 NONANAL	1 NONANAL	1 NONANAL	1 NONANAL

16.71	TETRADECANE	TETRADECANE	TETRADECANE	TETRADECANE
17.26			p-tBut PhePROPANAL	2-METHYL-1-CYCLOPENTANONE
17.64				OCTADECANE
18.18		LINALOOL OXIDE		
18.32	ACETIC ACID	ACETIC ACID	ACETIC ACID	ACETIC ACID
18.4		TETRAHYDRO GERANYLAc		
18.57	1 FURFURAL	1 FURFURAL	1 FURFURAL	1 FURFURAL
18.77	2,4-HEPTADIEN-1-AL			
18.97	DOCOSANE			NONADECANE
19.85	TRANS-2-TRANS-4-HEPTADIENAL TNO	2ETHYLHEXYL ACRYLATE	2,4-HEPTADIEN-1-AL	
19.97				

Result of sampling and determination of biochemical and nutritional quality for

Group 3

20.32	1 DECANAL	ETHYL2HEXANOL	ETHYL2HEXANOL	2ETHYLHEXYL ACRYLATE
20.66	PENTADECANE			CAMPHRE
20.73	1 BENZALDEHYDE			1 BENZALDEHYDE
20.99	3,5-OCTADIEN-2-ONE		3,5-OCTADIEN-2-ONE	
21.61			NONEN-2-AL-1 TRANS	
21.95			METHYL POLYSILOXANE	METHYL POLYSILOXANE
22.39		1-HEXADECANOL / CETYL ALCOOL		DODECANOL
22.63	ALPHA HUMULENE			VERDOX 2t BUT CYCLOHEXANYLACETAT
22.78	ISOMENTHYL ACETATE			
22.94	1-OCTANOL	1-OCTANOL	1-OCTANOL	1-OCTANOL
23.51	TR.2-TR.4-NONADIENAL	TR2-CIS-6 NONADIENAL		

23.71				GAMMA MUUROLENE
24.4	PROPYL CYCLOHEXANE			
24.55	HEXADECANE			
25.46	TOLUALDEHYDE	TOLUALDEHYDE	TOLUALDEHYDE	2-METHYLBENZALDEHYDE
25.57	SAFRANAL		SAFRANAL	SAFRANAL
25.61		ACETOPHENONE		ACETOPHENONE
25.92	MENTHOL	MENTHOL	MENTHOL	MENTHOL
26.82	1 1-NONANOL		1 1-NONANOL	
27.94	ALPHA TERPINEOL			ALPHA TERPINEOL
28.36	METHYL-15 HEXADECANAL			
28.68			NAPHTALENE	
28.83	(-)CARVONE		(-)CARVONE	

32.16	ANETHOLE CIS			
32.61				1 METHYL NAPHTALINE
33.17	ACIDE HEXANOIQUE		ACIDE HEXANOIQUE	
33.29	GUAIACOL METHOXY-2 PHENOL	GUAIACOL METHOXY-2 PHENOL	GUAIACOL METHOXY-2 PHENOL	GUAIACOL METHOXY-2 PHENOL
33.48	GERANYL ACETONE	GERANYL ACETONE		GERANYL ACETONE
33.96				ALCOOL BENZYLIQUE
35.14				1,2- PHENYLETHANOL
35.38		BHT DITERTIOBUTYL-3,5 H YDROXY-4 TOLUENE		BHT DITERTIOBUTYL-3,5 H YDROXY-4 TOLUENE
36.88	2ETHYLHEXANOIC ACID		2ETHYLHEXANOIC ACID	
37.57		DODECANOL		
37.85	FURAN CARBONAT METIYL	FURAN CARBONAT METYL	FURAN CARBONAT METIYL	

39.42	LILIAL			
39.53				1,5-DIMETHYL NAPHTALENE
39.87	ISO E SUPER 6	ISO E SUPER 6		ISO E SUPER 6
40.42				ACIDE OCTANOIQUE
43.71		NONANOIC (PELARGONIC) ACIDE		
44.36				HEXYLE SALICYLATE
44.94	HEXADECANOATE DE METHYLE			
46.03	HEDIONE DIHYDROJASMONATE DE METHYLE			HEDIONE DIHYDROJASMONATE DE METHYLE
46.69	DIHYDROACTINIDIOLIDE 2 (4H)BENZOFURANON	p TERBUPHENOXY-1 EPOXY-2,3 PROPANE		tri-ETHYLENE GLYCOL

47.31	DIETHYLE PHTALATE	DIETHYLE PHTALATE		DIETHYLE PHTALATE
48.39			STEARATE BUTYLE	
48.64		BENZOPHENONE		
48.95	5 HYDROXY 2 METHYL FURFURAL	5 HYDROXY 2 METHYL FURFURAL	5 HYDROXY 2 METHYL FURFURAL	
49				ACIDE DODECANOIQUE
49.51	PHTALATE DE DIBUTYLE	PHTALATE DE DIBUTYLE	PHTALATE DE DIBUTYLE	
49.77			METHYLE LINOLENATE	
51.12	DIBUTYL PHTALATE	DIBUTYL PHTALATE	DIBUTYL PHTALATE	DIBUTYL PHTALATE
51.26				ANTHRACENE