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## TABLE OF CONTENTS

1. Introduction .....	3
2. Sampling of <i>jaabi</i> and processed products.....	3
3. Samples analysis .....	5
4. Results .....	5
5. Conclusion.....	11
6. References .....	11

**Report on the quality of the traditional products from *Ziziphus mauritiana*****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. They are locally processed in *Yaabande*, a biscuit-like cake, sold on markets in the northern regions of Cameroon. Three processing methods have been identified, with variations in the product container used (cakabash of vegetable leaves): steam cooking, stifle cooking, sun drying

The present study, related to the deliverable D4.1.3.3 of the AFTER (African Food Tradition Revisited by Research) project, aims at characterizing the quality of traditional products from *Jaabi*, taking into consideration the effect of origin, variety and processing method.

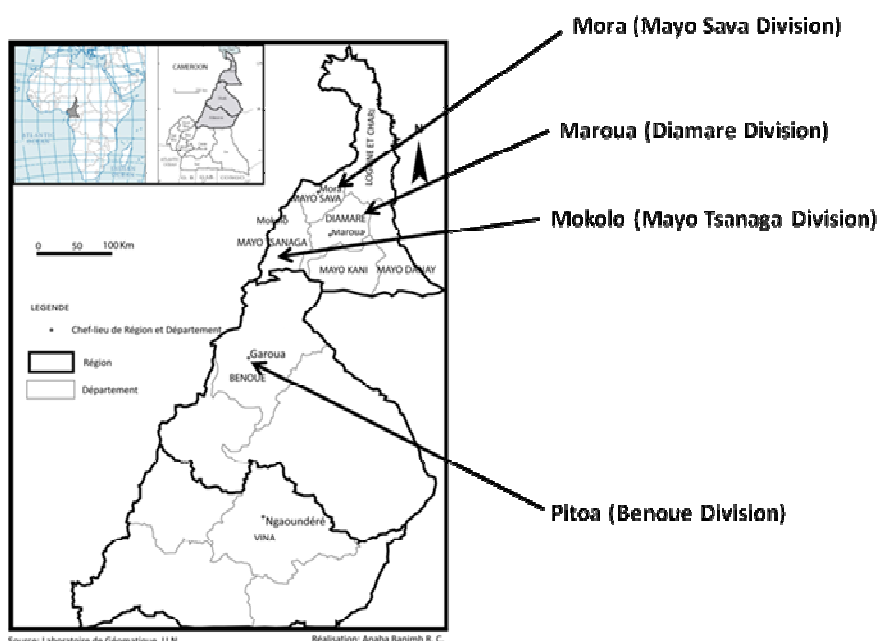
**2. Sampling of *jaabi* and processed products**

*Jaabi* and processed products (*Yaabande*) were collected in three villages of the Far north region (Mora, Maroua and Mokolo) and one village of the North region (Pitoa) (cf. Deliverable D1.2.1.3: SOPs for sampling strategy group 3) (**Figure 1**).

For each sampling area, the two varieties of consumable *Jaabi* identified during survey were collected. In addition, *Yaabande* processed from each variety, according to the processing method available locally was also collected. Both harvesters and processors in each sampling area were selected and sensitized in order to guarantee the original quality of collected products. Samples were progressively collected and stored by actors, and were transferred to laboratory when the ordered quantity was reached.

**Report on the quality of the traditional products from *Ziziphus mauritiana***

A total of 19 samples were collected, made of 8 samples of *Jaabi* grains (2 varieties and 4 origins) and 11 samples of resulting *Yaabande* (**Table 1**)



**Figure 1 :** Sampling areas of *Jaabi* and *Yaabande*

**Table 1.** Characteristics of collected samples of *Jaabi* and *Yaabande* according to variety, origin, and processing method

<i>Jaabi</i> Variety	Origin	<i>Yaabande</i>		
		steam cooking	Sun drying	Stifle cooking)
<i>Lammuji</i>	Garoua	X		
	Maroua	X		
	Mokolo	X		
	Mora	X	X	
<i>Dakamji</i>	Garoua	X		
	Maroua	X		X
	Mokolo	X		
	Mora		X	

### 3. Samples analysis

Chemical analyses of collected samples were analysed according to SOPs for chemical analyses group 3 (D1.2.3.10). Technological flora and pathogenic germs were analyzed using ISO standard methods.

### 4. Results

Some physico-chemical characteristics of *Jaabi lammuji* and *Jaabi dakamji* fruits and processed products (*Yaabande*) are shown on tables 1 and 2. Whatever the *Jaabi* variety, the origin and processing method, the physico-chemical properties analyzed are comparable for all samples. However, processing of *Jaabi* into *Yaabande* may result in slight reduction of crude ash content of the end product. Mineral losses during pounding or mineral complexation during cooking may be hypothesized as explanation. Anyway ongoing mineral analyses of samples may confirm or infirm these hypotheses.

Report on the quality of the traditional products from *Ziziphus mauritiana*

**Table 1.** Physico-chemical characteristics of *Jaabi dakamji* as a function of origin and processing methods

Parameter and unit of measurement	SOP number	Origin and processing method								
		Maroua			Mokolo		Mora		Garoua	
		Fruit	Steam cooking	Stifle cooking	Fruit	Steam cooking	Fruit	Solar drying	Fruit	Steam cooking
Moisture (%)	Chem-ExtPlantes-03-fr	6.8 ± 0.1	7.3 ± 0.2	7.8 ± 0.1	6.4 ± 0.1	8.0 ± 0.5	7.8 ± 0.4	9.1 ± 0.0	7.3 ± 0.4	6.81 ± 0.4
Density (g/l)	Phys-ExtPlantes-01-fr	0.63 ± 0.01	0.58 ± 0.01	0.59 ± 0.01	0.56 ± 0.01	0.62 ± 0.01	0.60 ± 0.02	0.75 ± 0.02	0.60 ± 0.01	0.63 ± 0.02
pH	Chem-ExtPlantes-01-fr	4.6 ± 0.1	4.8 ± 0.1	4.8 ± 0.1	4.6 ± 0.1	4.7 ± 0.1	4.8 ± 0.1	4.6 ± 0.0	4.8 ± 0.0	4.7 ± 0.1
Titration Acidity (g d'acide malique/100g poids frais)	Chem-ExtPlantes-02-fr	0.6 ± 0.0	0.5 ± 0.0	0.6 ± 0.0	0.7 ± 0.0	0.7 ± 0.0	0.7 ± 0.0	0.6 ± 0.0	0.7 ± 0.0	0.6 ± 0.0
Crude Ash (%)	Chem-ExtPlantes-004-fr	4.5 ± 0.2	3.7 ± 0.5	3.8 ± 0.3	5.0 ± 0.5	4.2 ± 0.3	4.6 ± 0.3	4.3 ± 0.4	4.5 ± 0.3	4.3 ± 0.8
Pectin (g/100g MS)	Chem-ExtPlantes-05-fr				1.9 ± 0.0					
Fibers (g/100g MS)	Chem-ExtPlantes-06-fr				1.9 ± 0.1					
Crude fat	Chem-ExtPlantes-08-fr				0.6 ± 0.0					
Total sugar (g/100g MS)	Chem-ExtPlantes-10-fr				35.6 ± 0.2					
Reducing sugar (g/100g MS)	Chem-ExtPlantes-11-fr				18.8 ± 0.1					
Total protein (g/100g MS)	Chem-ExtPlantes-12-fr				1.2 ± 0.0					

Report on the quality of the traditional products from *Ziziphus mauritiana*

**Table 2.** Physico-chemical characteristics of *Jaabi lammuji* as a function of origin and processing methods

Parameter and unit of measurement	SOP number	Maroua		Mokolo		Mora		Garoua	
		Fruit	Steam cooking	Fruit	Steam cooking	Fruit	Solar drying	Fruit	Steam cooking
		Density (g/l)	Phys-ExtPlantes-01-fr	0.65 ± 0.01	0.61 ± 0.02	0.60 ± 0.02	0.61 ± 0.02	0.61 ± 0.01	0.74 ± 0.02
pH	Chem-ExtPlantes-01-fr	4.47 ± 0.1	4.5 ± 0.0	4.4 ± 0.1	4.6 ± 0.1	4.6 ± 0.0	4.4 ± 0.1	4.3 ± 0.1	4.4 ± 0.1
Titration Acidity (g d'acide malique/100g poids frais)	Chem-ExtPlantes-02-fr	0.7 ± 0.0	0.6 ± 0.0	0.7 ± 0.0	0.7 ± 0.0	0.9 ± 0.0	0.8 ± 0.1	1.3 ± 0.0	1.1 ± 0.0
Moisture (%)	Chem-ExtPlantes-03-fr	7.4 ± 0.4	7.3 ± 0.4	7.8 ± 0.2	8.0 ± 0.2	8.0 ± 0.6	9.2 ± 0.2	8.0 ± 0.5	7.3 ± 0.5
Crude Ash (%)	Chem-ExtPlantes-004-fr	4.7 ± 0.1	3.4 ± 0.3	4.9 ± 0.7	4.4 ± 0.5	3.1 ± 0.2	3.2 ± 0.9	5.6 ± 0.2	5.0 ± 0.1
Pectin (g/100g MS)	Chem-ExtPlantes-05-fr			2.3 ± 0.1					
Fibers (g/100g MS)	Chem-ExtPlantes-06-fr			1.4 ± 0.2					
Crude fat	Chem-ExtPlantes-08-fr			0.6 ± 0.0					
Total sugar (g/100g MS)	Chem-ExtPlantes-10-fr			28.5 ± 0.3					
Reducing sugar (g/100g MS)	Chem-ExtPlantes-11-fr			14.4 ± 0.2					
Total protein (g/100g MS)	Chem-ExtPlantes-12-fr			1.4 ± 0.0					

**Report on the quality of the traditional products from *Ziziphus mauritiana***

Microbiological analyses of collected *Jaabi* and *Yaabande* samples are presented on **tables 3 and 4**.

Though yeast and mould are present in all samples, they are in the limits of acceptability ( $<10^4$  ufc/g for dry fruits), which may indicate an acceptable drying status of samples. But considering faecal contamination, the level of contamination with *E. coli* is above the accepted threshold for all samples. This indicates absence of good hygienic practices by actors who have manipulated the products.

Looking for pathogenic flora, though all samples are free of *Clostridium*, they are all contaminated by *Bacillus cereus* (except Lammuji fruit from Mokolo) and *Staphylococcus aureus*, which may indicate both inadequate hygienic conditions during processing and that the fruits, and even processed products, have been in contact with dust containing these spores. This hypothesis is probable since the fruits are harvested and processed during dry season, characterized by high levels of dust and sands in the atmosphere. In addition, products are processed and sold in open areas, exposed to dust and sands which may contain the spores. In the same way, the presence of *Salmonella* in some samples reinforces the hypothesis of weak hygienic practices in local *Jaabi* processing. However, analytical conditions have to be considered before consolidating the hypothesis.





AFTER (G.A n°245025) – Deliverable 4.1.3.3

Report on the quality of the traditional products from *Ziziphus mauritiana*

Table 4. Inventory of technological flora and pathogenic germs of *Jaabi lammuji* and resulting *Yaabande* (D1.2.5.3)

Parameter and unit of measurement	SOP number	Variety/Treatment/Process/Raw material used (Mean ± SD)							
		Maroua		Mokolo		Mora		Garoua	
		Fruit	Steam cooking	Fruit	Steam cooking	Fruit	Solar drying	Fruit	Steam cooking
Enumeration of microorganisms	Micro-01. ISO 4833								
<i>Enterobacteriaceae</i>	Micro-02. ISO 21528-2								
<i>Escherichia coli</i> (ufcx 10 <sup>2</sup> /g)	Micro-03. ISO 16649-2	190.0±25.5	4.3±2.0	18.0±2.8	18.0±2.83	100.6±0.9	61.0±0.1	140.0±20.3	140.0±20.3
<i>Bacillus cereus</i> (ufcx10 <sup>2</sup> /g)	Micro-04. ISO 7932	2.8±0.6	260.0±10.4	0.0	14.0±2.8	3.6±0.6	470.0±30.1	6.0±0.3	4400.0±16.0
<i>Staphylococcus aureus</i> (ufcx10 <sup>2</sup> /g)	Micro-05. ISO 6888-1	3.9±0.1	11.0±0.1	6.0±0.1	2.3±0.1	0.4±0.0	32.0±0.4	1.0±0.0	700±14
<i>Listeria monocytogenes</i>	Micro-06. ISO 112901/A1200 4								
<i>Salmonella</i> (presence: + Absence; -)	Micro-07. ISO 65792002	-	+	-	+	+	+	-	+
<i>Clostridium perfringens</i> (ufc/g)	Micro-08. ISO 7937	0±0	0±0	0±0	0±0	0±0	0±0	0±0	0±0
Yeasts (ufcx10 <sup>2</sup> /g)	Micro-09. ISO 7954	2008±2.3	180.0±5.6	18.8±2.3	1.0±0.1	2.0±0.5	90.0±0.3	2.4±0.6	1800±2.8
Moulds (ufc/g)	Micro-09. ISO 7954	14.0±2.8	0±0	6.0±0.6	10.0±1.8	20.0±2.8	7.1±0.6	4.0±0.1	0±0
Lactic acid bacteria (LAB)	Micro-10. M-METH-MO-13								

Report on the quality of the traditional products from *Ziziphus mauritiana*

## 5. Conclusion

The low level of hygienic practices appears as one of the main constraints to the quality of *Jaabi* and its processed product (*Yaabande*). This hygienic constraint may be attributed both to the actors and to the harvesting and processing environment, since fruits are harvested picking on soil and are sold or processed in open area with risk of dust and sand contaminations. In this respect, the reengineering of the local processing practices of *Jaabi* concern also the implementation of good hygienic practices in processing workshops and during commercialisation.

## 6. References

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