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Abstract

Baobab fruit, baobab juice and baobab pulp are generally processed on small and semi industrial scale in Senegal. The activities and the methods of processing were developed by the actors for the purpose of generating income rather than focusing on the quality attributes.. This survey helps actors to recognize variation in sensory properties of the mentioned products. From this survey it appears that the appreciation of the quality of baobab fruit, baobab juice and baobab pulp by the producers, traders and consumers is mainly based on observations of a number of sensory attributes such as high pulp content, colour, taste, texture, purity, cleanliness, appearance, shape, size, naturalness and caliber of these products. The therapeutic effects of these products have been highlighted by many consumers especially in the rural areas. Presence of foreign matter was mentioned as a problem by some actors. The improvement of packaging and storage conditions has also been pointed out by some consumers to influence the end products.

Introduction

Food products with good quality attributes are essential for consumer health, choice and preference. As a good source of nutrients, these products contribute to nutritional quality, which is influenced by the textural and sensory characteristics of the food because of their physical functional properties (Kim *et al.,* 2004; Allais *et al*., 2007, Augustin and Udabage, 2007). Indeed, traditional food products are characterized by typical sensory properties which originate from the traditional processing practices. Moreover, traditional food products are generally manufactured on small scale (at home) or on semi industrial scale (small factories, enterprise). Some of the producers are highly experienced, but often face a lack of technical tools to control the quality.

Baobab fruit, baobab juice and baobab pulp are consumed and used in different ways in Senegal. Its major constraints are the quality changes during production and storage (Cissé *et al*., 2009; Diop *et al*, 2005, Chadare, 2010). Evaluation of baobab fruit, baobab juice and baobab pulp quality characteristics is needed to identify the most important quality criteria according to various actors (producers, traders and consumers) involved. This investigation helps to develop a link between the quality properties mentioned by the different actors and the technology used to process the product as well as the impact of storage conditions.

Some information is available about the microbiological status of baobab fruit, baobab juice and baobab pulp, but very little is known about the sensory quality attributes, and the correlation with the consumer perceptions. Therefore, the objective of the present survey is to identify the quality attributes of baobab fruit, baobab juice and baobab pulp from the perspective of the different actors.

1.1 Choice of survey zones and sampling of surveyed

The survey was done in different zones: Dakar, Thiés, Kaolack, Fatick, Kédougou and Tambacounda according to the strong presence of baobab in these areas (Diop *et al.*, 2005; Cissé *et al.*, 2009). A preliminary poll has been conducted by visiting the processing sites of six (6) zones. In these zones, the production, trade or consumption are mostly performed by local population. Actors sample size was set according to previous works by Cissé *et al*. (2009) and Diop *et al*. (2005). In the different municipalities of the selected zones, the proportion of actors was assessed through a random-check on 727 people (70 processors, 308 traders, and 349 consumers).

1.2 Data collection

The survey was conducted on baobab fruit and by-product processors, traders and consumers in Dakar, Guédiawaye, Pikine, Rufisque, Thiés, Foundiougne, Kédougou, and Goudiry from 10th March to 10th April 2011. The survey was in the form of interviews conducted through a questionnaire as well as observations of the processors at work. A preliminary poll was firstly done in order to identify production sites and pre-test the questionnaire. Interviews were conducted in French and local languages (Wolof, Pheul, Diola, Maure, Sérére and Socé). A total of 727 randomly selected persons from different ethnic groups, areas and both genders at ages' ranging from 15 to 75, were effectively interviewed. The survey questions investigated the production, trade and consumption of baobab fruit, its juice, dried pulp and some very prized dishes containing baobab pulp. It investigated the various processing technologies, specific problems related to the processing, storage and commercialization as well as the important quality attributes according to the different actors of baobab fruit and by-products.

1.3 Data processing and analyses

The collected data were recorded and statistical analyses performed by using Excel software.

1.4 Quality attributes of baobab fruit, pulp and juice

During the survey, questions relating to baobab fruit and by-products quality attributes were posed to processors, traders and consumers in this sector. The main attributes registered are related to the colour, taste, texture, appearance, shape, size, naturalness and caliber of the baobab fruit. Other factors such as packaging and storage conditions were mentioned by some consumers, producers and traders to increase the on the product acceptability. The quality attributes identified as determinant factors by producers are given in Table 1.

Table 1: Determinant factors of baobab fruit quality for producers

Quality attributes	**Texture**	**Appearance**	**Texture**	**Shape-appearance**
Producers in %	4.44	2.22	73.33	20.00

The percentage of respondent producers who felt that some other quality attributes could add value to the baobab fruit are summarized in **Table 2**.

Table 2: Added value factors of baobab fruit quality for producers

Quality attributes	**Colour**	**Colour & caliber**
Producers in %	57.78	42.22

Most of the processors interviewed (73.33 %) claimed that good baobab fruit should have combined attributes of appearance and texture around 20 %. When texture and appearance was surveyed separately, only 4.44 % and 2.22 % respectively of the producers interviewed had affirmative responses. These results showed that for producers, a combination of attributes is more important in the appreciation or evaluation of the product. Most of the producers interviewed (57.78 %) thought that colour is the most important attribute that can increase the quality. Only 42.22 % gave their opinion about the colour and colour & caliber In **Table 3**, the quality criteria vs. selling price of the different products is mentioned for consumers and traders.

Table 3: Quality criteria vs. selling price (consumers and traders)

Quality attributes	**High pulp level**	**Cleanliness**	**Taste**	**Appearance**	**Size**	**White colour**	**Naturalness**
Baobab fruit	44.74	10.00	2.63			15.79	26.84
Baobab pulp	34.81	8.89	13.33	17.78	11.11	14.07	

Baobab juice	51.75		26.92			21.33	

From this table, high pulp level represents the most important quality attribute to consumers and traders for all three products. Most of interviewed consumers and traders of baobab fruit (44.74 %), baobab pulp (34.81 %) and baobab juice (51.75 %) claimed that a high pulp level of these products is a good tool to evaluate the selling price. Appearance and size were only mentioned by consumers and traders as important quality attributes for baobab pulp. It was only for baobab fruit that naturalness was pointed out by around 26.84 % of consumers and traders as an important attribute. Taste and white colour were the second most important quality attributes determining selling price. For baobab fruit, baobab pulp and the juice the taste was respectively of importance to 2.63 %, 13.33 % and 26.92 % of the consumers and traders in the zones surveyed, while the white colour was important to 15.79 %, 14.07 % and 21.33 % of total consumers and traders surveyed respectively. Cleanliness was such an obvious required attribute for consumers and traders that many of them did not mention it during the survey.

Table 4: Quality attributes of baobab fruit juice by consumers

Quality attributes	**High pulp content**	**Purity**	**Cleanliness**	**Naturalness**	**Strong taste**	**Appearance**	**White colour**
Consumers in %	41.73	6.17	6.17	16.30	21.48	1.48	6.67

The percentage of respondent consumers who felt that the mentioned quality attributes are important for baobab juice is summarized in Table 4. Most of the consumers (41.73 %) interviewed claimed that a good juice should have high pulp content to be attractive. About 21.48 % and 16.3 % of consumers interviewed responded that good baobab fruit juice should have a strong taste and naturalness respectively, while 6.17 % of consumers interviewed asserted that a good baobab fruit juice should be pure and clean. These results could misleadingly indicate that for consumers, the purity and cleanliness are not so important because most of the consumers interviewed felt that these two attributes are obvious for any product to be accepted. Around 6.67 % of consumers interviewed claimed that a good baobab fruit juice should have a white colour (whiteness), with a good appearance (1.48 % of the consumers surveyed).

1.5 Possible therapeutic effect(s) as perceived by consumers

The therapeutic effects perceived by consumers are highlighted in **Table 5** and **Table 6** for the baobab juice and baobab pulp respectively.

Table 5: Possible therapeutic effect(s) as perceived by consumers for baobab juice

Region	**Constipation**	**Fatigue**	**Stomach ache**	**Fortification**
Dakar	3	2	3	
Guédiawaye	19	16		9
Kédougou	10	10		14
Mbour	12	13	17	27
Pikine	33	32	1	63
Rufisque	1	2	1	1
Thiès	19	18	4	6

Table 6. Possible therapeutic effect(s) as perceived by consumers for baobab pulp

Region	**Constipation**	**Fatigue**	**Stomach ache**	**Cold**	**Digestion**	**Fortification**
Guédiawaye	9	7	4	1		9
Mbour	4	4	4	1	4	4
Pikine	9	9	9	2	3	9

Relief from constipation, fatigue, stomach ache, fortification have been cited by consumers of baobab fruit and baobab pulp as therapeutic effects especially in the rural areas. Cold and digestion therapeutic effects have been only mentioned by consumers after baobab pulp consumption. For the baobab fruit, consumers did not give an opinion on its therapeutic effects.

Conclusion

Survey findings showed that high pulp content, colour, taste, texture, purity, cleanliness, appearance, shape, size, naturalness and caliber & colour are the main attributes used by the actors (processors, traders, consumers) to appreciate the quality of baobab fruit, baobab fruit pulp and baobab fruit juice. According to the product some quality attributes could vary in importance and influence on the selling prices. The therapeutic effects have been highlighted only in the baobab fruit juice and pulp. However most of the actors felt that quality attributes would be improved by adequate packaging and storage conditions especially of the juice for increasing the shelf life.

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2. Survey results: quality attributes for bissap

Abstract

Bissap fruit calyx, leaves and drinks are traditionally processed in small portion and in scales of business level in Senegal without big interest on quality attributes instead of few microbiology evaluation. One part of survey findings was to recognize changes in sensory properties of the mentioned products by helping actors on this field. From this survey it appears that the appreciation of the quality of bissap fruit calyx, leaves and drinks by the traders, clients and consumers is mainly based on observations through a number of sensory attributes such as colour, taste, property, naturalness, hygiene, flavor and calibre of these products. The therapeutic effects of these products have been highlighted by many consumers. The improvement of traditional processing, packaging and storage conditions has also been pointed out by traders and consumers to influence the end products. Also from actors, the drying method of the bissap calyx should be monitored to improve the quality attributes.

Introduction

The contribution of foods products to nutritional quality is essential for consumer health, choice and preference. Mostly food products with quality attributes are good source of nutrients. The textural and sensory characteristics of these food products can be influenced by physical functional properties (Kim et al., 2004; Allais *et al*., 2007, Augustin and Udabage, 2007). Traditional food products are generally manufactured at home (in small scale) or small factories, enterprise (in semi industrial scale). Indeed, these products can be characterized by typical sensory properties which are in relation to traditional processing practices. Often facing against lack of technical tools to control the quality, producers still have high experience for practices.

Bissap calyx (drinks and in meals) and bissap leaves (in meals), are mostly used in different ways in Senegal. Its major constraints are the quality changes during production, processing and storage (Cissé *et al*., 2009; D 1.1.2.1-3., 2010). Evaluation of bissap calyx, bissap leaves and bissap drinks qualities' characteristics is needed for identifying the quality criteria according to various actors (producers, traders and consumers) involving. In this investigation we have tried to develop a link between the quality properties mentioned by the different actors and the technology used to process the product as well as the impacts of storage conditions.

Information is nearly absent about the microbiological status of bissap calyx, bissap leaves and bissap drinks. Rare is to find information about the sensory quality attributes, and these products' agreement with the consumer perception. Therefore, the objective of the present survey is to identify the quality attributes of bissap fruit calyx, bissap leaves and bissap drinks according to the different actors' point of view.

2.1 Choice of survey zones and sampling of surveyed actors

The survey was done in different zones: Dakar, Kaolack, Kédougou, Mbour, Thies and Velingara according to the recurrent use. This choice is justified by the fact that bissap fruit is processed in artisanal way into drinks, and used in some other dishes such as condiment (Cissé *et al.*, 2009). The survey zones were conducted according to previous work. Preliminary poll has been conducted by visiting the processing sites into six (06) zones. In these zones, the production, trade or consumption are mostly done by local population. Actors sample size was set according to Cissé et al. (2009) previous works. In the different selected zones, the proportion of actors was assessed through a random-check on 427 people (60 processors, 219 traders, and 148 consumers).

2.2 Data collection

The survey was conducted on bissap fruit calyx, leaves and drinks. It was in the form of interviews administered through a questionnaire. Producers, traders and consumers in Dakar, Kaolack, Kédougou, Mbour, Thies and Velingara were interviewed from 10th March to 10th April 2011. A preliminary poll was firstly done in order to identify production sites and pre-test the questionnaire. Interviews were conducted in French and local languages (Wolof, Pheul, Diola, Sérére and Socé).

A total of 427 persons from different ethnic groups and areas, and both genders at ages' range of 15 to 70, randomly selected were effectively interviewed on the production, trade and consumption of bissap fruit calyx (in drinks and meals) and bissap leaves (in meals), the various processing technologies, the specific problems related to the processing, the storage, the commercialization and the quality attributes according to the point of view of the different actors of bissap fruit and by-products.

2.3 Data processing and analyses

The collected data were recorded and statistical analyses by using Excel software.

2.4 Quality attributes of bissap fruit calyx (in meals and drinks) and bissap leaves

During the survey, questions linked to bissap fruit and by-products quality attributes were administered to actors in this sector. The main attributes registered are related to the colour, taste,

naturalness, hygiene, property and calibre of the bissap fruit. Other attributes such packaging, storage conditions were mentioned by some actors on the products acceptability increase.

The quality attributes identified as very important by traders and clients is given in **Table 1**.

Table 1. Detailed variation of quality attributes of bissap products by traders and clients

actors surveyed/products/area surveyed		Dakar	Mbour	Thiès	Vélingara
From clients surveyed					
calyx	color	22	17	6	3
	flavor	0	0	0	0
	taste	1	5	3	0
	hygiene	1	0	4	0
	naturalness	0	0	0	0
drink	color	5	0	6	0
	flavor	0	0	0	0
	taste	0	0	2	0
	hygiene	1	0	1	0
	naturalness	0	0	1	0
From traders surveyed					
calyx	color	22	18	11	3
	flavor	0	1	0	0
	taste	2	2	3	0
	hygiene	1	0	4	0
	naturalness	0	1	0	0
drink	color	4	0	7	0
	flavor	0	0	0	0
	taste	0	0	1	0

	hygiene	1	0	1	0
	naturalness	0	0	1	0

The property for many traders interviewed as clients is obvious for the quality attributes of a product. As we see the color was mostly mentioned by traders and clients of bissap calyx and bissap drinks. Taste and hygiene came in second place after traders and clients' interview. Flavor and naturalness have been rarely appreciated by traders and clients as most important quality attributes.

The quality attributes identified as very important by traders and clients to give more added values to bissap products are represented in **Table 2**.

Table 2. Global variation of quality attributes of bissap products by traders and clients for added value

actors surveyed/products/area surveyed		persons interviewed	The % calculated
From clients surveyed			
calyx	color	48	77.4
	taste	9	14.5
	hygiene	5	8.1
drink	color	11	68.7
	taste	2	12.5
	hygiene	2	12.5
	naturalness	1	6.2
From traders surveyed			
	color	54	79.4
	flavor	1	1.5
	taste	7	10.3

calyx	hygiene	5	7.4
	naturalness	1	1.5
drink	color	11	73.3
	taste	1	6.7
	hygiene	2	13.3
	naturalness	1	6.7

The obviousness for traders and clients to property and hygiene for any product make the other attributes more pronounced by them. From all person interviewed on bissap calyx, the color is the most important quality attributes if 78.5% in average (calyx interview for traders and clients together). For the bissap drinks, 71.04% in average (traders and clients interviewed together) have appreciated the color. Taste (around 21.85% in average for calyx and 9.6% for drinks) and hygiene (17.91% in average for calyx and 12.90% for drinks) have been also expressed.

In **Figure 1**, the quality attributes of calyx for consumers is represented.

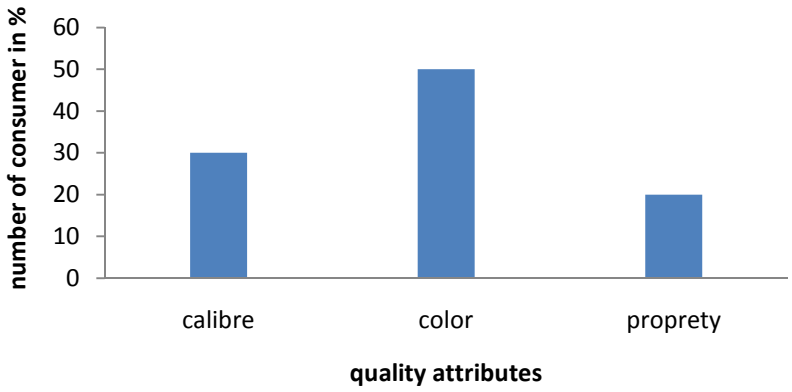

Figure 1: Global quality attributes of importance to consumer of calyx

From this figure, the color represents the most important quality attributes (50%) to consumers globally interviewed. Most of consumers if 30 % for calibre and 20% for property have also given their point of view to the calyx quality attribute.

The percentage of respondent consumers on bissap fruit drinks from some quality attributes are represented in **Figure 2.**

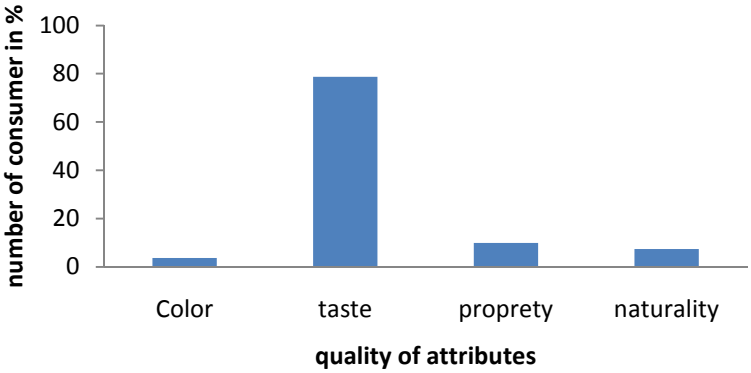

Figure 2. Quality attributes in bissap drinks of survey areas by consumers

Most of consumers (around 80 %) interviewed claimed that a good bissap fruit drinks should have a high taste. Property (10%) and naturalness (7.5%) have been also appreciated by consumers interviewed with affirmative response. These results showed that for consumers, the obviousness of color to bissap products made the other quality attributes more pronounced.

2.5 Possible therapeutic effect(s) as perceived by consumers

The therapeutic effects perceived by consumers are highlighted in **Table 3, Table 4** and **Table 5** respectively for the bissap drinks, leaves and calyx.

Table 3. Possible therapeutic effect(s) as perceived by consumers for bissap drinks

	Known*	**Unknown****	**fatigue**	**cold**	**other**
DAKAR	9	1	7	2	0
KEDOUGOU	0	0	0	0	0
MBOUR	8	0	6	0	2

KAOLACk	3	0	2	0	1
THIES	20	0	20	0	0
VELINGARA	0	0	0	0	0

*therapeutic effect known

**therapeutic effect unknown

Table 4. Possible therapeutic effect(s) as perceived by consumers for bissap leaves

	Known*	**Unknown****	**digestion**	**fatigue**	**other**
DAKAR	1	0	0	1	0
KEDOUGOU	1	0	0	1	0
MBOUR	1	0	0	1	0
THIES	14	0	1	13	0
VELINGARA	0	0	0	0	0

*therapeutic effect known

**therapeutic effect unknown

Table 5. Possible therapeutic effect(s) as perceived by consumers for bissap calyx

	Known*	**Unknown****	**appetite**	**digestion**	**fatigue**	**other**
DAKAR	1	0	0	1	0	0
KEDOUGOU	1	0	0	0	0	1
MBOUR	5	0	2	1	0	2
KAOLACk	0	0	0	0	0	0
THIES	3	0	0	1	1	1
VELINGARA	2	0	0	1	0	1

*therapeutic effect known

**therapeutic effect unknown

Fatigue, digestion, appetite and cold have been evoked by consumers of bissap drinks, leaves and calyx as therapeutic effects. Other has also been highlighted by consumers without knowing scientifically the effects. From literature, we can link these therapeutic effects by vitamin supply, anthocyanins, and the good source of iron which some consumers have thought to be probably the source.

Conclusion

Survey findings showed that colour, taste, property, naturalness, hygiene, flavor and calibre are the main attributes used by the actors (clients, traders, and consumers) to appreciate the quality of bissap fruit calyx, bissap fruit leaves and bissap fruit drinks. But according to the product some quality attributes are more pronounced than other and can influence the selling prices. The therapeutics effects have been highlighted also on bissap fruit calyx, bissap fruit leaves and bissap fruit drinks. However most of the actors need improvement on quality attributes by adequate packaging, process methods and storage conditions especially to the drinks for increasing the shelf life. For the calyx, the improvement of drying methods and conditions as well as the packaging is necessary to improve the quality attributes.

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3. Survey results: quality attributes for Jaabi

Abstract

In order to understand the processing and marketing system of *jaabi*, a wild jujube fruit harvested in the savannah region of Cameroon, a survey has been undergone towards 455 actors, representing harvested, processors, traders and consumers of the *jaabi* chain. The results confirm the seasonal availability of *jaabi* (November to March) and the existence of 4 main processing practices into a unique end product, Yaabande cake. The processing activity, exclusively traditional, is the panacea of women, originating mainly from 4 local tribes (Guiziga, Kapsiki, Kanuri and Mofou). The main problems experienced during processing, with impact on quality, are based on the processing environment which can carry dust, the pounding conditions of *jaabi* grains into flour and the cooking conditions of the Yaabande cake. These problems impact on the hygienic quality and the texture (firmness, homogeneity) of Yaabande. The cake is also accepted for its color (chocolate like, whitish, yellowish or orange). The rich biscuit-like aroma of *jaabi* and Yaabande did not clearly appear in their quality attributes. In addition, no local use of the product for its biological or therapeutic activity was mentioned. Since indicators of antioxidant activity have been previously found in *jaabi*, their characterization and diffusion appear as a possible innovation to address, in order to promote a local nutraceutical food from *jaabi*. In addition, the valorization of its biscuit-like aroma may also be addressed.

Key words: *Jaabi*, Yaabande, harvesting, processing, commercialization, consumption, quality.

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". The *processing* of the fruit into Yaabande represents a form of conservation of the product which is consumed throughout the dry season, and even thereafter.

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[1].

Out of information provided by Noyé (1989) on Yaabande [2], 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, the present survey on *Jaabi* production, processing, trading and consumption, aims at analyzing the product chain in order, both to characterize the quality attributes of the raw, intermediary and end products, and to rise up coherent scientific questions for its market development.

3.1 Survey methodology

The survey covered the northern part of Cameroon (Fig. 1), which is the principal area of production and consumption of *Jaabi*. This part of the country is divided in 3 administrative regions (Far North, North and Adamaoua), with the Far North region being the main *Jaabi* area. Three division of the Far North region, were particularly concerned: Mayo Sava Division, near the Nigerian border, Diamare Division and Mayo-Tsanaga division. In each division, the main city (capital) was tackled, coupled to villages were the fruits are harvested. In this respect, 6 villages were visited in Mayo Sava division, 11 in Diamare Division and 7 in Mayo Tsanaga Division. In addition, the capital of the 2 other administrative regions were visited, since *Jaabi* fruits are sold on their markets. 455 actors were visited (Tab/ 1).

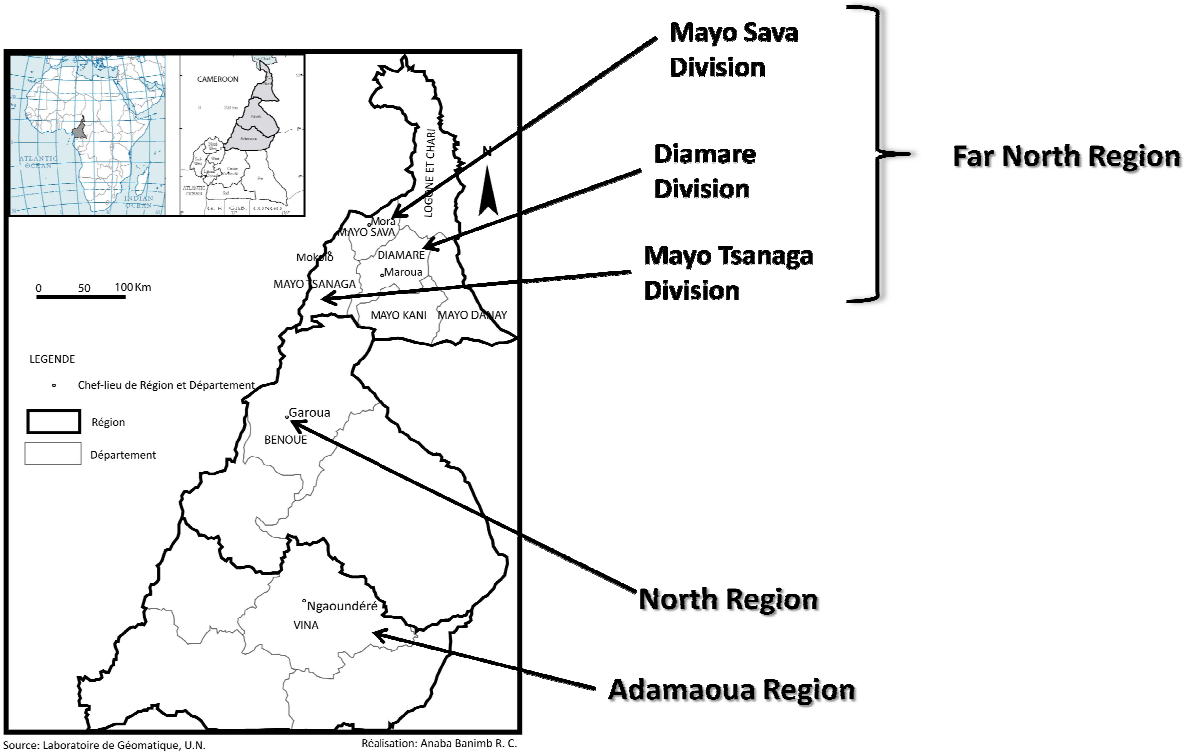

Figure 1: Survey zone

The survey was undergone in the form of interview, administered through a questionnaire and, when possible, observation of actors at work. Interviews were conducted in French and a local common language of the region (Fufulde). The actors, randomly selected, were made of both genders at various ages (young, adult, old). They had to provide information on the harvesting of *Jaabi*, the various processing technologies, the marketing and consumption systems, and particularly their appreciation of the product at each step of the *Jaabi* chain.

The collected data were recorded and analysed according to the frequency of occurrence of the different attributes. MS Excel package was used for the analysis, through Dynamic Cross Tables of the attributes.

Table 1: Survey logistics

Area surveyed	Total number of actors surveyed	Numbers of actors surveyed			
		Number of producers	Number of processors	Number of traders	Number of consumers
Mayo Sava Division	135	51	10	25	49
Diamare Division	156	53	12	31	60
Mayo Tsanaga Division	144	74	10	19	41
Ngaoundéré	10			10	
Garoua	10			10	
	455	***178***	***32***	***95***	***150***

3.2 Results

- HARVESTING AND SORTING

Jaabi is a wild fruit harvested by field collection of mature and dry grains fallen from jujube trees. The collection activity involves many tribes in the northern parts of Cameroon, particularly in the Far North region (Fig. 2). Among these tribes, Guiziga tribe represent 1/5 of the actors surveyed, followed by Mada and Mofou tribes. These actors are both male and female, with advantage to women, particularly at age around 40 years old, where the majority of harvesters are found (Fig. 3).

The harvesting activity of jaabi takes place between November and January, which correspond to the dry season in the region. During this season, the jaabi grains fallen from jujube trees are quite dry and can be easily collected. The activity is undergone, either in the morning or in the afternoon, but neither the whole day. Depending on the level of involvement of actors in the activity, harvesting may take half an hour to 4 hours in the day (Fig. 4). The relatively reduced number of actors harvesting jaabi for a whole half day (3-4 hours) indicates that this activity cannot be considered as the main activity of all actors. It is certainly associated to other farming activities. This assertion is confirmed by the relative quantity of jaabi harvested individually by actors. In fact, the majority of actors harvest lest than 10 bags of 100kg per month, during the harvesting period (Fig. 5).

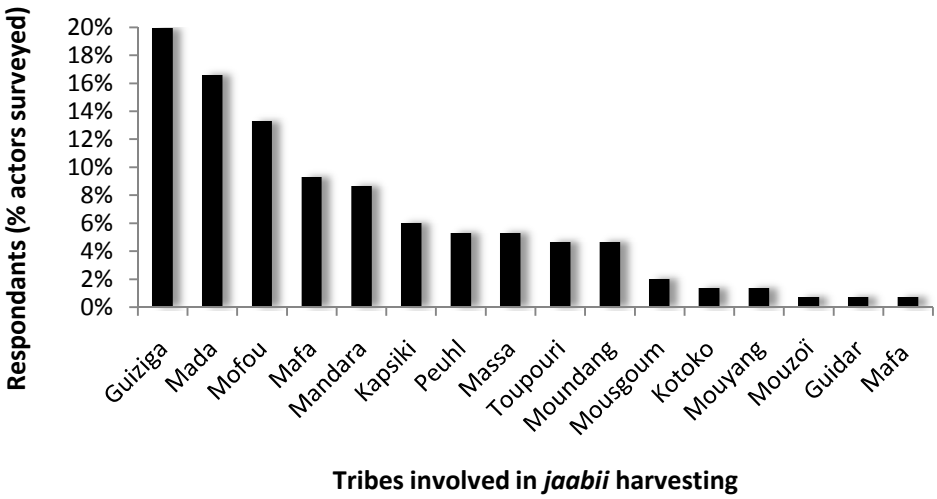

Figure 2: Distribution of tribes involved in *jaabi* harvesting

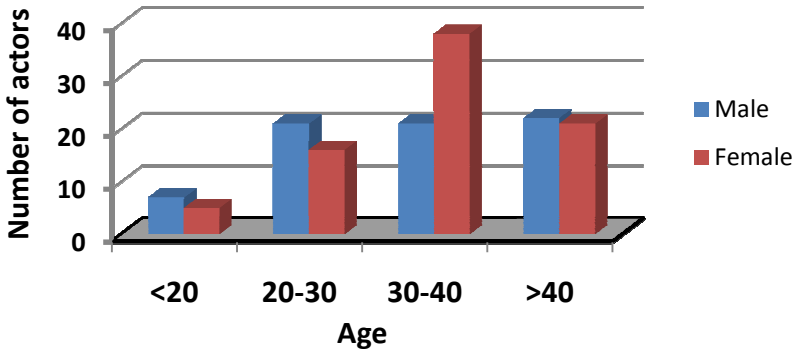

Figure 3: Distribution of *jaabi* harvesting actors by age

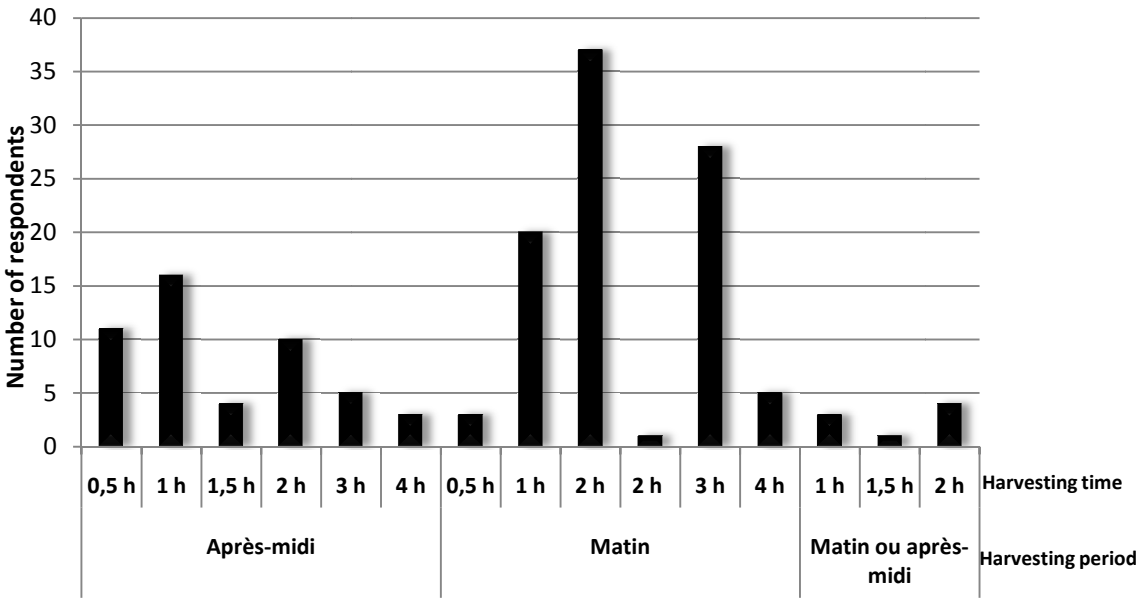

Figure 4 : Period of the day and time spent for *jaabi* harvesting

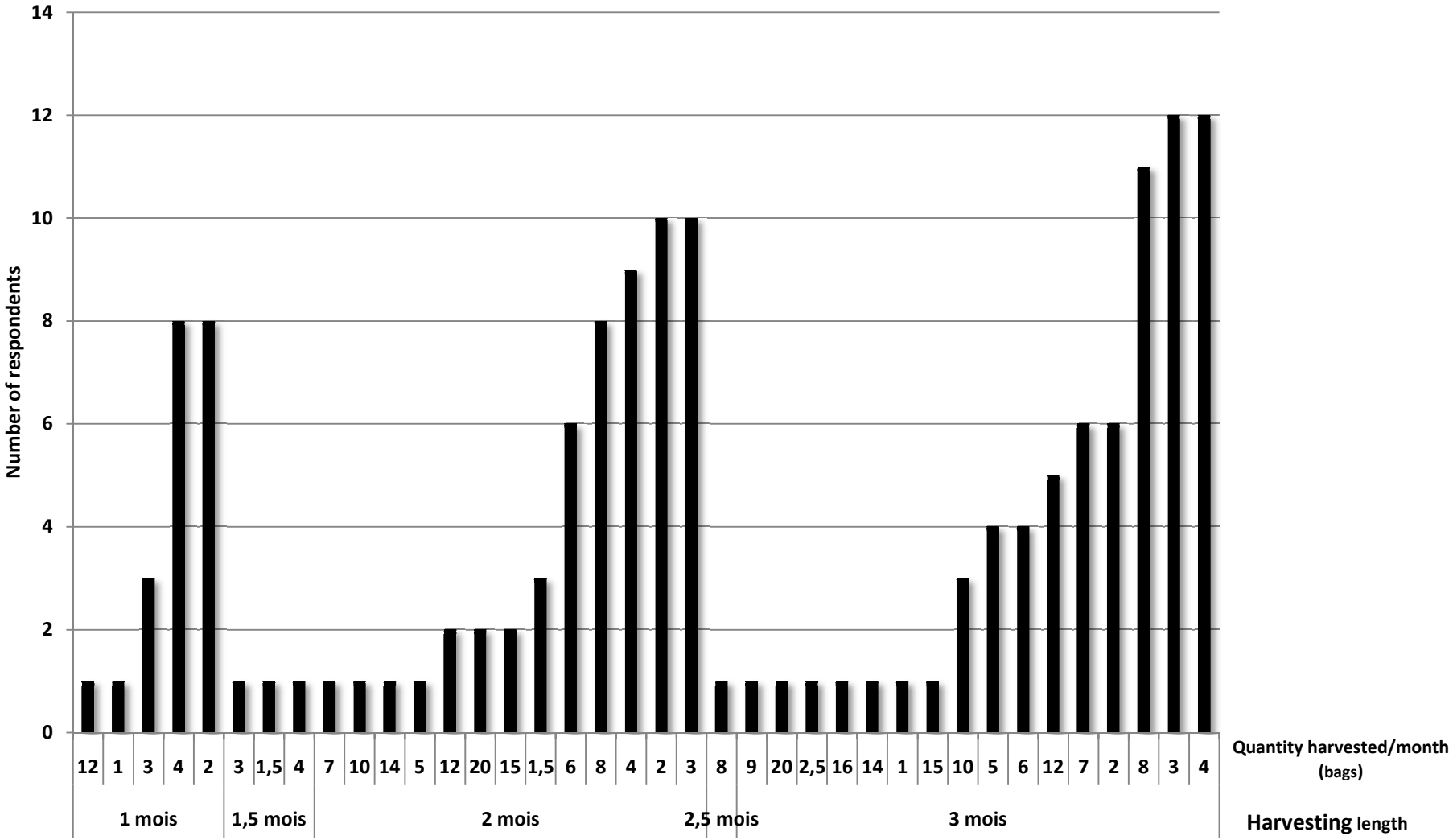

Figure 5: Relation between the quantity of *jaabi* harvested per month (bags of 100 kg) and number of harvesting months per year

Meanwhile, jaabi harvesting is coupled to sorting of grains, which determines the quality attributes of the raw material. In general, the surveyed actors recognize 4 varieties of jaabi: lammuji, dakamji, Kurnadje and hadinga. Their quality attributes are based on their size, color, texture and taste (Tab. 2). Jaabi lammuji and Jaabi dakamji are the varieties mostly preferred by population for their sweet taste. They are also the varieties used for the Yaabande cake preparation. The other two varieties are less preferred and they are consumed only during food scarcity period.

Table 2: Quality attributes of *jaabi* varieties

Variety	Size	Color	Texture	Taste	Use
Jaabi lammuji	Small	Reddish or violet		Acid - Sweet	Yaabande
Jaabi dakamji	Small	Brownish		Sweet	Yaabande
Kurnadje	big	Yellowish	floury	Slightly bitter	
Jaabi hadinga	big	Dark brown		Bitter, astringent	

Out of the above attributes, since jaabi is collected for consumption, both at home and commercial levels, the harvesting practice, from quality point of view, takes into consideration the aspect of the grain, which should be clean, without insect's attack. These attributes help to direct storage conditions of the grains, either for home consumption or for market. In this respect, jaabi grains are usually conserved in bags (plastic or jute) or canaries. Farmers surveyed recognize that this storage practice allow good conservation of jaabi grain up to 3 weeks. But above this period, problems of degradation occur, due to humidity and insect's attack. In general, for market purpose, jaabi grains are usually stored for up to 4 or 5 months.

The jaabi grains intended to market is sold in cups (retailing) or in bags. The prices vary greatly, according to area and period of the year (Tab. 3). In general, prices are low and stable during the harvesting period (November to January), but rise up after this period.

Table 3: Conditioning and selling price of *jaabi* at village level

Conditioning	Minimum price (FCFA)	Maximum price (FCFA)
Cup (≈ 1 kg)	50	200
Bag (100 kg)	5 000	10 000

-PROCESSING:

Out of the use of jaabi grains as side-dish, they are mainly processed in a cake, locally called "Yaabande" (a round biscuit like product). This activity is the panacea of women (Fig. 6),

among which, the majority buy the grains on the market or from farmers, while 30% harvest the grain themselves.

Producer profile

The processing areas are the same as those where harvesting is done, with the same tribe involved. Considering the tribes involved in the processing, based on the quantity of jaabi processed during the production season, 4 tribes (Guiziga, Mofou, Kapsiki and Mandara/Kanuri) carry more than 80% of jaabi processed in the northern Cameroon (Fig. 7). Though the processing activity occurs in all area where jaabi is harvested, some areas are characterised by a high level of processing activity. This is the case of Godola and Mokolo towns (Fig. 8), carrying respectively up to 30% and 27% of the processing activity in the region visited. The main residents of these towns are Guiziga and Mofou (for Godola town), and Kapsiki (for Mokolo town), the tribes highly involved in the processing activity. The Kanuri, other tribe highly involved in jaabi processing, are mainly in Mora town.

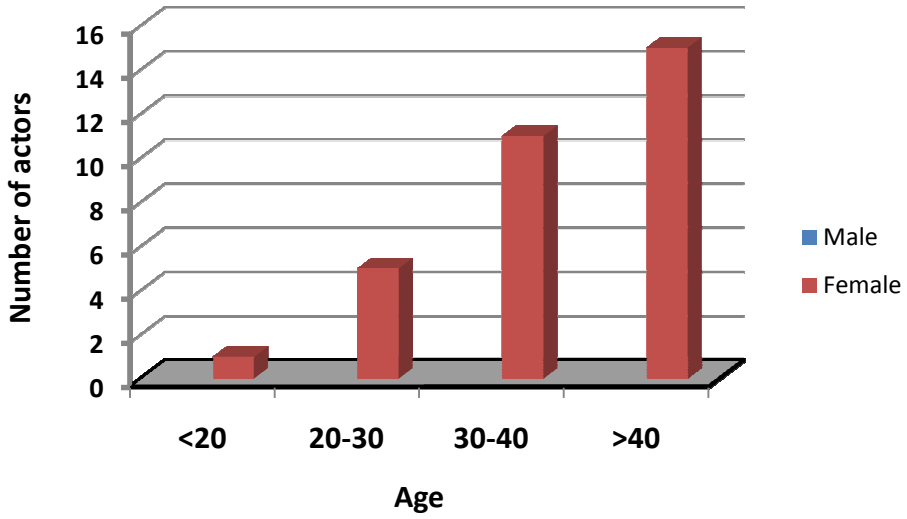

Figure 6: Distribution of *jaabi* processing actors by age

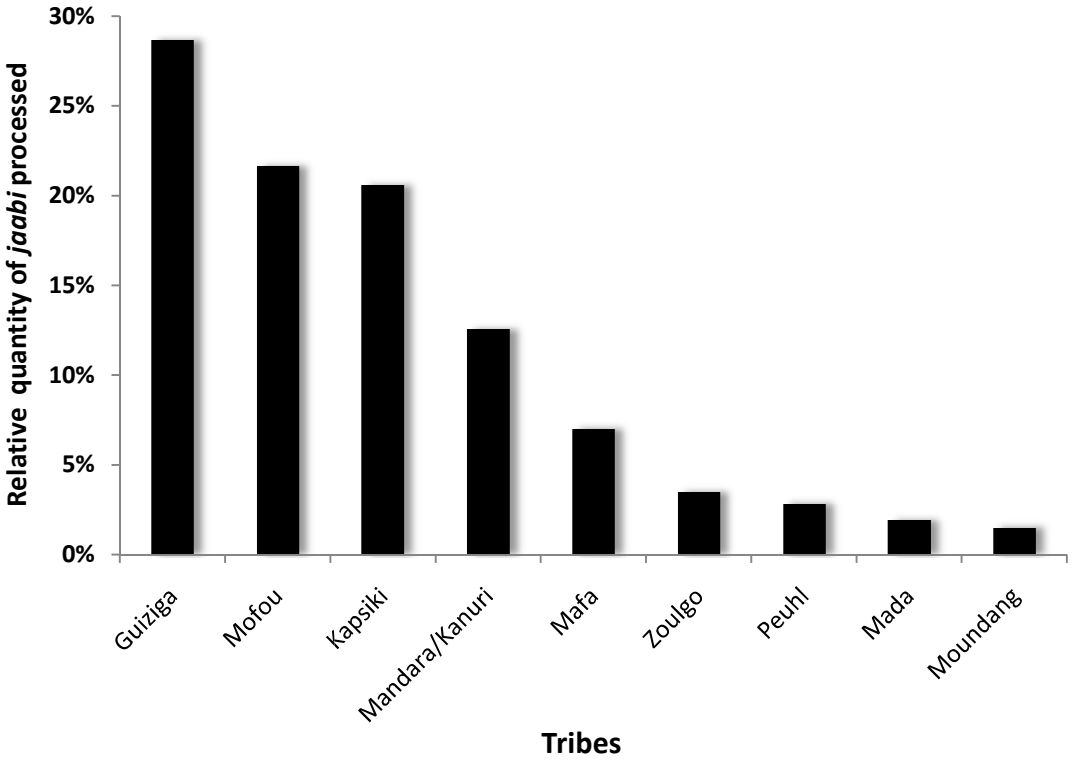

Figure 7: Relative importance of different tribes in *jaabi* processing

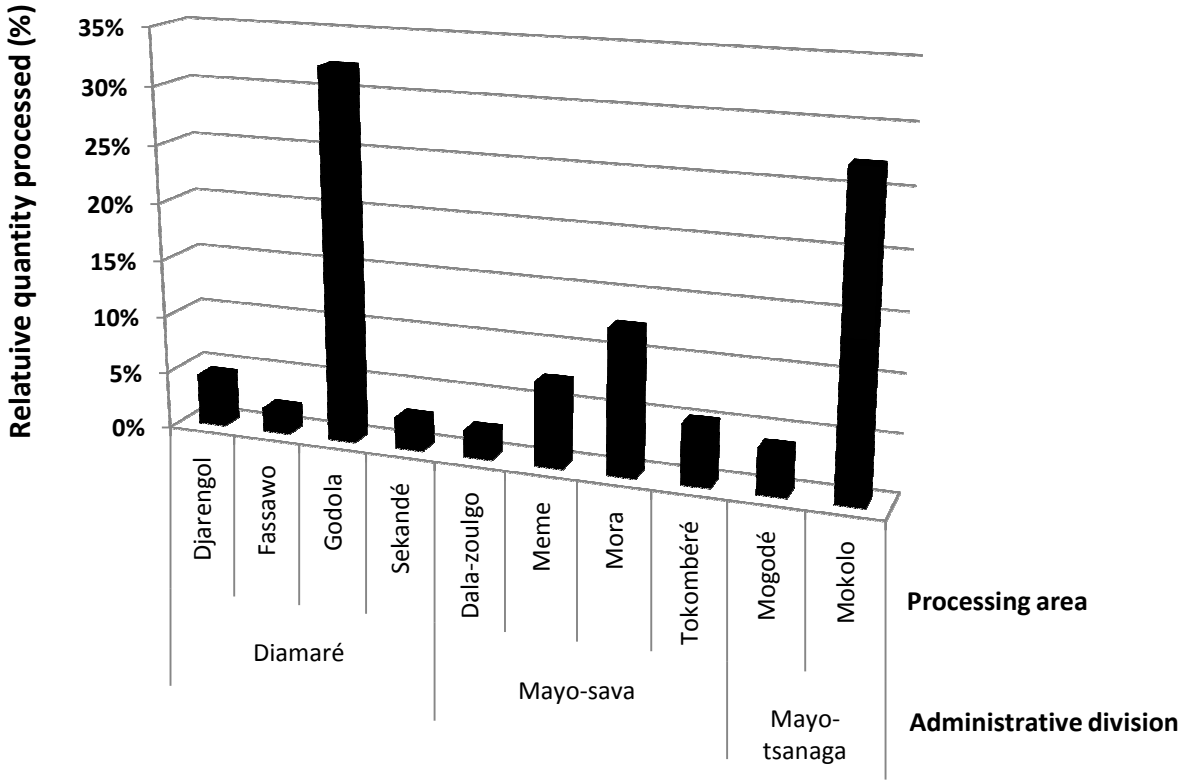

Figure 8: Relative level of *jaabi* processing in some main production areas

Processing methods and practices

Yaabande cake is produced, using exclusively Jaabi lammuji and Jaabi dakamji. The processing goes through pounding of jaabi grains to obtain flour, which is molded and processed (cooking, roasting or sun drying) into Yaabande. In general, the cake is produced using only jaabi flour, without additional ingredients. Meanwhile, some producers add honey during molding.

From the processing practices observed, four processing methods, originating from three main tribes (Kapsiki, Guiziga and Kanuri), have been identified (Fig. 9), confirming what was observed in a previous preliminary study3. Whatever the processing method, the main operations involved are successively: sorting of grains, pounding of clean grains in a mortar, sieving to obtain fine flour, molding of the flour and cooking (Tab 4). The variability of the methods is mainly based on the procedure used to pack and to cook the cake. In general the flour is sprinkled with water, then either molded using small calabash of wrapped in vegetal leaves. The cooking is either, roasting on fire (Kapsiki method), or vapor cooking (Guiziga method), or sun drying (Kanuri method). The Kapsiki and the Guiziga methods are the most encountered.

Depending on the quantity of jaabi processed, the production of Yaabande cake is undergone in 1 to 4 hours. In general, all producers realise 1 production batch per days. The production rate varies from 4 to 25 production batches per month.

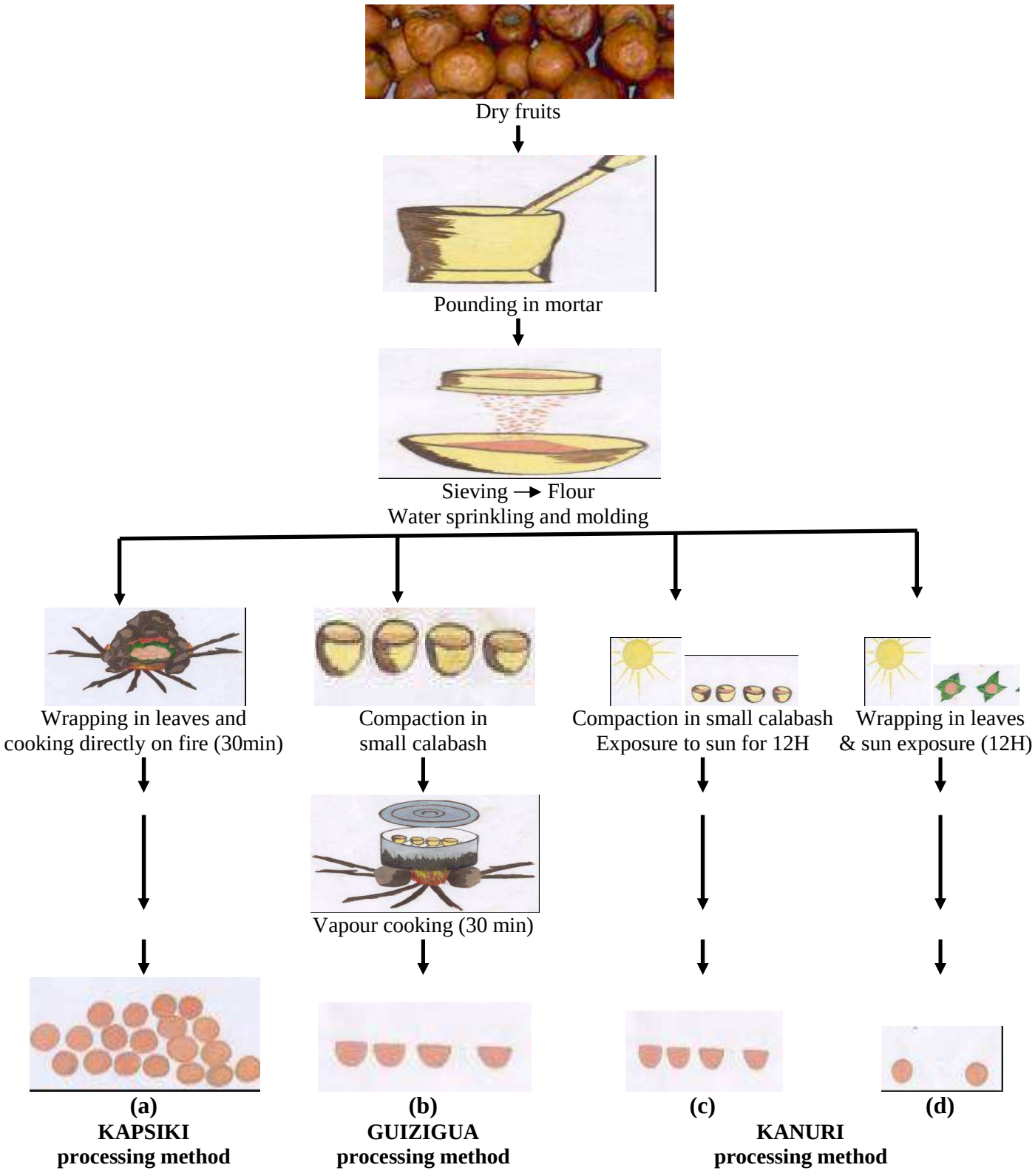

Figure 9: Traditional processing methods of *Jaabi* in the northern region of Cameroon

Table 4: Process description and variability

Process Operations	Function/objective of the operation	Variation of Materials/equipment	Duration per material/equipment used	Workforce (specify number and sex per material/equipment used)	Product resulting from the operation	Quality attributes of intermediate and end-product
Sorting of grains	Removal of inadequate grains	Cup, bowls	≈ 10 min*	1 woman	Clean *jaabi* grains	• Color, • aspect (clean, without insect, attack), • size
Pounding	Production of *jaabi* flour	Mortar	10 min – 1.5H*	1 - 2 woman*	*Pounded Jaabi* (flour + core)	
Sieving	Removal of core and peels	Sieve	8 – 10 min	1 woman	Fine and clean flour	• Texture (fineness) • Hygienic aspect, • color
Preparation of cooking pot**	• Cleaning of the pot • Pouring of water in the pot • Piling up of twigs in the pot. These twigs will serve as support for mold containing the cake	• Cooking pot (canary) • Wood twigs • Water	3 – 10 min	1 woman		
Boiling of water	Vapor production	• Cooking pot	10 – 15 min	1 woman	Boiled water	

Process Operations	Function/objective of the operation	Variation of Materials/equipment	Duration per material/equipment used	Workforce (specify number and sex per material/equipment used)	Product resulting from the operation	Quality attributes of intermediate and end-product
		(canary) • Wood twigs • Water • Fire				
Preparation of the molds	covering of the inside of molds with wheat flour, in order to avoid adhesion of cake during cooking	Molds	5 – 10 min	1 woman		
Molding	Compaction of *jaabi* flour in molds	• Molds • Water (for spraying on molded flour)	5 – 10 min	1 woman	Molded cake	
Leaves wrapping***	Wrapping of flour in vegetal leaves	Vegetal leaves	5 – 10 min	1 woman		
Cooking	Cooking of the cake	• Fire • Wood	3 – 30 min*	1 woman	Yaabande cake	• Color • Texture (firmness, compacity, homogeneity)

***** Depending on the quantity of product to processed. The value given is the minimum for about 1.5 kg of grains (minimum quantity processed)

** For vapor cooking processing (Guiziga processing)

*** For direct cooking of wrapped cake on fire (Kapsiki processing)

Considering the volume of Yaabande produced by the actors visited and the monthly rate of production (Fig. 10), it appears that the quantity of Yaabande produced is not related to the rate of production. In fact, up to 60% of Yaabande production is held by actors producing between 4 and 12 days a month, while some actors working almost daily (20 – 25 days per month) produce less. The first group is made of actors producing high quantity per batch, while the actors of the second group produce small quantity per batch. Out of this variation, when considering the ratio between the volume of jaabi processed by batch and the quantity of Yaabande obtained, the production yield of Yaabande is 70g ± 20g of jaabi grain per piece of Yaabande cake, whatever the production rate.

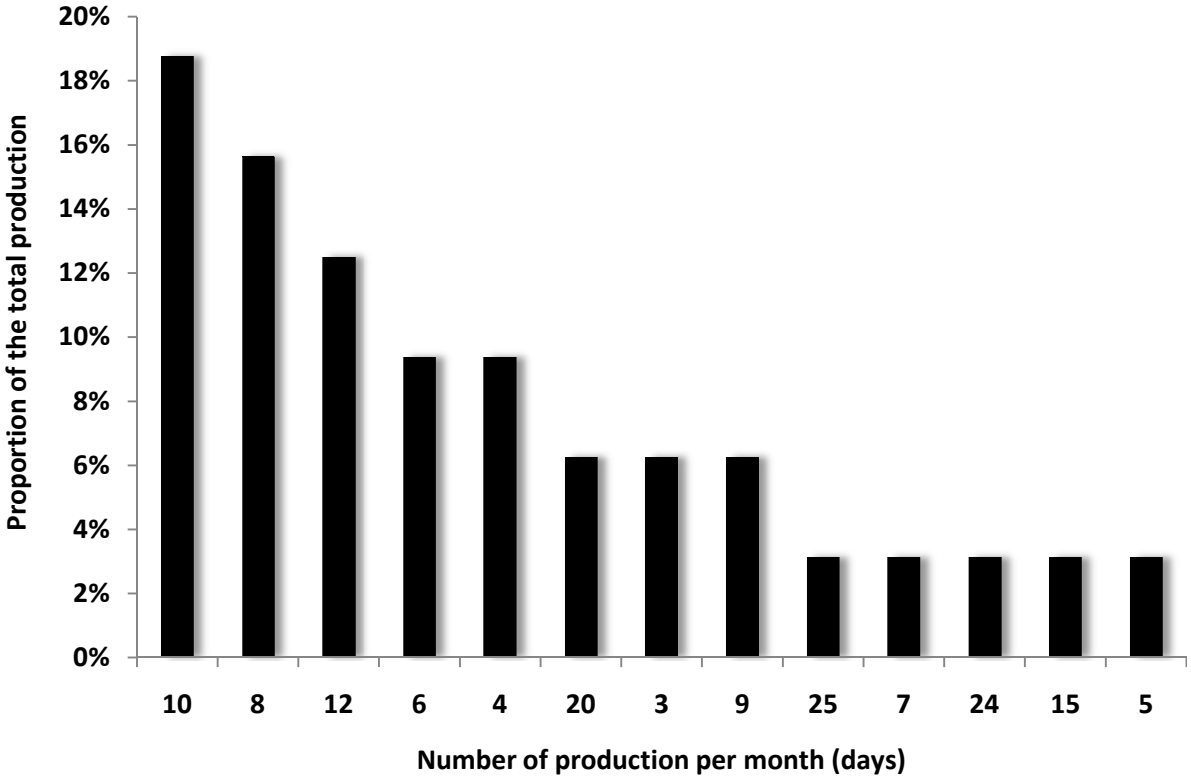

Figure 10: Relation between production volume of Yaabande and production rate

From quality point of view, the main technological steps building the quality of processed products are flour production (pounding and sieving) and cooking. These two steps have significant effect on the definition of the quality of end product. In this respect, pounding and sieving should avoid the presence of particles (84% of the respondents) and sand (15% of the respondents) in the flour, while cooking should improve the texture (69% of respondents) and color (31% of respondents) of the cake. In this respect, quality attributes of Jaabi processed flour and cake are based on texture, hygienic aspect and color (Tab. 5). The texture character of flour is defined by its fineness and smoothness, while for Yaabande cake, it is defined by firmness, density (compact) and homogeneity. The color of the flour should be whitish or yellowish, while the Yaabande cake should be either chocolate like or whitish. Whatever the product and the color tone, the color should be clear and regular.

Table 5: Quality attributes of *jaabi* flour and cake

Quality attributes	Percentage of respondents	
	***Jaabi* Flour**	**Cake (Yaabande)**
Texture	40.6%	50.0%
Hygienic aspect	25%	
Color	12.5%	34.4
Texture and hygiene	12.5%	
Texture and color	9.4%	
Undefined		15.6

The above quality attributes of processed *jaabi* products reflect good processing practices, and may be affected if these good practices are not respected. In this respect, the main problems affecting the quality of *jaabi* products are due to cooking conditions, and result in burned cakes, hard cakes and water hole in cake (Fig. 11).

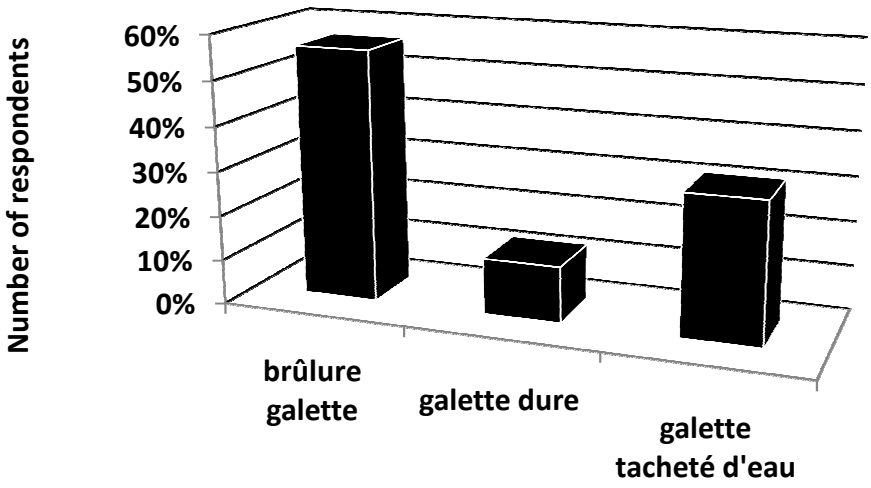

Figure 11: Quality problems of Yaabande cake

The burning of cake arise mainly in cooking process where Yaabande is directly roasted on fire (Kapsiki processing method), while the presence of water hole on cake occurs in vapor cooking (Guiziga processing method) when the quantity of water in the pot is too much. The hardness of the cake may be attributed to cooking conditions, particularly long time cooking. Anyway, the good Yaabande cake should be firm, without crumbling, but not too hard.

In addition to the above quality problems, other processing problems are encountered by actors, with risk to affect either the quality of the end product or its yield (Fig. 12). In this respect the presence of dust in flour is the main problem encountered, due to the fact that processing activities are done outside; thus product processed (flour particularly) are expose to win which carry dust. The availability of wood for fire, constitutes a significant problem, since, Yaabande is processed in a savannah region, highly affected by deforestation. This difficulty, certainly justify the Kanuri processing practice, in which sun is used for cooking the cake. Mastering of cooking time is another problem which may arise from wood availability.

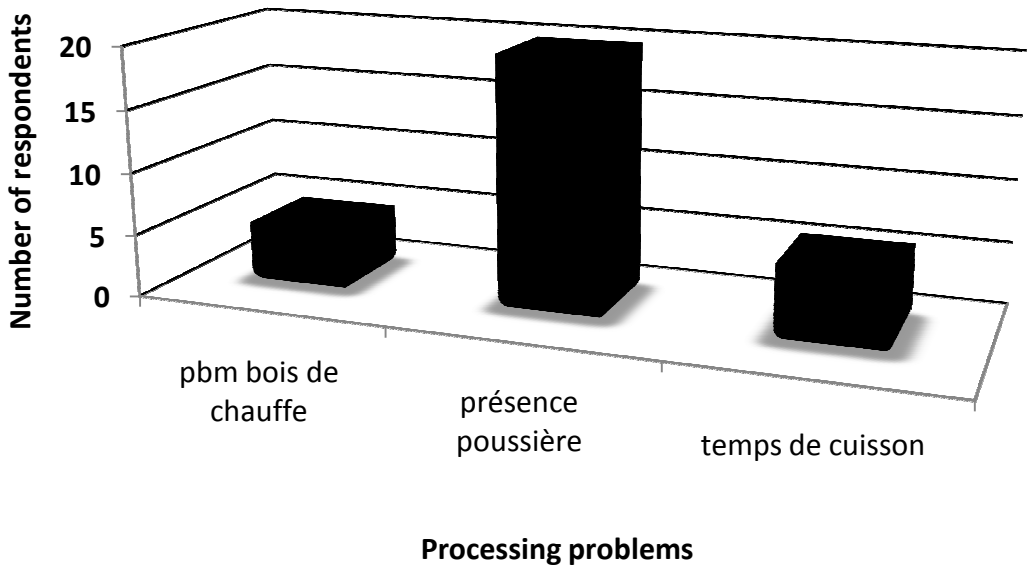

Figure 12: Main processing problems of *jaabi*

Table 6 summarizes some main problems experienced by actors and suggested solutions. Storage problems are the only one where actors have proposed solutions. In fact, when adequately stored, Yaabande could be conserved up to 5 months for market.

Table 6: Problems experienced during production

Intermediate and final products	Criteria used to appreciate the quality of the intermediate or end-product	Problems experienced in the management of the quality of the product and determining factors	Proposed solution for this problem
Jaabi Flour	• Texture (fineness) • Hygienic aspect, • color	Presence of dust Hardness of pounding Storage	Adequate Packaging (dry)
Yaabande cake	• Color • Texture (firmness, compact, homogeneity)	Wood availability Cooking time Storage	Dry storage and packaging conditions

-COMMERCIALISATION:

Jaabi traders are in majority actors above 40 years old (Fig. 13). Female actors are predominant in the activity. They are mainly in the retailing sector of trading with almost 50% of the respondents, while Men dominate in the wholesale sector (Fig. 14).

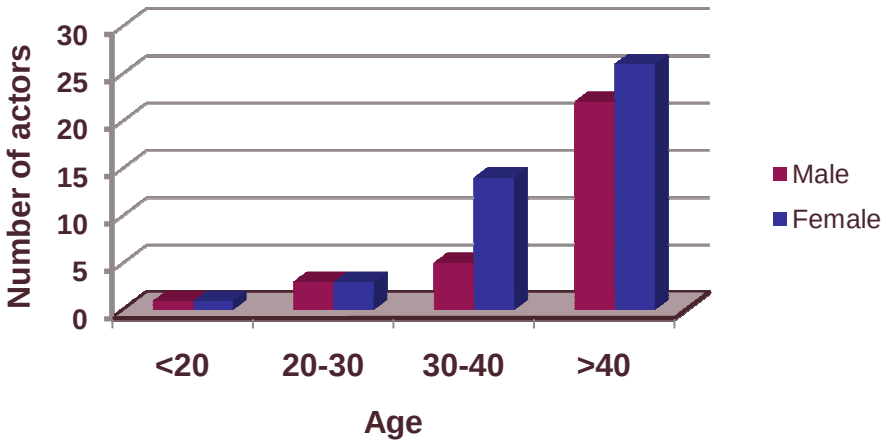

Figure 13: Distribution of *jaabi* traders by age and sex

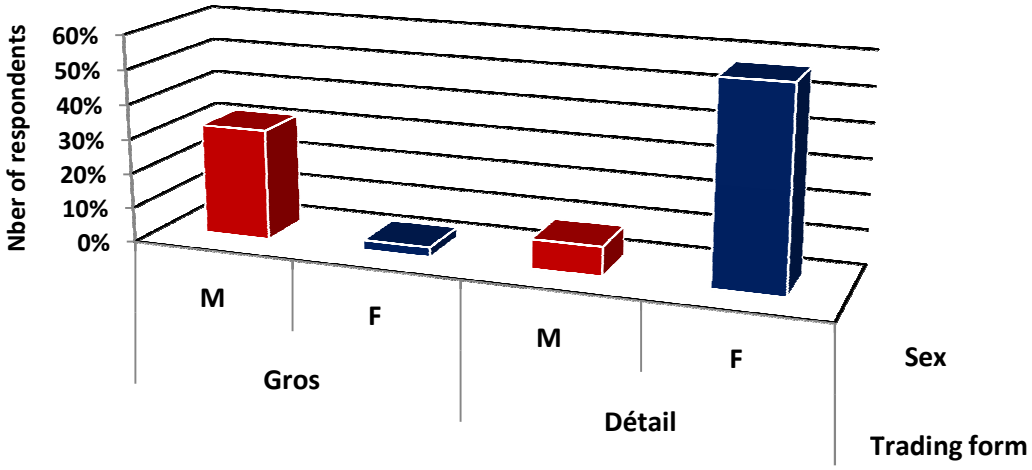

Figure 14: Distribution of trading actors according to trading form and sex

The main product sold is jaabi grains, presented, either in cups of about 750 g or in bags of 100kg. The prices practiced on the retailing market vary from 100 FCFA to 250 FCFA for cup, and from 3500 FCFA to 9000 FCFA for bags. These variations depend particularly on the period of year. From November to January, the period of harvesting, the prices are low and almost stable, while from March and above, they rise up.

When evaluating, through the difference between buying prices and selling prices, the profit earn all along the trading chain from wholesaler to retailer, the relative means of profits per bag of 100 kg, are 1260 FCFA, 600 FCFA and 1340 FCFA, respectively for wholesaler, intermediary and retailer (Fig. 15).

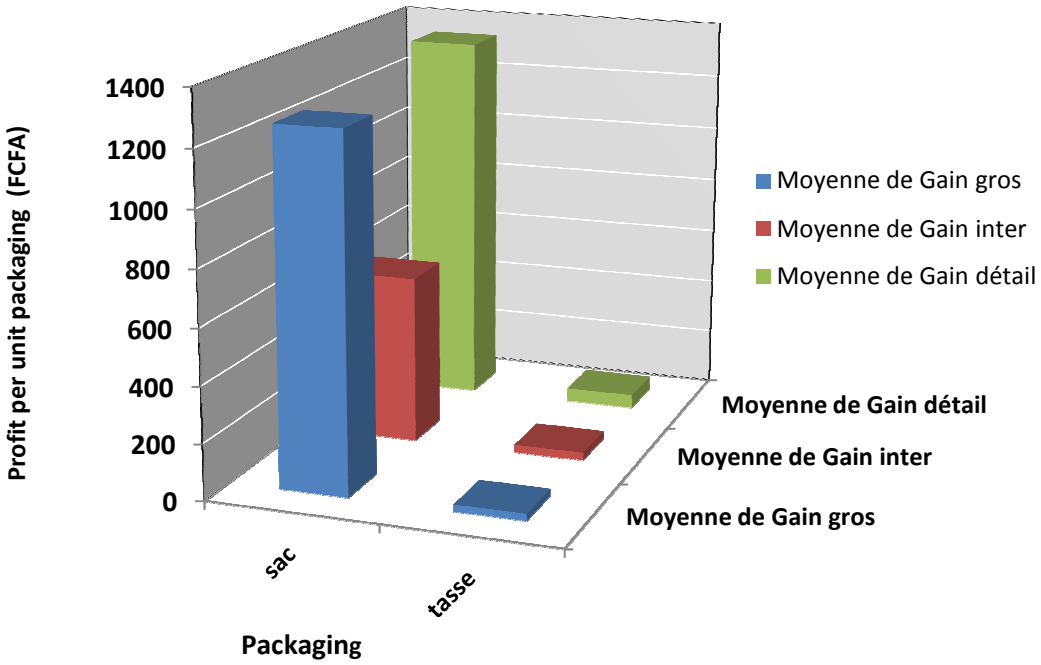

Figure 15: Apparent relative profit along the trading chain

Fig 15 also shows that cup packaging accounts in all steps of the trading chain. This is explained by the fact that, some traders prefer to evaluate their products in terms of number of cups they represents. These traders usually buy their products either from the farmer, the wholesaler of the intermediary by counting the quantity of cups. In this respect, the evaluation of profit earned at each step shows (Fig. 15) that the wholesaler earns 25 FCFA per cup, the intermediary, 28 FCFA per cup and the retailer 48 FCFA per cup. In all case, the higher profit is at retailing level.

Another observation derived from the problems experienced by traders and the solution they apply, can explain this variation of profit chain. In fact, the main problem faced by traders is the deterioration of grains during storage (Tab. 7). This problem is manifested by rotting of jaabi grains. The solution applied by traders consists, either in storing bags of grains out of contact of the soil for some actors, or regularly opening the bags and spreading the grain under sun, followed by sorting to remove bad grains. These operations are usual with wholesalers storing many bags. Anyway the consequence is the loss of products, at least partially, and the reduction of profit. Due to this problem, wholesalers usually sell the grain at a lower price than the initial defined price; reason why many of them consider that there is no money in jaabi trading. On the contrary, retailers rarely face this type of problem, since grains are regularly spread under sun and the necessary quantity is taken to the market. In this respect, the level of loss is lower. In general, due to these storage problems, jaabi grains are rarely stored above 3 or 4 months.

Table 7: Problems experienced during commercialisation

Intermediate and final products	Problems experienced in commercialisation	Detailled description of the problem	Proposed solution for this problem
Jaabi grains	Deterioration of product during storage	Rotting of grains Insects attack	Storage out of contact with soil Spreading of grains under sun
Yaabande cake	Crumbling of cake	The Yaabande cake loses its firmness and crumbles; this seems to be due to shaking during transport on bike or in vehicle.	One of the main reason of crumbling seems to derive from cooking conditions.
	Hygiene of the cake	Since Yaabande is usually distributed without special packaging, it is exposed to air and can carry dust.	Packaging of the cake in plastic bags for markets

-CONSUMPTION:

Jaabi consumers are of all age and sex, with a significant predominance of male (Fig. 16). This may be explained by the fact that the grain and the Yaabande cake are usually eaten as side-dish, particularly in the afternoon, and the practice of this consumption mode is apparently common with male.

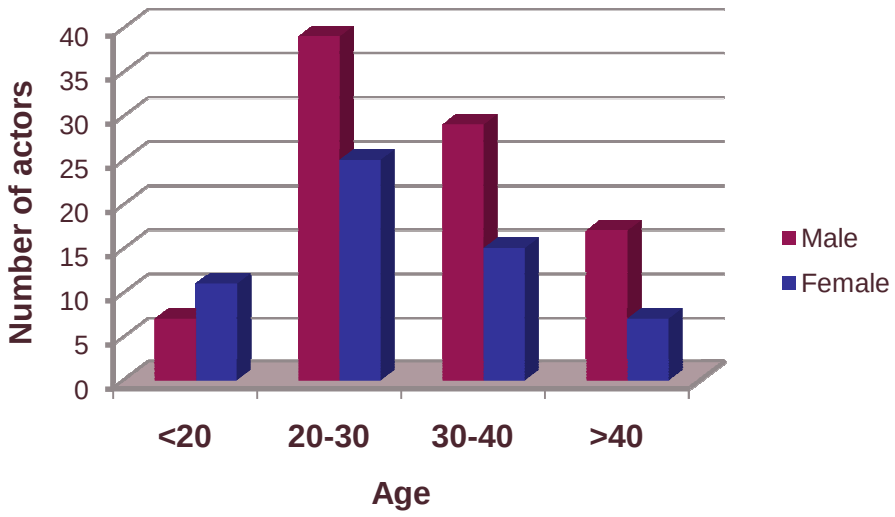

Figure 16: Sex and age profile of *jaabi* consumers

Jaabi consumers choose their product, either grain or Yaabande cake, primarily for its color (Tab. 8). This attribute is representative of their acceptance of the price of the product. The *jaabi* grain should be of red color, while the Yaabande cake should have a color tone yellowish or orange. The terms whitish and chocolate like are also used to define the color of the cake. Since the color of *jaabi* grain is indicative of its maturity, the color of Yaabande cake indicates the cooking quality. Secondary attributes concern texture (for Yaabande), taste, aspect, form and size.

Table 8: Quality attributes of *jaabi* and Yaabande cake as perceived by consumers

Quality attributes	**Percentage of respondents**	
	***Jaabi* grain**	**Yaabande cake**
Color	34.9%	86.3
Taste (sweet)	6.0%	2.0%
Texture		7.9%
Size	6.0%	
Aspect (clean and without hole)	2.4%	
Form		2.0%
Color and size	28.9%	
Color and taste	7.2%	
Color and texture		2.0%

1.3 Discussion

The main characteristic of *jaabi* processing system is its diversity, based on tribal practices and on the way that processors manage their natural environment. Since the northern part of Cameroon where *jaabi* is processed, is a savannah region, with high ecology risk in terms of deforestation and fire wood scarcity, the baking conditions of *jaabi* flour into Yaabande cake can be considered as the main limiting factor of *jaabi* processing. The Kanuri processing method, which valorise the abundance of sun in the region can be considered as an endogenous innovation. Unfortunately, in this practice, the moulded cake is exposed to sun without any protection. The consequence is then contamination with dust, which sometimes

brings sandy sensation when eating the cake. The support to provide to producers, in this condition may be based on introduction of simple and practical sun dryer. In addition, the Kanuri practice has a second limit which is the relative low firmness of the cake, which seems to crumble easily. In this respect, it may be assumed that, either the level of sun effect which might not be enough to favour cohesion of flour particles to form cake, or the ratio of sprinkled water and flour, are factors to be taken into account.

The cooking conditions of Yaabande as limiting factor may be considered also in Kapsiki and Guiziga processing methods. The roasting of Yaabande directly on fire (Kapsiki processing method) is the main cause of burned Yaabande, which is rejected by consumers. Though the vapour cooking technique applied by Guiziga appears as the most reliable method, there is a need of mastering the quantity of water used to produce vapour, since it influences the firmness of the cake, one of the main attributes of Yaabande, as perceived by consumers.

Considering quality attribute and acceptance of Yaabande cake, out of its texture, the colour is another attribute considered by consumers. The survey did not allow bringing out correlation between Yaabande colours and processing practice or *jaabi* variety. This question may be interesting to address, in terms of physico-chemical attributes of Yaabande colour. Analysis of the main *jaabi* constituents and their behaviour on processing conditions appears then instructive. In addition, though *jaabi* is characterized by an intense biscuit aroma, particularly the Yaabande cake, it is surprising to note that this attribute is not considered by actors to characterize the quality of the product.

Literature provides significant information on the biological properties of *Ziziphus*[iv,v,vi,vii,viii]. Indicators of these properties have been found in Cameroonian *jaabi*, particularly its potential anti inflammatory effect[ix,x]. In general, the biological properties of many foods and natural products are hypothesized from their use in subjective or traditional manner by local populations. The survey of *jaabi* processing and use did not bring any information concerning a hypothetical local use of this fruit for its biological or therapeutic properties. This may just indicate a bias in the targeting of users surveyed, or the fact that the local populations do not know the potential use of the product. In the later case, mastering, improvement and diffusion of the biological properties of *jaabi* may constitute an interesting scientific question to address, particularly the opportunity to promote a local nutraceutic food.

CONCLUSION

The survey of *jaabi* production, processing and use in the northern part of Cameroon has brought out the fact that this traditional wild fruit is available for a maximum of four months in the year. It is processed in a unique product, Yaabande, with four different processing methods which seem to reflect the way that local processors manage their ecological

environment. Processing and distribution practices remain essentially traditional, with relatively low quality level of end products.

The findings and observations issued from the survey rise up two research and scientific questions to be addressed, in terms of the valorisation of *jaabi*:

a) Characterisation and diffusion of biological properties of the product, in order to promote a nutraceutic food
b) Valorisation of the rich biscuit aroma of the fruit in baking.

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