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Kitouza

Identification of quality attributes by survey

Part of

D 1.1.2.2: Survey results: quality attributes for Group 2

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INTRODUCTION

For the Malagasy, zebu (or beef) is kept to produce meat for consumption. The meat of beef is subjected to diverse preparation and/or preservation techniques. These range from the production of kitoza (strips of dried meat) to that of « varanga » (fried shredded meat) and of « jaka » (meat preserved in fat). In countries Sakalava (west of Madagascar) and/or Tsimihety (north), one finds « maskita », which corresponds more or less with kitoza in the process of sun drying or smoking by fire in the hearth (Raharolahy, 2004).

Kitoza is a traditional Malagasy dish. It consists of strips of meat 20 to 50 cm long and 2 to 4 cm wide. Previously it was considered to be a royal dish. As there is only one market day per week, one method of preserving the meat is to let it dry and produce kitoza.

Currently, this dish still holds a place of choice on the household menu in Madagascar. And with the evolution of food technology, some producers now make smoked kitoza.

The survey was conducted amongst producers, retailers and consumers of kitoza and the information obtained gives us knowledge of the quality attributes and the manufacturing processes of kitoza.

METHOD OF SURVEY

Study area

The surveys were conducted in the Antananarivo province. This area was chosen due to the fact that kitoza is mainly consumed on the Highlands.

Surveys:

The surveys were conducted from 11 March to 13 July 2011 using a questionnaire which had been translated in Malagasy (please refer to the Attachment). 272 people were interviewed of which 11 were producers, 14 retailers and 258 consumers. The total number of interviewees is less than the sum of producers, retailers and consumers, because some producers also act as retailers.

The producers and retailers were identified by visiting various districts of Antananarivo, while the consumers were interviewed at random in the fokontany of the towns of Renivohitra and Atsimondrano in the Anamalanga region and the town Arivonimamo in the Itasy region (please refer to Table 1).

Table 1 : Categories of actors and location of survey

Categories of actors	Location of survey
Producers	Urban area : Ivandry, Behoririka, 67ha North East, Andravoahangy, Anatihazo Isotry Peri-urban area : Andoharanofotsy, Tanjombato, Ankadikely Ilafy
Retailers	Urban area : Ivandry, Behoririka, Antaninandro, 67ha Nord East, Andravoahangy, Anatihazo Isotry Peri-urban area : Andoharanofotsy, Tanjombato, Ankadikely Ilafy

Consumers	Town Antananarivo Renivohitra (urban area) : Fokontany of : Ivandry, Amboniloha, Behoririka, Ampandrana Andrefana, Antaninandro, 67ha North East, 67ha North West, Town of Atsimondrano (peri-urban area) : Fokontany Andoharanofotsy Town of Arivonimamo (rural area) : Fokontany Imerintsiatosika.

Data analysis:

The data was captured and interpreted with Sphinx Plus 2 software. Information was obtained regarding :

- For producers :
  - the raw materials and food additives
  - the manufacturing processes and problems experienced during production
- For retailers :
  - The criteria of commercialisation and the problems relating to marketing
- For consumers :
  - Dishes containing kitoza and the frequency of consumption
  - The quality attributes of kitoza
  - The social classes who consume kitoza

Table 2: Location of survey and number of persons interviewed

Location of survey	**Total number of persons interviewed**	**Number of persons interviewed**		
		Number of producers	**Number of retailers**	**Number of consumers**
Ivandry	33	1	2*	31
Amboniloha	21	0	0	21
Behoririka	30	1	2*	28
Ampandrana Andrefana	35	0	0	35
Antaninandro	31	0	1	30
67ha North East	27	1	1*	26
67ha North West	23	0	0	23

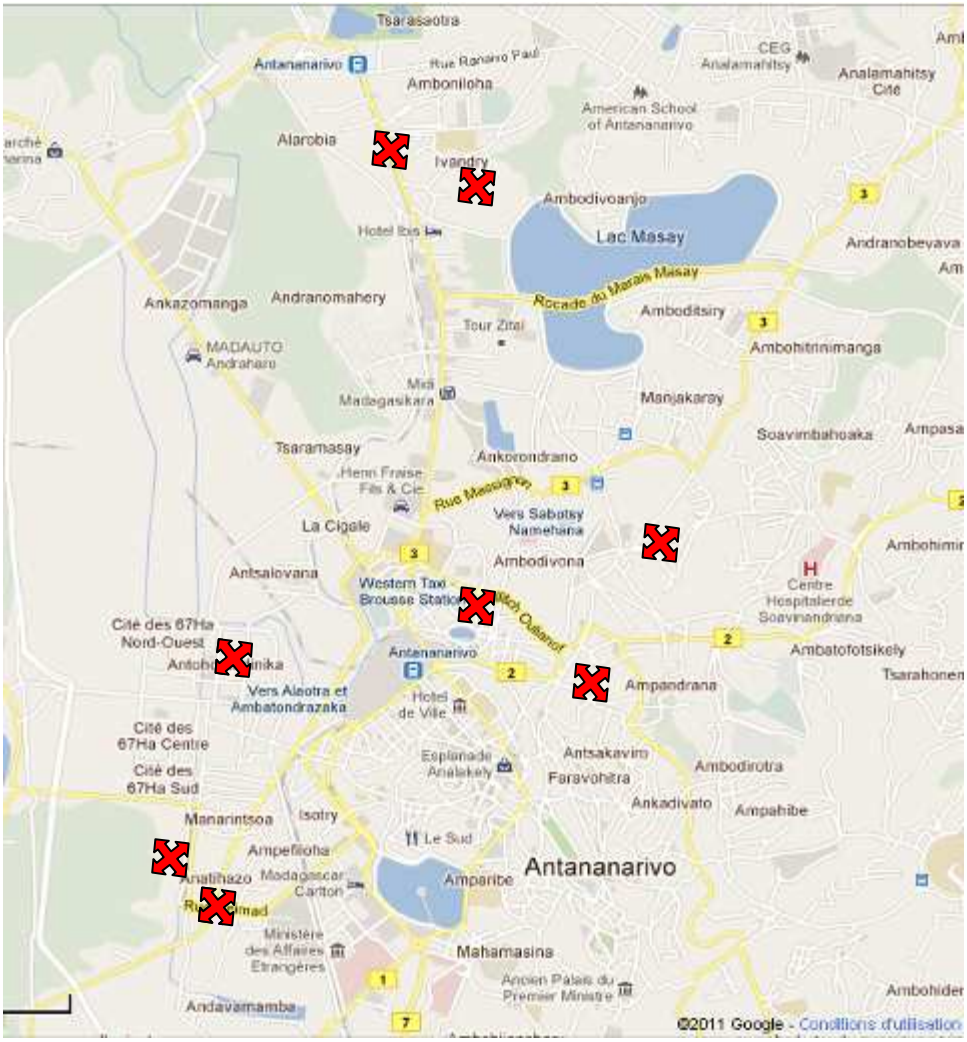
Anatihazo Isotry	2	2	2*	0
Andravoahangy	1	1	1*	0
Andoharanofotsy	32	2	2*	30
Tanjombato	1	1	1*	0
Ankadikely-Ilafy	2	2	2*	0
Imerintsiatosika	34	0	0	34
TOTAL	272	11	14	258

*: The producer is also the retailer

RESULTS

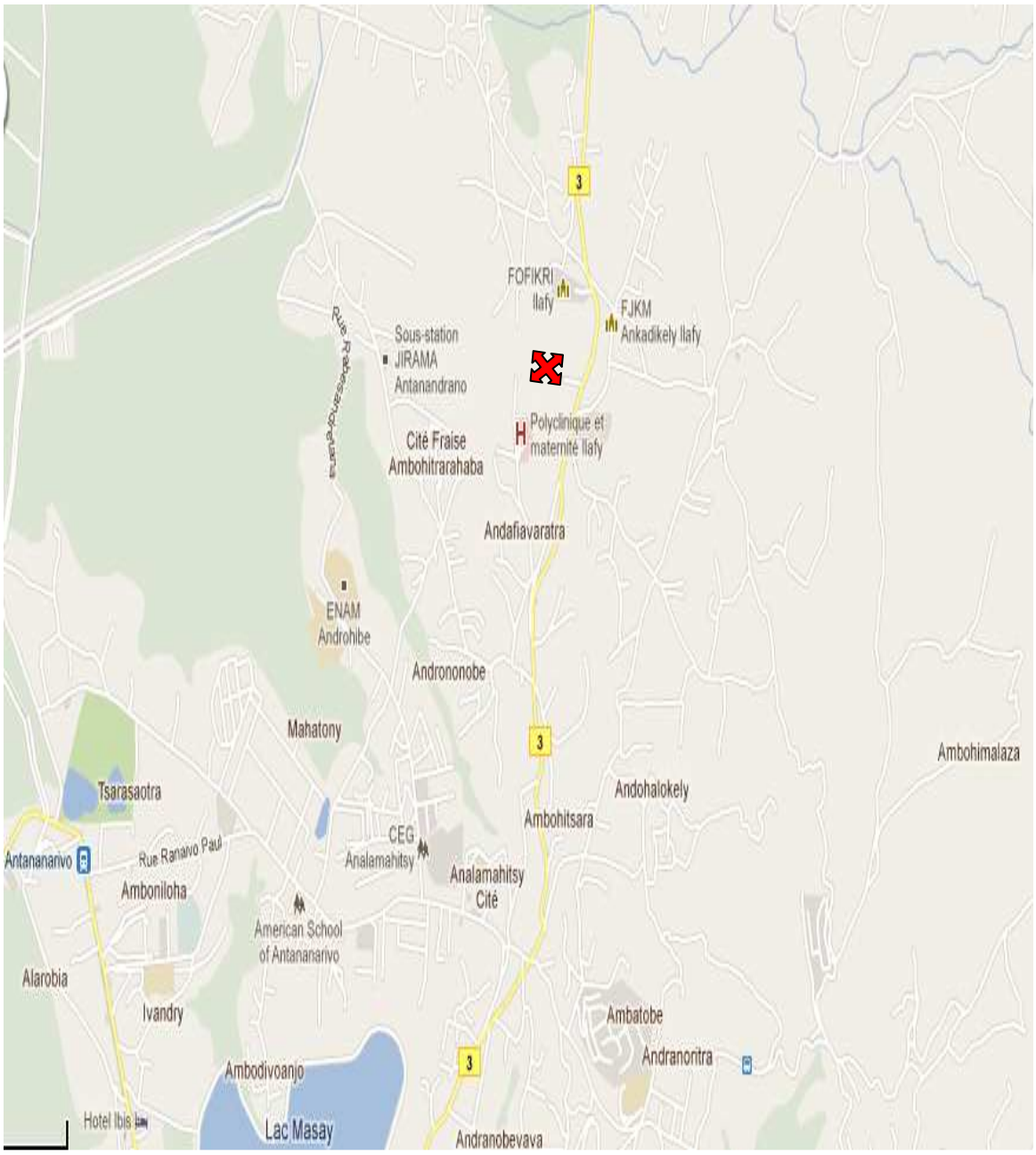
Before presenting the results on the production, commercialisation and consumption, it is important to note that certain questions were not answered or answers were unsatisfactory.

PRODUCTION



: Location of survey

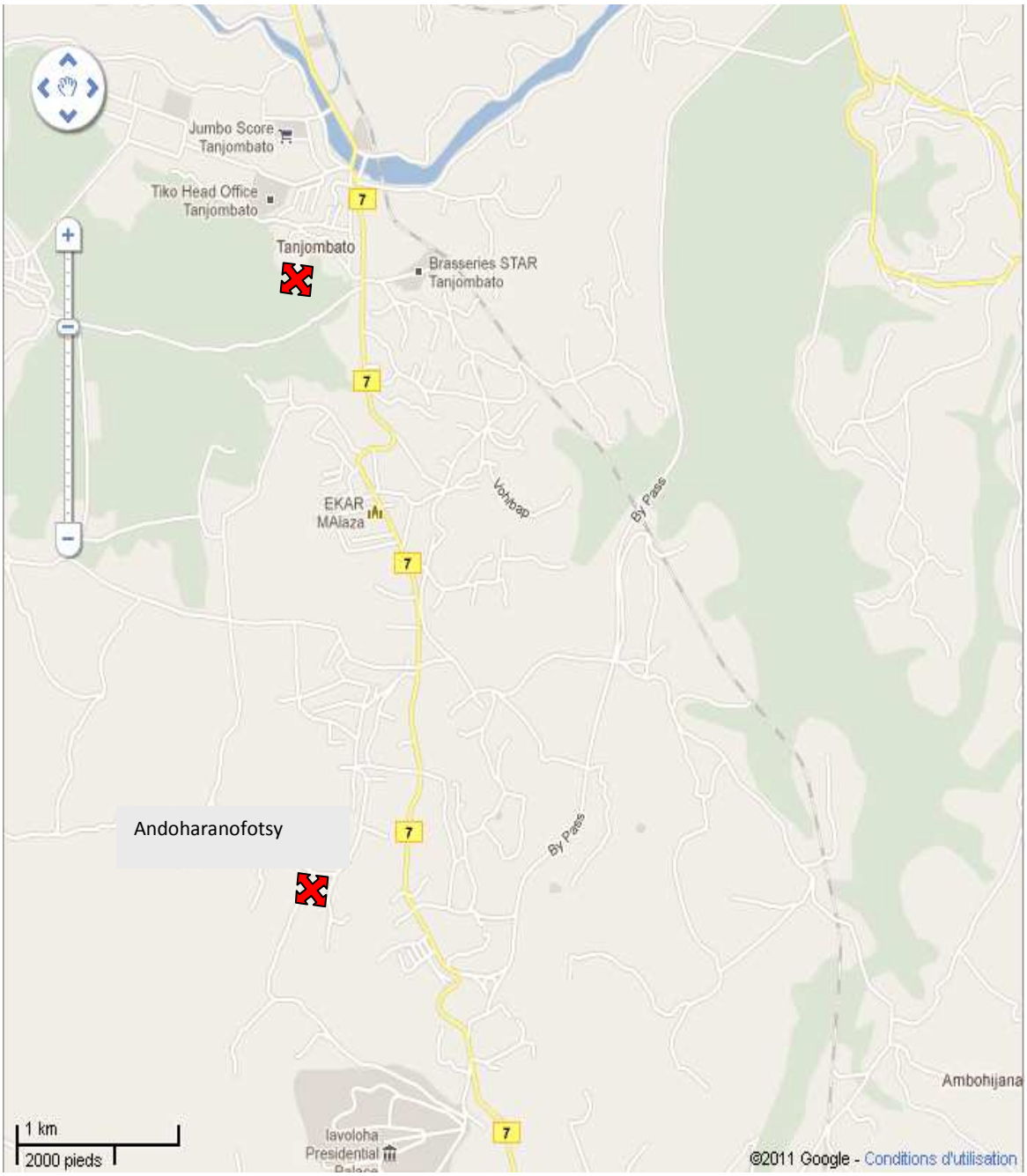
areas



: Location of survey

Source: Google Earth Madagascar Map

Figure 1b**:** Location of survey of producers and retailers in the peri-urban areas



: Location of survey

Source: Google Earth Madagascar Map

Figure 1c: Location of survey of producers and retailers in the peri-urban areas (continued)

Two types of kitoza exist: kitoza from beef and kitoza from pork. The interviewed producers manufacture these types of kitoza only in the smoked form. They are mostly Malagasy from the Highlands and some are Chinese half-caste.

63, 6% are male and 36, 5% are females. 18, 2% is younger than 22 years and 54, 5% are 32 or older. Regarding their educational level, 54, 5% followed secondary studies while 27, 3% studied at universities.

91% of the producers are married and heads of families, while 9% are single and independent. The size of households of producers vary between 2 (18, 2%) and 8 (9%) people.

Table 3: Types of kitoza and ingredients

Type of kitoza	Kitoza of smoked beef (72,72%)		Kitoza of smoked pork (81,81%)	
Ingredients	Meat of beef (filet, thin slices)	Salt, ginger,garlic, oil, sugar, papaya (one producer), thyme and saltpeter	Meat of pork	Salt, ginger, garlic, oil and saltpeter
Place of purchase of ingredients	Butchery (Analakely)	Wholesaler (Petite Vitesse, Anosibe)	Abattoirs (Ankadindratombo, Alasora et Anosizato)	Wholesalers (Ankazomanga, Analakely, Tsaralalàna)
Cost of ingredients	Beef meat : increase in August and September	Garlic and ginger: increase between January and April ; June and September	Porc meat : increase between November and April	Garlic and ginger: increase between January and April, June and September
Quantity of kitoza produced per week	3 to 4kg		5 to 20kg	
Quality criteria of kitoza	Tender, not fatty, colour gold/brown, dry appearance		Tender, colour gold/brown, dry appearance	
Duration of preservation	1 day (81,81%) to one week (9,09%)		1 day (81,81%) to one week (9,09%)	

The main ingredients used are salt, garlic and ginger. Oil is used by some producers to retain the flexibility of the meat. Fresh and tender meat is always used. For beef kitoza, thin slices and fillet are most often used.

72,72% of producers interviewed make smoked beef kitoza and 81,81% produce smoked pork kitoza. This means that producers could simultaneously produce smoked beef or smoked pork kitoza.

The maximum duration of preservation is one week but some sell their products within one day (81,81% of producers) while others sell within one week (9,09% of producers).

Manufacturing process

The manufacturing process of kitoza is described in the diagram of Figure 2.

This describes the process used by the producers and the one used by consumers who produce their kitoza for own consumption.

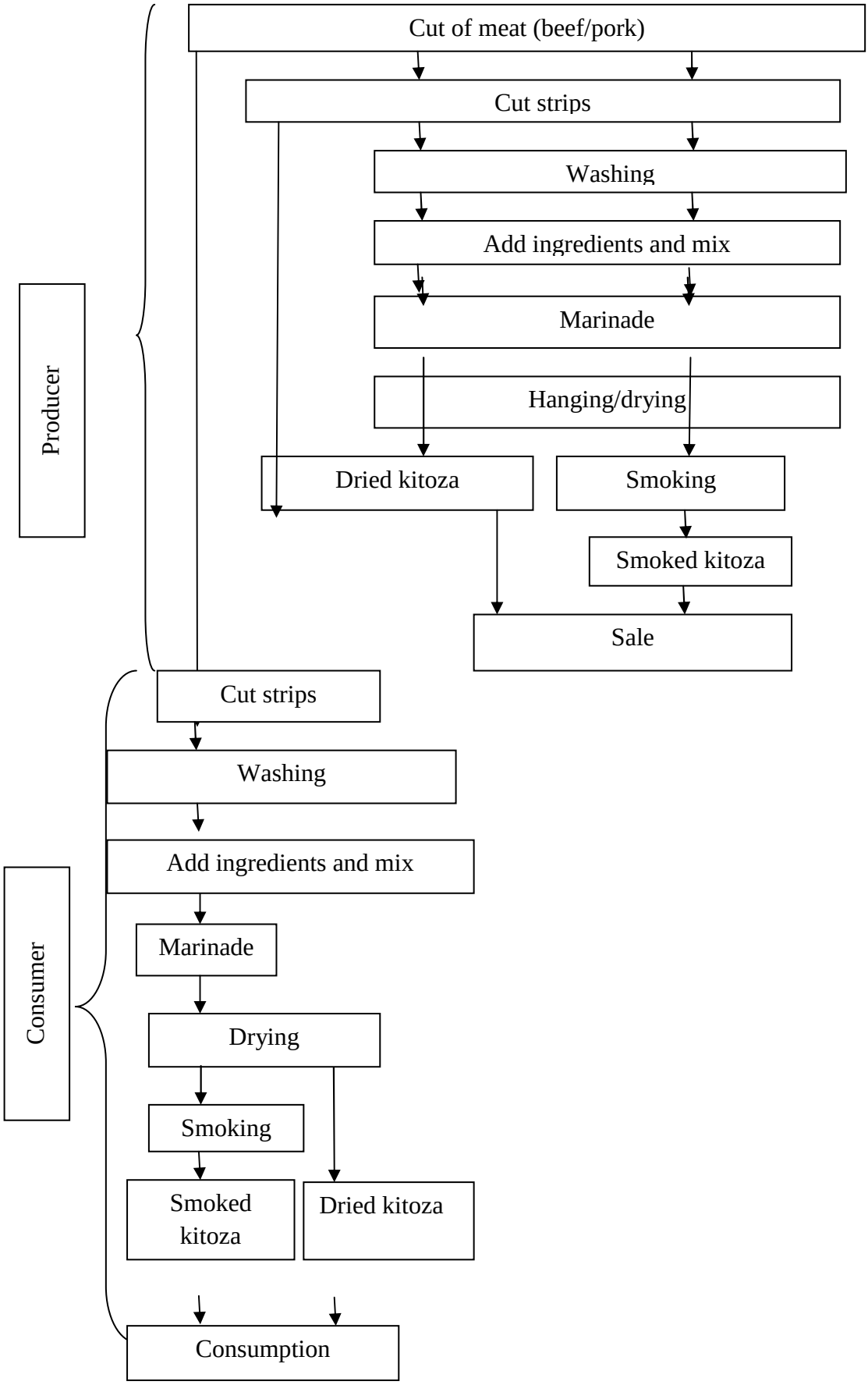


Figure 2 : Diagram of manufacturing process for dried and smoked kitoza

The meat is transported by automobile (73%), by motorcycle (5%) or on foot (21,5%) in bags or on a tarpaulin (transport by motor vehicle). On arrival, the meat is firstly cut and then washed. While cutting the strips, the fat and the tendons are removed from each strip. Then the ingredients are added and mixed. To ensure that the meat is well permeated by the ingredients, the meat is marinated for 24 hours. Afterwards the kitoza is hung for a period necessary to dry the meat, generally one hour for kitoza which is smoked. The dry kitoza produced in this way keeps several weeks if properly dried.

The dried kitoza could then be smoked. The smoking is done by exposing the product to a heat source and to smoke. The duration of the operation depends on each producer and could be between 45 min and 2h 30 min.

The smoking process causes a dehydration of 25% of the raw material.

Smoking is performed in brick smoking ovens, in sheet (metal) or in barrels. The heat source is wood charcoal or firewood.

The brick smoking ovens measure 2m in height and 1,5m in width. The hooks are situated 1,5m from the heat source placed in the inner section of the structure. The opening of the oven measures 0,7m by 0,7m. The smoke escapes through a chimney situated at the top of the smoke oven. Brick smoking ovens have the advantage of being durable.

The ovens made out of drums or barrels each consist of two superimposed barrels. The hooks are situated in the top barrel and the fire in the lower barrel. An opening is made at the top in which a zinc chimney is placed.

Smoking ovens from sheet metal measure 2m high by 1m long and 50cm wide. The hooks are found 1m above the fire in the internal part of the device. The disadvantage of sheet metal or barrels smoking ovens is the tendency to rust.

Note: Cut strips may be sold as it is (without drying nor smoking) but this type of kitoza was not subjected to survey nor analyses.

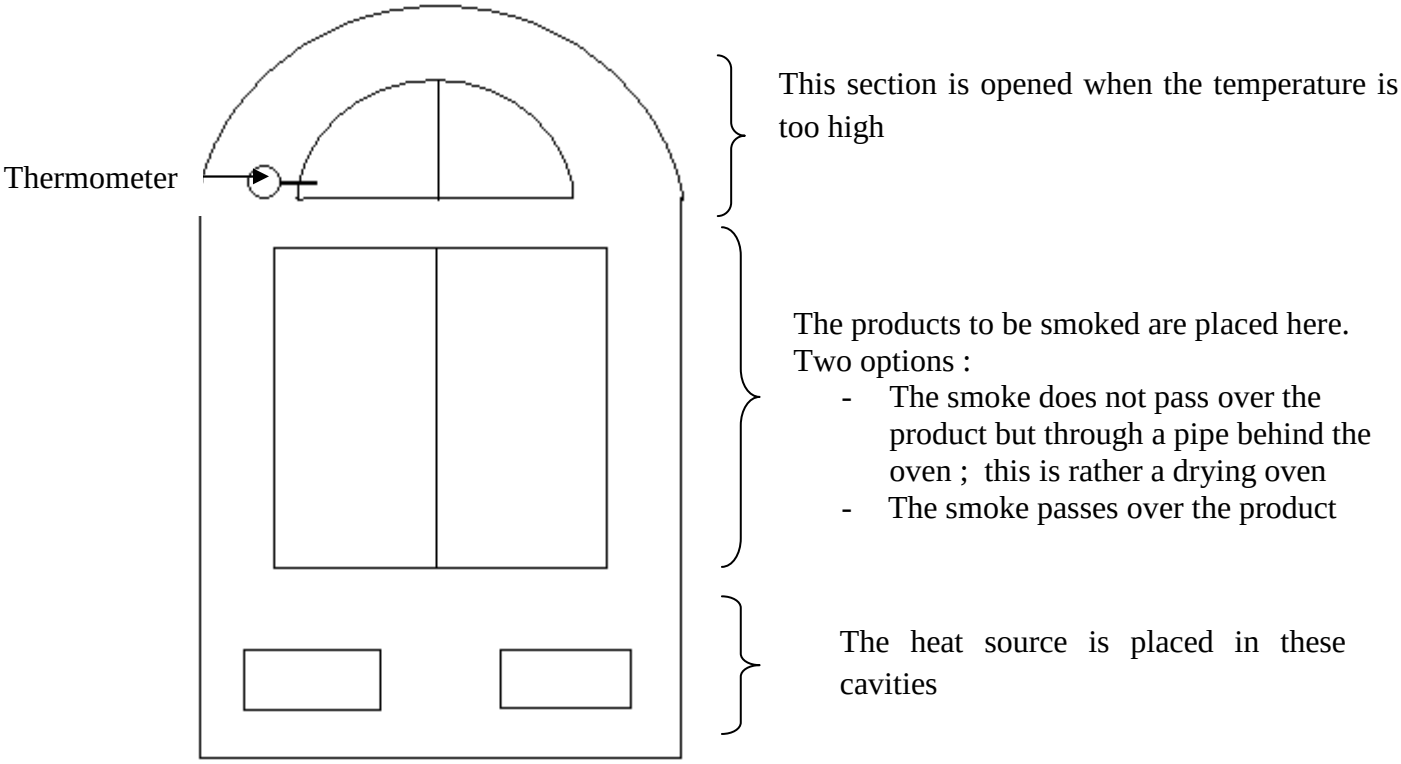
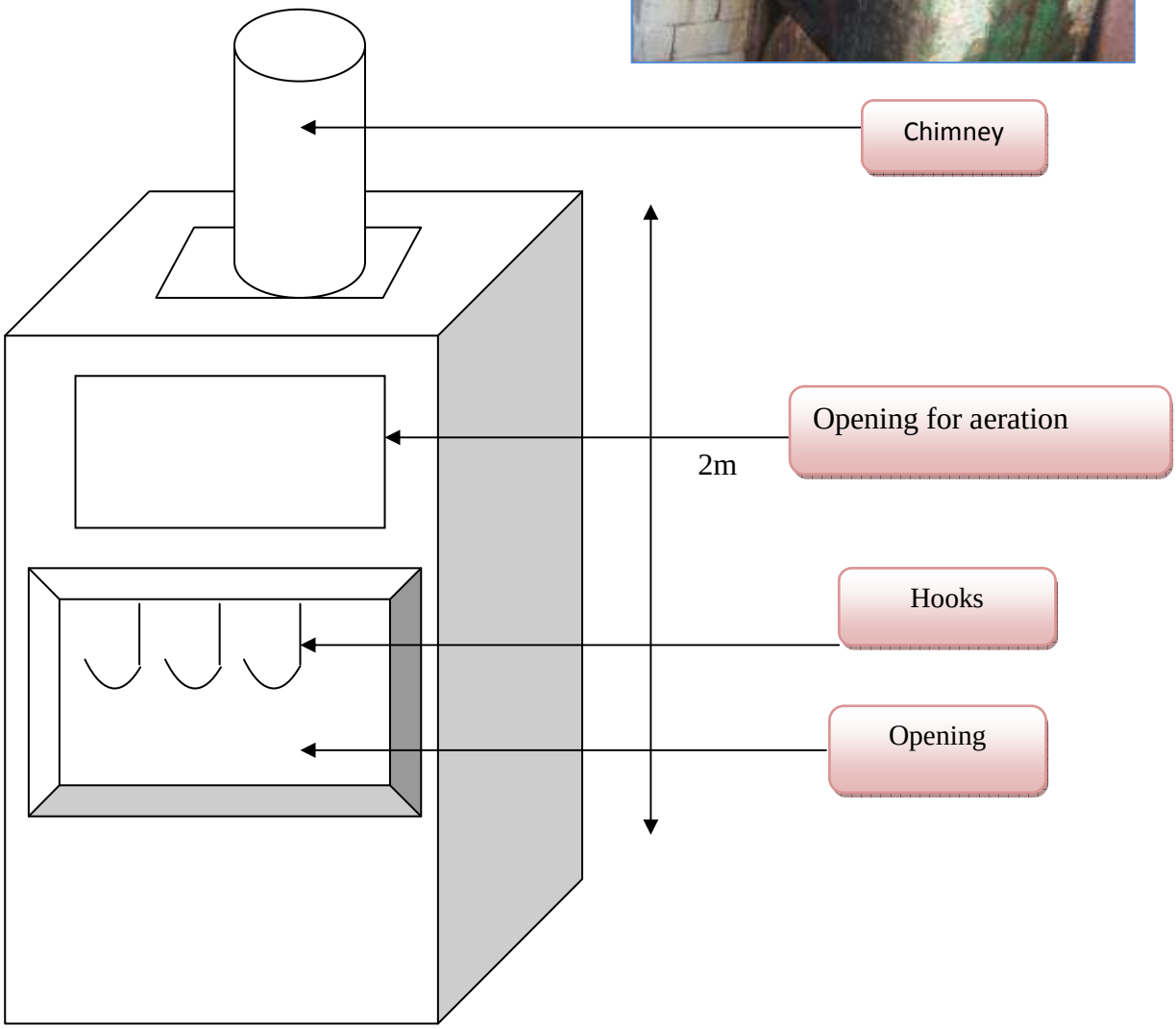


Figure 3 : Diagram of a brick smoking oven

Figure 4 : Brick smoking ovens


Chimney
Opening for aeration
2m
Hooks
Opening

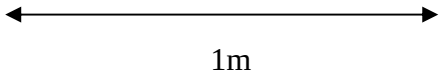


Figure 5 : Metal sheet smoking oven
The smoke passes over the product

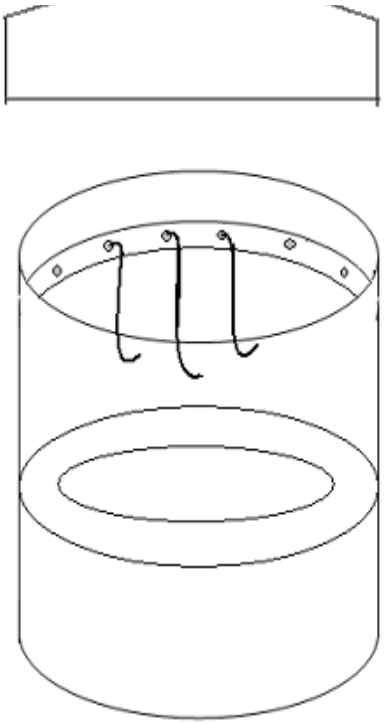


Figure 6 : Barrel smoking oven
The smoke passes over the product

Therefore smoking ovens are generally constructed with:
- an opening for aeration
- a platform with the hooks for hanging the meat
- a cavity in the bottom part for the fire

Table 4 : Operations during the production of kitoza

Operations	Duration of the operation	Quantity of raw materials used	Other ingredients	Equipment utilised	Workforce	Product obtained	Quality attributes of the obtained product
Cutting into strips	15 to 20min	3kg		Knife, board, bowl, tray,	One to 3 workers	Fresh meat cut into strips	Good size

Washing	15 to 20min	3kg		Bowl	One to 3 workiers	Fresh meat cut into strips	
Adding ingredients and mix	5min	3kg	**Salt** : 10 to17g/kg **Garlic** : 2 cloves to 2 kapoaka/kg **Saltpeter** : 8% salt **Sugar** : one pinch or 13g/kg (optional) **Ginger** : 4 pieces	Bowl, gloves and wooden spoon	One worker	Meat salted but not dried	Meat well seasoned and well scented
Marinade	1 to 24h	3kg	Papaya juice (optional)	Bowl			Tender kitoza
Hanging/ drying	1h (smoked kitoza) Indefinitely (dried kitoza)			Hooks, rope	One to 3 workers	Salted dried meat	Dry kitoza
Smoking	45min to 2h30			Smoking oven of metal, bricks, firewood, coal	One to 3 workers	Salted smoked meat	Tender kitoza

The frequency of production of smoked kitoza varies from 2 (27,27%) to 7 times (18,18%) per week with a quantity of at least 3 to 10kg per production to 4 to 20kg maximum, according to the size and importance of the producer. The maximum period of preservation is one week, but some sell their product within one day (81,81% of producers) whereas others sell within one week (9,09% of producers).

For the majority of the producers, the product is sold on the day of production or the following day and the problem of preservation therefore does not apply. Nevertheless, kitoza is preserved on refrigerated shelves. Apart from this, problems encountered during production (40%) are bottle-necks which delay production as well as scarcity of the meat, increase in meat price. Power cuts could also influence the preservation period.

The most difficult operations during the production of kitoza are the cutting of meat in strips (80%), and the smoking (35%). For the first, it is often necessary to sharpen the knife and remove the tendons while for the second, the smoke and heat has to be endured while monitoring the fire.

The know-how of kitoza production is acquired by family heritage (50%) as well as by apprenticeships (50%).

Table 5 : Problems encountered during production

Intermediary and final	Quality criteria for the appreciation of the product	Quality problems encountered	Solutions proposed
Fresh meat cut into strips	Tender flesh of the meat (tranche fine, filet)	Scarcity of tender meat	
Salted but not dried meat	- Correct seasoning - Slightly spicy	- Treatment too long - Incorrect dosage of ingredients (salt)	
Salted and dried meat	- Tender - Seasoning	Meat too dry	
Salted smoked meat	- Tender (37,5%) - Colour red or golden/brown (37,5%)	- Grilled meat - Meat too salty - Change in quality of the meat at the suppliers	

COMMERCIALISATION

The retailers of smoked kitoza are mostly producers themselves, but some are only retailers. The criteria are the same as for the producers.

Types of kitoza commercialised:
- Smoked beef kitoza 72,72% (of which 27,3% only on order)
- Smoked pork kitoza 81,81%
- Other types of kitoza 9,09%

Table 6 : Criteria for commercialisation

Types of kitoza	Place of sale	Quantity sold per month	Quality criteria	Price of sale (kg)
Smoked beef kitoza	Local market (40%) Home (40%)	24 to 30kg	Good presentation (62,5%), good taste (32,5%)	20000 – 25000 Ariary 7,6 – 9,6 euros
Smoked pork kitoza	Local market (40%) Home (40%)	10 to 240kg	Good presentation (60%)	16000 - 25000 Ariary 6,15 – 9,6 euros

The products could be vacuum-packed or kept as it is according to the producer. Kitoza is sold on the same day but it is stored in a refrigerator. It is transported by car in bags which are sometimes placed in a refrigerator.

The place of sale is usually the local market (40%) or shops at the homes of the merchants (40%). For smoked beef kitoza the quantity sold per month varies between 24 and 30kg according to the producer and for smoked pork kitoza it varies between 10 and 240kg.

The quality criteria for commercialisation of the product are good presentation and the smoked taste. The appearance of the product, the window display, the cleanliness of the shop and the vendor resorts under good presentation, Smoked kitoza is more expensive. The price varies between 16000 to 25000 Ariary (6,15 to 9,6 euros), kitoza from beef and pork combined.

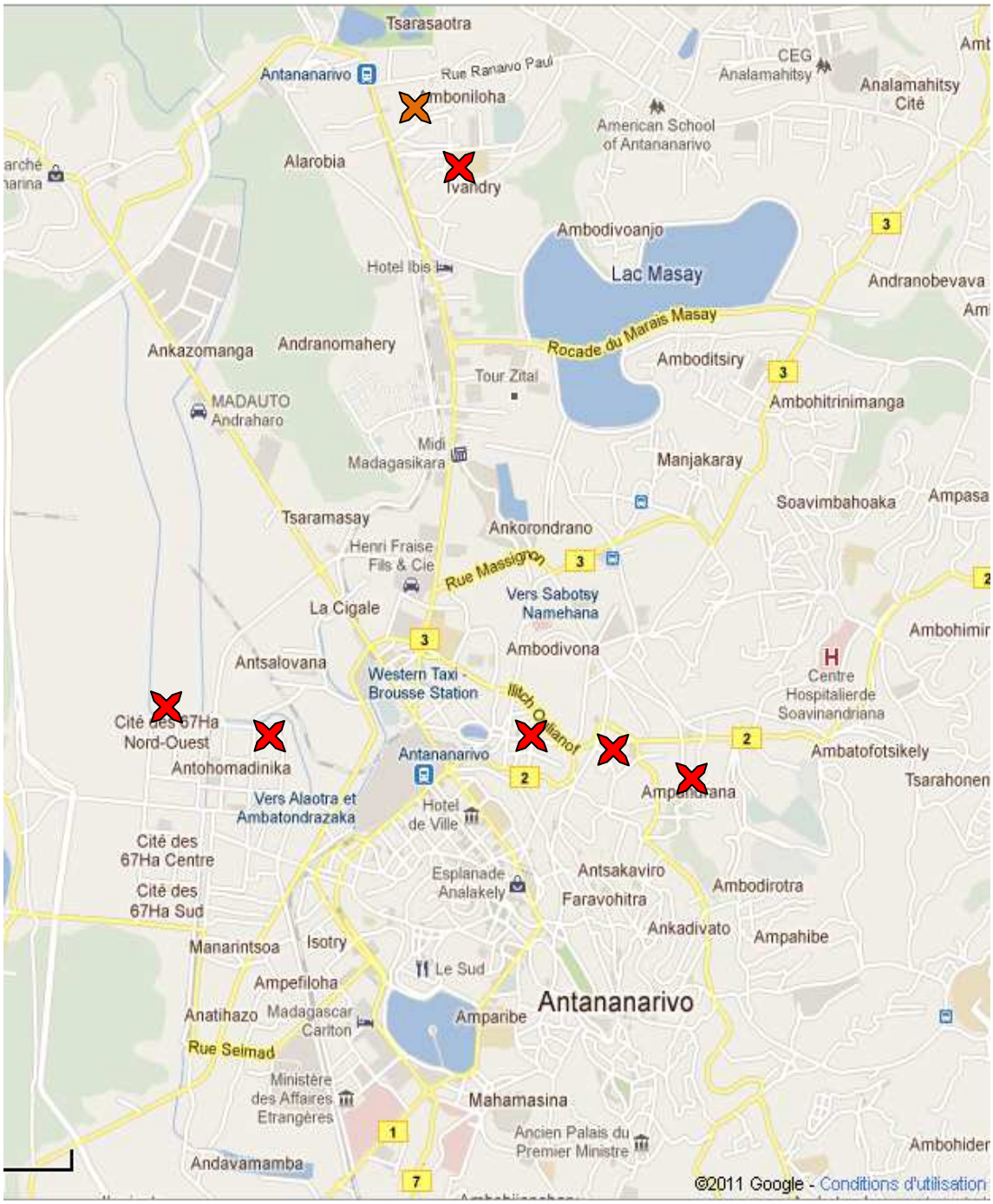
Table 7 shows the problems of commercialisation and the solutions proposed by the producers.

Table 7 : Problems of commercialisation

Commercialised products	Problems of commercialisation	Detailed description of the problems	Proposed solutions
Smoked beef kitoza	Electricity failure (power cuts)	Problems with preservation fo the products	None
Smoked pork kitoza	Competition, power cuts	Sales do not take place	None

CONSUMPTION

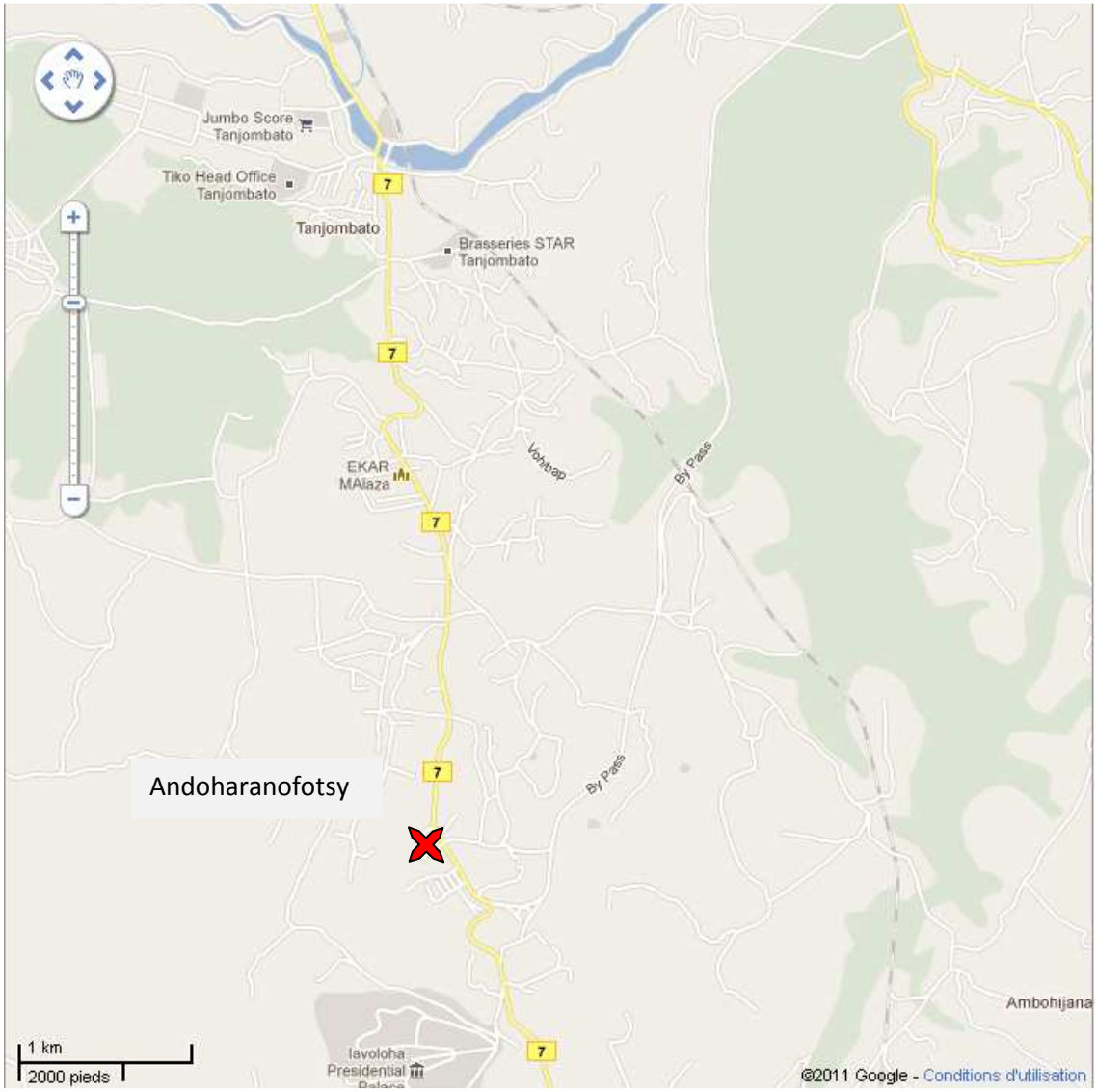
The interviewed consumers were found in the Analamanga and Itasy regions of the Antananarivo province.



: locations of survey

Source : Google Earth Madagascar Map

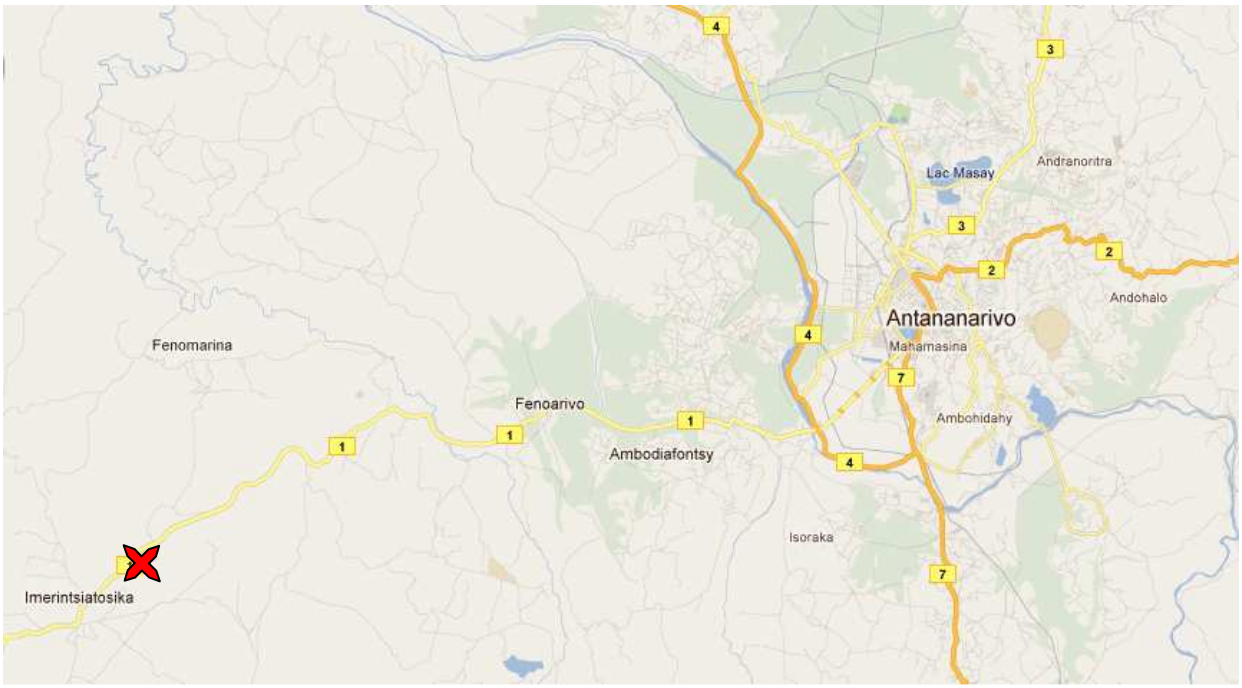
Figure 7a : Location of survey of consumers in the urban zone.



: locations of survey

Source : Google Earth Madagascar Map

Figure 7b : Location of survey of consumers in the peri-urban zone



: location of survey

Figure 7c : Location of survey of consumers in the rural area

The consumers who were interviewed are mostly between 30 and 40 years old and 72,5% of all persons interviewed were females.

53,9% of the interviewed persons followed soe secondary studies and 68,6% are married and heads of the household.

Dishes consumed with kitoza:

Kitoza is principally consumed with vary sosoa (rice soup) or with vary amin'anana (rice soup with green vegetables) at breakfast or dinner (please refer to Tables 8 and 9)

Table 8: Dishes consumed with kitoza and frequency of consumption

Dishes consumed with kitoza	Frequency of consumption(%)
Vary sosoa	81
Vary amin'anana	62,1
Vary maina	18,2
Pasta	5,03
Bread	1,16
Tsaky toaka (1)	8,13
Kitoza (2)	7,36
Green vegetables	5,03
Vegetables	3,1
Soup	2,32
Salad	3,1
Hot sauce	0,77

1: as an accompaniment to alcohol; 2: consumed alone

Table 9: Data on consumption (expressed as percentages)

Dishes containing kitoza	Frequency of consumption per week					Occasion					Place of consumption			
	6-7 times	4-5 times	2-3 times	1 time	Seldom	Breakfast	Lunch	Dînner	Between meals	Special occasion	At home	at street vendor	Restaurant	Other
Vary sosoa	14,9	4	26,7	22,5	22,3	60,9	11,15	70,4	1,8	3,7	97,7	14	1,8	1,9
Vary amin'anana	10,5	4,8	28	22	34,8	53,7	11,9	65,5	4,3	51,9	51,3	16,9	0,6	0,7
Vary maina	3,6	1,3	25,5	17,7	51,9	7,9	63,7	39,6	2,2	10,3	95,6	8,1	4,4	2,2
Pasta	0	6,3	28,8	16,3	48,8	7,2	41,5	30	7,2	24,3	53	10		
Bread	50					50			50	50	50			50
Tsaky toaka				52,1	47,9			33,9	14,3	58,9	41,1	7,2		66,1
Kitoza			45,9	16,7	37,5	10	43,4	43,4	10	20	100			
Green vegetables		12,5	75		12,5	12,5	62,5	25			100			
Vegetables		12,5	12,5	75			100	62,5			100			
Soup					50		50	50			100			
Salad			16,7	16,7	66,7		100	16,7			100			
Hot sauce	50			50		50	100	50			100			

The quality attributes for which the consumers are prepared to pay more are the tenderness of the meat, the smoked taste and the cleanliness of the product and its affordability.

Health effects of kitoza :

- 18,94% of consumers found kitoza to be energising
- 10,71% : kitoza causes blood pressure problems
- 19,15% : kitoza improves appetite
- 6,77% : kitoza supplies proteins
- 22,16% : kitoza strengthens women in labour and promotes the production of breast milk

50% of consumers interviewed consumes beef kitoza and 21,44% pork kitoza.

In a few households smoked kitoza is consumed, but the majority buy the meat and prepare the kitoza at their own homes or buy the meat already cut into strips (70%). At home the kitoza could be dried and kept for consumption throughout the month. Others eat kitoza with rice at the street vendors. In this case the kitoza is sold in slices costing 100 Ariary.

The quantity of kitoza bought by the majority of households varies between 125g and 250g with a price of between 700 and 1500 Ariary (0,3 to 0,8 euros) respectively for beef and 1000 to 2000 Ariary for pork meat.

Kitoza is relatively expensive and therefore households with high (78,68%) or medium (85,65%) income consume the most. Low income households mostly consume kitoza from the street vendors at the rate of 100 Ariary per slice (around 10g) or buy a 125g quantity.

Table 9 shows the frequency of consumption as related to the social class of the consumers.

Table 9 : Social classes

1.

Social classes	Frequency of consumption of kitoza(%)
Low income household	70,93
Medium income household	85,65
High income household	78,68
Depends on social level	0,77
Depends on the ability of each	5,81

DISCUSSION

The technology used to produce smoked kitoza varies greatly: the producers possibly use a smoking oven and preservative (saltpeter) while the consumers or producers for own consumption hang the kitoza over a fire to smoke it.

No study has been performed on the microbiological quality of kitoza both during the production stages and on the final products. The critical stages during the production of kitoza are the preparation, washing and drying of the meat.

The physico-chemical quality of kitoza has also not yet been studied (please refer to bibliography). This survey shows that research concerning the biochemical characteristics (pH, water activity, lipid content (Folch), total phenols, salt, D- and L lactic acid, aromatic hydrocarbons (HAP), oxidation level of lipids (TBARS), water, collagen and protein content) and microbiological properties (pathogens, lactic acid bacteria) is necessary at the different stages of production.

Special preparation methods (addition of ingredients) and the preservation method (particularly smoking) improve both the biochemical characteristics and the microbiological quality of the kitoza.

Smoking, in addition to preservation by drying, modifies the organoleptic quality of the meat: it changes the colour and aroma and hardens the texture (FAO 1990). The smoking introduces formaldehyde which acts both as a preservative and also enhances the taste of the meat (http://fr.wikipedia.org/wiki/Fumage).

The smoke produced by the combustion of wood contains fungistatic compounds which inhibit the growth of yeasts and molds on the surface of the product (FAO 1990).

Otherwise, though intense smoking could increase the shelf-life of the meat, it also has an unfavourable effect on the flavour and therefore on the quality, notably during prolonged storage when increasingly unpleasant tar-like aromas develop (FAO 1990).

As for salting, it serves to curb the development of micro-organisms on the surface of the product and to remove insects and other parasites (Maas-van Belkel et al. 2005, Yacouba, 2010).

Regarding the problems discussed by the producers and the retailers, we propose some solutions:

- For production : limiting the drying period and adapting the treatment to the quality (taste, colour, consistency, freshness, …) required for smoked meat ;

- For commercialisation: increasing the duration of the shelf-life of the products by improving the water content and purchasing generators and coolers in case of power failures.

Table 10 summarises the quality criteria of kitoza, whether it is smoked or dried.

Table 10 : Quality attributes

Actors	Colour/appearance	Consistency/Texture	Taste	Hygienic Quality
Producers	Colour golden/brown	Tender/dry	smoked	
Retailers	Colour golden/brown	Tender/dry	smoked	Presentation in bags and/or in window Cleanliness of the shop
Consumers	Colour golden/brown/red	Tender/dry	Dry or smoked meat	Cleanliness

CONCLUSION

The beef and pork meat constitute more than 85% of the total available meat. Zebu represents by far the most important fraction of Malagasy livestock (Barbe et al, 1966).

According to producers, smoked pork kitoza is most highly in demand and is also the most appreciated by consumers. In contrast, beef kitoza is most frequently found at household level where dry kitoza is consumed.

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Project coordinator : Cirad
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Kong

Identification of quality attributes by survey

Part of

D 1.1.2.2: Survey results: quality attributes for Group 2

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Abstract

Smoked Kong (wet and dried) is processed in traditional way by actors living generally in the coastline edge. Facing with many problems such as good combustible materials, good smoking equipment, the activities and the methods of processing were developed without big interests on the smoked Kong products' quality attributes instead of income. This survey helps from actors to recognize changes in sensory properties of the mentioned products. From this survey it appears that the appreciation of the quality of wet smoked Kong, and dried smoked Kong by the producers, traders and consumers is mainly based on observations through a number of sensory attributes such as colour, taste, flavor, humidity ratio and calibre of these products. Also, the way to appreciate the quality attributes depends also to the areas surveyed. The improvement of packaging and storage conditions has also been pointed out by some consumers to influence the end products. Also, the need of other tools for quality attributes' control was pointed out by many actors in this field to raise the added value of the smoked Kong.

Introduction

The contribution to nutritional quality of food products is essential for consumer health, choice and preference. Quality attributes depend on a good source of nutrients. They have roles in influencing 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 processing practices induce specific sensory properties to traditional food products. Furthermore, traditional food products are generally manufactured in many ways include at home (small scale), small factories, and enterprise (semi industrial scale). Lack of technical tools to control the quality is still a challenge for highly experienced producers in this field.

Wet smoked Kong and dried smoked Kong are mostly used in different ways in Senegal. Its major constraints are the quality changes during production and storage. Evaluation of wet smoked Kong and dried smoked Kong qualities' characteristics is needed for identifying the quality criteria according to various actors (producers, traders and consumers) involving. So, link between the quality properties by different actors and the technology used to process the product as well as the impacts of storage conditions is necessary.

Moreover microbiological status of wet smoked Kong and dried smoked Kong, the sensory quality attributes, and these products' agreement with the consumer perception are in embryonic status. Therefore, the objective of the present survey is to identify the quality attributes of wet smoked Kong and dried smoked Kong according to the different actors' point of view.

1. Choice of survey zones and sampling of surveyed actors

The survey was done in different zones: Dakar, Bignona, Kédougou, Fatick, Mbour and Ziguinchor according to the recurrent use. This choice is justified by the fact that smoked Kong is processed in artisanal way. The survey zones were conducted according to previous work. Preliminary poll has been conducted by visiting the processing sites into thirteen (13) zones. In these zones, the production, trade or consumption are mostly done by local population. Actors sample size was set according to Chadare et al, (2008) and Dagnelli (1998) previous works. In the different selected zones, the proportion of actors was assessed through a random-check on 1207 people (250 processors, 222 traders, and 742 consumers).

2. Data collection

The survey was conducted on smoked Kong producers, traders and consumers in Dakar, Bignona, Kédougou, Fatick, Mbour and Ziguinchor from 10th March to 10th April 2011. The survey was in the form of interviews administered through a questionnaire as well as observations of the producers 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 1207 persons from different ethnic groups and areas, and both genders at ages' range of 15 years old to 75, randomly selected were effectively interviewed on the production, trade and consumption of wet smoked Kong, dried smoked Kong and some very prized dishes with inside smoked Kong, 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.

3. Data processing and analyses

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

4. Quality attributes of wet smoked Kong and dried smoked Kong

During the survey, questions related to smoked Kong and products related quality attributes were administered to producers, traders and consumers in this sector. The main attributes registered to raw materials according to the survey, are the freshness of fish used. Mostly fish were processed just after pirogue discharge. For the smoked Kong, their quality attributes are related to the colour, taste, flavor, humidity ratio and calibre. Improvement of packaging, storage conditions were mentioned by some consumers, producers and traders on the products acceptability increase.

The quality attributes identified as determinant by producers is given in **Table 1**.

Table 1: Determinant factors of smoked quality attributes by producers (in %)

Type of smoked Kong/attributes		color	flavor	humidity ratio
wet smoked Kong	less dehydrated	75	25	-
	more dehydrated	71	29	-
dried smoked Kong	less dehydrated	25	-	75
	more dehydrated	68	-	32

From Table 1, the quality attributes by traders depend on the type of smoked Kong.

For the wet smoked Kong, the dehydration did not change to much the quality attributes perceived by traders. So, the less and more dehydrated wet smoked Kong showed that color (73.2% in average) was the most pronounced by producers compared to flavour (26.8% in average) and humidity ratio (not cited).

For the dried smoked Kong, producers appreciated more humidity ratio (75%) compared to color (25%) the in the case of the less dehydrated. While the color (68.3%) dominated the producers choice in the case of more dehydrated smoked Kong against 31.7% of humidity ratio.

Quality criteria vs. selling price for traders were related to preference and the **Table 2** shows the most pronounced preferences according to the two kind of smoked Kong.

Table 2: The preference by traders to the different kind of smoked Kong.

Preference	**number of traders interviewed**
wet smoked Kong	56
dried smoked Kong	20
semi dried smoked Kong	9

Most of traders (56) interviewed claimed that a good smoked Kong should be wet. For the dried one, 20 traders interviewed have displayed affirmative response. While for the semi dried smoked Kong, 9 traders have had their choice on it. These results showed that water content is an important quality attributes for traders choice on the smoked Kong. In **Table 3**, the reasons of smoked Kong preference are mentioned for traders.

Table 3: The reasons' preference by traders to the different kind of smoked Kong.

Smoked Kong	**reasons for the preference**	**number of traders interviewed**
wet smoked Kong	good conservation	1
	client taste	55
dried smoked Kong	good conservation	17
	client taste	2
semi dried smoked Kong	good conservation	1
	client taste	3

From this table, client taste (55 persons interviewed) was the main reason for traders' choice of wet smoked Kong. In the case of dried smoked Kong, good conservation was the most pronounced quality attributes according to traders preference.

The quality attributes are represented in **Table 4**. The color and humidity ratio are more pronounced (taken alone). Their interactions with the flavor are also appreciated by many traders interviewed.

Table 4: Quality attributes by traders and clients to the different kind of smoked Kong.

Area surveyed	From clients surveyed				
Thiés	wet smoked Kong		color	flavor	humidity
		flavor	1	0	0
		humidity	0	2	0
	dried smoked Kong	color	1	0	1
		humidity	0	2	3
	From traders surveyed				
	wet smoked Kong	humidity	0	5	1
	dried smoked Kong	humidity	0	5	5
Bignona	From clients surveyed				
	dried smoked Kong		color	flavor	humidity
		color	4	5	4
		humidity	0	0	1
	From traders surveyed				
	dried smoked Kong	color	4	1	8
		humidity	0	0	1
Ziguinchor	From clients surveyed				
	wet smoked Kong		color	flavor	humidity
		color	12	0	4
		flavor	0	5	0
		humidity	0	0	41
	From traders surveyed				
	wet smoked Kong	color	21	7	5
		humidity	0	0	31

The color and humidity ratio are the most important quality attributes according to traders and clients interviewed in the dried smoked Kong and wet smoked Kong. The interactions of these two quality attributes with flavour were highlighted by some traders and clients. The perception of the quality attributes mentioned depended on the areas surveyed. For example in the case of dried smoked Kong, traders from Thiés gave more attention to humidity, flavor and their interaction than in Bignona where the color and its interaction to flavor and humidity ratio were more pronounced by traders. The same trend could be observed in the case of wet smoked Kong. These results showed that the locality influences well the perception of quality attributes from actors surveyed.

The consumers appreciated the final products of wet smoked Kong and dried smoked Kong in the same way. The criteria the most appreciated by consumers are color and humidity ratio (**Table 5**) in the two kind of smoked Kong selected. But in the large scale, the consumers associated the five attributes quality such as color, humidity, taste, flavor and caliber for the

appreciation of the wet smoked Kong. While for the dried smoked Kong, the flavour did not influence too much the .

Table 5: Quality attributes of importance to consumer for smoked Kong

Quality attributes	color	humidity ratio	caliber	taste	flavor
	Wet smoked Kong				
color	154	26	18	5	2
humidity ratio		34	17	5	8
caliber			30	1	3
taste				9	3
flavor				-	17
	Dried smoked Kong				
color	55				
humidity ratio	19	21			
caliber	16	17	20	-	-
taste	2	4	3	1	-

In spite of the humidity ratio, which makes different the two kind of smoked Kong, the color is determinant for the consumer choice.

From all actors interviewed, an increase of smoked Kong added value will be set on two attributes: caliber of the fish because more the fish is big and more the smoked Kong is plump. The second attribute will be in concern to the type of packaging. This last will help to improve the shelf life of product and bring additional guaranty of product security (absence of maggot, stabilization of Total Volatile Nitrogen (TVN) ratio for the wet smoked Kong; absence of mold and stabilization stabilisation of Total Volatile Nitrogen (TVN) ratio for the dried smoked Kong. However, additional criteria quality attributes' controls have been pointed out to really increase the added value of the smoked Kong.

Conclusion

Survey findings showed that colour, taste, flavor, humidity ratio and calibre are the main attributes used by the actors (processors, traders, and consumers) to appreciate the quality of wet smoked Kong and dried smoked Kong. But according to the product some quality attributes are more pronounced than other and can influence the selling prices. However most of the actors

need improvement on quality attributes by adequate packaging and storage conditions especially to wet smoked Kong and dried smoked Kong for increasing the shelf life.

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Lanhouin

Identification of quality attributes by survey

Part of

D 1.1.2.2: Survey results: quality attributes for Group 2

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Sommaire

Abstract

Lanhouin, a Beninese traditional fermented fish, is generally processed in rural and informal small scales plants. The activities are mainly carried out by illiterate women as the major actors. A large number of women are engaged in the production and the commercialisation of Lanhouin and this constitute for most of them the main source of income. High amounts of Lanhouin are produced due to high demand at national and regional level. The survey also revealed that different variants of technologies were used to produce Lanhouin but all the processing methods were developed at home and improvements were based on the observations of actors**.** The quality attributes used by processors as well as by traders and consumers are mainly based on observations through a number of sensory attributes such as the colour, texture, aroma, consistency of flesh and the general appearance of the product. Other attributes such as taste, absence of foreign matter were mentioned by some actors. The lack of packaging has also been pointed out by some consumers as a negative aspect for Lanhouin handling. For consumption, slimy sauce, vegetable sauce and tomato sauce are the most popular dishes containing Lanhouin with possible therapeutic effects.

Introduction

Fisheries play an important role in the social and economic lives of large numbers of people around the world, many of whom are among the poorest and most marginalized people in rural communities. In Benin, fisheries are a significant economic sector with annual production estimated at 7291 tons in 2008 for maritime fisheries (DP, 2009). Fisheries generate many employments such as fish harvesting, processing and trade.

However, post harvest losses of fresh fish are estimated to be about 20 % in West African countries (Horemans, 1998). While in developed countries the practice of cold storage limits the problem posed by the extreme perishability of fish, in tropical regions, particularly in West Africa, traditional processes such as drying, salting, smoking, fermentation and combinations of these treatments are used for fresh fish preservation (Laurent, 1981; Essuman, 1992; Anihouvi et al., 2005). Salted, fermented and sun dried fish is generally known as “fermented fish” (Beddows, 1985). Fermented fish is any fishery product, which has undergone degradative changes through microbiological and enzymatic activities either in

the presence or absence of salt**.** Lanhouin, a Beninese traditional fermented fish, is mostly used as taste enhancer and flavouring agent in many types of dishes including dishes of European origin. The major constraints faced with Lanhouin and Lanhouin-like products processing include the processing methods as well as the quality of the product (Sanni et al., 2002; Anihouvi et al, 2006).

The present field investigation work carried out through a survey conducted on actors of Lanhouin sector aims to give a better understanding on the processing technologies of Lanhouin, the raw materials and other ingredients used to produce Lanhouin, the definition of quality attributes according to the actors of Lanhouin sector, the different consumption forms of the product and the specific problems related to the processing, storage, and commercialization of Lanhouin.

1. Survey methodology

1.1. Choice of survey zones and sampling of surveyed actors

The survey was done in Grand-Popo municipality (Fig 1). The choice of this area is justified by the fact that Lanhouin is a specific condiment for Xwla and Mina ethnic groups who live in that area (Anihouvi et al., 2005). The choice of the survey zones was done according to a list established during a previous work. All the processing sites in the list were visited during a preliminary survey and then three districts in the municipality were selected according to their location (coastal zone) and the main activity done in the zone (lanhouin production as major activity). Actors sample size was set according to Dagnelie (1998) as described by Chadare et al. (2008). In the different selected districts in Grand-Popo municipality, the proportion of actors was assessed through a random-check on 534 people (140 processors, 138 traders and 256 consumers) (Table 1).

1.2. Data collection

The survey was conducted on Lanhouin processors, traders and consumers in Grand-Popo municipality from 10th March to 10th April 2011. The survey was in the form of interviews administered through a questionnaire as well as observations of the processors at work. A preliminary survey was conducted in order to identify production sites and pre-test the questionnaire. Interviews were conducted in French and local languages (Xwla, Mina and

Pedah). A total of 534 persons (140 processors, 138 traders, 256 consumers), from different ethnic groups and localities, and both genders at various ages (young, adult, old) randomly selected were effectively interviewed on the consumption of Lanhouin, 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 Lanhouin sector.

1.3. Data processing and analyses

The collected data were recorded and statistical analyses were performed using Sphinx survey plus[2] (version 4.5) software.

Table 1: Survey logistics

Area surveyed	Total number of actors surveyed	Numbers of actors surveyed		
		Number of producers	Number of traders	Number of consumers
Agoué	275	57	53	165
Avloh	78	24	25	29
Grand Popo	105	52	10	43
Comé market	19	0	14	5
Djodah market	41	7	20	14
Anèho market	16	0	16	0
Total	534	140	138	256

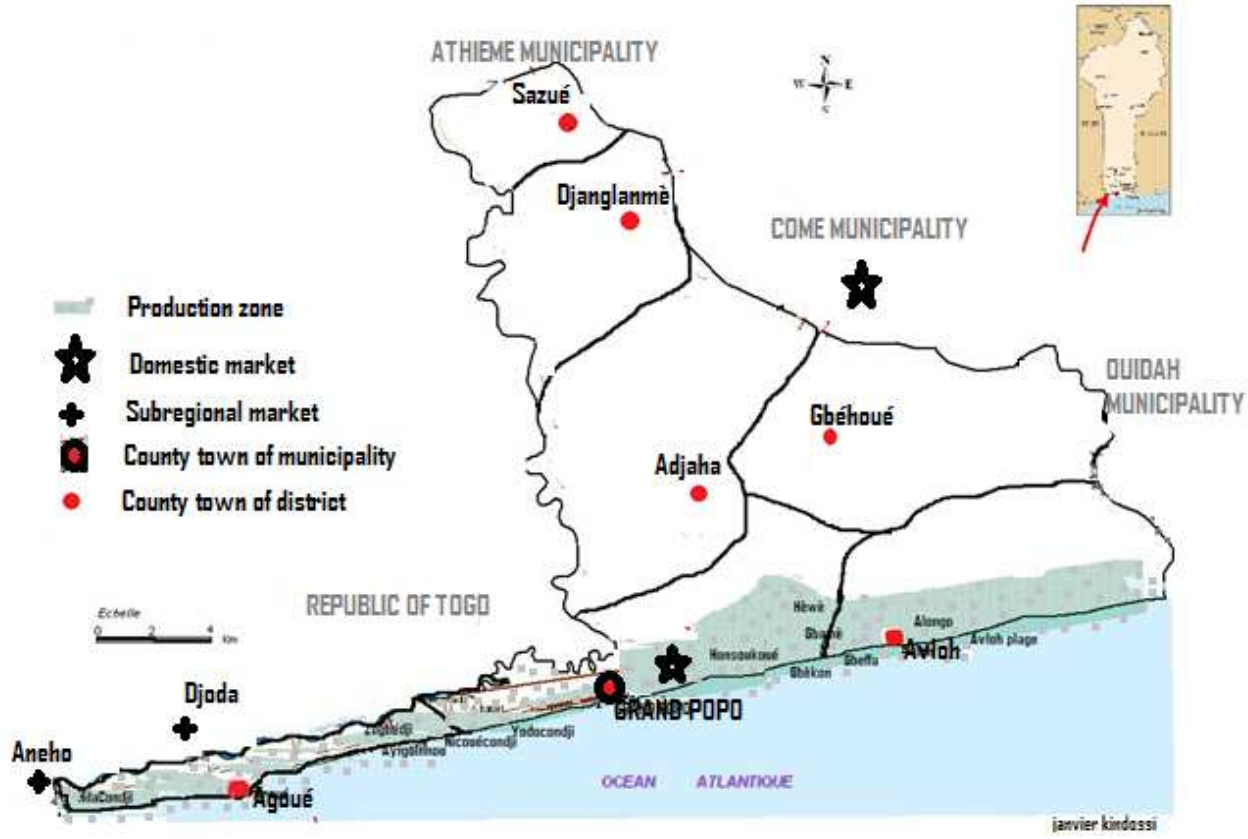

Fig 1: Survey zones including production zones and markets

2. Results

2.1. Production

2.1.1. Processor profile (socio-cultural characteristics)

All the one hundred and forty (140) processors interviewed were female aged between 25 and 65 years (Fig.2). The majority of them (99.3 %) is married with fishermen or has family relationship with them. In general, they have a low educational level. Most of them (61.4 %) had no formal education; 32.1 % had primary education and very small number of them (6.4 %) had secondary education. The production of Lanhouin in Grand Popo municipality is mainly done by heiress (88.6 %) and those (11.4 %) who received the knowledge from their friends. The main ethnic groups involved in the production of Lanhouin in the survey zones are: Keta (42.1%), Mina (36.4 %), Xwla (17.1 %), Pedah (1.4 %) and a very few numbers (2.8 %) of Fon and Adja.

For 91.4 % of them, the production of Lanhouin constitutes their main source of income. All the processors interviewed (100 %) produced fermented and sun dried Lanhouin, some of them (87.1%) produced fermented and non dried Lanhouin which is mainly sold to wholesaler and a very small number (1.4 %) produced Lanhouin zodéké (non dried Lanhouin fermented for 24 h) mainly during scarcity periods (claimed by 66.7 % of them) or to make more money (claimed by 33.3 % of them). Fifty one point seven percent (51.7 %) of processors interviewed claimed that the production of Lanhouin depends on the availability of fish and for 97.1 % of them, this constitutes a method of preservation of fresh fish, whilst 7.8 % of them mentioned that the processing of Lanhouin is a valorised form of rotting fishes. Other names of Lanhouin mentioned by the processors interviewed are: Lanhouinhouin or Lanpipi (claimed by 70.7 % of respondents), Yaya (claimed by 48.6 % of respondents) and Landodjè (claimed by 44.3 % of respondents).

Three categories of processors were identified: the large scale processors (41.4 %) who produce between 300 and 3000 kg of Lanhouin or more per month, the medium scale processors (22.9 %) who produce between 75 and 300 kg of Lanhouin per month and the small scale processors (33.6 %) who produce less than 75 kg of Lanhouin per month (Fig.3).

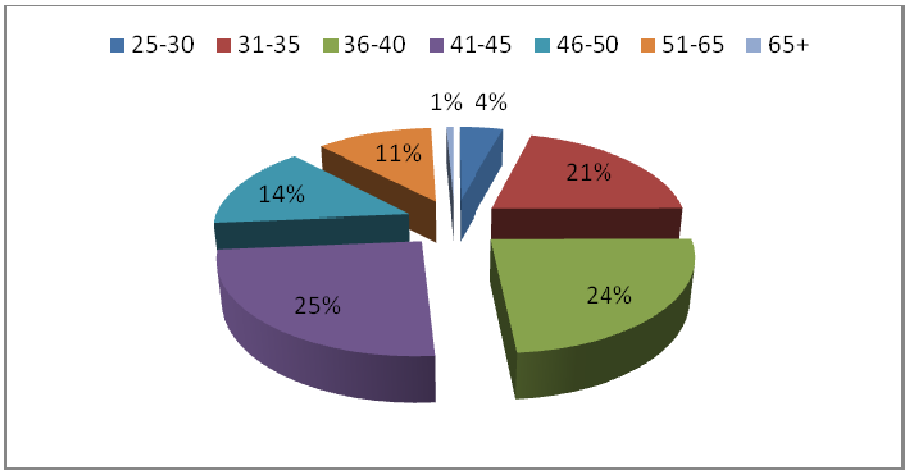

Fig. 2: Percentage of distribution of processors according to age

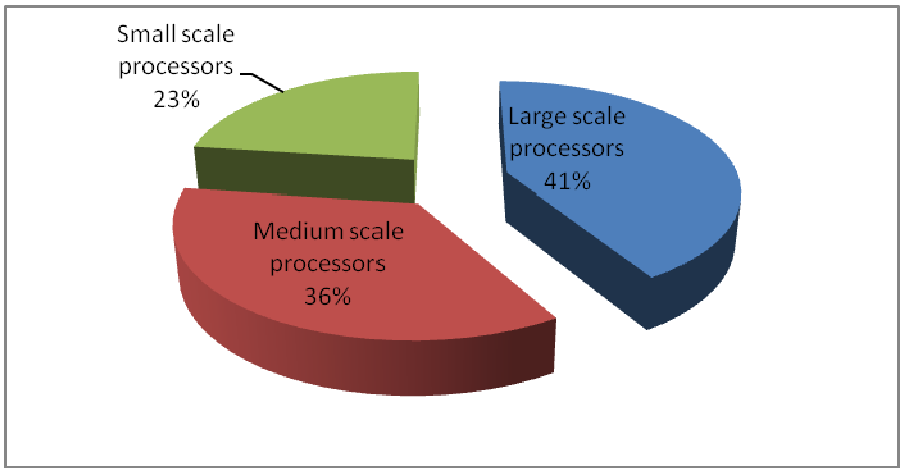

Fig.3: Categories of processors involving in Lanhouin production

2.1.2. Raw materials and other ingredient used

All the processors interviewed (100 %) claimed that they only used fresh sea fish and salt as the main raw materials for Lanhouin processing. However, products such as petroleum, insecticides and peel of lemon were used by 39.3 %, 10.0 % and 4.9 % of the processors respectively, in order to protect the product from flies and maggots infestation during drying step and storage period. According to the processors, different types of fish and different types of salt are used for Lanhouin processing. The fishes are generally bought at the beach from the fishermen; the salt and other ingredients are purchased on the production site or in the markets.

Fish

The survey showed that different types of sea fish are used for lanhouin processing and those indicated by the processors are showed in Table 2. The majority (95.0 %) of processors claimed that they mostly used Cassava croaker (*Pseudotolithus senegalensis*); this is followed by Lasser African threadfin (*Galeoides decadactylus*) (claimed by 88.6 %), Atlantic bumper (*Chloroscombrus chrysurus*) (claimed by 87.9 %), kingfish/Spanish mackerel (*Scomberomorus tritor*) (claimed by 81.4 %) and Crevalle jack (*Caranx hyppos*) (claimed by 77.1 %). In contrast, some of the processors (5.1 %) said they used all kind of fish to produce Lanhouin because they do not have adequate conditions to preserve the fresh fish.

About the quality criteria of fresh fish, the majority (97.6%) of processors interviewed claimed that they liked to use lean fish, because for lean fish a little amount of salt is needed while fatty fish usually needed more salt to produce the same amount of Lanhouin. However, 66.0 % of processors mentioned that Lanhouin produced with fatty fishes is sold more expensive than the one obtained from lean fish.

Considering the variation of the price of fish, most of processors (69.7-86.1 %) mentioned that the price of fish is constant from December to February; and it increases from March to July (60.9-81.7 %) and followed down from September to November (45.7-80.1 %) (Fig.4).

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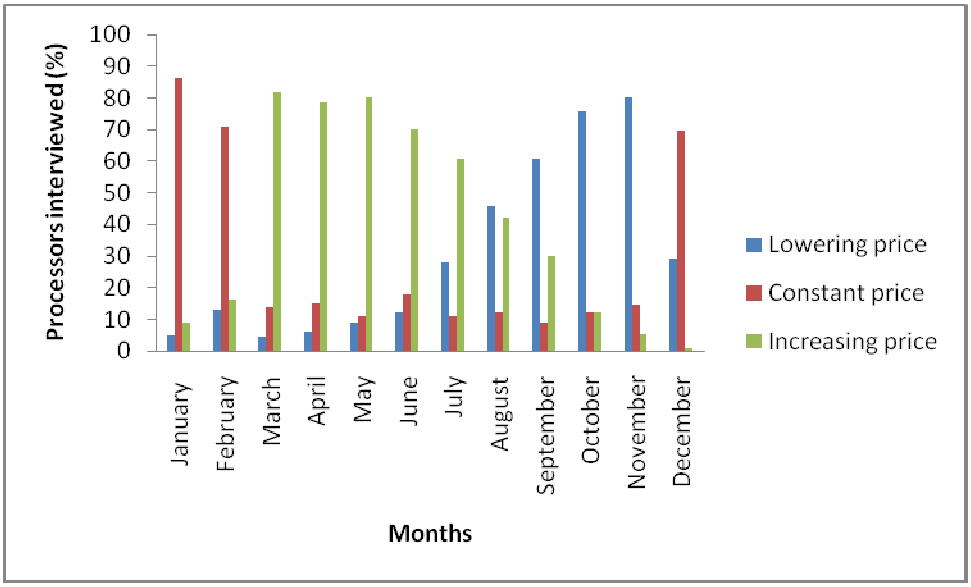

Fig 4 : Variation of purchase price of fish during the year

Table 2: Types of fish commonly used in Benin for lanhouin processing

Local names	**Common names**	**Scientific names**
Agbanmadoui/Zadoui	Kingfish/spanish mackerel	*Scomberomorus tritor*
Ahouê	Boga shad	*Athmalosa fimbriata*
Ekan/djoke	Cassava croaker	*Pseudotolithus senegalensis*
Fiovi	Senegal jack	*Caranx senegallus*
Finvi	Blackmouth croaker	*Pentheroscion mbizi*
Fohomê	Wide-eyed founder	*Bothus podas africanus*
Gbohloué	Milk shark	*Rhizoprionodon acutus*
Glanmatan/kobi	Longfin pompano	*Trachinotus goreensis*
Guinfio/guinlonou	Royal treadfin	*Pentanemus quinquarius*
Handjè	Goean snapper	*Lutjanus goreensis*
Hawui	Bigeye grunt	*Brachydenteus auritus*
Kanflanvi	West African ilisha	*Ilisha africana*
Kokouin	Bastard grunt	*Pomadasys incisus*
Kpankpan	Crevalle jack	*Caranx hippos*
Kplouloui	Atlantic rubyfish	*Erythrocles monodi*
Lipa	Largehead hairtail	*Trichiurus lepturus*
Lizi	Guachanche barracuda	*Sphyraena guachancho*
Manvi	Sardinella	*Sardinella aurita*
Oloto	Flying gurnard	*Cephalacanthus volitans*
Oungogba	African moonfish	*Selene dorsalis*
Sika-sika	Congo dentex	*Dentex canariensis*
Sinkplin	Round scad	*Decapterus punctatus*
Tchikoué	Lasser african threadfin	*Galeoides decadactylus*
Tchochovi	Guinea croaker	*Pseudotolithus epipercus*

Local names	Common names	Scientific names
Zozrovi	Atlantic bumper	*Chloroscombrus chrysurus*

Salt

According to the processors, two types of salt are used for lanhouin processing: the solar salt obtained from lagoon or sea water (used by 87.9% of processors interviewed) and the imported salt (used by 12.1 % of processors). Considering the most important criteria used to appreciate the quality of salt, 86.5 % of processors interviewed mentioned the salt should be a coarse salt and its colour should be white (claimed by 88.6% of respondents) while for 11.5% of them the colour should be russet red. The Fig.5 shows the variation of the purchase price of salt during the year. Most of processors (59.5-75.8 %) mentioned that the price of salt is constant from September to December, decreases from January to April (57.3-84.1 %) and then increases from may to august (48.4-78.1 %).

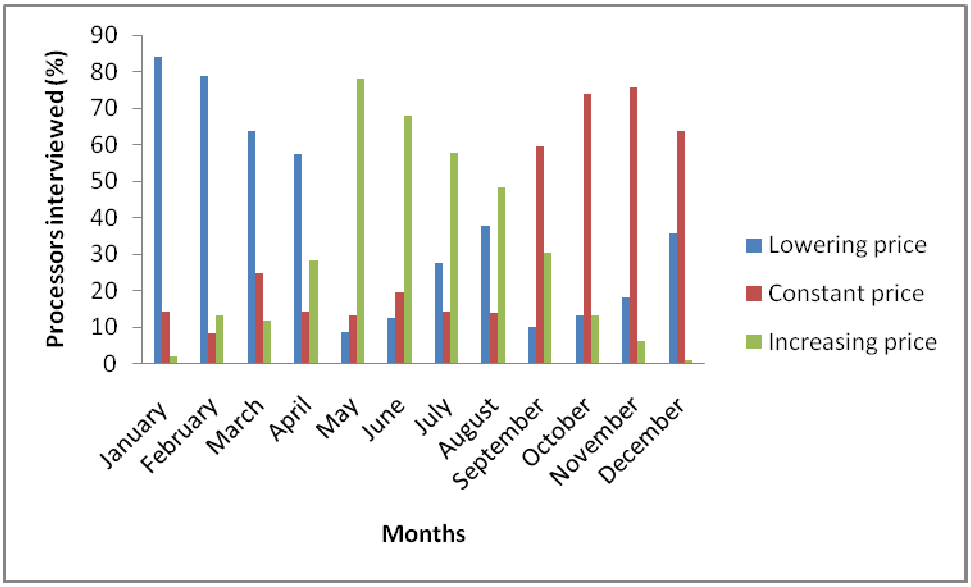

Fig.5 : Variation of purchase price of salt during the year

Other ingredients

Three different types of products (petroleum, mixture of insecticides or mixture of petroleum and insecticide), and peel of lemon are used as ingredient. Some of the processors interviewed (49.3%) claimed that they put some drop of petroleum or a mixture of petroleum and insecticide into the water used to rinse the fermented fish before the drying step. Some of them (10 %) sprayed the salt with the petroleum or the mixture of petroleum and insecticides before the salting in order to prevent the fish from blowfly and maggots infestation. Peel of lemon is also used by other processors (4.9 %) due to its gasoline which can prevent Lanhouin from maggot infestation.

2.1.3. Processing of fresh fish into Lanhouin

All the processors (100%) interviewed claimed that the processing of fish into Lanhouin is a very laborious and time consuming process. For 97.4 % of them, the fish is collected in a basket or a bowl after buying and covered with old clothes for transportation to the processing sites. According to the processors interviewed, the transportation is done by foot (96.4 %), by motor bike (8.6 %) or by car (1.4 %).

According to 91.4 % of processors, Lanhouin should be processed with fresh fish; however 7.8 % of them mentioned that rotting fish can also be used but in that case the ripening step is no more applied (Fig 6). For Lanhouin processing the fresh fish is scaled, gutted using a knife or scissors and then arranged in a bowl, a basket, a basket lined with cement, a can, a jar or a plastic barrel, then covered with old cleaned clothes, and left at ambient temperature for ripening during 11-24 h (Table 3). The ripened fish is then washed and arranged in basket for draining. Dry salt is rubbed into the gills, the belly cavity and on the surface. After this step, three (3) variants were observed for the fermentation step: fermentation in aerobic condition using basket as fermentation material (observed with 50% of processors interviewed), fermentation in semi aerobic condition using a basket lined with cement, a can, jar or a plastic barrel as fermentation material (observed with 51% of processors interviewed) and fermentation in anaerobic condition, for which the fish is buried in the ground (observed with 17.2 % of processors interviewed). Thus, through this survey it appeared that the fermentation in semi-aerobic condition, followed by the fermentation in aerobic condition are the two mainly processing techniques used by the processors interviewed.

For the fermentation in aerobic condition, the ripened and salted fish is arranged in a basket and covered with cleaned old clothes and allowed to ferment at room temperature for minimum of 3 days and maximum of 8-9 days. Sometimes a second salting is done at the first two days of fermentation and fermentation allowed to progress until the last day before sun drying step.

For the fermentation in semi aerobic condition the ripened and salted fish is arranged in a can, a tank, a jar, a basket lined with cement or a plastic barrel and allowed to ferment at room temperature for minimum of 3-4 days and maximum of 8-9 days.

Sometimes, the ripened and salted fish is immersed in a can, a tank, a jar, a basket lined with cement or a plastic barrel containing the exudates obtained from a previous fermentation and allowed to ferment at room temperature during the same fermentation time.

Concerning the fermentation in anaerobic condition, the ripened and salted is arranged in a jute sack and buried in a 2 meters depth hole and allowed to ferment for a minimum of 15-16 days and a maximum of 25-30 days.

At the end of fermentation, the fermented fish is removed, rinsed with water and with or without some drops of petroleum or a mixture of insecticide and petroleum or a mixture of insecticide, and sun dried on a flat basket (Photo 2), a mat, drying bed (terrace, Photo 2), a cloth spread on the ground, a drying hangar (Photo 2) for minimum of 1 day and maximum of 2 days. Then the fermented and dried fish, Lanhouin is packaged in a basket lined with old cleaned clothes or cement papers, in jute bag and attached with an old fishing net. In general, for the three types of fermentation (aerobic, semi-aerobic and anaerobic conditions) when rotting fish is used as raw material, the fish is directly salted and allowed to ferment (claimed by 11.4 % of processors)

Considering the amount of Lanhouin processed, per production, the large scale processors produce 20-188 kg, while the medium scale and the small scale processors

Photo 1: Various materials used in Lanhouin processing

Photo 2: Sun drying of Lanhouin

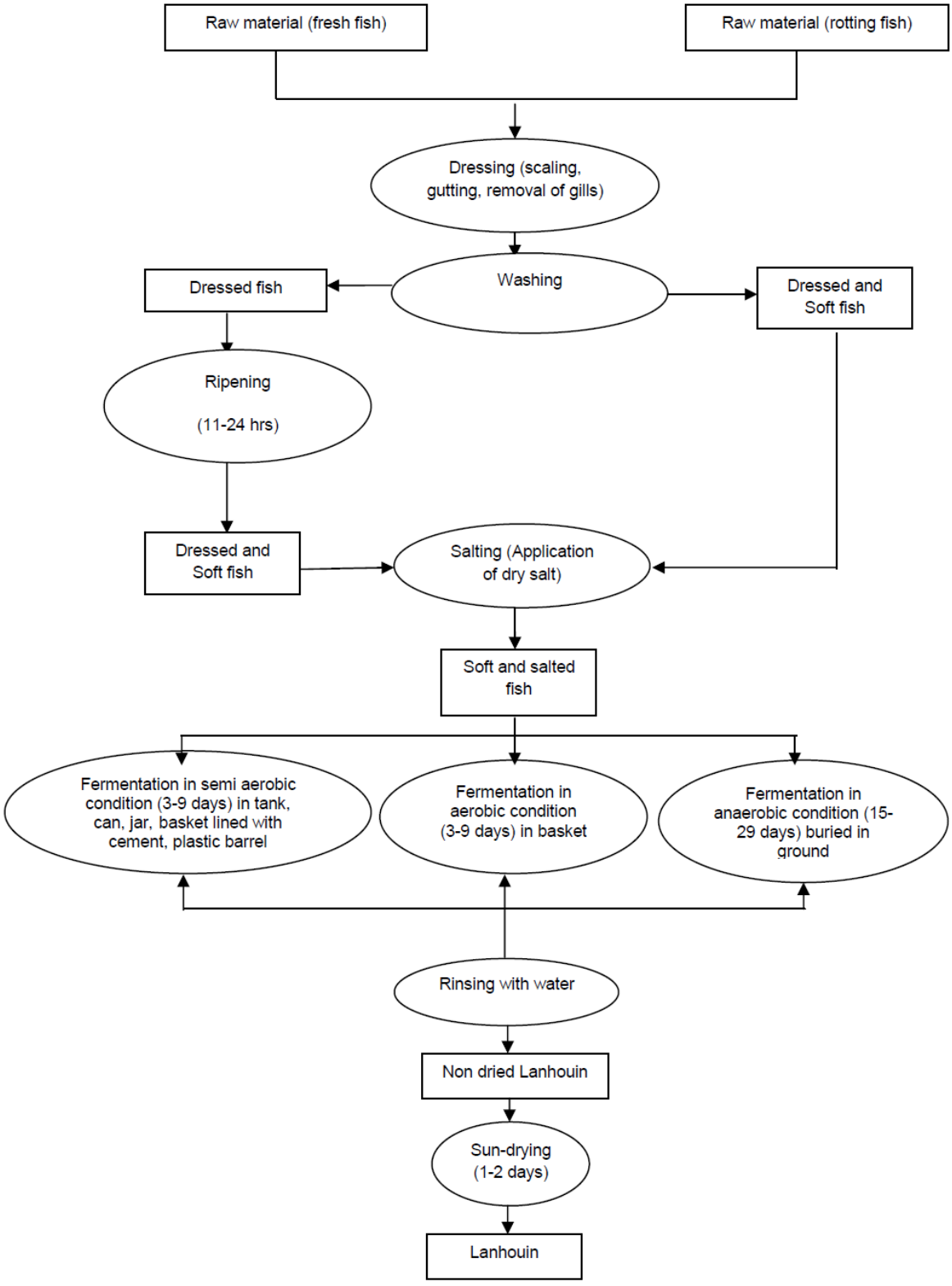

Fig.6: Flow diagram of Lanhouin processing

Table 3: 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
Fresh fish						
Washing	Elimination of foreign matter	Bowl, basket, can	unknown	(2 -5) females	Washed fish	
Dressing (Scaling, gutting)	Elimination of scale and viscera	Knife, scissors, bowl, basket, flat basket	unknown	(2 -5) females	Dressed fish	
Dressed fish						
Ripening (h)	Softening of fish tissue due to enzymatic and microbial activities	Basket, bowl, cloths, can, jar, basket lined with cement, plastic barrel	11-24 h	(2 -5) females	Soft fish	Soft texture
Soft fish						
Washing	Elimination of foreign matter and sticky aspect on the skin	Bowl, basket, can ,	unknown	(2 -5) females	Washed Soft fish	Soft texture, clean
Salting	Reduction of water content and microbial growth	Basket, can, bowl, basket lined with cement	unknown	(2 -5) females	Salted fish	
Salted fish						
Fermentation	Partial degradation of fish tissue through enzymatic and	Basket, cloths, heavy stones, tank, basket with cement layer, can, plastic barrel, jar, hoe, hole,	aerobic condition (3 -9days) semi aerobic condition (4- 9 days) anaerobic condition	(2 -5) females (1-2) males	Fermented fish	Soft texture / limp and spongy Consistency of flesh, Strong and non repugnant

	microbial activities	jute bag	15- 30 days			aroma
Fermented fish						
Rinsing	Reduction of salt content Elimination of foreign matter and sticky aspect on the skin	Bowl, basket, can	Unknown	(2 -5) females	Fermented fish	
Sun-drying	Reduction of water content	Flat basket, mat, drying bed (terrace), cloth spread on the ground, drying	1-2 days	(2 -5) females	Lanhouin	Soft texture / limp and spongy Consistency of flesh, Strong aroma , Bright, shining colour
Packaging		clothes, basket, jute bags, fishing net	unknown	(2 -5) females	packaged product	

2.1.4. Quality attributes of intermediate products and Lanhouin

The quality criteria used to appreciate the intermediate products (ripened fish and non dried Lanhouin) and the end product Lanhouin are seem to be the same. Thus, 97.1 % of interviewed processors claimed that a good ripened fish should have a soft texture and firm flesh; in the same way, a good non dried Lanhouin should have the similar texture. For dried Lanhouin most of processors (72.1 %), traders (71.7%) and consumers (97.3 %) interviewed claimed that a good Lanhouin should be bright and shining in terms of colour to be attractive. About 74.3 % of processors and 38.7 % of interviewed consumers responded that a good lanhouin should have strong aroma but not repugnant while 22.5 % of interviewed traders asserted that a good lanhouin should have a strong aroma. These results showed that for consumers and traders, the aroma is not important as criteria because most of consumers interviewed (61.3 %) and traders (77.5%) did not give their opinion about it. Around 85.7 % of processors, 86.2 % of traders and 98.0 % of consumers interviewed claimed that a good Lanhouin should have a soft texture, firm and spongy flesh for good dispersion in the dishes. In addition, the majority (86.2%) of traders said that the flesh of a good lanhouin should be lightly hard for long preservation. Moreover, 75.0 % of interviewed consumers and 23.2 % of traders insisted that Lanhouin should be free from dead flies and maggots (larvae) to be safe for consumption. Other attributes such taste (claimed by 38.7 % of consumers), absence of foreign matter (claimed by 67.6% of consumers) were mentioned by some actors. The lack of packaging has also been evoked.

2.1.5. Knowledge on ripening and fermentation

Considering the fermentation time, most of processors (80.0 %) claimed that the fermentation time varied with the types of fish and the state of fresh fish used. Then they asserted that the fermentation time is longer with fatty fish and big fish. In contrast, for 90.3 % of them there is no relationship between the fermentation time and the amount of salt used the quality of the salt and a particular period of the year. For 92.9 % of processors interviewed the end of ripening period of fish is known by the whitish colour of the gills and its soft texture appreciated through the suppleness of the fish body or when they press the flesh with their fingers or when they heard a noise when they put the ripened fish in longitudinal position For

the end of fermentation, most of processors (88.6 %) mentioned that the fermented fish presents soft texture but with more consistent flesh and strong aroma.

2.1.6. Important operations and problems faced and need for improvement

About 88.6 % of processors interviewed mentioned that the bad execution of ripening and salting would have a negative effect on the quality of lanhouin, on both sensorial and hygienic aspects (a hard texture of the end product, and presence of maggots in the product). Also 83.6 % of them claimed that dressing, washing, ripening and salting seemed to be the most difficult operations (time consuming operations). In addition, dressing, washing and salting can cause injury to them (claimed by 82.3 %) from the spine of the fish. Some processors (36.4 %) suggested the consumption of milk for the odour during the ripening operation. Most of processors interviewed (72.9 %) also indicated that the presence of maggots (larvae) in the ripened fish and the final product is a big quality problems they faced. In addition, 43.6 % of processors claimed that sometimes the colour of Lanhouin became dark and they attributed this to a bad drying process (Table 4).

Other problems faced by the processors are the difficulty for fish supply (claimed by 16.6 %); some of them mentioned they had head ??? ache (claimed by 55.7 %) and general tiredness (claimed by 60.7 %). About 78.5 % of them said that they need training and cooperation for the improvement of the processing method and a good packaging for the end product. The majority of them (92.1 %) do not make any suggestion about the improvement of the equipment they use, but 62.1 % wish to have a credit which can allow them to continue the production of Lanhouin in good condition.

According to 96.4 % of processors, the exudates (liquid coming out from the fish due to the salt) obtained from the fish during the fermentation is thrown or buried in a hole. Small numbers of them (3.6 %) used it to prepare sauces.

2.1.7. Selling price of Lanhouin

The selling price of Lanhouin depends on purchase price of raw materials (claimed by 71.4 % of respondents) and the scarcity period (27.1 % of respondents). According to 90.7 % of processors interviewed, the added value of Lanhouin is related to the quality attributes such

as the soft texture, the spongy consistency and the bright shining colour of the flesh. Most of processors interviewed (80.7 %) mentioned that the market demand is high to serve inside markets (home market, Comé market) and outside markets (Aneho market, Djoda market). Considering the variation of the selling price of lanhouin, most of processors (69.7-86.1 %) indicated that the selling price of lanhouin is constant from December to February, increased from March to July (60.9-81.7 %) and followed down from August to November (45.7-80.1 %) (Fig.5).

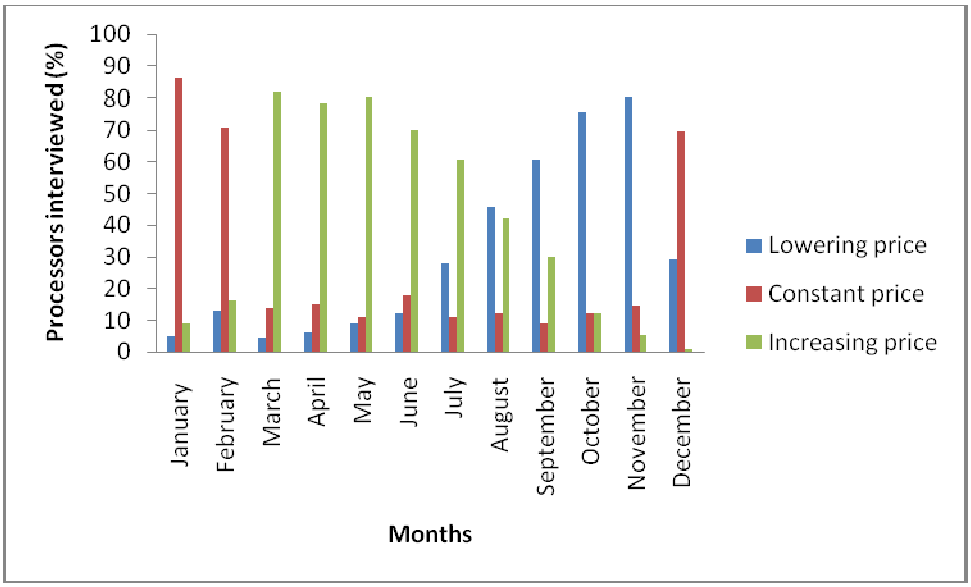

Fig.5 : Variation of selling price of lanhouin during the year according to processors interviewed

2.1.8. Preservation

The major problem in relation with the storage is the spoilage of lanhouin (68.8 % of respondents) due to presence of maggot and other types of insects in the product, and this because of the lack of appropriate packaging material. To reduce the consequences of this of problem, most of processors (88.6 %) packaged the product in cement paper and some of them (29.3 %) sprayed the packaging materials (basket, clothes etc..) with petroleum or insecticide or a mixture of petroleum and insecticide before packaging.

About the duration of storage of Lanhouin 67.0 % of large scale processors interviewed stipulated that the dried Lanhouin could be stored for 75-120 days while the non dried Lanhouin could be stored for 90 -180 days (claimed by 62.1% of them).

Table 4: 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
Ripening fish	Soft texture and spongy Consistency of flesh	Presence of maggots	Washing Peel of lemon
Non dried lanhouin	Soft texture and spongy Consistency of flesh, Bright and shining colour Strong aroma	Presence of maggots	Used of high quantity of salt Used of petroleum or mixture of insecticide or mixture of insecticide and petroleum Peel of lemon
Dried lanhouin	Soft texture and spongy Consistency of flesh, Bright and shining colour, Strong aroma	Presence of maggots, Dark colour	Used of petroleum or mixture of insecticide or mixture of petroleum and insecticide Peel of lemon Adequate drying process

2.2. Commercialisation

2.2.1. Traders profile

One hundred thirty eight 138 traders (30.6 % of wholesalers, 47.7 % intermediate sellers and 21.7 % of retailers) were interviewed during the survey (Fig.7). Both gender comprising 96.4 % of female traders and 3.6 % of male was interviewed. Most of them are aged between 20 and 65 years old (Fig 8). The trade is done by different ethnic groups including, Mina (38 %),

Keta (33 %), Xwla (12.3 %), Pedah (10.1%) and by few numbers of Saxwè (2.9 %), Haoussa (2.2), Adja (1.4 %), Watchi (1.4 %) and Fon (0.7 %), (Fig.9). Most of them (96.4 %) commercialized mainly dried Lanhouin followed by Lanhouin zodéké (claimed by 22.5 %) and non dried lanhouin (claimed by 12.3 %).

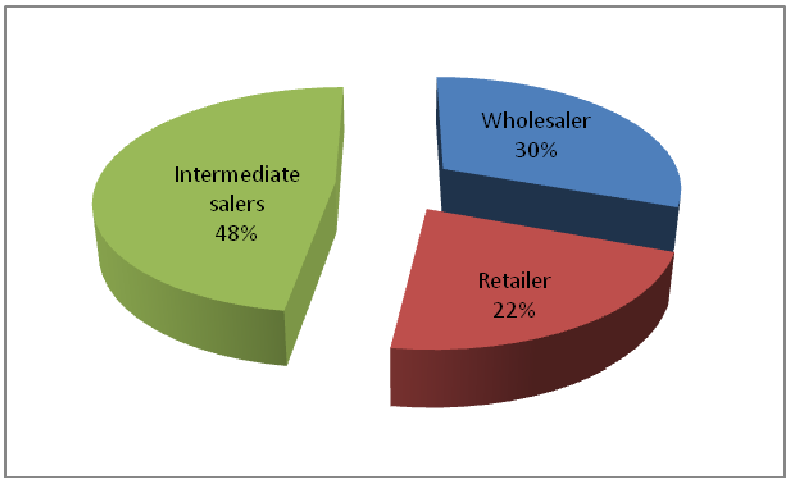

Fig. 7 : Categorie of traders involving in Lanhouin commercialisation

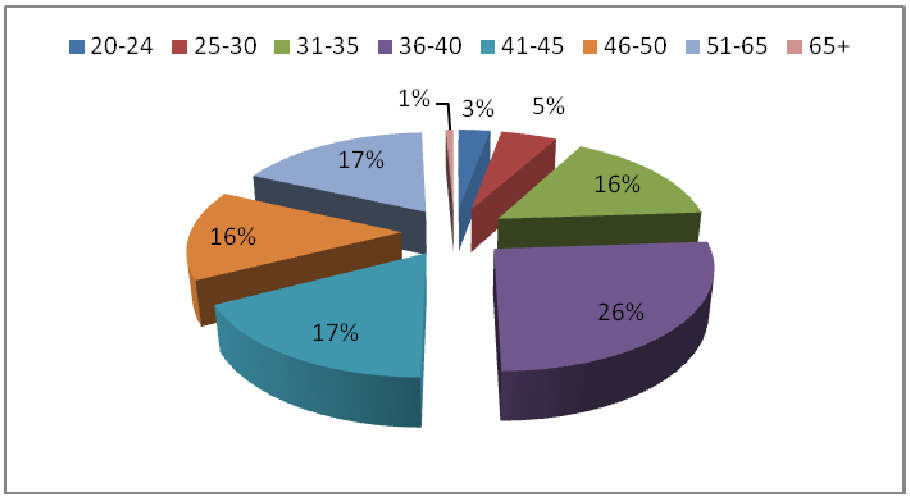

Fig.8 : Percentage distribution of traders age

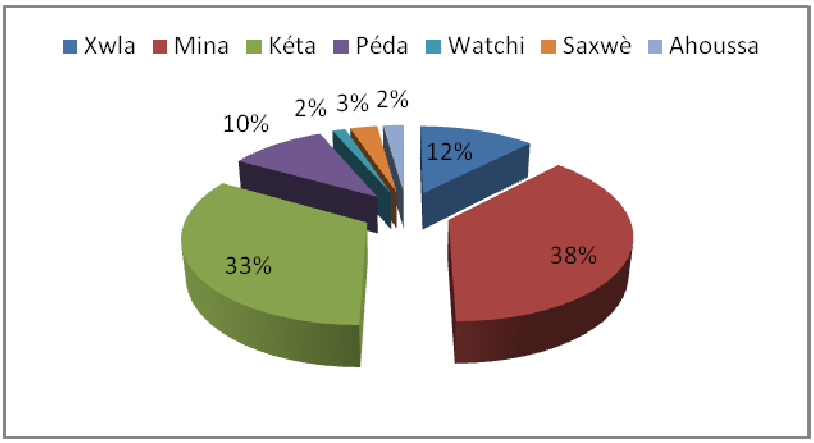

Fig 9 : Different ethnic groups involved in lanhouin conmmercialisation

2.2.2. Problems related to lanhouin commercialization

A number of problems related to the commercialization of lanhouin are evoked by the traders interviewed. These include slumps in sale (68.8%) mainly during the plenty period (claimed by 21.0 % of processors); consequently the product is sold under the normal price (claimed by 61.0 % of them). Another problem evoked is the competitivity with a type of Lanhouin called Lanhouin Dakar imported from Senegal (claimed by 22.4 % of processors) and non suitable place for sale (17.2) because they sell under the sun. Some suggestions concerning those problems evoked were enumerated such as the regulation of the production and pricing (claimed by 18.1 %); in addition 50.8 % of them claimed they have confidence that there will be a change; the lack of training is also evoked by them.

2.2.3. Preservation and storage period

Most of traders interviewed (65.2 %) claimed that they packed Lanhouin in clothes or in cement paper and jute sack (21.7 %). Some of them said that they sprayed loincloth and basket with petroleum (18.1 %) or with pesticide (3.6 %) to protect the product from insects infestation. About 70.3% of wholesalers claimed that the storage duration of Lanhouin varied between 45 and 80 days for the dried one, and 60-100 days for the non dried Lanhouin (claimed by 62%).

2.2.4. Quantity and variation of the selling price of lanhouin

Three categories of traders were distinguished such as Wholesalers (30.6 %) who buy (221-4160) kg or more of lanhouin from processors for (221 000-4 160 000) FCFA or more and sell it for (411 000-7 771 000) FCFA[1] or more per month, intermediate sellers (47.7 %) who buy (110-220) kg of lanhouin from processors and wholesalers for (110 000-220 000) FCFA and sell it for (170 000-400 000) FCFA per month, and retailers (21.7%) buy (40-60) kg of lanhouin for (40 000 – 60000) FCFA and sell for (45 000- 73 000) FCFA per month.

Considering the variation of the selling price of lanhouin, most traders (63-84 %) mentioned that the selling price of lanhouin is constant from December to February; increase from March to July (57.9-80.1 %) and fall down from August to November (42.6-78.2 %). Concerning the classes of the population who buy lanhouin, the majority of traders interviewed (92.4 %, 97.3% and 99.3 %) mentioned they sold Lanhouin to household with high income, household with low income and household with intermediate income respectively.

[1] 655.96 FCFA = 1 euro

Table 5: Problems experienced during commercialisation

Intermediate and final products	Problems experienced in commercialisation	Detailed description of the problem	Proposed solution for this problem
Non dried Lanhouin	Slump in sale	Plenty period	Regulation of the production
	Lack of suitable place for sale	Sale under the sun	Building of hangar at selling place
Dried Lanhouin	Slump in sale	Plenty period	Regulation of the production
	Competition	Sale at a loss	Pricing
	Non suitable place for sale	Sale under the sun	Building of hangar at selling place
	Attack with insects		

2.3. Consumption

2.3.1. Consumer profile

A total of 256 consumers were interviewed during the survey: 69.5 % of female and 30.5 % of male (Fig.10). Most of them (99.3%) were aged between 20 and 65 years. Different ethnic groups such as Mina (41.8 %), Keta (22.7 %), Xwla (16.4 %), Fon (7.4 %), Pedah (4.7 %), Adja (2.0 %), Saxwè (2.7 %), Wama (0.8 %) and Watchi (1.6 %) were interviewed during the survey. According to traders, classes of the population who consume dishes containing Lanhouin include housewife (1.2-37.3 %), trader (1.2-37.6 %), craftsman (1.3-37.7%) and public servant (1.2-37.7%).

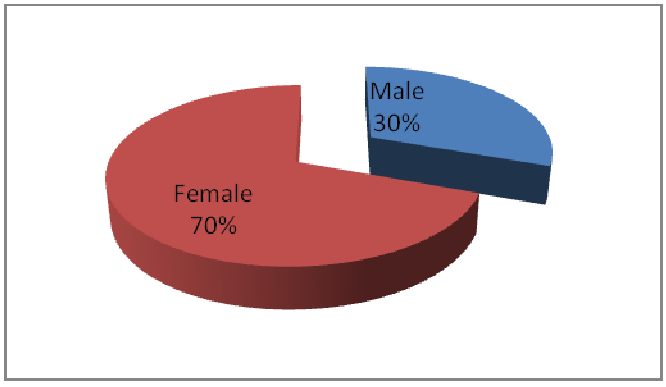

Fig.10 : Consumers profile according to the gender

2.3.2. Consumer attitudes towards dishes containing lanhouin

Table 6 gives consumers attitudes towards dishes containing Lanhouin. For most of consumers interviewed, Lanhouin is used as condiment to season some dishes such as slimy sauce (okra, crincrin and seed of gabonensis Irvingia) (claimed by 98.4 %), vegetable sauce (gbékoui, avouvo, gboma) (63.7 %), tomato sauce ("Agbanmèdessi", sauce of palm seed) (53.1 %), no cooked tomato sauce "yégbésséssi", "monyo" (29.3 %), fried rice (7.4 %), stew (5.5 %), sauce of sesame "egussi" or sauce of groundnut (3.1 %). About the frequency of consumption of these dishes containing Lanhouin, most consumers eat slimy sauce (13.7-51.8 %), vegetable sauce (12.8-34.3 %), tomato sauce (11.4-43.6 %), non cooked tomato sauce (7.5-18.8 %), fried rice (1.8- 5.1 %) stew (1.1-5.1 %), sauce of sesame or sauce of groundnut (0.9-1.4 %) one or more times per week. All these dishes containing Lanhouin are eaten at breakfast (1.8-35.3%), lunch (1.2-37.6 %), at dinner (1.3-37.7 %), between meals (2.6-39.5 %).

Most of consumers (5.9-52.9 %) eat dishes containing lanhouin at funerary ceremonies followed by other types of festivities (6.3-50 %), at home (1.2-37.6 %), from street food (1.2-33.7%), restaurants (2.4-33.3 %) and abroad (Togo, Ghana) (14.3-28.6 %).

2.3.3. Therapeutic effects of Lanhouin

For the possible therapeutic effects due to the consumption of dishes containing Lanhouin, 71.9 % of consumers said they don't know any virtue related to Lanhouin consumption while 28.1 % of them claimed that the consumption of dishes containing Lanhouin had therapeutic effects. According to 14.3-52.1 % of consumers the consumption of dishes containing Lanhouin regularize blood pressure, prevent heart attack (1.4-14.3 %), give appetite (22.9-33.3 %), make easy the digestion (12.6-42.9 %) and eliminate the apparition of abscess (10.4-11.3 %).

Table 6: Consumer attitudes towards dishes containing Lanhouin

Question/Observation	Consumer response (%)						
Dishes containing lanhouin	slimy Sauce (okra, crincrin, seed of *gabonensis Irvingia*)	vegetable Sauce (gbékoui. avouvo. gboma)	Tomato sauce (agbanmèdessi. sauce of palm seed)	Non cooked tomato Sauce (yégbéssési. monyo)	Fried rice	Stew	Sauce of sesame (egussi) or sauce of groundnut
Dishes containing lanhouin	98.4	63.7	53.1	29.3	7.4	5.5	3.1
Frequency of consumption of dishes containing lanhouin							
6-7 times per week	20.5	12.8	43.6	12.8	5.1	5.1	0.0
4-5 times per week	13.7	21.4	40.2	18.8	2.6	2.6	0.9
2-3 times per week	51.8	25.0	11.4	7.5	1.8	1.1	1.4
1 times per week	36.4	34.3	12.9	11.4	4.3	0.0	0.7
Rarely/ Never	41.4	25.9	5.2	15.5	1.7	6.9	3.4
Occasion/moment of consumption of dishes containing lanhouin							
Breakfast	35.3	24.4	23.5	10.9	2.3	1.8	1.8
Lunch	37.6	25.1	20.4	11.5	2.5	1.6	1.2
Dinner	37.7	25.0	20.8	11.1	2.5	1.7	1.3
Between meal	39.5	15.8	21.1	10.5	2.6	7.9	2.6
Consumption place of dishes containing lanhouin							
At home	37.6	25.0	20.2	11.5	2.5	1.9	1.2
From a street food saleswoman	33.7	25.4	18.9	14.8	1.2	3.6	2.4
Restaurants	33.3	28.6	19.0	9.5	4.8	2.4	2.4
Aboard	28.6	28.6	28.6	14.3	0.0	0.0	0.0
At ceremony of festivities	50.0	25.0	18.8	6.3	0.0	0.0	0.0
At funerary ceremony	52.9	23.50	17.6	5.9	0.0	0.0	0.0

Question/Observation	Consumer response (%)						
Dishes containing lanhouin	slimy Sauce (okra, crincrin, seed of *gabonensis Irvingia*)	vegetable Sauce (gbékoui. avouvo. gboma)	Tomato sauce (agbanmèdessi. sauce of palm seed)	Non cooked tomato Sauce (yégbéssési. monyo)	Fried rice	Stew	Sauce of sesame (egussi) or sauce of groundnut
Possible therapeutic effects of consumption of dishes containing Lanhouin							
Blood pressure	47.3	49.1	52.1	52.1	33.3	33.3	14.3
Heart attack	1.4	1.9	2.1	3.3	11.1	10.0	14.3
Give an appetite	23.0	24.5	22.9	23.3	33.3	30.0	28.6
Regular consumption eliminate of the apparition of abscess	10.8	11.3	10.4	0.0	0.0	0.0	0.0
Easy digestion	17.6	13.2	12.6	16.7	22.2	20.0	42.9
Classes of the population who consume dishes containing Lanhouin							
Housewife	37.3	25.1	20.1	11.8	2.7	1.9	1.2
Traders	37.6	26.0	19.9	10.8	2.5	2.0	1.2
Craftsman	37.7	25.5	19.6	11.4	2.5	2.1	1.3
Public servant	37.7	26.2	19.4	10.9	2.8	1.7	1.2

3. Discussion

As reported by Anihouvi et al. (2005), the survey revealed that the production of Lanhouin is an artisanal activity which is mainly done by women from ethnic groups Xwla and Mina but other ethnic groups such as Keta, Pedah, Adja and Fon were observed in the Lanhouin sector. This means that a large number of people are engaged in Lanhouin production mainly because of high demand for Lanhouin at national and sub-regional level, and therefore there is a flourishing export potential. Through the survey, it appeared that Lanhouin is also called Lanhouinhouin, Lanpipi, Yaya and Landodjé in Benin level. Similar observation was reported by Essuman (1992) and Abbey et al. (1994) for other African fermented fish products. Diverse types of Lanhouin are sold in the market : non dried lanhouin, dried Lanhouin and Lanhouin zodéké, other name of Lanhouin zokpa, which is a Lanhouin obtained within 24 h of fermentation (Anihouvi et al., 2005); Lanhouin zodéké is mainly produced during the scarcity period of the year.

The study showed that the processors use simple artisanal technologies for fermentation, drying, packaging and storage. All these methods date back in history and are used by different ethnic groups. The methods are transferred either by tradition within a family and through non-formal training. Some variants were observed in the processing technologies used, mainly at the fermentation step; but they conducted apparently to the same final product. In addition, there is a lack of standardization of the processing techniques and product quality could change from batch to batch or from one processing site to another in the different zones visited.

From this survey it appeared that colour, aroma, texture and consistency of the flesh are the main attributes used by the actors (processors and traders) and consumers to appreciate the quality of traditional Lanhouin. According to processors, these quality attributes are conferred to the product through a number of unit operations such as the ripening which involves a partial hydrolysis of the flesh and breakdown of proteins into their constituent peptides and amino acids due to microbial and enzymatic activities. The development of strong aroma mainly during the fermentation step could be also seen as a consequence of microbial and enzymatic activities. However the contact of salt during the fermentation step limit the activity of spoilage bacteria since in the presence of salt only halophilic bacteria can survive.

The major problems observed with the Lanhouin processors are the general unhygienic conditions of the processing environment as well as the equipment used for processing. This practice could be a potential source of contamination by pathogenic bacteria. The ratio of salt used varies from one production site to another and from one processor to another, and is not usually quantified. As salt is the only preservation agent used, low salt fermentation could allowed the growth of some pathogenic organisms in the product. In addition, the salt is not stored under good conditions and most of the time the salt is reused in subsequent fermentation. This practice could also be a potential source of contamination by the undesirable halophilic bacteria. Flies and insects infestation are also a big problem leading to illegal use of household insecticides or petroleum or a mixture of petroleum and insecticide to prevent flies setting on the product. The use of these types of substances could pose a health hazard to consumers.

Drying on the ground exposes the end product to domestic animal and may also be contaminated with sand when they dried on the bare ground. Processors usually package the Lanhouin in baskets covered with old sacks, old clothes or cement paper bags during fermentation, storage and when transporting the product to the market. The unhygienic nature of these materials could be potential sources of microbial of other types of contaminations.

Packaging form used for Lanhouin such as baskets does not offer any barrier to insect infestation. During storage Lanhouin is also susceptible to larvae infestation, mould growth and bacterial spoilage. Another storage problem is the continuous bacterial and enzymatic activity within Lanhouin leading to instable product (Anihouvi et al., 2006). So, there is a need to find the way to stabilize the Lanhouin during processing. Also long storage and further drying darkens the product. When Lanhouin is dried to very low moisture content, it tends to break up during packaging and storage.

The commercialisation of Lanhouin follows local and sub-regional flows through domestic and external market (fig.1). The quantity of Lanhouin produced per year is high with an annual turnover of 6 billion FCFA or more. The problem related to commercialisation of Lanhouin is the non observation of national or regional regulation trade. Also there are no statistical data on the commercialisation of Lanhouin at both national and regional levels because the trade is informal.

Some consumers evoked that consumption of dishes containing lanhouin had therapeutic effects as regulation of blood pressure and heart attack, an appetite and easy digestion. These observations follow the fact that fermented foods may help to protect the consumers against diseases by providing minute doses of antibiotics produced by the microorganisms involved in the fermentation (Dirar, 1993).

Conclusion

The survey contributed to better understanding of Benin traditional lanhouin processing, commercialisation and consumption. Three variants of fermentation were noticed through the survey but they conducted apparently to the same product. The survey revealed that the processing of Lanhouin is not only a form of preservation of fresh fish but it is also a form of recycling of rotting fish. The raw materials for the production include fish and salt, and ingredients such as peel lemon, and illegal ingredients such as petroleum and insecticides. Common unit operations observed were: dressing, ripening, salting, fermentation and sun drying, but the ones which can impact the quality of the end-product are the ripening, the salting and the drying. The quality attributes evoked by processors, traders and consumers are similar and mainly related to the appearance (colour, texture) of the product and the aroma. The presence of foreign matters including maggots or dead insects and the lack of appropriate packaging has also been pointed out by some consumers as a negative aspect for Lanhouin handling. For consumption, slimy sauce, vegetable sauce and tomato sauce are the most popular dishes containing Lanhouin with possible therapeutic effects mentioned.

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