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Introduction

Kitoza is a traditional Malagasy meat product. Long time considered as a royal delicacy, it still has its important role in the daily meal of Malagasy people. It is presented as 20-50cm x 2cm-3cm strips, generally salted, dried and or smoked. It is no more just prepared by housewives but presently produced at higher modern commercial levels.

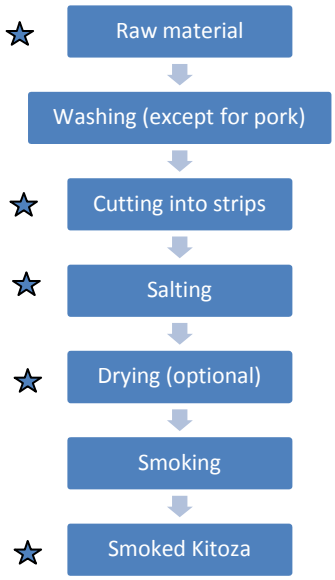
The objective of the present deliverable is to determine and better understand the different steps of smoked kitoza production as well as to identify critical points and to study the microbiological characteristics of the product at each production phase.

Material and methods

Three producers were monitored for the production process namely two smoked beef kitoza (Beef 1, Beef 2) and one pork. The beef kitoza producers work in urban area, Ivandry and Behoririka, while the smoked pork kitoza producer is located in the suburban area of Andoharanofotsy.

The preparation procedures for smoked kitoza are identical except for the Beef 2 kitoza producer who adds a drying step.

Samples were taken at different steps (Figure 1).



★: sampling

Figure 1: *Sampling and smoked kitoza preparation*

Microbiological parameters and sampling steps are given in Table 1.

Table 1: *Sampling steps and microbiological parameters for analysis*

Sampling steps / Microbiological parameters	Raw material	Cutting into strips	Salting	Drying	Smoking
Total Aerobic Mesophile Flora (TAMF)	X	X	X	X	X
E. coli	X	X	X	X	X
Lactic bacteria	X	X	X	X	X
Salmonella	X	X	X	X	X

Results and discussion

Microbiological analysis results are presented in Table 2.

Total mesophile count (TAMF) for fresh meat ranges from 5,1±0,2 to 7,0±0,1 log CFU/g.

This concentration tends to increase following the strips cutting step except for Beef 2 production for which a washing step is included before cutting whereas for Beef 1 production, the meat is washed at reception and kept in the refrigerator waiting for the kitoza preparation. Pork meat is not washed in order to keep the color.

Following the salting step, TAMF concentrations progressively decrease until smoking step from 5,6±0,2 to 4,1±0,0 ; 6,5±0,1 to 3,5±0,1 ; 6,4±0,1 to 3,8±0,3 log CFU/g respectively for Beef 1, Beef 2 and Pork.

E. coli is present in the raw material of all producers, concentration ranging from 2,2±0,1 to 4,6±0,4 log CFU/g. The concentration increases following the strips cutting step and decreases after the salting step to reach a non detectable level in the final product.

With regard for lactic bacteria, concentrations increase after the cutting step then decrease following the salting and smoking steps. However they are always present in the final product ie 4,0±0,1 for Beef 1, 2,4±0,1 for Beef 2 and 3,4±0,5 log CFU/g for Pork.

During the drying step, all microorganisms' concentrations increase. It is worth to mention that the drying step lasts from 45 minutes to 1 hour at 70-150°C, this allows microorganisms development, especially lactic bacteria. In addition, a marinating step is carried out right before then at 30-40°C.

No pathogenic germ was indentified during the process for all producers.

Table 2: *Microbiological analyses results at different sampling steps* (log CFU/g)

	Steps / Microorganismes	Raw material	Cutting into strips	Salting	Drying	Smoking
Beef 1 Salted/smoked	TAMF	5,1±0,2	5,6±0,3	5,6±0,2	ND	4,1±0,0
	E. coli	2,2±0,1	3,8±0,1	3,2±0,1	ND	<0,7
	Lactic bacteria	4,7±0,4	5,3±0,3	5,2±0,1	ND	4,0±0,1
	Salmonella	Absent	Absent	Absent	ND	Absent
Beef 2 Salted/dried/smoked	TAMF	7,0±0,1	6,7±0,1	6,5±0,1	7,7±0,1	3,5±0,1
	E. coli	3,5±0,2	3,4±0,2	3,0±0,2	3,2±0,1	<0,7
	Lactic bacteria	6,6±0,1	6,3±0,2	6,1±0,2	7,5±0,2	2,4±0,1
	Salmonella	Absent	Absent	Absent	Absent	Absent
Pork Salted/smoked	TAMF	6,6±0,2	7,5±0,2	6,4±0,1	ND	3,8±0,3
	E. coli	4,6±0,4	4,6±0,1	3,2±0,1	ND	<0,7
	Lactic bacteria	6,5±0,2	7,4±0,2	6,2±0,1	ND	3,4±0,5
	Salmonella	Absent	Absent	Absent	ND	Absent

ND : non determined

The same evolution trend is observed for all microorganisms. It increases following the strips cutting then decreases following the salting and smoking steps. This phenomenon

might be caused by salt bacteriostatic effect combined with smoking effect through temperature and phenolic products. Smoking process also induces water loss as well as water activity decrease. All these factors contribute to the decrease of microorganism concentration.

The study of production process allows recommending some re-engineering possibilities as follows:

- Beef 1:-Use well dried firewood for smoking for a better consumption- Clean well the bench – Improve smoke evacuation for the employees' health sake especially to avoid chronically intoxication.

- Beef 2:-Carry out marinating process in the refrigerator instead of room temperature – Use well sharpened knife and well trained employees.

- Pork: - Make a careful choice of raw material since the meat is not washed to keep the original color - Keep the working space clean.