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Evaluation of the hygienic and sanitary quality of attiéké produced by hand in Burkina Faso: case of "Burkina journalier", a local processing unit in Dedougou

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Abstract

In Burkina Faso, the lack of good hygienic practices (GHP) by producers and the uncontrolled sale of attiéké expose consumers to health risks like the Toxi-Infections Food (TIF). Our study aims to establish the hygienic quality of attiéké produced at Dédougou (Boucle du Mouhoun) and how to apply good manufacturing practices (GMP) and good hygiene practices (GHP) improving this attiéké. Two samples of attiéké were collected for analysis of which tasting test by 24 tasters (men and women) on characteristics such as color, flavor, appearance (fibres), texture, moisture, granulometry and hardness ; measurement of pH, determination of acidity, humidity, ash content, enumeration of bacteria, yeasts and molds were also done according to the recommanded methods. For both samples, our study showed 3.6, 0.85 and 1.9, 49.13 and 53.5, 0.82 respectively for pH, acidity, moister content and ash content. Humidity levels were 49.13 ± 0.02 and 53.5 ± 0.05 respectively for sample 1 and sample 2. Total aerobic mesophil flora of $3.73.10^4$ cfu/g and $4.52.10^4$ cfu/g, total coliforms rate ≤ 15 cfu/g and yeasts and molds value ranging from $3.1.10^3$ to $4.2.10^3$ cfu/g were observed. Special attention should be given to the following: transmission of fecal germs; handling of attiéké after cooking and equipments used for serving; and hand washing and environmental hygiene.

Keywords: *Attiéké, quality, improvement, manufacturing practices, hygiene practices.*

Introduction

Cassava (*Manihot esculenta* CRANTZ) is an important root crop in Africa, Asia, South America and India, providing energy for about 500 million people (Padmaja and Steinkraus, 1995). Traditionally, cassava roots are processed by different methods varying from region to region, leading to many different products like "gari", "tapioca", "placali" and "attiéké". Among the products derived from cassava, attiéké seems to be the most demanded and most consumed at the level of large and medium-sized cities in Burkina (Diancoumba, 2008). It is an essentially flavour starchy food, produced from fermented cassava dough and starch is known to be very important in body growth because of energy produced. Attiéké is widely consumed in Burkina Faso and its production is incoming generator activity especially for women (Diabcoumba, 2008). People in Burkina Faso enjoy it as a staple food, accompanied with salt, raw onions, spices, oil and fried fish (Guira *et al*, 2016). Attiéké is produced in a traditional way by producers often grouped in association or cooperative.

However, the lack of good hygienic practices (GHP) by women producers and the uncontrolled sale of attiéké in the street expose consumers to health risks, that is to say, the Toxi-Infections Food (TIF). Otherwise, it's known that food borne illness of microbial origin are a major international health problem associated to food safety and an important cause of death in developing countries (WHO, 2002a ; 2002b). The problems of food safety in the developed countries differ considerably from those of developing countries. Whereas, in developing countries traditional methods of processing and packaging, improper holding temperature, poor personal hygiene of food handlers are still observed during food marketing

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and technology (Barro *et al*, 2002 ; Mensah *et al*, 2002). In Burkina Faso, several studies were done concerning the nutritional quality of the "Attiéké" (Bassolé, 2009 ; Guira *et al*, 2016) but its hygienic quality is poorly understood and unevenly studied. Therefore, the present study aims to establish the hygienic status of Attiéké produced at Dédougou and how to apply good manufacturing practices (GMP) and good hygiene practices (GHP) improving the sector and the products.

Material and methods

Sampling

Two samples of Attiéké (AT1 obtained before production scheme improvement and AT2 obtained after improvement) were collected for analysis. The samples were transported to the laboratory on ice and processed within 2 h after the collection.

Tasting test

A tasting test was conducted from our two prepared and flavored samples. The panel consisted of 24 tasters, men and women included. A hedonic test made it possible to measure the acceptability of our products by the panelists. Consumer reactions were recorded using a rating scale of technological variables such as color, flavor, appearance (fibres), texture, moisture, granulometry and hardness. Assessment of Good manufacturing practices (GMP) and good hygiene practices (GHP) application was done (ONUDI, 2005).

Measurement of pH and determination of Acidity

Ten gram (10 g) of each sample were dissolved in 75 ml of sterile peptoned buffered water and mixed. The pH was directly measured with a numeric pH-meter (WTW multi line P4). For Total acidity, 10 g of each sample are mixed with 75 ml of distilled water in an erlenmeyer. Ten ml (10 ml) of the dilution were then titrated against NaOH 0.1 N using phenolphthalein as indicator.The total acidity was then calculated as a percentage of lactic acid.

Determination of humidity

According to the AOAC method (2000), the samples were weighed (P_0) using a SARTORUIS BP 310S precision balance (Gottingen, West Germany). They were dried in a brand oven (MEMERT, Schwabach West Germany) at 105 °C for 24 h. At the out let of the oven, the samples were cooled in a desiccator and weighed (P_1); the percentage of humidity (H) has been determined by calculation according to the formula: $H=\frac{P0-P1}{P0} \times 100$

Determination of ash content

According to the AOAC method (2000), this content has been determined by mineralization of a sample of 5 g (P_0) at 550 °C for 6 h in a muffle furnace (NABERTERM, Gmbh LT9/11/B180, Germany), until destruction of all organic matter in the sample. The weighing (P_1) after cooling in a desiccator of the ash obtained made it possible to determine the ash content according to the formula:

$$\% \text{ ash content} = \frac{P0-P1}{P0} \times 100$$

Enumeration of Bacteria, Yeasts and Molds

In the laboratory, the preparation of samples and tenfold dilutions for inoculation outs agar plates were carried out according to ISO-6887**(**ISO-6887,1999). For all numerations, 10 g of the samples were homogenized in a stomacher bags with 90 ml of sterile peptoned buffered water. The Tenfold serials dilution was prepared and spread-plated for microorganisms count. Yeasts and Molds were cultivated on Sabouraud-Chloramphenicol Agar (Oxoid LTD, Basingstore, Hamsphire, England) after incubated at 25˚C for 4 - 5 days and counted according to ISO 7954 standards ISO-7954 (1988). Lactic acid bacteria were cultivated onto Violet Red Bile Lactose (VRBL) agar (Liofilchem, Italy) and incubated anaerobically in an anaerobic conditions (anaerobic jar) at 37˚C, for 2 - 3 days and counted according to ISO 15214 standards ISO-15214(1998).

Results

Hedonic test parameters

The **figures 1 to 7** show the results obtained after performing the tasting test. The different appreciations are given as "low grade", "less good", "good", "very good" and "excellent".

Good manufacturing practices (GMP) and good hygiene practices (GHP) diagnosis

Our findings are recorded in the tables below. **Table 1** gives the characteristics of the GMP and GHP concerning the workers staff and **table 2** is about the same characteristics evaluation in the food environment.

Measures of pH, acidiy, humidity and ash content

For both samples, the pH average was 3.6 ± 0.08. The acidity ranged from 0.85 ± 0.02 to 1.9 ± 0.07. In this study, the moister content of attiéké samples varies from 49.13 ± 0.02 to 53.5 ± 0.05 per 100g of attiéké. Our analysis showed that the total ash content is 0.82 ± 0.05 per 100g of attiéké. Humidity levels were 49.13 ± 0.02 and 53.5 ± 0.05 **(Table 3).**

Determination of microbiological parameters

Our study showed a total aerobic mesophil flora level varied between$3.73.10^4$ and $4.52.10^4$ cfu/g while the total coliforms were found at the rate ≤ 15 cfu/g. Yeasts and molds showed value ranging from $3.1.10^3$ to $4.2.10^3$ cfu/g **(Table 4).**

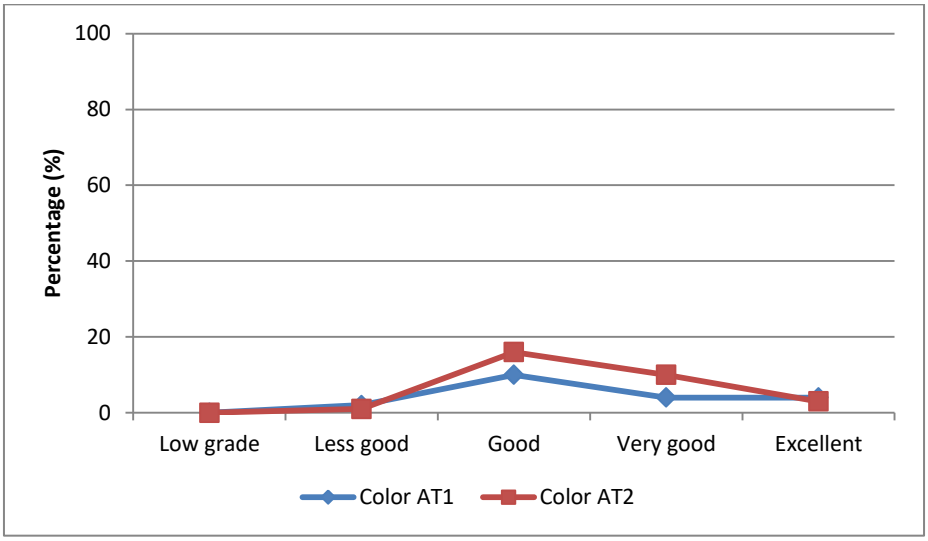

Figure 1. Tasting panel results of color

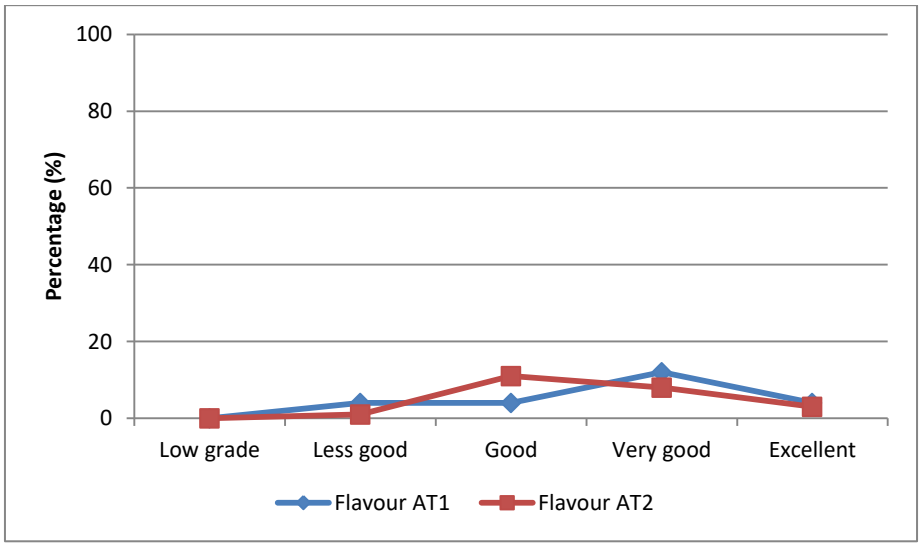

Figure 2. Tasting panel results of flavour

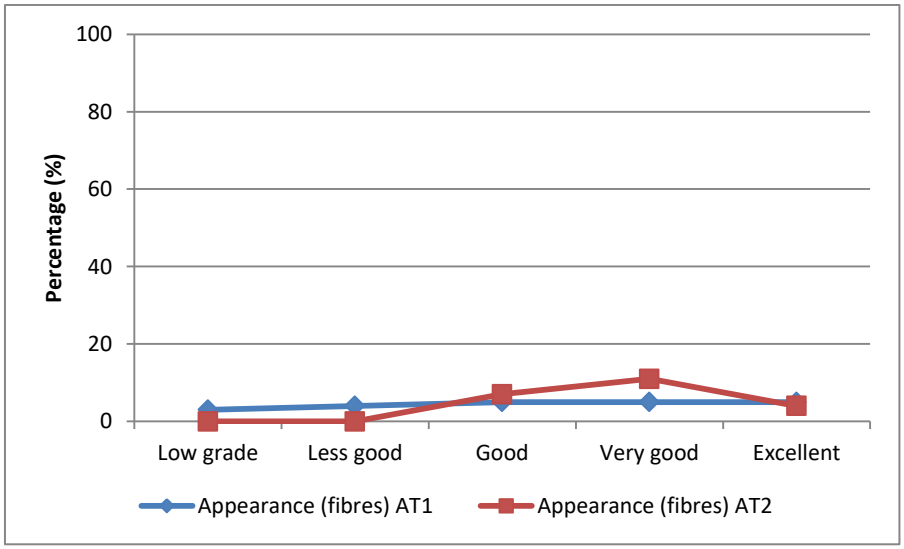

Figure 3. Tasting panel results of appearance

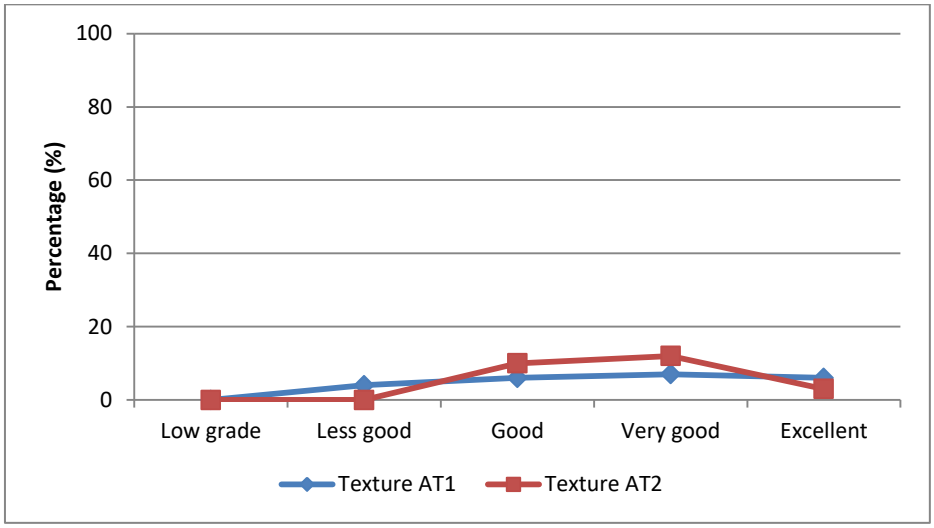

Figure 4. Tasting panel results of texture

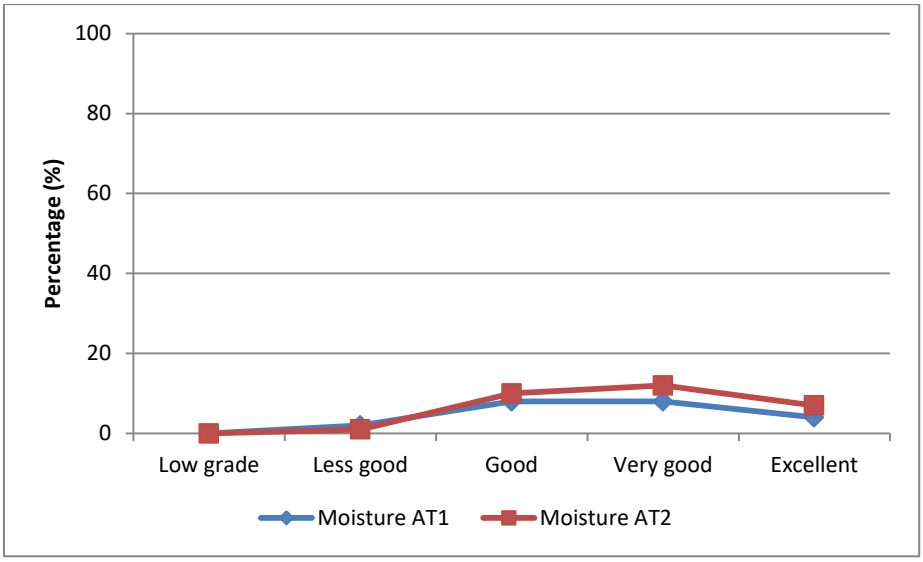

Figure 5. Tasting panel results of moisture

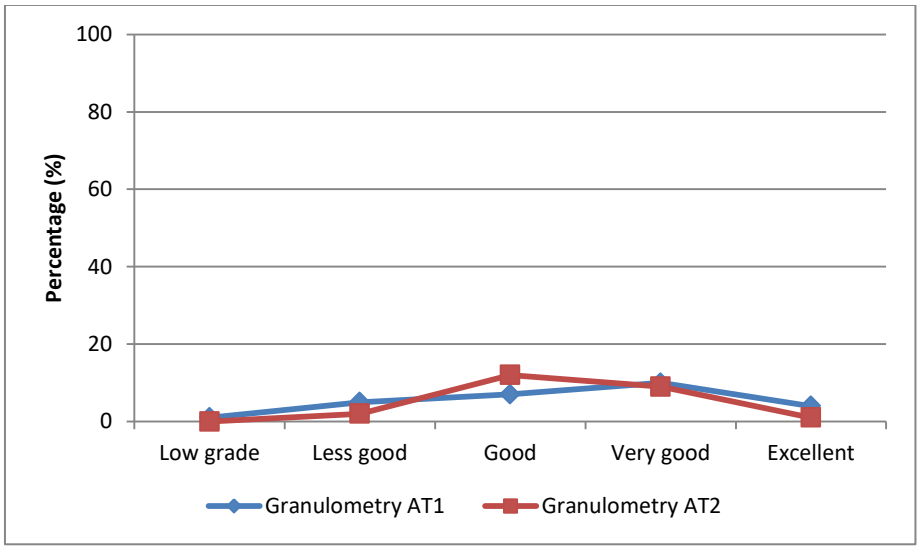

Figure 6. Tasting panel results of granulometry

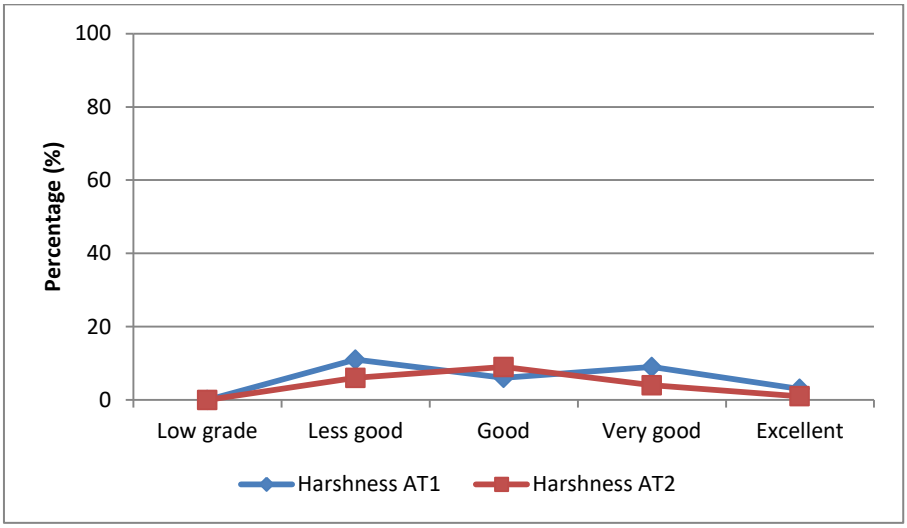

Figure 7. Tasting panel results of harshness

Table 1. Good manufacturing practices (GMP) and good hygiene practices (GHP) for attiéké producers

Subjects	Requirements	Findings	Assessments	Recommendations
Personal items (jewelery, watches, rings); nails, polishing, smoking, drinking and eating during the service.	People involved in peeling, grinding, sieving cassava and dough should have short, clean and healthy finger nails. Jewelry and watches are not allowed. During the service you must not smoke, eat or drink	In accordance with the requirements	Convenable	No recommendations
Wounds	In the event of an accident at work, such as knife wounds during peeling, a bandage must be made.	In accordance with the requirements (within the unit we have a bandage kit)	Convenable	No recommendations
Hand washing	Staff should wash their hands at the beginning of each operation, after using toilet, after having lathered ...	Not in accordance with the requirements	Not convenable	Install sinks (hands washing system) where it's necessar and make sure that it normally operates
Diseases	Any sick or infected person must take leave of the processing operations.	In accordance with the requirements	Convenable	No recommendations
Medical visits	Before hiring and at least once a quarter, medical visits must be organized	Not in accordance with the requirements	Not convenable	Organization of quarterly medical check-ups and health record requirements for hiring.
Staff work clothes	The staff must have different colored work clothes (one for handling in the clean area and the other for the dirty area). He must have at their disposal puffers, hair-covers, boots.	In accordance with the requirements	Convenable	No recommendations
Locker rooms	Staff must get rid of their city outfits, their private belongings and put on cloakroom work clothes.	Not in accordance with the requirements	Not convenable	Have cloakrooms for this purpose and different cabinets for dirty outfits, clean for production and outfits.
Workers staff training	All staff must receive appropriate training prior to the start of activities and have adequate supervision during the work.	In accordance with the requirements	Convenable	No recommendations

Table 2. Good manufacturing practices (GMP) and good hygiene practices (GHP) in food environment

Subjects	Requirements	Findings	Assessments	Recommendations
General plan	Respect for the forward march of the product and workers staff	Not in accordance with the requirements	Not convenable	Separation of dirty and clean places
Construction and materials	Wall and floor coverings smooth, clear, washable, resistant. Sufficient lighting; roof ceiling, windows with fine grates, doors with smooth surfaces	Not in accordance with the requirements	Not convenable	Apply the requirements using accommodated buildings
The entrance and exit doors	A door for the entrance of the cassava, a door for the entrance of the workers staff, a door for the exit of the finished product (the atiéké)	Not in accordance with the requirements	Not convenable	Application of walking forward
Toilets	Toilets can never be directly accessible from the packaging or storage area	In accordance with the requirements	Convenable	No recommendations
Establishment of a pest control plan	Pest control plan, insect control plan in the buildings (window wire-netting, smooth doors) including the surroundings. Registration form for periodic control operations.	Not in accordance with the requirements	Not convenable	Develop a pest control plan and a record of periodic operations.

Table 3. Characteristics of analyzed attiéké

Characteristics	Samples	
	AT1	AT2
pH	3.6±0.08.	3.6±0.08.
Acidity	0.85±0.02	1.9±0.07
Humidity	49.13±0.02	53.5±0.05
Ash content	0.82±0.05	0.82±0.05

Legend : AT1 = Attiéké 1, AT2 = Attiéké 2

Table 4. Microbiologycal quality of analyzed Attiéké

Microbiologycal parameters	Samples	
	AT1	AT2
Total Aerobic Mesophil Flora	$4.52.10^4$ cfu/g	$3.73.10^4$ cfu/g
Total coliforms	$\leq$ 15 cfu/g	$\leq$ 15 cfu/g
Fecal coliforms	0 cfu/g	0 cfu/g
Yeasts and Molds	$4.2.10^3$ cfu/g	$3.1.10^3$ cfu/g

Legend : AT1 = Attiéké 1, AT2 = Attiéké 2

Discussion

For acidity and pH, our results are in agreement with those of (Guira, 2013) which found values between 0.92 ± 0.05 and 4.08 ± 0.57 for acidity and 3.7 to 4.5 ± 0, 01 for pH. Our results are also consistent with the results of Sotomey *et al*. (2001) which after analysis of the Beninese diet had an average pH of 5.03 ± 0.24 and an acidity of 2.12 ± 0, 21. Guira *et al*. (2016) found a pH between 3.48 and 6.30 with an acidity of between 1.8% and 12.4% which is consistent with our results. CODINORM standards require a pH between 4 and 5 (CODINORM, 2006).

The washing and soaking of the dough would have a key role in the adjustment of the acidity. It can be controlled by tasting the dough before pressing. If the acidity is not suitable, the dough can be washed once more.

In this study, the moister content of attiéké samples varied from 49.13 ± 0.02 to 53.5 ± 0.05 per 100g of attiéké. These results are in agreement with that found by (Guira, 2013) which ranged between 50.19 and 55.12 ±

0.17. Sahore and Nemlin (2010) found a moister content of 48 ± 0.1 for that of cassava from the bitter variety and55.21 ± 0.03 for attiéké from cassava of the sweet variety. Standards CODINORM recommends moisture content between 45 and 55% (CODINORM, 2006).

This rate should not be too high because it will promote the proliferation of microbial flora. It can be controlled during the press, the pre-drying, the cooking and it will also allow the attiéké conservation long enough. Our analysis showed a total ash content which is in agreement with those reported by Guira (2013) which were between 0.14 and 0.78 ± 0.02. Sotomey *et al*. (2001) also reported ash content of 0.68 ± 0.09%. According to CODINORM (2006) which requires less than 1.4% dry matter as mineral salts values, our result (0.82 %) reflects the quality of our product. The ash content can also vary as a result of good hygienic and manufacturing practices during the different processes.

Otherwise, this study showed a total mesophilic flora level varying between $4.52.10^4$ and $3.73.10^4$cfu/g. This result is framed by those found by Sotomey *et al*. (2001) who found a variant flora between $3.4.10^3$ to $2.6.10^7$ cfu/g. Our results confirm those of Guira *et al*. (2016) who reported a total flora population of 5.11 log at 9.3 log cfu/g. CODINORM standards require a rate ≤ at 10^6 cfu/g (CODINORM, 2006).

For yeasts and molds we had a population respectively $3.1.10^3$ and $4.2.10^3$cfu/g for the 100g of attiéké analyzed. These results are consistent with the results of previous work conducted by Sotomey *et al*. (2001) who found $2.6.10^3$ ± $1.1.10^3$cfu/g. CODINORM standards (2006) recommend a rate between 8.10^4 and 2.10^8ufc/g. These yeasts and molds decrease considerably in the fresh diet and this reduction of microbial populations in the diet may be due to the effect of heat during cooking.

The total coliforms of our samples were≤15 cfu/g and faecal coliforms were not found. This result might be due to the respect of Good Manufacturing practices (GMP) and Good Hygiene Practices (GHP). Indeed, Barro *et al*. (2006) showed the need for more respect of GMP and GHP in order to reduce street foods contamination. Our finding about faecal coliform is perfectly in agreement with the requirements of CODINORM and reflects the state of health quality of the analyzed attiéké. This quality can decrease with the presence of coliforms when the moisture content of attiéké increases, thus constituting a risk for the consumers.

Conclusion

Our findings show the importance of Good Manufacturing practices (GMP) and Good Hygiene Practices (GHP) to stabilize attiéké's production and also to reduce its contamination. In fact, special attention should be given to the following: transmission of fecal germs; handling of attiéké after cooking and equipments used for serving; and hand washing and environmental hygiene. Action along these lines can be expected to improve the safety of attiéké and protect consumers. Otherwises, it seems that food safety education is a critical part of the overall strategy to reduce the incidence of food borne illness and complements regulatory and other activities. Meeting the huge challenge of food safety in the 21st century will require the application of new methods to identify, monitor and assess food borne hazards. Both traditional and new technologies for assuring food safety should be improved and fully exploited.

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