

Cassava's Size and Methods of Preparation of Ferments for The Production of Attiéké in The South of Côte d'Ivoire

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Abstract: The ferment of cassava is prepared according to various methods by the producers of Attiéké, according to the ethnic group. During the investigation, five main methods of preparation of the cassava ferment, used for the production of Attiéké, were identified. The method of preparation of the ferment from the raw cassava, begin with the cutting roughly or small cylindrical pieces of the not peeled cassava tubers, before the fermentation by all of the producers of Attiéké of the ethnic group Abouré (9.4 %). The fermentation time is of 3 days for the whole boiled and braised peeled cassava, of 2 days for the cassava cut in pieces boiled and of 4 days for the braised not peeled and raw cassava. The packing material is constitutes in the majority of the cases (51.1 %) of bag of polypropylene (collectively called bag of rice or salt). The fishing net and the bag of jute are particularly also used for the ethnic groups Adjoukrou and Abouré. However, the plastic bag is used to create the waterproofness of the packing material and the envelope of the bark of the palm tree to favor the colonization of the cassava by germs fermentatives for the ethnic group Attié. Only the ferment of cut boiled cassava in certain cases, does not undergo cleaning before its use in the process of preparation of Attiéké.

Keywords: cassava, ferment, Attiéké, fermentation time, packing material, ethnic group.

INTRODUCTION

The cassava (*Manihot esculenta Crantz*) is one of the most important tropical tubers cultivated. Its root constitutes the basic food of eight hundred million of people in the world [1]. It represents quantitatively the third most important source of food in tropics after the rice and the corn [2]. It can be also used as source of carbohydrate in the animal feed [3,4].

In spite of its importance, this tuber present three major inconveniences which limit its use in human and animal food: a post-harvest rapid deterioration [5], a low protein content [6] and a toxicity bound to the presence of the cyanogenetics glycosides that are the linamarine and in a lesser measure the lotaustraline (or méthylinamarine), [7]. The linamarine (glycoside cyanogenetic prevailing in the manioc) is hydrolyzed in acetone cyanohydrine and glucose by an endogenous enzyme, a linamarase (β -glucosidase, EC 3.2.1.21) [8, 9]. One of the products resulting from the fermentation of cassava and the most consumed in Ivory Coast, is Attiéké [10]. It is a food of whitish color and slightly acidulated taste [11], produced from tubers of cassava peeled grated cheeses. The obtained semolina is steamed after a lactic fermentation of the pulp [12].

The Attiéké constitutes the basic food of the ethnic groups Adjoukrou, Ebrié, Alladjan, Avikam and Ahizi, living in lagunaires regions in the South of Côte d'Ivoire [13]. Its manufacturing process contains an essential stage of fermentation, which contrary to the

other food fermented with cassava in Africa, is introduced by a traditional ferment (called "Mangnan" in language Ebrié).

Development of a country passes inevitably by its food safety, based on the processing and the valuation of the primary products such as the manioc, which can contribute to the improvement of the living conditions of the populations. So, the processing of cassava in Attiéké, food rich in starch, could constitute an excellent source of calories for the populations of Côte d'Ivoire. However, the traditional methods of manufacturing of Attiéké, which call on to a spontaneous fermentation for the preparation of the cassava ferment, could constitute a sanitary risk for the consumer, if this fermentation is not well controlled by the producers.

All these observations allowed to identifying the various methods of preparation of the ferment of cassava ("Mangnan"), by leading an investigation among the producers of Attiéké of ten (10) ethnic groups in the South of Côte d'Ivoire. This study will

allow to identify the variability of the various varieties of cassava and methods of preparation of ferments used for the manufacturing process of Attiéké.

MATERIALS AND METHODS

Zone of study

From November, 2016 till July, 2017, a transverse study of descriptive type was led with 715

producers of Attiéké of 10 ethnic groups to the South of Côte d’Ivoire, to identify the various methods of preparation of the ferment of cassava used in the manufacturing process of Attiéké. This study was led in 74 localities (villages or municipalities) aroused ethnic groups and concerned 13 departments (Figure 1). The Table 2 presents the distribution of the ethnic groups according to the visited localities.



Fig-1: Localization of the zone of investigation) in the Côte d’Ivoire space
Source: center of cartography and remote detection (BNETD), october 2002.

MATERIALS OF DATA COLLECTION

A standard questionnaire realized following a pre-investigation, was used for the data collection on the stages of production of Attiéké and more specifically on the preparation of the cassava ferment by every producer. This questionnaire contained twenty three questions with multiple choices or binary

them, distributed in 13 departments, were chosen at random for investigation. Within every locality, a minimum of 5 producers of Attiéké were selected in a random way for the study, according to the availability. The ethnic group and the ethnicity constitute independent variables. The experimental unit corresponds to the producer questioned in the locality. In every experimental unit, is connected the answers to the questions with multiple or binary choices of the questionnaire. The table 2 presents the distribution of the producers of Attiéké by ethnicity within every ethnic group.

Methods
Sampling

The Localities (municipalities or villages) of the 10 reserved ethnic groups, were sounded and 74 of

Table-1: Frequency of the producers of Attiéké questioned by ethnic group within every ethnic group

Ethnic group	Abbey			Abi dji	Abo uré	Adjou krou	Ah izi	Alladjan			Att ié	Avik am	Baoulé		Ebrié			
	Ab bey	Bao ulé	Burkin abé					Ah izi	Allad jan	Ag ni			Bao ulé	Adjou krou	Bao ulé	Eb rié		
Numbers of producers	66	4	1	72	67	71	70	6	67	73	66	3	70	1	1	77		
Total	71			72	67	71	70	73			73	66	73		79			71
Percentage (%)	9.9			10.1	9.4	9.9	9.8	10.2			10.2	9.2	10.2		11.1			10.0

Table-2: Distribution of the ethnic groups according to the visited localities

Ethnic groups	Village or municipality									Department
Abbey	Agboville commune	Agouahin	Erimakouguié	Grand Morié	Grand Moutcho	Laoguié	Petit Yapou	-	-	Agboville
Abidji	Badasso	Elibou	Gomon	Katadji	Sahué	Sikensi commune	Yaobou	-	-	Sikensi
Abouré	Diao ¹	Samo ¹	Bonoua commune ¹	Yaou ¹	Ebra ²	Moosso ²	-	-	-	¹ : Bonoua ² : Grand-Bassam
Adjoukrou	Agneby	Akradio	Armabé	Dibromou	Pass	Lopou	-	-	-	Dabou
Ahizi	Abrako ¹	Bapo ¹	Koko ¹	Tabot ¹	Niguisaff ²	Tiagba ²	M'bra ²	-	-	¹ : Jacquville ² : Grand-Lahou
Alladian	Adoumagan	Akrou	Avagou	Breby	Jacquville commune	N'djem	Sassako	-	-	Jacquville
Attié	Agou ¹	Boudépé ¹	Diapé ¹	Miandzin ¹	Ebimpé ²	Alépé commune ³	Montézo ³	Bécédi-Brignan ¹	-	¹ : Adzopé ² : Anyama ³ : Alépé
Avikam	Grand-lahou commune	Braffedon	Lahouplage	Nadibo I	Nadibo II	Tchebessou	-	-	-	Grand-lahou
Baoulé	Aheremou I	Aheremou II	Ahondo	Gbovia	Kenessou	Kotissou	Taabo cité	Taabo village	-	Toumodi
Ebrié	Agban ¹	Abobodomé ¹	Locodjoro ¹	Anono ¹	Blockhass ¹	M'bado ¹	M'pouto ¹	Anouambo ¹	Anouambo ¹	San té ² ¹ : Abidjan ² : Binger ville

Collection of the data

Within every municipality or village, every producer of Attiéké was subjected to the various multiple-choice or binary questions and the obtained answers were brought back directly on the questionnaire. The mentions "yes" for the positive answers and "no" for the negative answers are registered in compartments planned for that purpose on the questionnaire. Several subjects were used in this questionnaire, in particular the method of preparation of the ferment of used cassava, the variety of cassava used, the treatment of the cassava before fermentation, the conditions required for the fermentation, the place of fermentation, the fermentation time, the treatment of the cassava after fermentation, etc...

Analyses of the investigation data

The obtained data were treated on a computer equipped with the software of statistical treatments (SPSS). We used the SPSS software (Statistical

packages for Social Science) for the data analysis composing of the study of the frequencies and the crossed boards. The data of the investigation were grouped according to the ethnic groups. The data of the investigation being qualitative data, the various results obtained will be presented following the frequencies.

RESULTS AND DISCUSSION**Size of the cassava used for the manufacturing process of the ferment**

The method of preparation of the ferment from the raw cassava, begin with the cutting roughly or small cylindrical pieces of the not peeled cassava tubers, before the fermentation by all of the producers of Attiéké of the ethnic group Abouré (9.4 %). From 63.1 % of the cases, the producers of Attiéké cook the cassava in the water without cutting it, however the other 22.2 % cut the cassava to produce their ferment. Also, the cassava does not undergo cutting when it is cooked in the ember in 5.3 % of the cases (Table 3).

Table-3: Distribution of the size of cassava used for the preparation of the ferment

Ethnic groups	Entier			Cutting						Total
				roughly pieces			Small pieces			
	Raw	Boiled	Braised	Raw	Boiled	Braised	Raw	Boiled	Braised	
Abbey	0%	9.4%	0%	0%	0.5%	0%	0%	0%	0%	9.9%
Abidji	0%	0%	1.5%	0%	2%	0%	0%	6.6%	0%	10.1%
Abouré	0%	0%	0%	8.7%	0%	0%	0.7%	0%	0%	9.4%
Adjoukrou	0%	9.9%	0%	0%	0%	0%	0%	0%	0%	9.9%
Ahizi	0%	9.8%	0%	0%	0%	0%	0%	0%	0%	9.8%
Alladjan	0%	10.2%	0%	0%	0%	0%	0%	0%	0%	10.2%
Attié	0%	1.7%	0%	0%	4%	0%	0%	4.5%	0%	10.2%
Avikam	0%	9.2%	0%	0%	0%	0%	0%	0%	0%	9.2%
Baoulé	0%	2.4%	3.5%	0%	1.2%	0%	0%	3.1%	0%	10.2%
Ebrié	0%	10.5%	0.3%	0%	0.3%	0%	0%	0%	0%	11.1%
Total	0%	63.1%	5.3%	8.7%	8.1%	0%	0.7%	14.1%	0%	100%

Mode of cooking of cassava for the preparation of the ferment

85.3 % of Attiéké producers preferentially use the boiled cassava for the preparation of the ferment whereas the cassava cooked in the ember is used for 5.3 % and the raw cassava for 9.4 %. Analysis of the results shows that the raw cassava is only used by the producers of Attiéké of the ethnic group Abouré (9.4 %). The mode of cooking cassava in the ember is used by certain producers of the ethnic groups Baoulé (3.5

%) and Abidji (1.5 %). However, certain producers of Attiéké from the ethnic groups Baoulé (6.7 %), Ebrié (10.8 %), Abidji (8.5 %) and those from ethnic groups (Abbey, Adjoukrou, Ahizi, Attié, Alladjan and Avikam), exclusively in 59.3 % of the cases use only the cooking in the water (boiled cassava) for the preparation of their ferment, (Table 4). The figure 2 indicates the various forms of cassava before fermentation.

Table-4: Distribution of the mode of cassava cooking for the preparation of the ferment

Ethnic groups	Mode of cooking of cassava			Total
	Without cooking (Raw)	cooking in water(Boiled)	cooking in the ember(Braised)	
Abbey	0%	9.9%	0%	9.9%
Abidji	0%	8.6%	1.5%	10.1%
Abouré	9.4%	0%	0%	9.4%
Adjoukrou	0%	9.9%	0%	9.9%
Ahizi	0%	9.8%	0%	9.8%
Alladjan	0%	10.2%	0%	10.2%
Attié	0%	10.2%	0%	10.2%
Avikam	0%	9.2%	0%	9.2%
Baoulé	0%	6.7%	3.5%	10.2%
Ebrié	0%	10.8%	0.3%	11.1%
Total	9.4%	85.3%	5.3%	100%

Cooking time of the cassava for the preparation of the ferment

The tubers of cassava are partially cooked in the water or in the ember, by the majority of the producers of Attiéké of the various visited ethnic groups (in 86.3 % of the cases). Only 4.3 % of the producers cook totally the cassava for the preparation of ferments

with cassava whole boiled and cut boiled. However, those of the ethnic group Abouré (9.4 %), do not make leather the cassava before fermentation for the preparation of the raw cassava ferment. The Table 5 presents the distribution of cooking time of the cassava used for the preparation of ferments according to the ethnic groups.



Fig-2: Forms of the cassava before the fermentation

a : Raw cassava cut in pieces ; **b** : cassava whole boiled ; **c** : cassava cut in small pieces boiled; **d** : cassava braised not peeled ; **e** : cassava braised peeled.

Table-5: Distribution of cooking time of the cassava used for the preparation of ferments

Groupe ethnique	Pas de cuisson	Cuisson partielle	Cuisson totale	Total
Abbey	0%	9.6%	0.3%	9.9%
Abidji	0%	9.9%	0.2%	10.1%
Abouré	9.4%	0%	0%	9.4%
Adjoukrou	0%	9.6%	0.3%	9.9%
Ahizi	0%	9.8%	0%	9.8%
Alladjan	0%	10.1%	0.1%	10.2%
Attié	0%	10.2%	0%	10.2%
Avikam	0%	8.7%	0.5%	9.2%
Baoulé	0%	9.8%	0.4%	10.2%
Ebrié	0%	8.6%	2.5%	11.1%
Total	9.4%	86.3%	4.3%	100%

Packing material of the cassava before the fermentation

The material used for the packaging of the cassava in the five methods of preparation of the cassava ferment of manioc, is constituted for the greater part by bags of polypropylene collectively called bag of rice or salt (51 %), followed by a combination between bags of polypropylene and plastic bag (18.3 %) and of a set of jute bags and plastic bag (17.5 %), (Table 6). The set constituted by bag of jute and plastic bag, is particularly used by the ethnic group Abouré (9.4 %), for the method of preparation of the raw cassava ferment. The packing material constituted by the set of combined between fishing nets in bags of polypropylene (6.3 %) or plastic bag (4 %), is used for the producers of the ethnic group Adjoukrou (9.9 %), for the method of preparation of ferment of the boiled whole cassava. Besides, the packing material used in the ethnic group Attié is constituted in addition to the bags of polypropylene or jute combined in the plastic bag, of an envelope which recovers the heart of the palm tree in 1.8 % of the cases, for the method of preparation of the ferment of cut boiled cassava. The

figure 3 presents the material used in the packaging of the cassava before the fermentation.

Fermentation time

The fermentation time is of 3 days for all the methods of preparation of the cassava ferment. The fermentation time of 3 days (79.6 % of the cases), concern the methods of preparation of ferments of whole boiled and braised peeled cassava and to a lesser extent, those of the ferments of cut boiled and raw cassava. However, this time is of 2 days in 13.8 % of the cases for the producers of Attié using the method of preparation of the ferment of cut boiled cassava. Contrary, the fermentation time is of 4 days for producers group of Attié using the method of preparation of the ferment of braised not peeled cassava, (0.3 %) and for the majority of the producers using the method of preparation of the ferment of raw cassava (6.3 %). The fermentation time of the cassava for the five methods of preparation of cassava ferment, according to the ethnic groups is presented by the table 7.

Table-6: Distribution of the packing material of cassava used for the preparation of the ferment

Ethnic Groups	packing material									Total
	Bag of rice ¹	Bag of cocoa ²	plastic bag	Bag of rice ¹ + sachet ³	Sac de cacao ² + sachet ³	Nets ⁴ + sachet ³	Nets ⁴ + Bag of rice ¹	Bag of rice ¹ + envelope de palm tree	Bag of rice ¹ + Tree bark	
Abbey	7.3%	0.1%	0%	2%	0.5%	0%	0%	0%	0%	9.9%
Abidji	8.4%	0%	0%	1.6%	0.1%	0%	0%	0%	0%	10.1%
Abouré	0%	0%	0%	0%	9.4%	0%	0%	0%	0%	9.4%
Adjoukrou	0%	0%	0%	0%	0%	4%	5.9%	0%	0%	9.9%
Ahizi	7.3%	0%	0%	2.5%	0%	0%	0%	0%	0%	9.8%
Alladjan	8.4%	0%	0%	0.8%	0.6%	0%	0.4%	0%	0%	10.2%
Attié	3%	0%	0%	4.8%	0.3%	0%	0%	1.8%	0.3%	10.2%
Avikam	6.5%	0.3%	0%	1.4%	1%	0%	0%	0%	0%	9.2%
Baoulé	2.5%	0%	0%	3.4%	4.3%	0%	0%	0%	0%	10.2%
Ebrié	7.6%	0.1%	0.3%	1.8%	1.3%	0%	0%	0%	0%	11.1%
Total	51%	0.5%	0.3%	18.3%	17.5%	4%	6.3%	1.8%	0.3%	100%

¹ bag of polypropylene; ² jute bag; ³ plastic bag; ⁴ fishing nets



Fig-3 : Material used for cassava packing

a : bag of polypropylene; **b** : jute bag; **c** : plastic bag; **d** : nets; **e** : envelope of palm tree ; **f** : tree bark + bag of polypropylene

Cleaning of the cassava after fermentation

The producers of Attiéké in their majority (87.6 %) clean the ferment of cassava before its use, for the methods of preparation of ferments of whole boiled, braised peeled, braised not peeled, and raw cassava and to a lesser extent, ferment of cut boiled cassava. It should be noted that ferments of whole boiled and braised peeled cassava are directly cleaned in the water with knife, sponge, spoon or hand. However, braised

not peeled, and raw cassava are peeled at first, then cleaned in the same conditions as previously for the ferment of braised not peeled cassava and dry with a knife, for raw cassava. On the contrary, more than half producers of Attiéké using the cut boiled cassava ferment (13%), not clean it before its use in process of preparation of Attiéké. The cleaning of the fermented cassava before its use in Attiéké is presented by the table 8.

Table 7: Distribution of the fermentation time of cassava

Ethnic groups	Fermentation time			Total
	2 days	3 days	4 days	
Abbey	0%	9.9%	0%	9.9%
Abidji	1.5%	8.6%	0%	10.1%
Abouré	0%	3.1%	6.3%	9.4%
Adjoukrou	0.7%	9.2%	0%	9.9%
Ahizi	0.4%	9.4%	0%	9.8%
Alladjan	0%	10.2%	0%	10.2%
Attié	8%	2.2%	0%	10.2%
Avikam	0%	9.2%	0%	9.2%
Baoulé	2.9%	7.3%	0%	10.2%
Ebrié	0.3%	10.5%	0.3%	11.1%
Total	13.8%	79.6%	6.6%	100%

Table-8: Distribution of the cleaning of the cassava ferment before its use in the manufacturing process of Attié

Ethnic Groups	not cleaning					cleaning					Total
	Raw	Whole boiled	Cut boiled	Braised peeled	Brais. not peeled	Cru	Whole boiled	Cut boiled	Braised peeled	Brais. not peeled	
Abbey	0%	0%	0%	0%	0%	0%	9.4%	0.5%	0%	0%	9.9%
Abidji	0%	4.5%	4.1%	0%	0%	0%	0%	0%	1.5%	0%	10.1%
Abouré	0%	0%	0%	0%	0%	9.4%	0%	0%	0%	0%	9.4%
Adjoukrou	0%	0%	0%	0%	0%	0%	9.9%	0%	0%	0%	9.9%
Ahizi	0%	0%	0%	0%	0%	0%	9.8%	0%	0%	0%	9.8%
Alladjan	0%	0%	0%	0%	0%	0%	10.2%	0%	0%	0%	10.2%
Attié	0%	0%	6.2%	0%	0%	0%	1.7%	2.4%	0%	0%	10.2%
Avikam	0%	0%	0%	0%	0%	0%	9.2%	0%	0%	0%	9.2%
Baoulé	0%	1,7%	2.6%	0%	0%	0%	0.7%	1.7%	3.5%	0%	10.2%
Ebrié	0%	0%	0.1%	0%	0%	0%	10.8%	0.1%	0%	0%	11.1%
Total	0%	6.2%	13%	0%	0%	9.4%	61.7%	4.7%	5%	0%	100%

DISCUSSION

The packing material of the cassava for the five methods of preparation of the cassava ferments is constituted in half of the cases (51.1 %), of polypropylene bags, indicating that these bags are available and easy to use. Indeed, this synthetic material used for the packaging and the storage of the rice and the salt sold on the market, his easily accessible to the producers of Attié in all the ethnic groups. So, the bag of jute is used (17.5 %) in the cassava packaging and constitute a natural environment of growth of microbial drills. According to [14] (2002), the bag of jute used for the packaging of the cassava appears as an environment necessary for the fast colonization of the cassava by germs. The use of the plastic bag, material tight in the packaging of the cassava contributes to create the anaerobics conditions, necessary for the process of fermentation. The fishing net used for the packaging of the cassava, indicates its importance in the life of the lagunaires peoples, in particular the ethnic group Adjoukrou. It represents for these peoples of fishermen, a symbol in the supply in fish, source of protein. So, it intervenes at the same time in the process of preparation of Attié, source of energy, particularly for the preparation of the ferment of cassava. The use of the envelope of the heart of palm tree, plant material in

the packaging of the cassava represents for the producers, a natural environment which participates in the fast microbial colonization of the cassava. This explains partially its use by the producers of Attié of the ethnic group Attié.

The packing material creates the conditions favorable to the growth of the lactic bacteria which intervene in the process of fermentation of the cassava (an acid PH, an optimal temperature of growth situated between 25 and 30 °C and shielded from the light) [15]. When the packing material (bag of jute, bag polypropylene or net) is used for the first time, the cassava is rejected after fermentation. This measure taken by the producers favors the colonization of the packing material by the microbial flora, necessary for the obtaining of a better ferment of cassava, during the next preparations. The use of old packing bags confirms the loads of the very high microbial microflora, as shown by the works from [16].

The fermentation of the manioc takes place generally in a hot environment, particularly in a kitchen ([15]). During the storing, certain microorganisms (yeasts, molds, mushrooms), possessing a linamarasic activity degrade the linamarine (major cyanogenetic

compound), responsible for the toxicity of the cassava [17- 19]. So, these microorganisms by degrading the toxic glucosides release in the ferment of cassava the linamarase necessary for the decrease of the toxicity of the Attiéké [20, 21]. According to [22], the lactobacillus, the yeasts and the bacillus are only the fermentaires germs. During the fermentation, yeasts, just like lactobacillus produce aromatic compounds responsible for the aroma of the ferment [23, 22], looked for the production of Attiéké.

The fermentation time of the cassava is of three 3 days, but it is influenced by its peeling before the fermentation [24]. Indeed, the peeling of roots influences the content in cyanide [25] and the final yield of the product [26]. This would explain fermentation time of 4 days for the ferments of cassava not peeling (ferment of braised not peeled and raw cassava). Besides, the semi-crystalline structure of the native starch reduces the enzymatic activity, increasing the fermentation time of the raw cassava. The fermentation time is influenced by the cutting of the tubers of cassava in pieces [27]. Indeed, the reduced size of the pieces accelerates the degradation of the cassava by increasing the contact area with microorganisms, so decreasing the fermentation time. This explains the fermentation time of 2 days for the method of preparation of the ferment of cut boiled cassava, instead of 3 days for ferments of whole boiled and peeled braised cassava. The ferments of braised not peeled and raw cassava can be used beyond 4 days of fermentation by keeping them respectively outdoors or in the sun, what is not the case of the other ferments. For certain producer's of the ethnic group Ebrié, from the village of Anono (Cocody), after two days of fermentation of the cassava in bag, the cassava ferment is removed, cleaned, then put backin the water to pursue the fermentation process during a day. That would facilitate the softening of the ferment and its action on the fresh pulp of cassava which will be use to the production of Attiéké.

The ferment of cassava obtained is carefully cleaned by the producers, to clear it of the dirt due to the fragments of packing material, or to the microorganisms. This stage is very important for the producer, because the contamination of the dough of Attiéké by certain germs would give too sour Attiéké and of blackish color. However, concerning the method of preparation of the ferment of cut boiled cassava, the cassava does not still undergo cleaning, because the wash would make lose an important quantity of ferment to the producer. It is then cut in small pieces or crushed, then incorporated into the fresh dough of Attiéké to facilitate the mixture.

CONCLUSION

The fermentation time is of 3 days for the whole boiled and braised peeled cassava, of 2 days for the cassava cut in pieces boiled and of 4 days for the

braised not peeled and raw cassava. The packing material is constitutes in the majority of the cases (51.1%) of bag of polypropylene (collectively called bag of rice or salt). The fishing net and the bag of jute are particularly also used for the ethnic groups Adjoukrou and Abouré. However, the plastic bag is used to create the waterproofness of the packing material and the envelope of the bark of the palm tree to favor the colonization of the cassava by germs fermentatives for the ethnic group Attié. Only the ferment of cut boiled cassava in certain cases, does not undergo cleaning before its use in the process of preparation of Attiéké.

REFERENCES

1. Tatsuma, T., Tani, K., Oyama, N., & Yeoh, H. H. (1996). Linamarin sensors: amperometric sensing of linamarin using linamarase and glucose oxidase. *Journal of Electroanalytical Chemistry*, 407(1-2), 155-159.
2. Nartey, F. (1978). *Manihot esculenta (cassava): cyanogenesis, ultrastructure and seed germination*. Munksgaard..
3. Hillocks, R. J., Thresh, J. M., & Bellotti, A. (Eds.). (2002). *Cassava: biology, production and utilization*. CABI.
4. Westby, A. (2002). Cassava utilization, storage and small-scale processing. *Cassava: Biology, production and utilization*, 281-300.
5. Rickard, J. E. (1986). Tannin levels in cassava, a comparison of methods of analysis. *Journal of the Science of Food and Agriculture*, 37(1), 37-42.
6. Ekpenyong, T. E. (1984). Composition of some tropical tuberous foods. *Food chemistry*, 15(1), 31-36.
7. Kakes, P. (1990). Properties and functions of the cyanogenic system in higher plants. *Euphytica*, 48(1), 25-43.
8. Cooke, R. D., Blake, G. G., & Battershill, J. M. (1978). Purification of cassava linamarase. *Phytochemistry*, 17(3), 381-383.
9. Hock-Hin, Y., & Hin-Cheow, W. (1992). Cassava leaf β -glucosidase specificity and inhibition. *Phytochemistry*, 31(7), 2263-2265.
10. Kakou, A. C. (2000). Optimisation des conditions d'application d'une méthode de conservation longue durée de la pâte de manioc (*Manihot esculenta*, Crantz) en vue d'améliorer la qualité alimentaire de l'attiéké et du placali. *PhD Report, University of Cocody (Côte d'Ivoire) Pp, 123*.
11. Kouadio, N. A., Kouakou, K. E., Angbo, S. F., & Mosso, K. (1991). Etude comparative des méthodes traditionnelles de préparation de l'Attiéké dans le sud de la Côte d'Ivoire. *Industries alimentaires et agricoles*, 108(9), 703-706.
12. Aboua, F. (1988). Préparation traditionnelle d'aliments à base de manioc en Côte d'Ivoire. Manioc, bulletin d'information, volume 12, 1, CIAT, p10-12.

13. Assanvo, J. B., Agbo, G. N., Behi, Y. E. N., Coulin, P., & Farah, Z. (2006). Microflora of traditional starter made from cassava for "attieke" production in Dabou (Côte d'Ivoire). *Food control*, 17(1), 37-41.
14. Assanvo J. B., Agbo G. N., Behi Y. E. N., Coulin P. et Farah Z. (2002). La microflore du ferment de manioc pour la production de l'Attiéké Adjoukrou à Dabou (Côte d'Ivoire). *BIOTERRE, Rev. Inter. Sci. de la Vie et de la Terre*, N° spécial, 2002.
15. Assanvo J. B., Agbo, N. G., Behi, N. et Farah Z. (2000). *Enquêtes de consommation et de production d'attiéké réalisées à Abidjan, Dabou et à Jacqueville*. Rapport. LBSA (Université de Cocody, Côte d'Ivoire)/ CSRS/ ETHZ, 6 p.
16. Bourgeois C. M. et Leveau J. Y. (1991). Le contrôle microbiologique, Dans : Technique d'analyses et de contrôle dans les industries agroalimentaires. Méthodes d'évaluation des différentes microflores. Edition 2, volume 3. Lavoisier et Apria, édit., Paris.
17. Giraud, E., Brauman, A., Keleke, S., Gosselin, L., & Raimbault, M. (1995). Contrôle de la fermentation du manioc pour un meilleur gari: Utilisation d'un starter de *Lactobacillus plantarum* à activité linamarase et amylase. *Agbor-Egbe et al.(eds) Transformation Alimentaire du Manioc, ORSTOM, Paris*, 353-365.
18. Okafor, N., & Ejiofor, M. A. N. (1986). The microbial breakdown of linamarin in fermenting pulp of cassava (*Manihot esculenta* Crantz). *MIRCEN journal of applied microbiology and biotechnology*, 2(2), 327-338.
19. Okafor, N., & Ejiofor, A. O. (1990). Rapid detoxification of cassava mash fermenting for garri production following inoculation with a yeast simultaneously producing linamarase and amylase. *Process Biochemistry International*, 25, 82-6.
20. Giraud, E., Brauman, A., Keleke, S., Gosselin, L., & Raimbault, M. (1995). Contrôle de la fermentation du manioc pour un meilleur gari: Utilisation d'un starter de *Lactobacillus plantarum* à activité linamarase et amylase. *Agbor-Egbe et al.(eds) Transformation Alimentaire du Manioc, ORSTOM, Paris*, 353-365.
21. Obilie, E. M., Tano-Debrah, K., & Amoa-Awua, W. K. (2004). Souring and breakdown of cyanogenic glucosides during the processing of cassava into akyeke. *International journal of food microbiology*, 93(1), 115-121.
22. Amoa-Awua, W. K., & Jakobsen, M. (1996). The role of microorganisms in the fermentation of Agbelima cassava dough. CSIR-Food Research Institute/Danida/KVL.
23. Raimbault, M. (1995). Importance des bactéries lactiques dans les fermentations du manioc. *Transformation Alimentaire du Manioc. T. Agbor Egbe, A. Brauman, D. Griffon, S. Trèche (éd ORSTOM)*.
24. Ampe, F., Agossou, A., Trèche, S., & Brauman, A. (1995). Etude des facteurs influençant la durée du rouissage et la qualité du fofou en Afrique Centrale= Studies of factors which influences retting period and foo-foo quality in Central Africa. *Agbor-Egbe, Tom; Brauman, Alain; Griffon, Dany; Treche, Serge (eds). Transformation alimentaire du manioc= Cassava food processing*.
25. Tinay, A. E., Bureng, P. L., & Yas, E. A. E. (1984). Hydrocyanic acid levels in fermented cassava. *International Journal of Food Science & Technology*, 19(2), 197-202.
26. AYERNOR, G. S. (1985). Effects of the retting of cassava on product yield and cyanide detoxication. *International Journal of Food Science & Technology*, 20(1), 89-96.
27. Okafor, N., Ijioma, B., & Oyolu, C. (1984). Studies on the microbiology of cassava retting for foo-foo production. *Journal of Applied Microbiology*, 56(1), 1-13.