



Production Mapping and Description of the Organoleptic Qualities of Local Varieties of Plantain (*Musa spp. AAB*) Cultivated in Côte d'Ivoire

H. Kouassi^{1*}, E. Assemand¹, B. Konan¹ and H. Gnahé¹

¹Laboratory of Food Biochemistry and Technology of Tropical Products, Department of Food Sciences and Technologies, University Nangui Abrogoua, 02 BP 801 Abidjan 02, Côte d'Ivoire.

Authors' contributions

This work was carried out in collaboration among all authors. Author HK designed the study, managed the literature searches, collected the data of the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author EA contributed to design the study. Author BK performed the statistical analysis and reviewed the manuscript. Author HG collected the data and reviewed the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aims: A field survey was carried to apprehend the full diversity of Ivorian's plantain. The aim was to produce a reliable and up-to-date production map of the local varieties. This study was also intended to determine their level of appreciation by local consumers on the basis of their physical, technological and sensory characteristics.

Place and Duration of Study: The enquiries data were collected in 87 villages distributed into 22 regions of Côte d'Ivoire, between September and December 2017.

Methodology: During the survey, data on the production, description, processing and consumption of local plantains were collected by direct individual interviews using a structured questionnaire. This information was collected in a participatory manner from 1232 (14 producers/villages).

Results: This study identified twenty-two (22) varieties of plantain, traditionally cultivated for several generations in Côte d'Ivoire. The greatest varietal diversity has been observed in the South-East and the East, notably in the regions of Sud-Comoé, Indénié-Djuablin, Mé and

*Corresponding author: E-mail: antoninkouassi@live.fr;

Agneby-Tiassa. These varieties are variously appreciated according to their physical and organoleptic characteristics. People used them to make the usual plantain-based dishes found in Côte d'Ivoire. However, for the most questioned people, cooking specific plantain dishes requires the using of specific varieties with particular characteristics. The *Agnrin*, *Molegna*, *N'gretia*, *Molekotoba*, *Ameletia*, Purple banana and *Banadiè* varieties have been designated to be the best for "foutou". In addition, the *Banadiè* variety, even in the green state, gives a nice yellow "foutou". The above varieties are said to be perfect to prepare "Aloco", "Docklounou" and "Clacro" at advanced ripening stages. The *Afoto*, Spotted banana, *Kpatrè-kou*, *Kpatragnon*, *Kpatrè-n'san* varieties, were recommended for "foutou", "foufou", roasted or chips because of their volume.

Conclusion: Further researches are underway to explain, scientifically, the sensory and technological differences usually observed between local plantains varieties.

Keywords: Local plantain; survey; plantain mapping; sensory quality; traditional food; banana; Côte d'Ivoire.

1. INTRODUCTION

Belonging to the cooking bananas, plantain banana is a strategic crop for food security. In Côte d'Ivoire, it is the 3rd source of starch after yam and cassava. With a production close to 1.6 million tons, its national consumption is estimated at 70 kg/inhab/yr [1–3]. Plantain cultivation is mainly practiced in the subtropical zone of the country. According to Traoré et al. [4], it is in 92% of cases associated with food and/or industrial crops and 85% of plantations are family owned. Several local varieties of plantains exist in Côte d'Ivoire [5] and have been produced for several generations. They belong to the four types identified in the world: "True Horn", "False Horn", "Intermediate Horn/French" and French" [6]. However, most of these varieties are unknown to consumers and urban processors because they're not frequently cited in literature. Some of them only exist under vernacular names and are specific to an area of production. Very little exploited, they are known only by the natives, who often praise their organoleptic, nutritional and technological qualities. All of this varietal diversity is consumed in several culinary forms according to the food habits and the preferences of the consumers [7,8]. They do not hesitate to choose specific varieties for the preparation of their dishes. Moreover, it is really not easy to predict the best combination between the type of culinary preparation, the plantain variety and the stage of maturity.

In order to promote plantain and increase knowledge about the unknown and unexploited local varieties, a survey about their production and their using has been carried out. Firstly, this study has consisted of all, in assessing the varietal diversity of plantain in Côte d'Ivoire. Secondly, we carried a reliable mapping of the

production areas. Thirdly we determined the specific food uses.

This work intends to be an information guide about the geographical availability and the supplying sources of Côte d'Ivoire typical plantain's varieties. It should facilitate plantain's processors and consumers choices by directing them towards plantains varieties showing the best characteristics to obtain their desire meal or products.

2. METHODOLOGY

For the survey, only the traditional plantain (*Musa spp*), genome AAB, have been considered. It has been carried out for September to December 2017.

2.1 Survey Areas and Producers Selection

A pre-survey and bibliographic researches have permitted us to choose the survey areas. These resources have made possible to identify areas with high and low production of plantains in Côte d'Ivoire. According to the collected information, 87 villages belonging to 22 regions of Côte d'Ivoire have been chosen for their importance in the production of plantains. The sample size has been calculated according to the progressive method described by Magnani [9].

2.2 Survey Behavior

In each village, 14 producers have been selected at random or after referral to producers known by their fellow citizens. The data have been collected through direct interview using a structured questionnaire. In a participatory

manner, the interviews have permitted to collect information relating to production, physical and sensory description, processing and consumption patterns of local plantain varieties. Local plantain diversities have been inventoried on the basis of local vernacular names. The inter-varietal distinction has been based on the agromorphological descriptions and technological particularity noted by the producers.

2.3 Statistical Analysis

The analysis of the collected data was carried out using the Stata software (version 13.1, 2013). The flat sorting allowed to count and verify the coherence of the responses. Next, Khi-2 test was used to compare the means. Descriptive statistics (frequency, average) were showed in the form of figures or tables.

3. RESULTS AND DISCUSSION

3.1 Local Plantains Varieties Knowledge's Level

All the interviewed people are familiar with plantain. Among them, 40.67% were between 40 and 60 years old. The persons aged under 40 years old represent 38.23% while 21.10% were over 60 years old (Fig. 1). In most cases, women (58.91%) know most of the varieties than men. This ascertainment is closely link to their traditional position in village communities. Indeed, in certain regions, the cultivation, the

sale and the preparation of plantain are women's exclusively responsibility. In addition, culinary knowledge, including the names and technological features of plantains, are transmitted from mother to daughter.

3.2 Plantain's Systems of Production

The cultivation of local plantains is essentially non-intensive and uses rudimentary agricultural methods. Thus, only 48.66% of the farms were larger than 1 ha while 33.89% had an area less than 0.5 ha (Fig. 2). The cultivation of the different varieties is mainly associated, in 87.47% of the cases, with perennial crops (cocoa, coffee and more and more rubber) and food crops (Fig. 3). However, in the case of the association plantain/rubber, the bananas trees are only associated with the young rubber trees. In all types of associations, plantain trees are used to shade the other plants. Similar plantain cultivation techniques had been observed by Traoré et al. [4]. In Cameroon, Efanden et al. [10] concluded that plantain is associated with perennial and food crops in 77% of cases. Formerly, the primary objective of plantain cultivation in the areas surveyed was to satisfy the food needs of the families. Today, there are many monoculture plantations of plantain, those mainly intended for commerce. This proportion represents 12.53% of the respondents. Some modern production techniques adopted by the farmers have made possible the increasing of the production and its extending throughout the year (off-season cultivation).

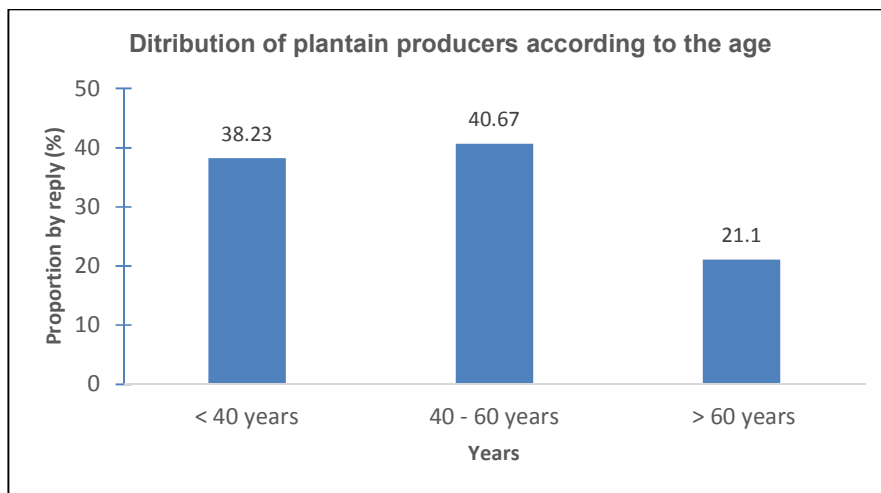


Fig. 1. Knowledge of local plantains varieties according to the producer's age

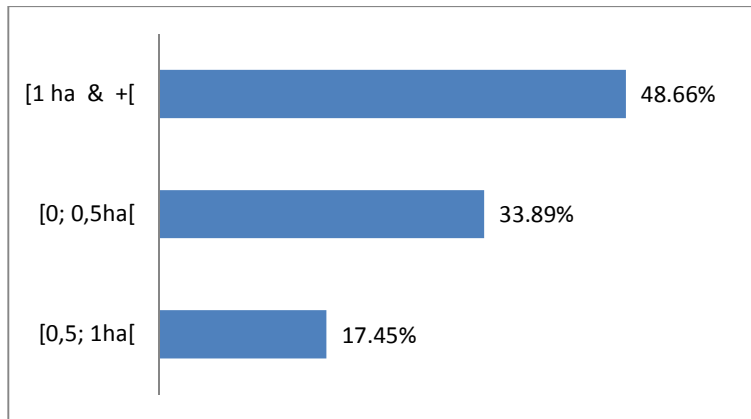


Fig. 2. Average area of plantain plantations in Côte d'Ivoire

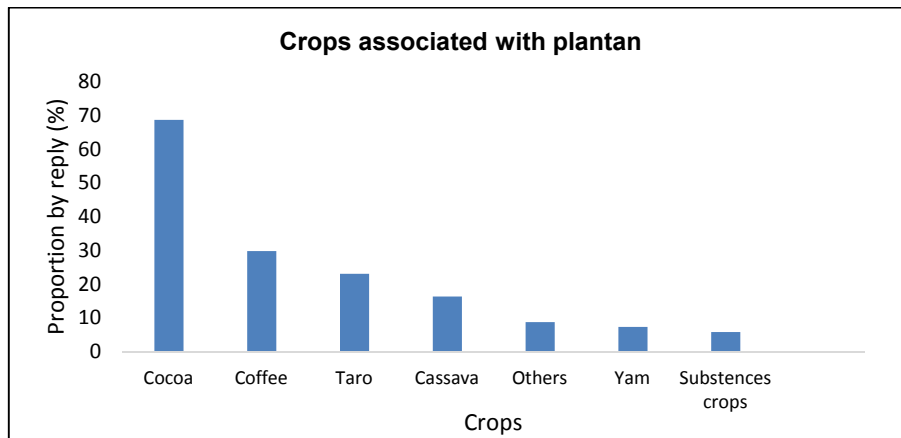


Fig. 3. Crops associated with plantain in Côte d'Ivoire

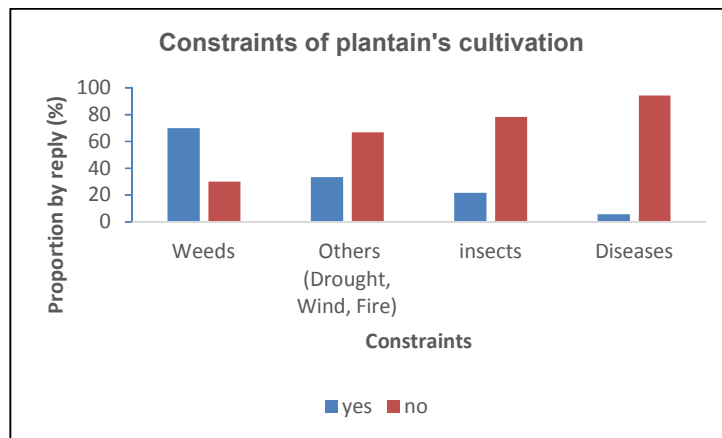


Fig. 4. Constraints of plantain cultivation in Côte d'Ivoire

3.3 Constraints of Plantain Cultivation

According to the interviewed people, the main constraints of plantain cultivation remain weeds,

insects, bad weather (drought, wind) and diseases (Fig. 4) as also observed by Ngosamnick [11]. In addition, some much praised popular local varieties have great agronomic

requirements. For example, *Molegna* has very few shoot (2 or 3 shoots) and have a very short lifespan. Therefore, producers judge them difficult to perpetuate. That is the reason why they quickly disappear. It's the case of varieties producing 2 or 3 bunches on the same stem. In addition, these constraints are amplified by some inadequate cultural practices. Indeed, as some authors have noted, the higgledy-piggledy purchase of often sick rejects, tested or unproductive, the poor preparation of plant material (poor uprooting, bad or no trimming or pralinage, etc.) and the random spacing between plants are additional constraints to the cultivation of local plantains [10,12]. Some producers don't make any distinction between the different varieties before planting the shoot. They plant them in bulk. That is what for the agricultural training would therefore be an asset to increase the local plantain's production [13]. In addition, another problem is the plantain's variable natural cycle of production (9 to 15 months) [14].

3.4 Traditional Local Varieties

In the areas surveyed, producers described twenty-two (22) varieties of local plantains (Table 1). The majority of them have been described in the vernacular languages of Côte d'Ivoire. Some varieties are found in almost all regions (*Afoto*, *Kpatragnon*, etc.) while others are more specific to production areas (*Banadiè*, *Molekotoba*, *N'glétia*, *Banablé* à l'Est). Others are endangered and are only produced on a small scale by nostalgic producers, attached to the particular characteristics of these varieties (2 or regimes one 1). All listed varieties belong to the four known types of plantains: True Horn; False Horn, Intermediate Horn/French and French [6,15]. *Molekotoba*, Intermediate type between the Horn and the French, was met in Aboisso in the south-east of the Ivory Coast. All these varieties have been very little studied on the agronomic, technological and sensory and nutritional levels. Only Wohi [16] has studied the physical and biochemical characteristics of the fruits of 9 of them.

3.5 Production Mapping of Côte d'Ivoire's Traditional Plantains

West, South-West and Center-West of Côte d'Ivoire are currently the main area of plantain production. However, the greatest varietal diversity of plantains has been observed in the

country's South-East and East, notably in the regions of Sud-Comoé, Indénié-Djuablin, Mé, and Agneby-Tiassa. The East, formerly the loop of the coffee-cocoa binomial, was once the major plantain producing area. These results confirm Perrin's [17] observations during his investigation into the plantain sector in Côte d'Ivoire. The indigenous populations of these areas, having found particular interests in each type of traditionally produced plantain, have been able to conserve and perpetuate all these cultivars. According to the survey, the majority of plantain plants, cultivated in the West zone were reported from the East by teachers, farmers looking for new land, etc. Abengourou is the city where the largest number of varieties has been recorded (21 varieties) followed by Aboisso (20) and Agboville (18). The maximum number of varieties found in the West and the Center-West is 12 in the cities of Bouaflé and Soubré. All the varieties of the West zone are also found in the East zone. The northern part of the country does not really produce bananas. Nevertheless, the *Afoto* and *Kpatragnon* varieties were observed around water points and in concessions (Table 2). All the local plantain varieties identified in the different production areas were plotted on the map of Côte d'Ivoire (Fig. 5) to reflect their geographic availability.

Table 3 provides information on the local names of mainly plantain in vernacular languages of the covered regions. These names with specific meanings often remind a peculiarity of the variety in question. This peculiarity concerns the color (*Banablé* for the purple banana), the finger's shape and size (*N'glétia* or *Tilenin*) "very small banana"; the number of hands per bunch (*Kpatragnon* "two hands"; *Kpatrè-kou* "one hand", "*Kpatrè-n'san*" 3 hands "; the good technological quality of the pulp (*Banana Diè* "king banana", *Olegna* "grain-free pulp"); the presentation of the *Molekotoba* " bunch without terminal bud "etc. ... Among Dida's region for example, the variety *Tilenin* and *Kpatragnon* are offered to a foreigner or a friend as a sign of great esteem. Lescot [14] had observed such a peculiarity linked to a culture of ancestral myths and symbols in Costa Rica. Each plantain variety have a particular meaning, whether in the context of agricultural activity: planting of a particular variety linked to a particular birth for example, or in the context of consumption: culinary preparation of a no specific variety during funeral or celebration meals.

Table 1. List of the identified local plantains varieties of Côte d'Ivoire

N°	Local plantains varieties	N°	Local plantains varieties
1	Afoto, Banakpa, or ordinary plantain	12	N'glétia
2	Agnrin	13	Agnrin
3	Ameletia	14	Plantain-poyo
4	Kpatragnon	15	3 bunch associated in 1
5	Kpatrè kou	16	Bodouka
6	Kpatrè n'san	17	Agnrin with 2 bunchs associated in 1
7	Banablé or purple plantain	18	Agnrin with 3 bunchs associated in 1
8	Spot plantain	19	Ehor
9	Olegna, Molegna, Sintré or striated plantain	20	Red big
10	Banadiè, Diè or Dechair	21	Broukalo
11	Lorougnon variety or 2 bunch associated in 1 stem	22	Molekotoba

Table 2. Number of varieties per area

Region	City	Varieties quantity	Region	City	Varieties quantity
Indénié-Djuablin	Abengourou	21	Guemon	Bangolo	7
Sud-comoé	Aboisso	20	San-Pédro	San-Pédro	7
Agneby-Tiassa	Agboville	18	Cavally	Guiglo	7
Mé	Adzopé	15	Cavally	Blolekin	7
Indénié-Djuablin	Agnibilékro	13	Gboklè	Sassandra	7
Nawa	Soubré	12	Iffou	Daoukro	7
Marahoué	Bouaflé	12	Tonkpi	Man	6
	Bonon	11	Grands ponts	Dabou	6
N'zi	Bongouanou	10	Gbèkè	Sakassou	5
Haut Sassandra	Daloa	10		Bouaké	5
Marahoué	Sinfra	9	Gontougo	Bondoukou	4
Gôh	Gagnoa	9		Séguéla	4
Guemon	Duékoué	8	Boukani	Bouna	2
Tonkpi	Danané	8	Poro	Korhogo	2
Loh-djiboua	Divo	7			

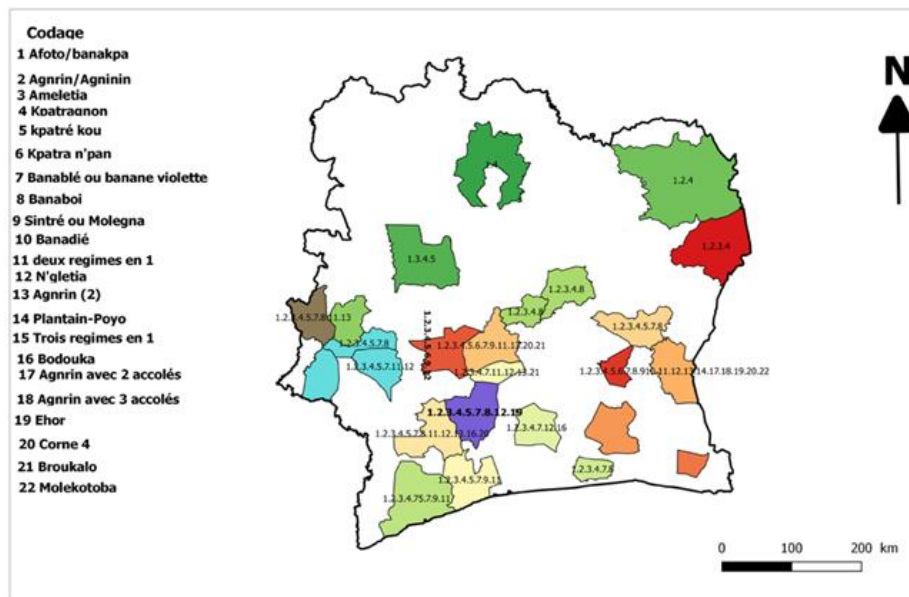


Fig. 5. Mapping of local plantains varieties production in Côte d'Ivoire

Table 3. Local plantains names in several ethnics group of Côte d'Ivoire

N°	Usual/Local name	ethnics and plantains names							
		Agni	Baoulé	Attié	Abbey	Beté	Gouro	Wê	Dan
1	Afoto/Banakpa/Ordinary banana	Banakpa	Afoto/Banakpa	Doumou	N'dé	Kofahi/kofo	Bongue	Gbloh	Gbaha
2	Agrin	Agrinin	Agrin	Doumougè	N'deté	Bétré/bitré/glodjehi	Chiefan	Soho	Slôh
3	Ameletia	M'meletia	Meletia	Assaman	N'dé assamala	-	-	Téhè	Mlohoun-pouhou
4	Kpatragnon (2)	Ataplègnon /Assaboué	Kpatragnon/ Assamiegnon	Amantékô	N'dé-chihalagnon	Panfié	Zianin/pinfié	Mahé-sonh /Bahé-sonh	Gnandolet
5	Kpatrè-koun (1)	Taplekoun	Kpatrè-koun	-	N'dé-chihankpô	-	-	Mahodoué/Bahodoué	-
6	Kpatrè-n'san (3)	Taplé-n'zan	Kpatrè-n'san	-	N'dé chiharin	-	-	-	-
7	Banablé/Purple banana	Banablé/Kaki	Banablé	Amandoumou/Gabo	N'déséhé	Gbagbogamahi	-	Nô-pélé	-
8	<i>Spotted banana</i>	Banaboi/Aboua	Kagalémanda	Kékédoumou	-	-	-	-	-
9	Olegna, Sintré or <i>Striated banana</i>	Olegna/Molègna	Bolaya/Atipo	Bana-hein /kiekpo	-	-	-	-	-
10	Banadiè	Banadié/Déchaire	diè	diè	N'débrandadirè	-	-	-	-
11	Lorougnon variety	-	-	-	-	-	-	Doè	Kokoulaglô
12	N'glétia	N'glétia	N'gretia/Assaboué	Apétoua	N'deba-n'guidi	Tiré	Tilenin-tiré	-	-
	Attiebana	-	-	-	-	-	-	-	-
13	Agrin (2)	-	Agrin	-	-	-	-	-	Boué pélé
14	plantain-poyo	-	Kolatia	-	N'dé-koko	-	-	-	-
15	<i>Plantain 3 bunches associated</i>	-	-	-	-	-	-	-	-
16	Bidouka	-	-	-	-	-	Bidouka	-	-
17	Agrin 2 bunches associated	-	-	-	-	-	-	-	-
18	Agrin 3 bunches associated	-	-	-	-	-	-	-	-
19	Ehor	Éhor	-	Doussin	N'dé bagbo	-	-	-	-
20	Big red	-	-	-	-	-	-	-	M'lohoun tih
21	Broukalo	-	Bana-maya	-	-	-	Broukalo	-	-
22	Molekotoba	Molekotoba	-	-	-	-	-	-	-

Table 4. Local plantains varieties features and adapted traditional dishes in Côte d'Ivoire

N°	Local name	Scientific name	Genotype	Type	Varieties physicals features of fruits	Adapted dishes
1	<i>Afoto ou Banakpa</i>	Horn 1	AAB	False horn	Most encountered original banana, fleshier fruit, large size, easy to pound	<i>Foutou, Foufou, Roasted, Dockounou</i>
2	<i>Agnrin</i>	light French	AAB	French	Thin, lots of hands (9 to 12 hands), very sweet after ripening	<i>Foutou, Akpesi, Aloco, Tankan-tankan</i>
3	<i>Ameletia</i>	-	AAB	False horn	Short and large with rounded tip, banana eaten by the <i>kômians</i>	<i>Foutou, Roasted, Aloco</i>
4	<i>Kpatragnon (2)</i>	-	AAB	Horn	Bunch with 2 hands, very large fruit 30 to 40 cm	<i>Foutou, foufou, Roasted, chips</i>
5	<i>Kpatrè kou (1)</i>	-	AAB	True horn	1 hand on the bunch, very large fruit 30 to 40 cm in size	<i>Foutou, foufou, Roasted, chips</i>
6	<i>Kpatrè n'san (3)</i>	-	AAB	True horn	3 hands on the bunch from 30 to 40 cm	<i>Foutou, foufou, Roasted, chips</i>
7	<i>Purple plantain or banablé</i>	Horn 5	AAB	False horn	Purple fruit	<i>Foutou, Akpesi et purée</i>
8	<i>Banaboi or Spotted banana</i>	Spotted Horn	AAB	False horn	Green fruit with black spots. When ripe, it turns yellow with black spots	<i>Foutou</i>
9	<i>Olaya, Sintré, Striated banana</i>	-	AAB	French	Thin and joined fingers with or without ring, pulp without black grain	<i>Foutou, Apesi, Boiled</i>
10	<i>Banadiè, Dechair or Diè</i>	-	AAB	False horn	Smooth skin, no sap, yellowed pulp after cooking with water even in the green state, pound hot	<i>Foutou, Aloco</i>
11	<i>2 bunch associated Variety</i>	Lorougnon Variety's	AAB	False horn	2 adjoining bunches carried by a pole, Do not cut the leaves,	<i>Foutou, Aloco</i>
12	<i>N'glétia</i>	-	AAB	French	Fruit of small size 10 to 15 cm and numerous with the rounded tip	<i>Foutou</i>
13	<i>Agnrin 2</i>	French dark green	AAB	French	Large banana tree with more than 15 hands, thin and elongated fruits	<i>Foutou, Akpesi</i>
14	<i>Plantain-poyo</i>	-	-	Dessert	Small fruit eaten raw or cooked, boiled with the skin	<i>Foutou, raw</i>
15	<i>Plantain 3 Bunches on 1 stem</i>	-	AAB	False horn	3 adjoining bunches carried by a pole, Do not cut the leaves	<i>Foutou</i>
16	<i>Bodouka</i>	-	AAB	French	Slender fruits, elongated, large in size with a pointed apex	<i>Foutou</i>
17	<i>Agnrin 2 bunches associated</i>	-	AAB	French	Thin fruits on 2 bunches joined by a pole	<i>Foutou</i>
18	<i>Agnrin 3 bunch associated</i>	-	AAB	French	Thin fruits on 3 different diets combined	<i>Foutou</i>
19	<i>Ehor</i>	-	AAB	False horn	Banana with 1, 2 or 3 fruits on the bunch	<i>Foutou</i>
20	<i>Big Red</i>	Horn 4	AAB	False horn	Purple (or brown) banana tree with shorter and larger green fruits	<i>Foutou, Foufou</i>
21	<i>Broukalo</i>	-	AAB	French	Many hands with very large thin bananas (rare)	<i>Foutou</i>
22	<i>Molekotoba</i>	-	AAB	Intermediate French/Horn	Fruit more or less bulky and elongated with many hands on the bunch	<i>Foutou</i>

3.6 Appreciation of the Different Varieties

The level of appreciation of local plantain is mainly guided by agro-morphological, sensory and technological parameters. However, for the respondents, based on their culinary experiences and habits, only the organoleptic and technological characteristics are primordial in the choice of varieties for the preparation of specific dishes. When the choice is given, they use certain varieties more than others for traditional foods at various stages of ripening. In general, the True horn and Horn, which are fleshier and easier to mix or crush, are commonly used for "foutou". These bananas are also used by people who like less tender "foutou". Conversely, the French, with a firmer pulp, will give a firmer and tender "foutou". In fact, the "Akans" people who live in central Côte d'Ivoire, generally prefer a very tender and firmer "foutou". That's why they frequently use Agnrin. It means that the desire quality of foutou is closely linked to the type of plantain and dietary habits as in Cameroun [18]. For water-cooking or frying ("Aloco"), French type are much appreciated more than Horn type .

3.7 Special Features of Traditional Local Varieties in Côte d'Ivoire

Afoto or Banapka or ordinary banana: *Afoto* or *Banapka* or *ordinary banana* is scientifically known as Horn 1. This variety is the most widespread and used in Côte d'Ivoire. The *Afoto* variety is especially appreciated for its short production cycle, its robustness face of climatic conditions and the average size of its fingers (20 and 30 cm). According to the respondents, *Afoto's* fruit is thick and easy to be transformed into "foutou" or "foufou". It is therefore much appreciated in the roasted form.

Agnrin or Agninin: *Agnrin* or *Agninin* variety is the most popular after *Afoto* in rural and urban areas [8]. Its bunch can carry up about 12 hands on average. The fruits are thin, elongated and measure 20 to 30 cm. *Agnrin* is very popular because its use guarantees a firmer and tenderer "foutou" (easy to cut and chew). These are the main qualities sought by lovers of "foutou". This variety is also adulated in water-cooked form named "N'gbô" or "Akpesi" or after frying ("Aloco", "craçlo") at full ripeness stage. *Agnrin* is very sweet and absorb less oil when frying. It is also advised to breastfeeding women in rural areas for its nutritional qualities [19].

Ameletia or M'meletia: *Ameletia* or *M'meletia* fruits are short, large and have a rounded apex. They give a very elastic, tender and sweet "foutou". *Ameletia* also gives good "Aloco" and good chips. This plantain, a false horn, is widely consumed by the "Komians" (exorcising fetishists) during exorcism rituals among the "Akan" area. Lescot [14] made a similar observation in Costa Rica regarding the using of certain bananas for celebrations or funerals. *Ameletia* fruit's size is between 10 and 20 cm.

Kpatragnon, Kpatrè-kou and Kpatrè-n'san varieties: *Kpatragnon*, *Kpatrè-kou* and *Kpatrè-n'san* varieties are "True horns" and have respectively 1, 2 and 3 hands on a bunch. They are appreciated for their short reproduction cycle, their resistance to drought and for the large size of the fruits (30 to 40 cm). Twins are not allowed to consume *Kpatragnon* among the "Dans", people living in the West of Côte d'Ivoire.

Purple plantain or Banablé: *Purple plantain* or *Banablé* is known by scientists under the name of "Horn 5". It is a "False horn" which has purple fruits. It's very appreciated for the preparation of "foutou", *Akpesi* and puree.

Banaboi, Spotted banana, or spotted Horn: *Banaboi*, *Spotted banana*, or *spotted Horn* is a "False horn" with black spots on the peel. It is recommended in "foutou" or roasted. Its fruit measures between 20 and 30 cm.

Olaya Sintré, Striated banana, Ninglinin, Molegna or Molaya: *Olaya Sintré*, *Striated banana*, *Ninglinin*, *Molegna* or *Molaya* is a "French" type. Its fingers are thin, numerous and close together with or without a ring (or streaks on the fruit). The pulp does not contain black seeds or aborted seeds. This plantain is the best for a very tender and smooth "foutou". It is also very good for stews and "Akpesi" because of its sweetness. It would also be suitable for a good "Aloco". It remains firm and sweeter at the advanced ripening stage. The size of the fruit is between 10 and 20 cm.

Banadiè, Banadirè, Dechair, King Banana or Diè: *Banadiè*, *Banadirè*, *Dechair*, *King Banana* or *Diè* do not produce sap when it is removed away from the bunch. His skin is light green and very smooth. The fruit can measure on average 20 to 30 cm long. In the green state, it has a yellow pulp after water-cooking. It gives a tender "foutou", with a beautiful yellow coloring.

2 bunch associated variety: This variety is also called parental variety Lorougnon; the first name of Professor Lorougnon Guédé who discovered it [20]. The tree emits two simultaneous bunches carried on a single flower stalk during the inflorescence. It is appreciated for “*foutou*” and “*Akpesi*”.

N’glétia or N’gretia: N’glétia or N’gretia is a French type. Its fruits are very small (5 to 10 cm) with a number of hands greater than 15 like a bunch of dessert bananas. It gives a firmer “*foutou*” and a very sweet and firm “*Aloco*”. However, the preparation of dishes with this variety requires a significant number of fingers.

Agnrin 2: The skin of the fruit is dark green. The fingers are thinner and elongated with many hands on the bunch. The fruits attain 20 cm and would be suitable for “*foutou*” and “*Akpesi*”.

Plantain-poyo: It is a dessert banana with small fruits. It can be eaten raw after ripening or boiled with the skin. It is found in the regions of Agboville and Abengourou.

Plantain 3 bunches on 1 stem: This variety is rare. It produces three bunches simultaneously on a single stem. It has been identified in the region of Divo. Good for “*foutou*”, the size of the fruits is between 20 and 30 cm.

Bodouka: Bodouka is a rare variety that has been listed in the region of Soubré (Daberoua). The bunch has many hands like French type bananas. Fruit size is between 30 and 40 cm.

3.8 Most Popular Consumption Patterns of the Identified Varieties

In the study areas, water-cooking is the most used cooking method before roasted and frying. Other modes of consumption (sun-dried, raw, etc.) are rarely mentioned (Fig. 6). All of these methods are simultaneously used by individuals, depending on the time availability, the means and the ripening stage of the plantain. Frying is not much used in rural areas because of poverty (people haven’t money to buy oil) and people culinary habits. According to the respondents, all varieties can, by default, be used to cook plantain-based dishes. However, the French type varieties, *Agnrin*, *Molegna*, *N’gretia*, *Molekotoba* (Intermediate type), *Ameletia* and *Banadiè* (False horn type) are the most praise for “*foutou*” (Fig. 7). This dish is very popular in rural and urban areas of Côte d'Ivoire [8,17]. These varieties give a very tender, firm, elastic, smooth and well-colored “*foutou*”. Assemmand et al. [19] observed that the Agnrin variety (French type) has a good intrinsic binding capacity so that the use of a small quantity of cassava (ingredient used as binder) was enough to make a good “*foutou*”. The varieties of this type of plantain, are also excellent in the form of porridge and “*Akpesi*”. Also, they would give a very good “*Aloco*” because of their very pronounced sweet taste and their firmness in an advanced stage of ripening. True horn and false horn type plantain are very popular because of the large size and volume of their fingers. Seeing that, their weak intrinsic bonding capacity is weak. That make

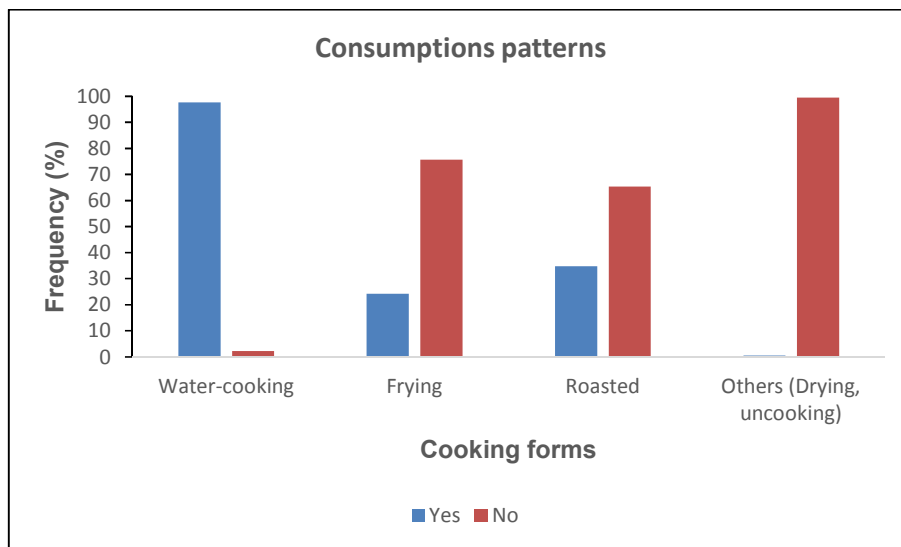


Fig. 6. Cooking forms of plantain in Côte d'Ivoire

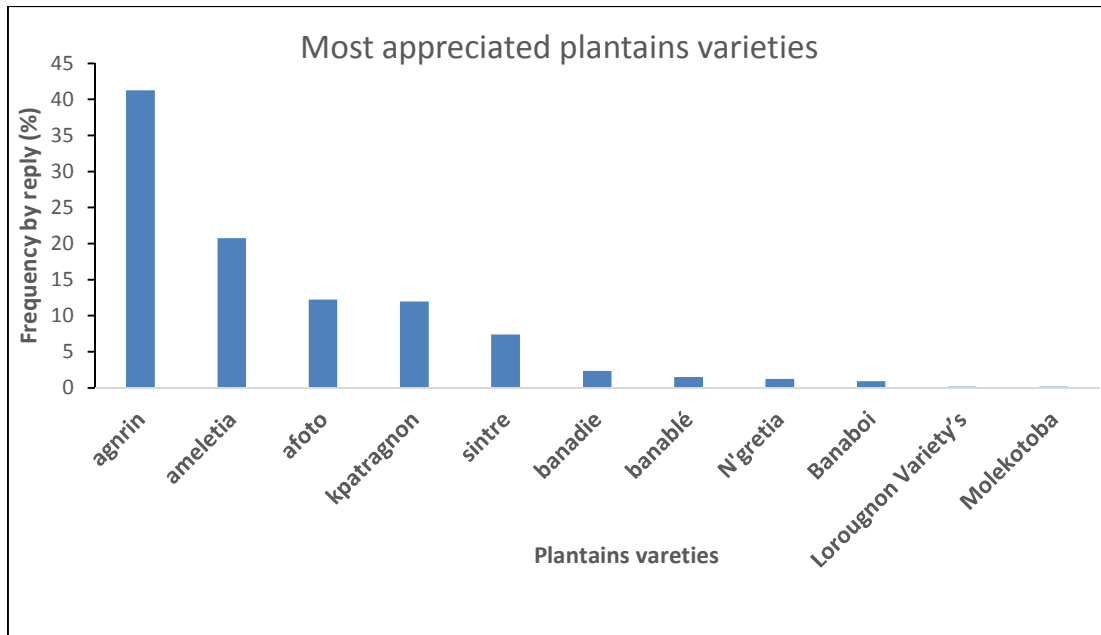


Fig. 7. Most appreciated plantains varieties in Côte d'Ivoire

them very easy to crush and very malleable. They are therefore suitable for making "foufou". However, *Ameletia*, *Purple Banana* and *Banadié* are very popular. According to the interviewed consumers, they give a firmer "foutou" with a nice color.

At the very advanced ripening stage, most of the varieties would be suitable for making "Dockounou" [21] and banana sauces. The "Tankan-tankan" (sun-dried ripe crumbled plantain) and the "N'gasro" are the much known plantain meal in Centre of Côte d'Ivoire.

These dishes have been often cited because only eight (8) plantain-based dishes are known by more than 90% of the population [1,18]. Some preparations are specific to the culinary habits of the natives, such as the "Gamanzohoun" specific to the Bété in the Centre-west of the country. It's a sort of mashed plantain, ripe or green, mixed with seed sauce or red oil.

Obviously, a link exists between the cooking behavior of plantains, their mode of consumption and their adoption by consumers as could be attested Belayneh et al. [22] in his survey on 4 varieties of cooking bananas from Ethiopia. In Nigeria boiled plantain is the most important consumption mode after fried cooking bananas [23,24]. In Cameroon, consumers prefer a specific type of plantain, more than others, to make boiled bananas [25,26].

4. CONCLUSION

This exploratory study identified twenty-two (22) local varieties of plantain traditionally produced for several generations in Côte d'Ivoire. All of these bananas have special features. The east of Côte d'Ivoire is the home of the greatest variety diversity. Women know more ancestral varieties than men. Even if, some of the local varieties of plantain are known by consumers and processors (such as *Afoto* and *Agnrin*), most of them remain unknown in scientific, agronomic, technological and nutritional terms. For most of the producers encountered, the appreciation of local varieties is strongly linked to their agromorphological and especially sensory and technological characteristics. Some varieties would be better to prepare some special popular dishes ("Foutou", "Akpassi", etc.). The consumers consider the plantain varieties abilities in their eating habits. Water-cooking is the most common plantain processing method in Côte d'Ivoire. *Agnrin*, *Molegna*, *N'gretia*, *Molekotoba*, *Ameletia*, *Purple banana*, and *Banadié*, are adored for making a firm, elastic, sweet and very yellow foutou. These same varieties would be perfect for making Aloco, "Docklounou" and "Clacro". Varieties *Afoto*, *Spotted plantain* (False horn) and *Kpatrè-kou* (1), *Kpatragnon* (2), *Kpatrè-n'san* (3) [True horn] are larger, better for preparing "foutou", "foufou", roasted banana and chips.

Far from pretending to be an exhaustive repertoire of plantains from Côte d'Ivoire related to consumption patterns, this work lays the groundwork for scientific work to be carried out about neglect local plantain. In continuation of this investigation, a study of the impact of culinary preparations on the sensory quality of local plantains is being carried out.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Coulibaly S. Physico-chemical, rheological characterization, sensory analysis of the fruits of some banana cultivars (*Musa* AAB, AAAA and AAAB). Doctoral Thesis, Department of Food Science and Technology, Abobo-Adjamé University, Abidjan (Côte d'Ivoire). 2008;171.
- FAO. The world banana economy 1985-2002. 2003;1–10.
Available:<http://www.fao.org>
- FAOSTAT. Plantains statistic. Food Agric. Organ. United Nations; 2017.
Available:<http://www.fao.org/faostat/en/#data/QC>
Cited: 2018 Jul 20
- Traoré S, Kobenan K, Kouassi KS, Gnonhourig G. Plantain cultivation systems and pests management by smallholder producers in Côte d'Ivoire. *J Appl Biosci*. 2009;19:1094–101.
Available:<http://m.elewa.org/JABS/2009/19/8.pdf>
- Kouassi KS, Gnonhourig GP, Yao NT, Kobenan K, Assiénan AB. Cultivate plantains well in Côte d'Ivoire. *Centre Nati Rech Agron (CNRA)*; Abidjan. 2005;4.
- Thiémélé D, Traoré S, Aby N, Gnonhourig P, Yao N, Kobenan K, et al. Diversity and participatory selection of local productive varieties of plantain from Côte d'Ivoire. *J Appl Biosci*. 2017;114:11324–35.
- Coulibaly S, Koffi LB, Amani NG. Sensorial compared analysis of two with vegetable oil fried products from four new banana hybrids and orishele variety. *Agron Africaine*. 2007;19(2):223-231.
- Kouamé CA, Kouassi K, Yao N, Amani N. Plantain (*Musa spp.*, AAB genome) cultivar preference, local processing techniques and consumption patterns of plantain based foods mostly consumed in urban area of Abidjan, Côte d'Ivoire. *Nat Technol*. 2015;12:117–29.
- Magnani R. Sampling guide. *Food Nutr Tech Assist*. 2001;51.
- Efanden C, Kwa M, Temple L, Foudjemtita D. Plantain production in the peri-urban area of Yaoundé. In: L'Harmattan, editor. *Agriculture and urban development in West and Central Africa*. Yaoundé. 2005; 139–47.
Available:<http://hal.cirad.fr/cirad-00951298>
- Ngo-samnack EL. Plantain banana tree. *La Voix Du Paysan (LVDP)* No. 260. Cameroun. 2013;6–14.
- Thiemele D. Cropping systems with plantains in Côte d'Ivoire. *Atelier CRP-RTB*, Abidjan. 2013;6.
- Dépigny S, Tchotang F, Talla M, Fofack D, Essomé D, Ebongué JP, et al. The 'Plantain-Optim' dataset: Agronomic traits of 405 plantains every 15 days from planting to harvest. *Data Br. Elsevier Inc*. 2018;17:671–80.
Available:<https://doi.org/10.1016/j.dib.2018.01.065>
- Lescot T. Environmental fertility and peasant strategies in the humid tropics. In: CIRAD, editor. *Colloq Actes séminaire 13-17 Novembre 1995*. Montpellier, France: CIRAD. 1995;9.
- Wohi M. Physical characterizations of the fruits and biochemical, physico-functional parameters of the flours and starches of the fruits of nine local cultivars of plantain (*Musa* sp.) from Côte d'Ivoire. Doctoral Thesis, Department of Food Science and Technology, Nangui Abrogoua University, Abidjan (Côte d'Ivoire). 2015;214.
- Wohi M, Coulibaly S, Fatoumata C, Yao BN, Tano K. Minerals and phytochemicals contents of nine local plantain cultivars (*Musa spp.*) of Côte d'Ivoire. According to the Boiling Time. 2017;3:87–94.
- Perrin A. Study of the plantain banana sector in Côte d'Ivoire. Côte d'Ivoire. 2015;66.
- Dury S, Bricas N, Tchango-Tchango J, Temple L, Bikoi A. The determinants of

- urban plantain consumption in Cameroon. *Food Qual Prefer.* 2002;13:81–8.
19. Assemamd E, Camara F, Kouamé F, Konan V, Kouamé LP. Biochemical characterization of plantain fruits (*Musa paradisiaca* L.) "Agnrin" variety from Ivory Coast and sensory evaluation of its derived products. *J Appl Biosci.* 2012;60:4438–47.
 20. Kouadio K. Determination of the optimal cutting point and nutritional potential of the fruits of the plantain hybrid PITA 3, PITA 8 and of the plantain varieties Lorougnon and Corne. Doctoral thesis, Department of Food Science and Technology, Nangui Abrogoua University, Abidjan (Côte d'Ivoire). 2015;155.
 21. Kra KAS, Akoa E, Megnanou R-M, Yéboué K, Akpa EE, Niamké LS. Physicochemical and nutritional characteristics assessment of two different traditional foods prepared with senescent plantain. *African J. Food Sci.* 2013;7:51–5.
Available:<http://academicjournals.org/journal/AJFS/article-abstract/0427E6B12299>
 22. Belayneh M, Workneh TS, Belew D. Physicochemical and sensory evaluation of some cooking banana (*Musa spp.*) for boiling and frying process. *J Food Sci Technol.* 2014;51:3635–46.
DOI: 10.1007/s13197-013-0940-z
 23. Honfo FG, Tenkouano A, Coulibaly O. Banana and plantain-based foods consumption by children and mothers in Cameroon and Southern Nigeria: A comparative study. *African J Food Sci.* 2011;5:287–291.
Available:[http://www.academicjournals.org/AJFS/PDF/Pdf2011/May/Honfo et al.pdf](http://www.academicjournals.org/AJFS/PDF/Pdf2011/May/Honfo%20et%20al.pdf)
 24. Odenigbo M, Asumugha VU, Ubbor S, Nwauzor C, Otuonye C. Proximate composition and consumption pattern of plantain and cooking-banana. 2013;3: 1035–43.
 25. Dury S, Bricas N, Tchango JT, Biko A. Consumption and plantain quality criteria in Douala and Yaoundé. *Afrique / Africa.* 1998;507–23.
 26. N'goh Newilah G, Tchango-Tchango J, Fokou E, Etoa F-X. Processing and food uses of bananas and plantains in Cameroon. *Int Food Res J.* 2016;23:998–1004.
DOI: 10.1051/fruits:2005031

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