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RESEARCH ARTICLE

Cooking practices, consumption and sensory perception of *Ntuba ekōn*: a traditional dish consumed in Cameroon

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Abstract

Ntuba ekōn is a traditional dish commonly consumed in Cameroon, made from boiled and pounded plantain (*Musa paradisiaca*). Nowadays, it is gradually disappearing from household eating habits in urban areas. A better understanding of the different artisanal culinary practices, consumption habits and acceptance criteria for this traditional dish is needed to popularize it in urban areas. This study aimed at evaluating the cooking practices and consumption habits of *ntuba ekōn* in five regions of Cameroon. A survey was conducted through structured questionnaires amongst 916 individuals living in urban areas (Centre, East, Littoral, West and South Cameroon regions). The survey revealed the existence of two main groups of culinary practices: cooking with or without peel, with small variations in the sequence of unit operations between them, but also with regard to traditional culinary practices. The main unit operations were peeling, washing, scalding and pounding the cooked plantain pulp. The paste is then rolling and cutting. Whatever the urban cooking practices, the difficulties are the same: tedious pounding and time-consuming preparation, the cost of plantain due to its scarcity, and storage problems. This traditional dish is usually eaten at traditional events. The desired sensory perceptions are: smooth, tender texture, yellow color and slightly sweet taste, characteristics that could only be obtained by using plantains between the third (more green than yellow) and fourth (more yellow than green) stages of ripening. Cooking *ntuba ekōn* remains tedious and not adapted to the new urban lifestyle.

Keywords: Ntuba ekōn, traditional dish, cooking practice, sensory perception.

1. Introduction

Plantains are amongst the major food crops cultivated and consumed in many sub-Saharan countries (Kataliko *et al.,* 2022). They play an important role in food security and contribute to generate employment in Central and West African countries (De Langhe, 2000; Dzomeku *et al.,* 2007; IITA, 2000).

In 2020, the production of plantains and cooking bananas was estimated at 32 420 031 tonnes in sub-Saharan Africa, with Cameroon producing about 4 523 625 tonnes (FAO, 2020). Plantains are widely consumed in Cameroon because of their sweetness. Furthermore, plantain constitute a rich energy source respectively, rich in vitamins A, B6, C, minerals and dietary fibre (Honfo *et al.,*

2007; Lusty *et al.,* 2006; Ngoh *et al.,* 2005). Plantain also plays an important role in family events such as weddings, funerals, and the celebration of a newborn child, particularly in the South (Dury *et al.,* 2002; Okolle *et al.,* 2009). Despite the importance of plantains in the region and Cameroon at large, it still suffers post-harvest losses along the supply chain. According to the National Institute of Statistics, 20 to 40% plantains are lost at post-harvest stages in Cameroon (NIS, 2017). Strategies to reduce the effect of post-harvest losses are numerous, amongst them there is a variety of processing or cooking methods depending on the region and the ripening stage (Mbarga, 2013; Ngoh Newilah *et al.,* 2005).

Some studies have presented the main forms of plantain consumption in Cameroon. These include plantain chips and fries, boiled or roasted plantain, and plantain porridge, flour or dough (Ngoh Newilah *et al.,* 2005; Nafack Tsazeu *et al.,* 2023). This last form is also called *ntuba ekōn* in Centre and South Cameroon. This paste is obtained by grinding plantain pulp, which is generally green and cooked with boiling water. This traditional dish is highly prized by the *Fang* people because it is satietogenic and represents a luxurious form of plantain consumption (Mbarga, 2013). It was originally developed for elderly people with chewing and swallowing problems. Over time, consumption of this dish gradually spread to the diets of other ethnic communities in Cameroon. In rural areas, the consumption of *ntuba ekōn* remains anchored in the culinary habits of the *Fang* people (Mbarga, 2013). With the modernization of lifestyles and cooking practices in urban households, traditional dishes like *ntuba ekōn* considered difficult to prepare, are tending to disappear from eating habits (Essomba *et al.*, 2010). In some African countries, similar traditional dishes made from plantain have been characterised, such as "*foutou*", a dish originating from West Africa and "*foufou*" (Gnagne *et al.,* 2017; 2023; Zoumenou *et al.,* 1999), or "*M'bahou*", a traditional couscous based on plantain, from the culinary heritage of Agni and Baoulé, an ethnic group from the east and centre of Ivory Coast (Nguessan *et al.,* 2022). To our knowledge, scientific information about traditional cooking practices and consumers perception of *ntuba ekōn* is still limited. A better understanding of such information is needed to enhance the adoption, production, and utilization of plantain derived products in Cameroon. In order to contribute to the reduction of post-harvest losses and to improve traditional products based on it, the present study aimed to provide a better understanding of a traditional plantain-based foods *ntuba ekōn* cooking practice and consumption in five regions of Cameroon using survey.

2. Materials and Methods

2.1. Study area

The study was carried out in five regions of Cameroon (Centre, East, Littoral, West and South), in the main towns of these regions (Fig. 1). The Centre region covers 68.926 km^2 and is composed of rolling hills on a vast plain with a mean altitude of 700–800 m, with lowered mounds. The population density is about 36 inhabitants/km^2 (BUCREP 2010; NIS, 2006). The Littoral region is covering an area of 20.239 km^2, the population density is 124 inhabitants per km^2. The west region covers 13.872 km^2 and is mountainous, marked by highlands with a mean altitude of 1600 m and narrow valleys with catchments separating them. The climate has a unimodal wet season. The population density is relatively high, with about 143 inhabitants/km^2 (BUCREP 2010). The East region is the largest

region as well as the most sparsely populated with 109,002 km^2 of territory. The population density is 7.7/km^2.

The climate is a wet equatorial climate meaning that it experiences high temperatures. The south region occupies 47,720 km^2 of territory, making it the fourth largest region. Humidity is high, and precipitation averages 1500–2000 mm per year in the interior and 2000–3000 mm per year in the coastal region, the density is 16 inhabitants per km^2. These regions were chosen for various reasons, as they are plantain producers and consumers compared with regions with a Sudano-Sahelian climate where plantain consumption is very moderate. Figure 1 presents the study areas.

Figure 1. Map of the study area.

2.2 Study design and data collection

In March 2022, a pre-survey was carried out in the Littoral (Douala, Nkongsamba), Centre (Yaoundé, Soa), South (Ebolowa, Sangmélima), West (Dschang, Bafoussam) and East (Bertoua) regions. It enabled preliminary data to be collected in order to define the urban structure of the product studied. Then a descriptive survey was carried-out from May to August 2022. The data was collected through structured questionnaires using the "showball effect" method. The questionnaire was introduced online via the Sphinx Declic 2 platform and the access link was shared via various social networking platforms. This approach permits to collect and process data easily. It allows the variables to be ordered and minimises any errors that might arise during the questionnaire processing phase. The survey was carried out among 916 individuals spread across the various urban sites studied. Finally, a small field survey was conducted among 10 producers of *ntuba ekɔ̄n* in suburb of the city of Ebolowa to determine their traditional culinary practices.

2.3. Questionnaire design

The questionnaire provided to the panel included: Raw material selection criteria; Knowledge and consumption of pounded plantain (*ntuba ekɔ̄n*); The sequence of unit operations involved in the preparation of this traditional dish; The constraints that may limit the preparation of *ntuba ekɔ̄n*; The occasions, places, motivations and frequency of consumption of *ntuba ekɔ̄n* and their sensory perception of this food. The socio-demographic characteristics of the respondents were considered as additional variables. Four socio-demographic variables were used to characterise the individual: gender, age, region of origin and sector of activity.

2.4. Statistical Analysis

Data were processed using univariate analysis as the chi-square test combined with an analysis of variance (ANOVA). The interdependence of the observations was evaluated at the 5% risk

threshold. Multivariate analysis was done through principal component analysis (PCA). The results of the analysis were illustrated by graphical representations between the different variables and the study factor. Univariate analyses were performed using Statgraphics v.19. Principal Component Analysis was performed on Excel using the XLSTAT 2016 extension.

3. Results and discussion

3.1. Socio-demographic characteristics of consumers

Socio-demographic characteristics are presented in Table 1. About 916 persons participated to the survey around the five regions selected, respectively 32.76% in the Littoral, 27.40% in the Centre, 17.13% in the West, 15.63% in the South and 7.06 % in the East. Amongst them, 50.98% were men and 49.02% women. The age group mostly represented was between 21-30 years (52.51%). Students were the most represented (34.61%), followed by the employees of the public sector. In terms of region of origin, 42.36% of individuals were from West Cameroon.

3.2. Cooking practices of Ntuba ekōn in urban area

3.2.1. Selection of plantain variety and ripening stage according to study region

Consumer choice criteria are guided by the fact that the cultivar can be compared to a plant that has developed specific characteristics that are maintained to maintain certain desired characteristics, and fruit ripening as a complex developmental process involving significant changes in texture, colour, flavour, aroma, nutrient metabolism and other quality characteristics that ultimately make the fruit attractive, desirable and edible (Bouzayen *et al.,* 2010; Liu *et al.,* 2023). The use of appropriate plantain cultivars is critical, since the choice of plantain cultivar and the stage of ripening are determining factors in the final quality and acceptability of this traditional food as described by Assemand *et al.* (2012). A correct interpretation of the survey data requires a multivariate analysis that takes into account the socio-demographic characteristics of the study by region.

Figure 2 shows the Principal Component Analysis (PCA) of the choice of plantain variety and ripening stage for the preparation of *ntuba ekōn* according to the different regions studied. The active variables likely to influence the choice of raw materials used in the preparation of this food are the variety and ripening stage of the plantain and the addition of starchy foods. These were defined on the basis of a chi-square test. Additional variables were added in order to better discriminate the whole population living in the same study region. These variables include all the socio-demographic characteristics defined in this study. Two principal components (F1 and F2) explain 74.85% of the total variance. The first principal component (F1) explains 46.01% of the total variance and the second principal component (F2) explains 28.84%. According to the correlation circle (Figure 2A), the F1 axis corresponds to the variety of plantain (green to slightly more yellow than green), while the F2 axis correspond to the addition of starchy foods to the ripe plantain (yellow to yellow with black spots). Information on starchy foods (active variables) such as cocoyam (macabo) and taro, people (additional variables) from the Centre (CE) and South-West (SW) region, or who work in the public and private sectors (PPS) or in other activities (OA) are carried by the 3rd (F3) and 4th (F4) principal components. These axes divide the figure into four zones (Figure 2B).

Zone 1 includes people interested in the variety of plantain used to prepare *ntuba ekōn*. *Ntuba ekōn* is prepared using all the varieties available on the local market, in particular *Mbouroukou* N°3 and *Batard*, which are collected at different stages of ripeness, from semi-ripe (more yellow than green) to over-ripe (yellow with black spots). This choice reflects the interest that people in this group may have in moderately sweet foods. Depending on the cost and availability of the raw material on the market, some people in this group may add starchy foods such as bananas and cassava to the plantain to be crushed. This approach modifies the textural and organoleptic properties of this food, with the risk of denaturing the traditional dish.

Table 1. Socio-demographic characteristics according to regions surveyed

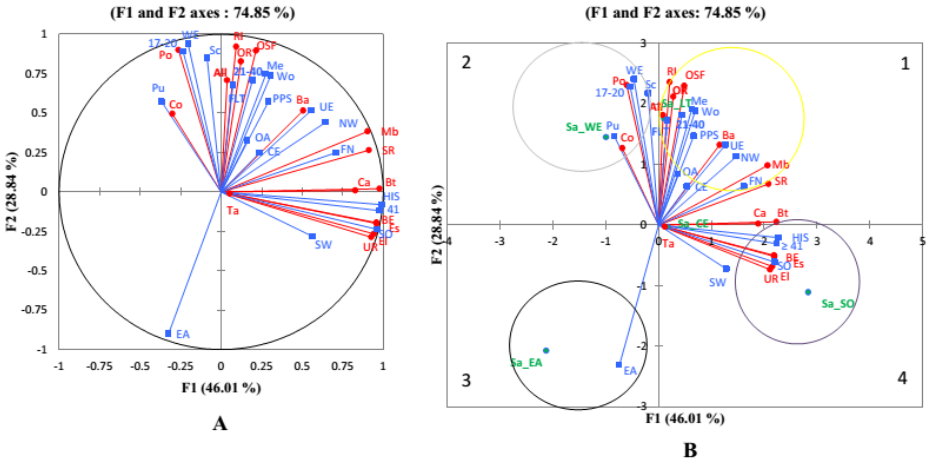
Variables	Littoral (%)	Centre (%)	West(%)	South (%)	East (%)	Total (%)
Socio demographic						
Gender						
Male	153 (32.76)	128 (27.40)	80 (17.13)	73 (15.63)	33 (7.06)	467 (50.98)
Female	165 (36.74)	120 (26.72)	70 (15.59)	71 (15.81)	23 (5.12)	449 (49.02)
Age (Years)						
17 - 20	23(26.74)	22(25.58)	36(41.86)	3(3.48)	2(2.32)	86 (9.39)
21 - 30	187(38.87)	126(26.19)	81(16.83)	51(10.60)	36(7.48)	481 (52.51)
31 - 40	89(33.33)	83(31.08)	30(11.23)	49(18.25)	16(5.99)	267 (29.15)
41 - 50	15(27.27)	11(20.00)	3(5.45)	24(43.63)	2(3.63)	55 (6.00)
> 50	4(14.81)	6(22.22)	0	17(62.96)	0	27 (2.95)
Main activity						
Pupils	3 (13.64)	2 (9.09)	14(63.64)	1 (4.54)	2 (9.09)	22 (2.40)
Other	3 (13.04)	8(34.78)	6(26.08)	4 (17.39)	2 (8.69)	23 (2.51)
Housewife	6(18.18)	6(18.18)	6(18.18)	13(39.39)	2 (6.06)	33 (3.60)
Unemployed	22(44.89)	12(24.48)	3(6.12)	12(24.48)	0	49 (5.35)
Informal sector	17(20.73)	16(19.51)	7(8.53)	39(47.56)	3(3.65)	82 (8.95)
Private sector	45(33.33)	44 (32.59)	17 (12.59)	23(17.03)	6 (4.44)	135 (14.74)
Public sector	92(36.07)	69(27.05)	29 (26.72)	39(11.37)	26(10.19)	255 (27.84)
Students	130 (41.00)	91(28.70)	68 (21.45)	13(4.10)	15(4.73)	317 (34.61)
Region of origin						
Foreigners	6 (66.67)	1 (11.11)	0	1 (11.11)	1 (11.11)	9 (0.98)
Southwest	3 (33.33)	0	0	4 (44.45)	2 (22.22)	9 (0.98)
Adamawa	4 (33.33)	2 (16.67)	1 (8.33)	4 (33.33)	1 (8.33)	12 (1.31)
North	5 (41.67)	1 (8.33)	1 (8.33)	4 (33.33)	1 (8.33)	12 (1.31)
Northwest	2 (16.67)	2 (16.67)	4 (33.33)	4 (33.33)	0	12 (1.31)
Extreme North	8 (40.00)	5 (25.00)	0	6 (30.00)	1 (5.00)	20 (2.18)
East	3 (9.37)	5 (15.63)	1 (3.12)	7 (21.88)	16 (50.00)	32 (3.49)
Littoral	76 (65.52)	17 (14.65)	12 (10.34)	8 (6.90)	3 (2.59)	116 (12.66)
South	24 (19.51)	24 (19.51)	1 (0.81)	70 (56.91)	4 (3.25)	123 (13.43)
Centre	51 (27.87)	88 (48.09)	10 (5.46)	24 (13.11)	10 (5.46)	183 (19.98)
West	136 (35.05)	103 (26.55)	120 (30.93)	12 (3.09)	17 (4.38)	388 (42.36)

This group is mainly made up of people of both sexes, aged between 21 and 40, from the Littoral region and foreigners, as well as unemployed people living in the Littoral region. This could be explained by the fact that people who live in the city of Douala, the country's economic capital, and have time-consuming jobs, no longer have the

time or energy to prepare a tedious dish at the end of the day.

Zone 2 represents a group of people who do not necessarily have specific knowledge or requirements regarding the type of plantain recommended for the preparation of *ntuba ekōn*, but use any plantain available on the local market, preferably ripe.

Zone 3 is made up of people who have no particular preference as to which variety to use. However, it must be completely unripe. This zone is mainly made up of people from and living in the East Region, whose expectations are the opposite of those in zone 1. It is important to note that people from the East, Centre and South regions of Cameroon form a large group with a common past (ethnography).



Caption: a) Actives variables: **Bt**: batard; **BE**: big ebanga; **El**: elat /akoss; **Es**: essong; **Mb**: mbouroukou N°3; **All**: all plantain varieties; **UR**: unripe; **SR**: semi-ripe; **RI**: ripe; **OR**: overripe; **Ba**: banana; **Ca**: cassava; **Co**: cocoyam; **Po**: potatoes; **Ta**: Taro; **OSF:** other starchy food; **b)** Additional variables: **Me**: men ; **Wo**: women; **Pu**: pupils; **Sc:** Scholar; **PPS**: private and public sector; **HIS**: housewife and informal sector; **UE**: unemployed; **OA**: other activity; **CE**: Centre; **EA**: East; **WE**: West; **SO**: South; **FLT**: foreigners and Littoral; **FN**: Far North; **NW**: North West; **SW**: South West; **c)** Actives: **Sa_LT**: study area Littoral; **Sa_CE**: study area Centre; **Sa_WE**: study area West; **Sa_SO**: study area South; **Sa_EA**: study area East.

Figure 2 PCA for raw material selection according to regional study (A: Correlation circle, B: Biplot)

They tend to mix plantain with potatoes. This could be explained by their eating habits, given that they are mainly from and live in the West region. In their diet there is a similar traditional dish consisting of potato dough, plantain dough or a mixture of the two starchy foods stuffed with black beans. As a complementary socio-demographic characteristic, this group is mainly made up of young people (17-20 years old) and is more likely to break the codes of eating habits, taking into account their main activity (pupils and scholars). Academic circles are known to be ethnic melting pots.

Zone 4, on the other hand, represents a group of people who have knowledge of and demand for the variety of plantain (*Elat/Akoss*, *Essong* or *Big Ebanga*) to be used in the preparation of *ntuba ekōn*. Another characteristic of the raw material is that the plantain must be unripe (green). This finding is consistent with information from Newilah *et al.* (2005) and Mbarga (2013), who reported that unripe *Elat* is the plantain variety most commonly used in the preparation of *ntuba ekōn*. This group consists mainly of individuals from the South region (the region of origin of *ntuba ekōn*), most of whom work in the informal sector or are housewives, and are aged 41 years

and above (mature person). Residing mainly in the South Region, they may have a certain know-how of traditional cooking practices acquired over the years that needs to be preserved.

Some culinary practices that seem to improve *ntuba ekōn* quality are for instance adding starchy tubers like cassava or potatoes on pounded plantains.

for consumers with a preference for plantain *fufu*. Plantain is known to have available starch of 56.29% and 17.50% of resistant starches but lacks the viscoelastic/pasting properties that are required in typical plantain-cassava pounded *fufu* (Pacheco-Delahaye *et al.,* 2008). However, the textural characteristics of pounded plantain (usually not smooth and elastic) are improved by adding cassava (Ogazi, 1996).

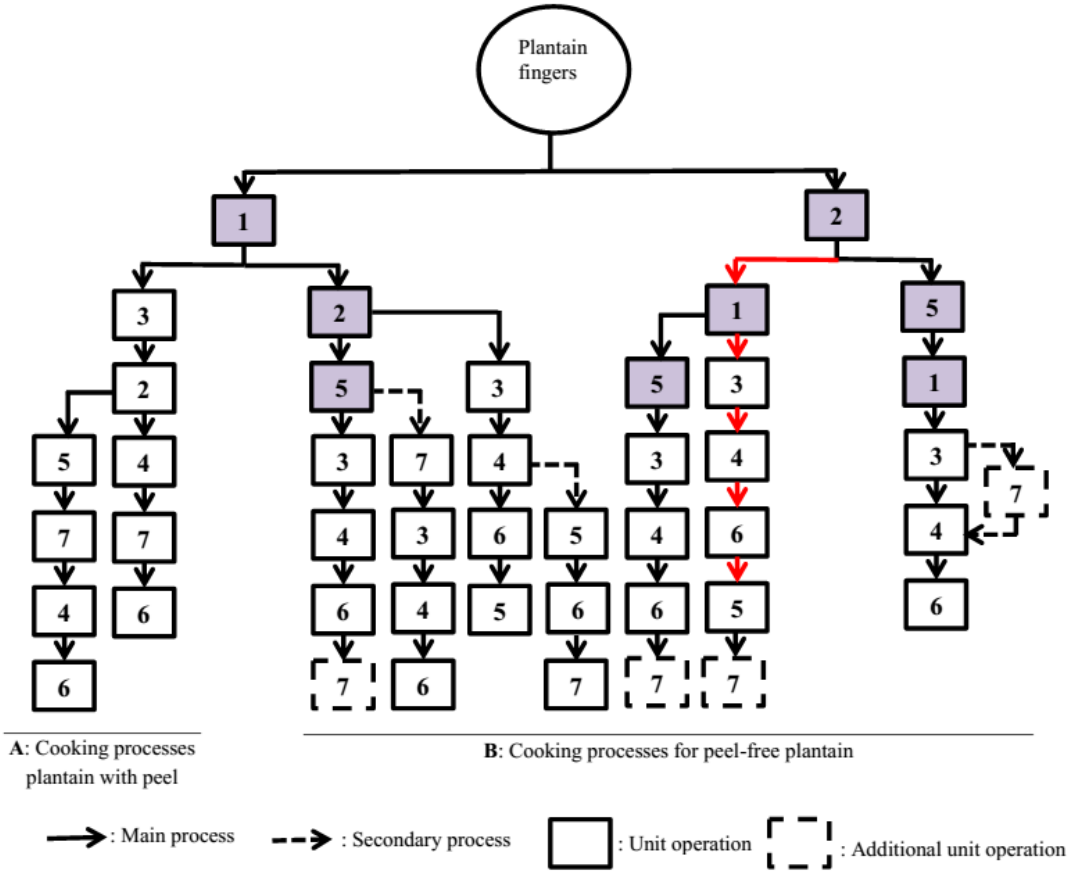


Figure 3 Block flow diagrams of *ntuba ekōn* production in urban areas

Similar traditional foods, such as *fufu* or *foutou* in some African countries such as Ghana or Ivory Coast, are cooked by mixing plantains with other tubers (Yao *et al.,* 2019). Nowadays processors have developed flours with high plantain content

Starch is the main component of the cassava roots and plays a vital role in the use of cassava as a food and industrial crop (Ceballos *et al.,* 2006). The starch is expected to behave as texture modifier and hence should modulate or control

the pasting properties of the resulting *fufu.* Hence the production of *fufu* from plantain puree and cassava starch with the right proportion will give a desired texture that will be appealing to consumers.

3.2.2. Ntuba ekōn cooking process and constraints

In the traditional process for preparing *ntuba ekōn* (Figure 4), after peeling, the sliced plantain pulps are washed with water at room temperature. They are then cooked by scalding.

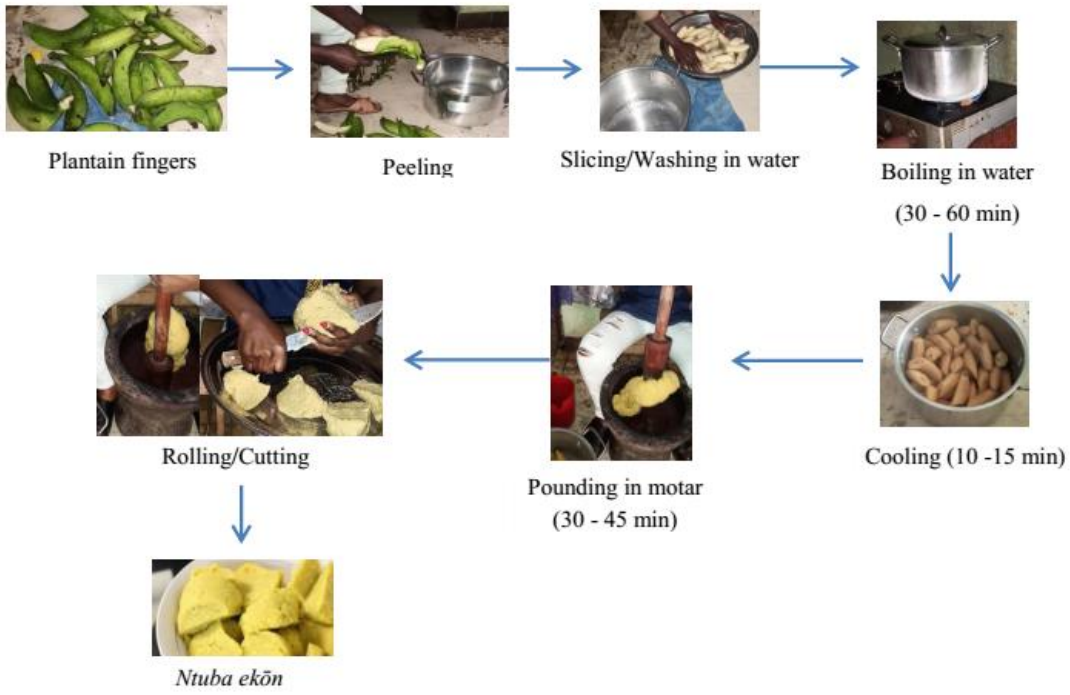


Figure 4: Traditional cooking process of *ntuba ekōn*

After cooking, the pulp is drained, cooled to room temperature and ground in a wooden mortar. This process continues until a supple, homogenous paste is obtained that is more or less sticky (Mbarga, 2013; Ngo newilah *et al.,* 2005). The plantain paste is then rolled and cut with a braiding wire or knife. The food is now ready to eat. As part of this study, only 17 of the numerous processes listed were selected on the basis of the number of citations (≥ 5 times) and subjected to a technical analysis in order to be presented in the form of a Block Flow Diagram (BFD). This study revealed two main processes (A and B; Figure 3). The process consisting of scalding plantain pulp with its peel (A) presented an interesting prospect that could have an impact on the technological and nutritional properties of the final food (Ngo Newilah *et al.,* 2020; Egwujeh & Yusufu, 2019).

The survey also revealed that the most common production method for this foodstuff (chain in red) in urban areas consists of peeling the plantain fingers, washing the pulps, scalding them, pounding them, and finally rolling and cutting the paste. These *ntuba ekōn* production processes

differ from the traditional process mainly because the plantain pulp is not cooled before pounding (B: chain in red; Figure 3 and 4). This modification of the process would have an impact on the texture profile of the final food. Similarly, interchanging the unit operations (grey box) of washing, peeling and cutting would have no real impact on the final nutritional and textural properties of the food.

The unit operations identified during the survey in urban areas are presents in figure 4, these are washing/peeling/slicing the plantain fingers, seasoning, scalding and pounding the plantain pulp followed by rolling and cutting the dough. Washing/Peeling/Slicing are generally manual. They consist respectively of removing all forms of impurities from the plantain fingers, separating the peels from the pulp used for preparation and cutting it into pieces. 74.42% of producers first peel (A) the plantain fingers. Washing is done using only water in a basin. Peeling is an operation carried out with a knife (74.65%) or a bamboo spatula (25.35%), and some authors have worked on mechanising it (Olutomilola, 2021). These operations are interchangeable without affecting the properties of the food. In the case of scalding, 75.20% of respondents said they cooked plantain pulp by immersion in water, compared with 24.80% who used the steam method. The average cooking time is 30 min. The variability of the energy source has an impact on cooking time. Despite the lack of dependence observed between the cooking method with or without peel/immersion or steam and cooking time or energy source, it is important to emphasise that the work of Egwujeh & Yusufu (2019) and Ngo Newilah *et al.* (2018) showed the effect of cooking methods and time on the general properties of food. Scalding is therefore an operation that determines the final quality of the food and deserves to be investigated. Plantain pulp is pounded to obtain a more or less homogenous paste. This is the most critical operation in the preparation process due to a lack of hygiene. It also requires physical energy to obtain a homogenous paste (Gnagne *et al.,* 2023). It has a direct impact on the granulometry, textural properties and acceptability of the product (Markusse *et al.,* 2018). The study showed that 97.37% of producers carried on this operation using a wooden pestle and mortar. The majority of producers (72.35%) pounded the plantain pulp while it was still hot. The average duration of pounding was 15-25 min. Seasoning is controversial and is not listed in the traditional process (Figure 4). The survey revealed that 37.98% of producers said they don't use it, 34.43% of them added salt, 16.51% added water during the pounding and 11.08% used other ingredients. Rolling is the process of shaping the plantain dough before cutting. The round shape is the most frequently cited (51.87%) by producers. Cutting is done using a braiding wire (traditional practice) or a kitchen knife (modern practice). The method, time and heat source of cooking, the thermal state of the plantain pulp and the duration, is pounded depends on the respondent's region, age, occupation and region of origin. The study confirmed that the natives of the South Cameroon region allowed the plantain pulp to cool before pounding it. It is believed that this is the best way to preserve the characteristics of the plantain dough for the longest time. These process parameters and the characteristics of the raw material have an impact on the organoleptic properties and texture profile of the food, as well as its essential nutrient content (Kristianwan *et al.,* 2019).

Table 2. Limitation of traditional *ntuba ekōn* preparation by study region

Variables	Cooking constraints					
	Littoral (%)	Centre (%)	West(%)	South (%)	East (%)	Total (%)
Tedious pounding	62 (28.05)	56(25.33)	27(12.21)	63(28.50)	13(5.88)	221 (28.30)
High cost	59 (33.90)	58(33.33)	25(14.36)	28(16.09)	4(2.29)	174 (22.28)
Sap cleaning	34 (24.28)	25 (17.85)	22 (26.72)	56(15.71)	3 (2.14)	140 (17.92)
Long preparation time	17 (16.19)	22 (20.95)	14(13.33)	50 (47.61)	2(1.90)	105 (13.44)
Shortage	26 (32.09)	19 (23.45)	12 (14.81)	24 (29.62)	0	81 (10.37)
Hygienic	4(12.12)	8(24.24)	2(6.06)	17(5.51)	2(6.06)	33 (4.22)
Another	8(29.52)	4(14.81)	7(25.92)	8(29.62)	0	27 (3.46)

The cooking process of *ntuba* is accompanied by a certain number of constraints as shown on table 2. Most *ntuba ekōn* producers (28.30%) living in urban areas complained about the tedious nature of the production process. Pounding, which requires extra preparation time and an enormous expenditure of energy, tends to make this food gradually disappear from the diet in the homes of working men and women (Otoo *et al.,* 2018). The high cost (22.28%) and shortage (10.37%) of plantain observed in urban markets are two constraints associated with post-harvest losses due to the perishability and seasonal nature of this fruit-vegetable, transportation problems caused by bad roads between production basins and urban consumption sites, the lack of storage facilities for this fruit-vegetable and many others (Dury et al., 1998; Bakouétila et al., 2016; Gnagne et al., 2023). The sap cleaning (17.92%) and the hygienic aspect of the process (4.22%) is the third constraint reported by *ntuba ekōn* producers, who are increasingly aware that the traditional pounding of foodstuffs puts off many consumers (Otoo et al., 2018). The very long preparation time (13.44%) and other problems (3.46%) constitute the fourth group of constraints that could contribute to the reduction of the *ntuba ekōn* preparation process in urban areas.

This result corroborates those obtained by Otoo *et al.* (2018) and Treche *et al.* (1992). Technological innovations that contribute to the development of new products could be considered as possible solutions to overcome the difficulties associated with the traditional method of preparing *ntuba ekōn* (Fakorede *et al.,* 2021).

3.3. Consumption of ntuba ekōn by type of urban area

The survey results showed that about two out of three people in urban areas (65.17%) consume *ntuba ekōn.*

This is in line with the work of Ngoh Newilah *et al.* (2005) who presented *ntuba ekōn* as one of the preferred forms of plantain consumption in Cameroon. The breakdown of consumption by study region is as follows: South: 93.75%; East:

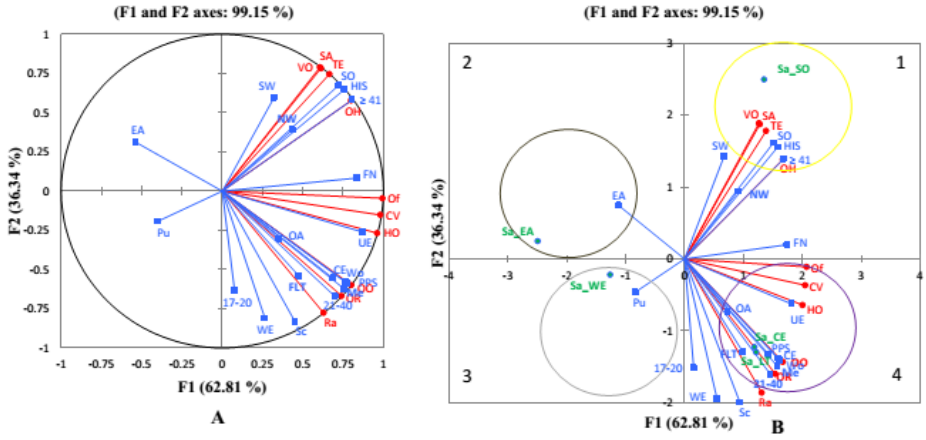
73.24%; Centre: 67.74%; West: 54.66%; Littoral: 53.77%.

This result could be explained by the fact that the first three regions in this ranking are home to the trilogy of sister peoples known under the global name of Ékang. These sister peoples share certain cultures and eating habits. The large disparity in *ntuba ekōn* consumption between these study regions suggests the significant influence of other variables that require multivariate analysis.

Figure 5 shows the principal component analysis (PCA) of *ntuba ekōn* consumption by study region. The active variables likely to influence consumption of this food are place of consumption, occasions of consumption, reasons for consumption and frequency. These were defined on the basis of a chi-square test. Additional variables were added in order to better discriminate the whole population living in the same study region.

total variance. The first principal component (F1) explains 62.81% of the total variance and the second principal component (F2) explains 36.34%. According to the correlation circle (Figure 5A), the F1 axis reflects the recency of the place of consumption, while the F2 axis reflects the frequency of consumption occasions and motivations. These axes divide the figure into four zones (Figure 5B).

Zone 1 is made up of people who very often eat *ntuba ekōn* at traditional events, usually outside the home, where the main motivation is to feel full. This group is mainly made up of people aged 41 and above, from the South, South West, North West and Far North regions, who either work in the informal sector or are housewives. These characteristics are specific to people living in the South Region of Cameroon.



Caption: a) Active variables: **HO**: house; **OH**: outside the house; **TE**: traditional events; **OO**: others opportunities; **Ra**: rarely; **Of**: often; **VO**: very often; **SA**: satietogenic; **CV**: cultural values; **OR**: others reasons; b) Additional variables: **Me**: men; **Wo**: women; **Pu**: pupils; **Sc**: Scholar; **PPS**: private and public sector; **HIS**: housewife and informal sector; **UE**: unemployed; **OA**: other activity; **CE**: Centre; **EA**: East; **WE**: West; **SO**: South; **FLT**: foreigners and Littoral; **FN**: Far North; **NW**: North West; **SW**: South West; c) Actives: **Sa_LT**: study area Littoral; **Sa_CE**: study area Centre; **Sa_WE**: study area West; **Sa_SO**: study area South; **Sa_EA**: study area East.

Figure 5. PCA of *ntuba ekōn* consumption according to region surveyed (A: Correlation circle, B: Biplot)

These variables include all the socio-demographic characteristics defined in this study. Two principal components (F1 and F2) explain 99.15% of the

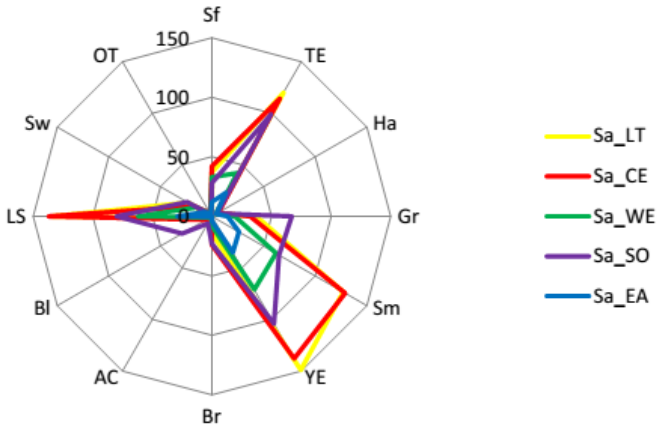
The fact that the South is the most popular region for eating *ntuba ekōn* is understandable, as *ntuba ekōn* is a traditional dish in this region, which is

not as urbanised as the Centre and Littoral regions.

Zone 2 is made up of people who, like those in Zone 1, consume *ntuba ekōn* on a regular basis, but less so outside the home, beyond traditional events. The majority of these people come from and live in the East region. The East region is in second place just behind the South. This result can be explained by the eating habits of the inhabitants of this region, who are known for their high consumption of '*couscous*', a food made from cassava flour (Biwole, 2017; Njiembokue & Moupou, 2020).

Zone 3 represents a group of people who often consume *ntuba ekōn* opportunistically and without any real motivation. This eating habit is characteristic of people living in the West Region and can be likened to that of schoolchildren who are generally not given a choice of foods to eat at family meals. This could simply be explained by the fact that this is a community that is still very attached to its traditional culture and, despite the ethnic mix, is not sufficiently open to the outside world. What's more, their eating habits include a variation of this dish: pounded plantain, which consists of roasting the plantain with beans and then pounding it. The result is plantain dough stuffed with beans.

Zone 4 characterises a group of individuals who occasionally consume *ntuba ekōn* for its cultural values and when the opportunity arises. Consumption is mainly at home. This could be mainly due to the fact that this group is characterised by young people (21-40 years old) of both sexes, whose main daily activities (scholars, public and private sector workers) are time consuming and exhausting, and a mix of people from the Centre, Littoral and West regions, as well as foreigners.



Caption: Sf: soft; **TE**: tender; **Ha**: hard; **Gr**: grainy; **Sm**: smooth; **YE**: yellow; **Br**: brown; **AC:** another colour; **Bl**: bland; **LS**: lightly sweet; **Sw**: sweet; **OT**: other taste; **Sa_LT**: study area Littoral; **Sa_CE**: study area Centre; **Sa_WE**: study area West; **Sa_SO**: study area Sout ; **Sa_EA**: study area East.

Figure 6. Sensory attributes of *ntuba ekōn* according to Cameroonian urban areas of study

of its traditional dishes based on crushed tubers (Markusse *et al.,* 2018), the West region ranks fourth in terms of consumption of *ntuba ekōn*. fifth respectively in terms of ntuba ekōn consumption. The disparity in *ntuba ekōn* consumption between the South and Centre

regions, despite their ethno-cultural proximity, is proportional to the disparity in the rate and level of urbanisation. It is also important to note that the Centre and Littoral regions are respectively home to Yaoundé (the political capital) and Douala (the economic capital), the country's two main urban centres.

All these data corroborate those of Essomba *et al.* (2010), Poulain *et al.* (2015), Bokombola *et al.* (2018), Grandval *et al.* (2012) and Bricas *et al.* (2016) and reflect the dynamics of food habits under the influence of cultural urbanisation.

3.4. Sensory perception of ntuba ekōn

According to Bodnaruc *et al.* (2019), food choices are guided by a multitude of interrelated factors grouped into three categories: factors related to the food itself (e.g., sensory attributes), factors related to the individual making the choice (e.g., expectations, health status) and external factors (e.g., availability, cost). The sensory attributes of *ntuba ekōn* were determined in this study through data on respondents' perceptions of this food. As a result, *ntuba ekōn* is described as a tender smooth, yellow and slightly sweet plantain paste (Figure 5). These attributes depend closely on the production process. The colour and taste of the food are directly related to the nature and ripening stage of the plantain variety (Assemand *et al.,* 2012; Gnagne *et al.,* 2017; Fakorede *et al.,* 2019). To have a yellow colour and a slightly sweet taste, plantain should be chosen between stages 3 and 4 (from greener than yellow to yellower than green). They also depend on the cooking conditions (Aboubakar, 2009). The consistency and appearance of the paste depend on how it is pounded. Knowing that this is one of the pillars on which the organoleptic quality of a food product is based the analysis of the texture profile and granulometry of *ntuba ekōn* could be one of the levers of innovation worth investigating by technologists.

4. Conclusion

Ntuba ekōn is a traditional dish consumed in rural and urban area. The high consumption of this food at home and friends' houses makes it a family food. Cooking practices are not very varied, but are considered chronophagus and tedious. Some unit operations need to be optimised to make the cooking process less tedious and ensure more consistent quality in the finished products. The current production system for this foodstuff is therefore poorly adapted to the demands of the new consumer style and urban lifestyle. From these observations could arise a multitude of prospective work aimed at optimising and standardising the technology for preparing *ntuba ekōn*.

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Conflict of interest

The authors declare that there are no conflicts of interest.

Ethics

This Study does not involve Human or Animal Testing.

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