

Identification of the processes and the uses of *Tanga*: Dried ripe plantain (*Musa paradisiaca*) pulp produced in Côte d'Ivoire

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Abstract

The plantain banana is an excellent source of energy and nutrients and one of the main financial resources for many people in Côte d'Ivoire. Its losses due to rotting during storage make it impossible to ensure its availability. To fight against losses, northern population in the Gontougo region dry plantain pulp "*Tanga*" for many others uses. This study was undertaken to identify the drying process of "*Tanga*" and its main uses. Thus, a food consumption survey was made in the departments of Bondoukou, Koun-Fao and Transua with 135 households per zone. Data revealed that "*Tanga*" production is most carried out by women (76.05%). High percentage of producers and consumers were uneducated (74.32%), Ivorians (96.15%) and farmers (94.82%). To produce "*Tanga*", plantain bananas are dried to avoid losses (94.81%) in Koun-Fao and for cultural practice in Bondoukou and Transua (96.30% and 73.33% respectively). "*Tanga*" is consumed by rural populations to have strength, for health reasons and the eating habits. The production processes of "*Tanga*" vary according to the localities studied and eight (8) dishes based on "*Tanga*" were identified. The frequency of consumption varies from 1 to 3 times a month. The production pattern for "*Tanga*" is different in all three localities. Encouraging the full use of plantain by developing products from senescent plantain is a good step towards improving food sustainability.

Keywords: Plantain; *Tanga*; Food uses; Production diagram; Côte d'Ivoire

1. Introduction

Plantain (*Musa paradisiaca* AAB) is an economically important crop for food security, particularly in developing countries [1]. In Côte d'Ivoire, plantain is the third most widely grown food crop after yam and cassava [2,3], with production of 2 126 264 million tonnes [4]. Plantain is a very important traditional staple food for rural and urban populations, as well as a vital source of income. Its importance as a cash crop is increasing with urbanisation and its growing use, thus having an impact on Gross National Product [5]. The main plantain cultivars in Côte d'Ivoire are the 'French' and 'Corne' cultivars [6]. All these varieties are classified as triploid with the AAB genomic group [6]. Plantain is very difficult to preserve due to its high perishability [7]. This high perishability is essentially due to two types of factors, exogenous and endogenous [8], and is the cause of major post-harvest losses in the banana industry. As a result, plantain is mainly marketed and consumed immediately after harvest, with around 85% of production consumed and/or sold locally [9].

Plantain undergoes several processing technologies that depend on its ripening stage. These transformations include different preparation methods such as frying, boiling, roasting, pounding, boiling and steaming [10, 1]. In its senescent

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state, plantain is used in the preparation of many local dishes or snacks [1] in which the most common are claclo, m'bahou, dockounou and apity [11, 12]. However, in some regions of Côte d'Ivoire, particularly in Gontougo, senescent ripe plantain pulp is dried in the sun to produce a food product called "*Tanga*". This dried pulp is eaten directly or can be used to make numerous dishes. The use of "*Tanga*" for other dishes depend on many parameters such as the stage of plantain ripeness, the degree of pulp drying, the method of solar drying and the method of storage. But no scientific data exist concerning these variations factors. So, the aim of this study is to identify the "*Tanga*" production process in all the Gontougo region.

2. Materials and Methods

2.1. Study area

Three departments (Bondoukou, Koun-Fao and Transua) compose the region of Gontougo in Côte d'Ivoire. The Gontougo region covers an area of 1 770 km². It is bordered to the north by the Bounkani region, to the south by the Indénié-Djuablin region, to the east by the Republic of Ghana, to the north-west by the Hambol region and to the south-west by the Iffou region. The region has an estimated population of 917 828 including 473 635 men and 444 193 women [13]. The Gontougo region is 420 km from Abidjan, the economic capital, and around 418 km from Yamoussoukro, the political capital of Côte d'Ivoire. The region is located in a Sahelian climate zone, characterised by a long rainy season from May to July and a long dry season from November to April [14].

2.2. Target population and sampling

The target population consisted of households in the departments of Bondoukou, Koun-Fao and Transua, which are areas where ripe dried bananas are produced and consumed. Based on the importance of dried ripe bananas consumption practices, villages were selected after a pre-survey with village chiefs in the various localities in each department. A total of nine villages were selected, including three villages per zone. The selected villages in the department of Bondoukou are Amodi, Amoitini and Gbéréda. Akroidokikro, Kotoukou-Ayéra and Kokomian are the villages selected in the department of Koun-Fao. In the department of Transua, the villages of Yao-Nango, Nyame-Beykre and Kouadio-Kissikro were surveyed. The number (n) of individuals to be surveyed was calculated using the [15] formula for an independent non-exhaustive sample

$$n = \frac{t^2 \times p(1 - p)}{e^2}$$

where:

n = minimum number sought for the sample;

t= 95% confidence level (standard value of 1.96);

p = estimated prevalence of households making dried bananas in the study area, p estimated at 50% since the total number of people making dried bananas is not known;

e = margin of error at 5% (value of 0.05).

Thus, the minimum number (n) of the sample sought is:

$$n = \frac{1,96^2 \times 0,5(1 - 0,5)}{0,05^2} \approx \mathbf{385 \text{ individuals}}$$

The minimum size of consumers was 385. They were selected using snowball techniques and the criterion used was the representativeness of households by department. To compensate for errors in items that could probably be filled incorrectly, a further 20 households were added per zone, bringing the total number of households surveyed to 405, i.e 135 households per zone [16].

With a survey form sent to the chief of households, the identification of the respondent, the "*Tanga*" production process and its uses were investigated.

3. Results

3.1. Socio-demographic characteristics of "Tanga" producers and consumers

The socio-demographic characteristics of "Tanga" producers and consumers in the households of Bondoukou, Transua and Koun-Fao departments are presented in Table 1. Data showed that Tanga production is more carried out by women (76.05%). The heads of household are natives (92.84%), with a minority of allochthonous (3.33%) and non-natives (3.95%). Producers are uneducated (74.32%) and their main activity is farming (94.82%).

Table 1 Socio-demographic characteristics of dried banana-producing households.

Characteristics	"Tanga" production and consumption areas			Total
	Bondoukou	Transua	Koun-Fao	
Gender (%)				
Male	11.85	25.93	34.07	23.95
Female	88.15	74.07	65.93	76.05
Level of education (%)				
No instruction	80.74	78.52	63.70	74.32
Primary	12.59	15.56	25.93	18.03
Secondary	6.67	3.70	9.63	6.67
Higher education	0.00	0.74	0.74	0.49
Koranic	0.00	1.48	0.00	0.49
Origin (%)				
Aboriginal	100.00	85.19	93.33	92.84
Allochthonous	0.00	8.15	1.48	3.33
Non-native	0.00	6.67	5.19	3.95
Occupation (%)				
Unemployed	0.74	1.48	3.70	1.97
Minor occupation	2.96	2.22	4.44	3.21
Farmer	96.30	96.30	91.85	94.82

3.2. Motivations for producing and consuming "Tanga"

3.2.1. Production reasons

Table 2 data showed that the reasons differ significantly ($P < 0.05$) according to departments. In the department of Bondoukou, 3.70% of households dried bananas to avoid throwing away waste, and 96.30% for cultural reasons. In the department of Transua, 26.67% of households dried bananas to avoid losses and 73.33% for cultural reasons. In the department of Koun-Fao, "Tanga" production is to avoid waste and cultural practice respectively at 94.81% and 5.19%.

Table 2 Reasons for producing "Tanga".

Production reasons	Bondoukou	Koun-Fao	Transua	ddl	χ^2	P
Avoiding losses (%)	3.70 ^c	94.81 ^a	26.67 ^b	2.00	249.332	< 0.001
Cultural practice (%)	96.30 ^a	5.19 ^c	73.33 ^b	2.00	249.332	< 0.001

Data with the same alphabetical letters on the same line are not significantly different at the 5% threshold according to the Chi 2 test.

3.2.2. Consumption reasons

Consumption reasons differ significantly ($P < 0.05$). In the department of Bondoukou, 39.26% of households consumed Tanga for strength, 57.78% for health reasons and 2.96% for dietary reasons. In Transua, 60%, 27.41% and 12.59% of households consumed Tanga for strength, health reasons and cultural practice respectively. In the department of Koun-Fao, 23.70% of respondents consumed the "Tanga" for health reasons, 68.15% for strength and 8.15% for eating habits (Figure 1).

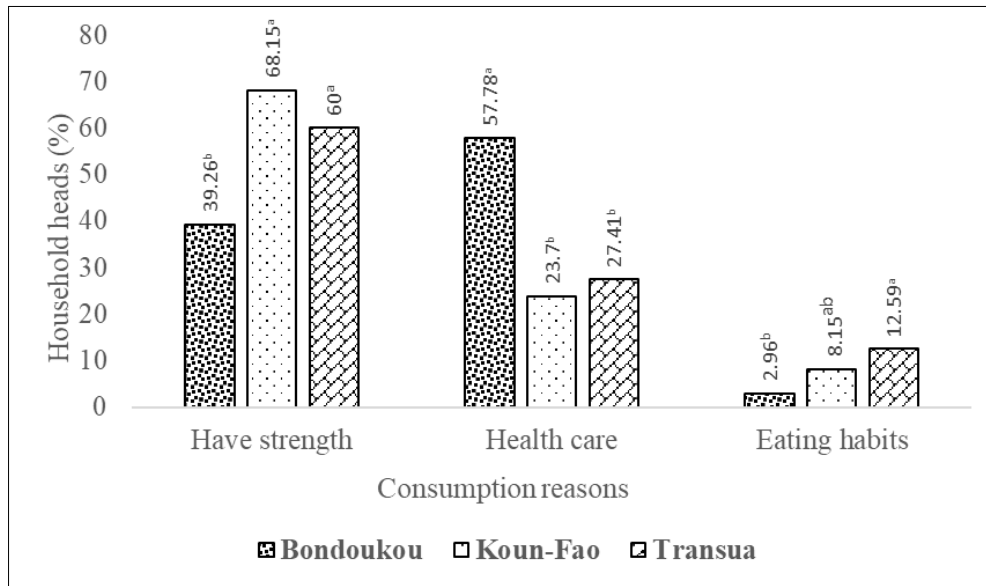


Figure 1 Reasons for "Tanga" consumption by locality

For the same modality, histograms bearing the same alphabetical letters are not statistically significant at the 5% threshold according to the Chi-square test.

3.2.3. Consumption patterns and derived dishes

Figures 2 and 3 shows consumption patterns and dishes derived from "Tanga". The data show that in Bondoukou, "Tanga" is either directly consumed (2.96%) or processed (38.52%) and in both forms (58.52%). "Tanga" is processed into Baca (47.41%), Samlê Baca (94.07%), Siékou (74.07%), Broh (3.70%) and Dockloun (3.70%). In the department of Transua, "Tanga" is eat directly by 8.15% of households, 78.52% processed this form and 13.33% use both forms. In this area "Tanga" is used to produce Baca, Samlê Baca, Siékou, Broh, Dockloun and M'Bahou by respectively 19.26%, 77.04%, 49.63%, 22.22%, 5.93% and 3.70% of households. In Koun-Fao, "Tanga" is consumed in direct form (18.52%), in processed form (56.30%) and in both forms (25.19%) by the households. The preparation forms in this department are Baca (64.44%), Samlê Baca (80.74%), Siékou (18.52%), Broh (8.15%), Gari (3.70%), Apity (3.70%) and Dockloun (3.70%).

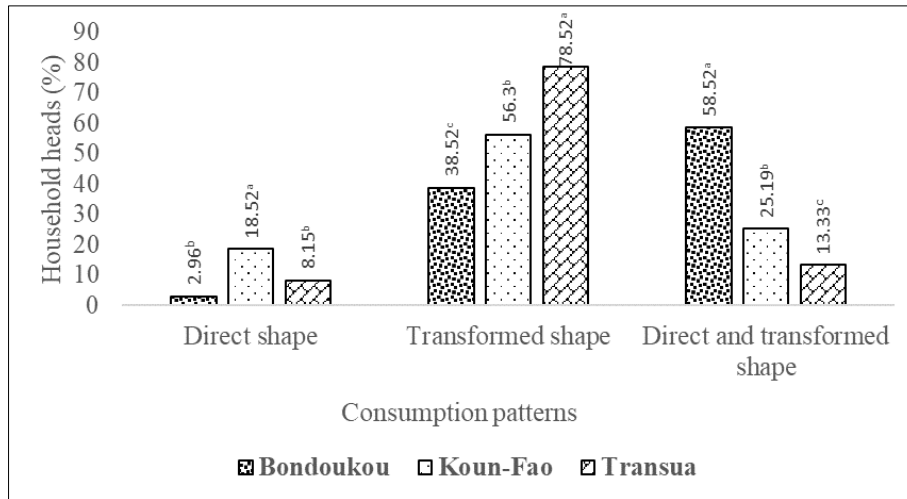


Figure 2 "Tanga" consumption patterns by department

For the same modality, histograms bearing the same alphabetical letters are not statistically significant at the 5% threshold according to the Chi-square test.

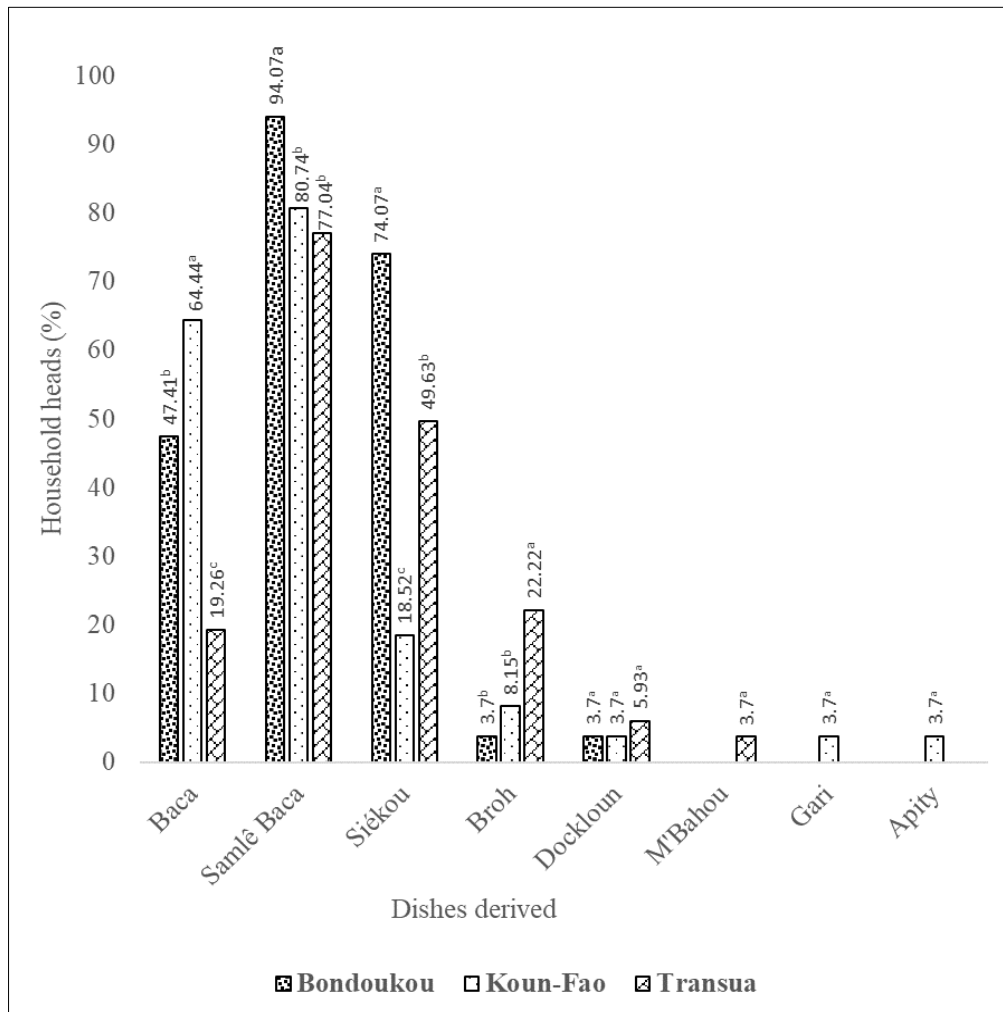


Figure 3 "Tanga" dishes by departments.

For the same modality, histograms bearing the same alphabetical letters are not statistically significant at the 5 % threshold according to the Chi-square test.

3.2.4. Consumption frequency

The frequency of consumption of "Tanga" is shown in Figure 4. The significantly variation ($P < 0.05$) is observed in each locality such as Transua where 58.52% of households consumed "Tanga" once a month, 28.15% twice and 13.33% three times a month. In Koun-Fao, 70.37%, 19.26% and 10.37% of households consumed "Tanga" once, twice and three times a month respectively. In the department of Bondoukou, 74.07% of households consume "Tanga" once a month, 22.22% twice a month and 3.70% 3 times a month.

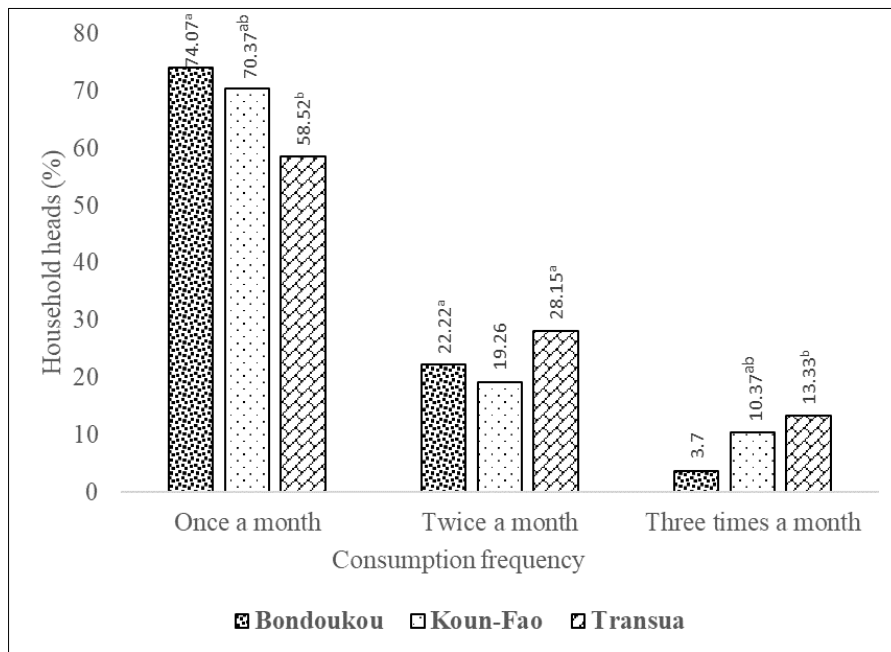


Figure 4 "Tanga" consumption frequency by locality

For the same modality, histograms bearing the same alphabetical letters are not statistically significant at the 5% threshold according to the Chi-square test.

3.3. Tanga production process

3.3.1. Use of plantain ripening stage

The stages of ripening plantain used to make "Tanga" (Table 3) show significantly difference ($P < 0.05$) in the departments. In Koun-Fao, 11.11% of households used the yellow stage with spots, 74.07% the yellow stage with patches and 14.81% the senescent stage of plantain. In Bondoukou department, 11.85%, 65.93 % and 22.22% of households used respectively yellow with spots, yellow with patches and senescent stages of plantain. Households in Transua used yellow stage with spots (16.30%), yellow stage with patches (72.59%) and senescent stage (11.11%) of plantain.

Table 3 Ripening stages used in the departments studied.

Ripening stage	Koun-Fao	Bondoukou	Transua	χ^2	ddl	P
Yellow with spots (%)	11.11 ^a	11.85 ^a	16.30 ^a	1.87	2.00	0.441
Yellow with patches (%)	74.07 ^a	65.93 ^a	72.59 ^a	2.46	2.00	0.292
Senescent (%)	14.81 ^{ab}	22.22 ^a	11.11 ^b	6.41	2.00	0.040

Data with the same alphabetical letters on the same line are not significantly different at the 5 % threshold according to the Chi-square test.

3.3.2. Plantain cutting

The cutting of bananas differs significantly from one production area to another (Figure 5). Bananas are use either into the whole form or into slices according the departments. Correspondence factor analysis (CFA) shows that the whole

form is more used by households in the three departments. However, Koun-Fao households cut banana into small slices while those of Bondoukou and Transua use big slices (2 or 4 lengthways per plantain).

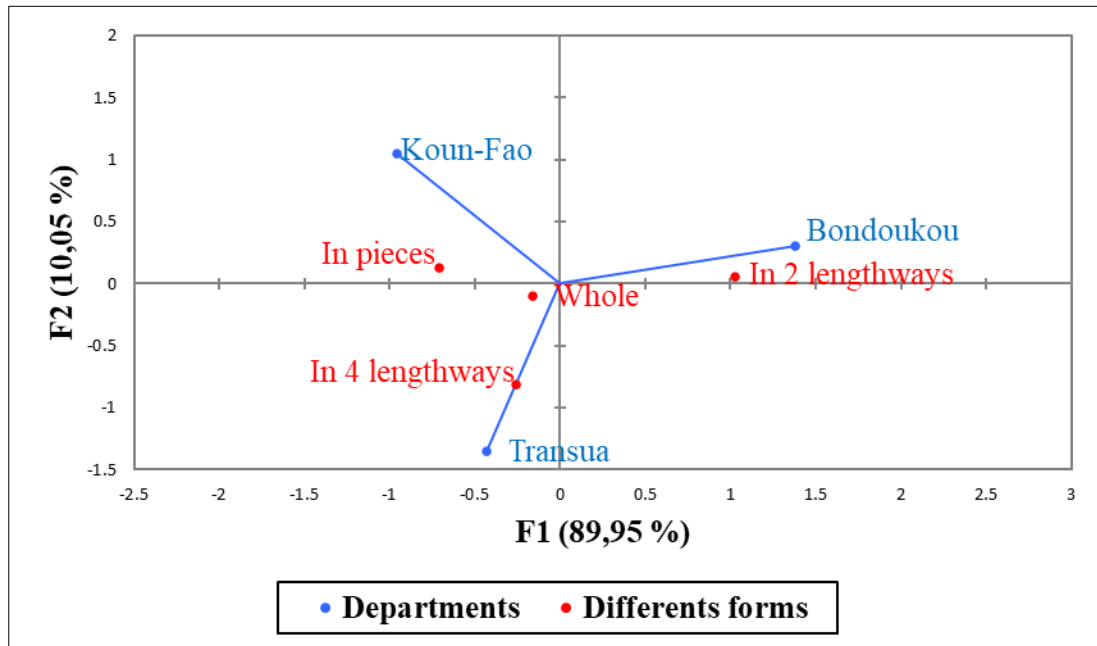


Figure 5 Differents forms of "Tanga" by departments.

3.3.3. Plantain drying times

Table 4 shows significant difference in times and lengths of banana drying in areas surveyed. In the department of Bondoukou, 91.11% of households dried bananas during the sunrise and 8.89% during all the day. In Koun-Fao, 85.93% of households dried bananas during the sunrise and 14.07% during all the day. Transua households (77.78%) dry plantain during the sunrise and 22.22% during all the day. It also the same for drying time where significantly ($P < 0.05$) difference is observed in all of the departments. In the Bondoukou area, 20.74%, 55.56% and 23.70% of households dried bananas during 1, 1-2 and 2-3 weeks respectively comparatively for 59.26%, 37.04% and 3.70% of those of Koun-Fao for the same drying time. Finally, in Transua department, 70.37%, 23.70% and 5.93% of households surveyed dried bananas for 1 week, 1-2 weeks and 2-3 weeks respectively.

Table 4 Period and drying time of plantain in the departments.

Drying times	Bondoukou	Koun Fao	Transua	ddl	χ^2	P
Drying period (%)						
During the day	91.11 ^a	85.93 ^{ab}	77.78 ^b	2.00	9.534	0.009
Day and night	8.89 ^b	14.07 ^{ab}	22.22 ^a	2.00	9.534	0.009
Drying time (%)						
1 week	20.74 ^b	59.26 ^a	70.37 ^a	2.00	73.26	< 0.001
1-2 weeks	55.56 ^a	37.04 ^b	23.70 ^b	2.00	29.10	< 0.01
2-3 weeks	23.70 ^a	3.70 ^b	5.93 ^b	2.00	32.85	< 0.01

Data with the same alphabetical letters on the same line are not significantly different at the 5% threshold according to the Chi-square test.

3.3.4. Plantain dryness measurement

Different methods are used by the households to appreciate plantain dryness (Figure 6). Correspondence factor analysis (CFA) revealed that slices breaking is the common method used. However, colour and tasting slice are used by Bondoukou households while the touch is a practice of those of Koun-Fao.

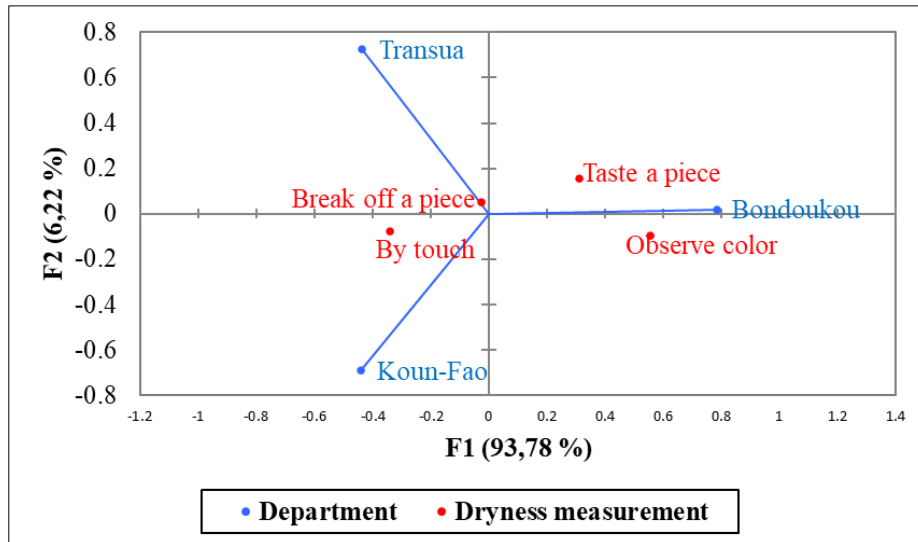


Figure 6 "Tanga" dryness measurement by department.

3.3.5. Tanga" production diagram

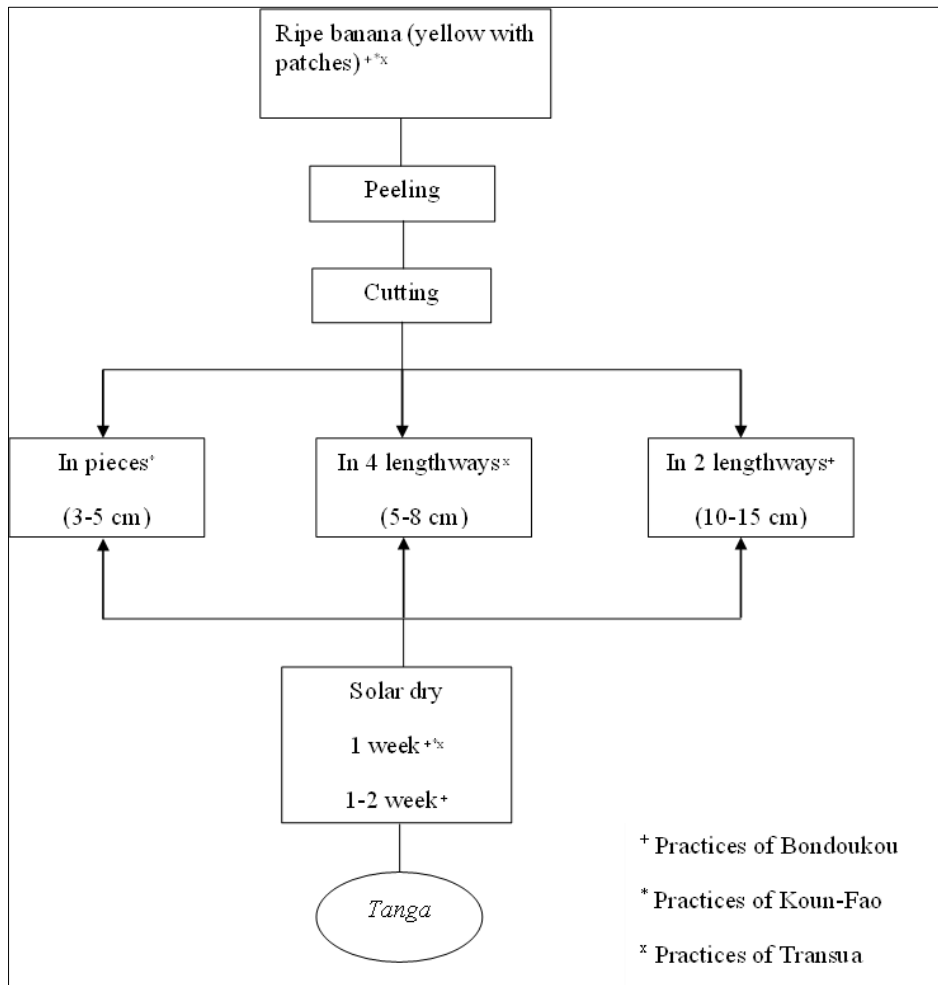


Figure 7 "Tanga" production process

In all the departments surveyed, the production process for ripe dried bananas commonly known as "Tanga" is the same with a few exceptions. The various stages involved are shown in Figure 7. When the plantain is ripe (yellow with

patches), it is peeled. It is then either cut lengthways (2 or 4) or in small pieces. The pieces of banana are then spread out on a support and left to dry in the sun for 1 to 2 weeks without the addition of any additives.

4. Discussion

The drying and consumption of ripe dried bananas, commonly known as "*Tanga*", is a well-known practice in Côte d'Ivoire, particularly in the Gontougo region in the north-east of the country. The study consisted in identifying the process for obtaining and using "*Tanga*" in the Gontougo region. The survey was carried out in this region, particularly in the departments of Koun-Fao, Transua and Bondoukou. Socio-demographic data showed that 76.05% of the head of households were women. This high proportion of women could be justified by the fact that it is women who generally do the cooking in rural households and are therefore more skilled in the preparation and knowledge of the dishes consumed. These results are in line with those of Kouakou et al. [17] and Monyn et al. [18], who highlight the fact that in Côte d'Ivoire, as in all African societies, household tasks are performed by women and they devote more time to them. Furthermore, the study data showed the group of uneducated people and farmer represent is the major "*Tanga*" consumer. Our research confirms the findings of the report by the National Literacy Committee [19] in which the Gontougo region as an area with a high rate of uneducated people (56.40% men compared with 70.80% women).

The consumption of "*Tanga*" is a dietary habit and could be a health food. This hypothesis is in line with the data of Alasalvar et al. [20] who indicated that the consumption of dried fruit has multiple beneficial effects on the body through their contribution of sugars, vitamins, minerals, fibres, bioactive or phytochemical compounds to the body. Others researchs Van Der Merwe et al. [21] and Alasalvar et al. [22] showed that the consumption of dried fruit affects the composition of the human microbiota, thereby increasing gastrointestinal transit.

The reasons for producing and consuming "*Tanga*" are the globally the same in all the departments. This similarity could be explained by the interaction between peoples and be linked to their culture and eating habits. This hypothesis is corroborated by Al-Fatimi [23], who has shown that there is a strong relationship between local populations and their environment, so that traditions are passed down through the generations. Van Der Stege et al. [24] link it to the sharing of knowledge and interactions between ethnic groups living in the vicinity. These interactions are the cause of exchanges through inter-ethnic marriages and bonds of friendship [25].

"*Tanga*" is generally consumed once a month. This low frequency of consumption could be explained by the fact that it is a staple food coupled with modernisation, which favours a change in living conditions as reported by Andreeva et al. [26]. According to Shahzad et al. [27], modernisation disrupts and creates conflicts with the cultural traits of rural populations by changing their lifestyles. As a result, the younger generation is heavily exposed to prepared, packaged and convenience foods whose effects may reduce their interest in adopting traditional cooking knowledge and practices [28]. "*Tanga*" is a very important product, being used to make a number of derivative dishes such as *M'Bahou*, *dockounou*, *samlê baca*, *siékou*, *baca*, *apity*, *gari* and *broh*. This wide range of uses could be explained by its food value and its nutritional qualities. This hypothesis is in line with the findings of Nguimbou et al. [29], who used over-ripe plantains to improve the taste of maize-based fritters. Similarly, Rahman et al. [30] improved the sensory characteristics of bread by incorporating 5 % of plantain flour.

5. Conclusion

The aim of this study was to identify the process for obtaining and using "*Tanga*" in the Gontougo region in the north-east of Côte d'Ivoire. The study revealed that ripe bananas are mainly dried to avoid losses. In addition, "*Tanga*" is consumed directly or transformed into many others dishes. The "*Tanga*" is a nutritional product and its production process is largely cultural. However, it is important to improve the production process to perform it nutritional value for consumers health benefit.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare they have no competing interest.

Availability of Data and Material

The studies included were retrieved from Google scholar databases.

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