



IMPORTANCE OF LOCAL CEREAL FLOURS IN THE DIET HABIT OF CONSUMERS IN THE DISTRICT OF ABIDJAN COTE D'IVOIRE

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Abstract: *The aim of this study is to gain understanding of the potential of local cereal flours in an urban context and the segment of the urban population concerned with traditional dishes made thereof. In Côte d'Ivoire cereals are produced in the northern areas where they are traditionally consumed. These local cereals concerns: rice, maize, sorghum, millet and fonio. This survey showed that only maize along with millet flours were in greatest demand among the consumers in the districts of Abidjan ($p < 0.05$). Ash-containing yellow maize and pure white maize flours are commonly consumed. The consumers surveyed, all ethnic groups combined, preferred white maize and millet flours more than yellow maize flour according to the Pearson Chi2 test ($p < 0.05$). Millet flour is predominantly cooked in the form of thin porridge, while the main form of preparing white and yellow maize flours is a dense paste (tô) eaten with sauce. The higher frequency of consuming millet flour derived product is linked to its availability as ready to eat food. The potential for convenient local cereal in the urban setting is real provided convenience and quality are met.*

Keywords: *cereals consumption, local dish, flours, survey, District of Abidjan, Côte d'Ivoire*

1. Introduction

In Côte d'Ivoire, cereals are traditionally grown in savannah zones (northern areas). Their production concerns mainly *Oryzasativa* (rice), *Zea mays* (maize), *Sorghum bicolor* (sorghum), *Pennisetumtyphoides* (millet) and *Digitariaaexilis* (fonio) [1]. These food crops produced by rural populations, essentially women, are usually intended for self-consumption however an important quantity is marketed [2]. Traditionally, cereal flours were produced by hand pounding using wooden pestle and mortar,

or by grinding with stones. These cereals, whether decorticated or not, are milled into flours which are cooked and consumed as a thin porridge or a dense paste called *tô*; flours can also be rolled into couscous. Alcoholic and non-alcoholic beverages can be produced from flours of germinated cereals [3, 4]. Traditional flours production however is time consuming, arduous and day-to-day chores [5]. These inconveniences have been the major pretext to adopt imported easy to cook foods such as refined rice and wheat flours,

and to abandon local cereal flours production [6]. Moreover urbanization has led to diversities in food consumption patterns due to increased food choice in markets and changes in lifestyles such as time constraints particularly caused by women's employment [7].

People do not have much time to spare for long traditional meal preparation and would look for local convenient quality products [8]. Urban consumers look for processed and pre prepared foods at a good economic cost [9].

This indicates that there are potential value-generating opportunities for local production if only adequate processing and eventually suitable marketing are provided [10]. African local cereal valorisation has made subject to plenty of research topics and over thousands of scientific articles have been published [11]. In many sub Saharan areas, namely Sahelian and coastal countries, tremendous progresses with regard to processing technologies and good hygiene practices are being achieved [12-14].

At present, a wide range of easy to cook local cereal flour derived products with improving qualities [15] are available on the markets of countries like Mali [16], Senegal [17], Niger [18], Benin [19] and Burkina Faso [20]. In Côte d'Ivoire, no formal reports exist on local cereal flours production and consumption. The actual reports only referred to the existence of maize flours with ash, being sold on Abidjan markets [21, 22].

This study aimed at getting on overview on the potential of local cereal flours in an urban context as well as the segment of the urban population concerned with traditional dishes consumption made thereof In this study, a survey was carried out to take inventory on the types of local cereal flours consumed and how they fit in

the consumers eating habits in areas of the District of Abidjan.

2. Material and methods

Study area and selection of respondents

The survey was carried out in nine (9) areas of the District of Abidjan (Côte d'Ivoire, West Africa), namely Abobo, Adjamé, Attécoubé, Cocody, Marcory, Koumassi, Port-Bouët, Treichville and Yopougon. Respondents were customers in selling sites and persons at home that are head of household.

Consumers were randomly approached by leading questions to evaluate their appreciation of local cereals grains or flours.

These particular selections have been made in order to gain reliable understanding of persons who consume local cereal flours, those who do not, and their motivations.

In all, 2,700 people were interviewed during the survey with an overall mean of 300 persons per district. The main information collected concern: the socio-demographic status, the kind of local cereal flours consumed, the influence of ethnic origin on the preference of local cereals, the main dishes made out of these cereal flours, the frequency of consumption, the preferred form of cereals purchased (grains or flours), the purchase sites and the high regarded criteria at time of buying flours.

Statistical analysis

Data were collected under complete disjunctive matrix. Multivariate Statistical Analysis (MSA) by classification with Tree diagram, Euclidean distances metrics and single linkage distance methods were jointly used to analyse these data.

Pearson Chi square (Chi²) test was used to see correlation between frequencies at 5% level. ANOVA (Analysis of Variance) was done and Fisher's Least Significant

Difference was used for means comparison at 5% level. SPSS 17.0 software was used for Chi square (Chi²) test while Statistica 7.1 software was used for MSA classification and ANOVA.

3. Results

Socio-demographic status of consumers

The consumers surveyed were composed in majority of women (93%) with 73 %

Ivoirians and 23 % foreigners (Table 1). The Ivorian respondents were from different ethnic origins: 28% northern, 20% midland, 19% eastern, 16% western, 17% southern. Regarding marital status, 61% were married, 34% single, 3% divorced and 3% widower. For education level, respondents were divided up in the following way: 30% were illiterate, 25% primary level, 27% secondary and 18% higher education level.

Table 1.

Characteristics of surveyed consumers

Gender	Nationality	Ethnic origin (Ivorian only)	Marital status	Education level
93% Women	73% Ivorian	28% Northern	61% Married	30% Illiterate
7% Men	27% Foreigner	20% Midland	34% Single	25% Primary
		19% Eastern	3% Divorced	27% Secondary
		17% Western	3% Widowed	18% High
		16% Southern		

Local cereal flours consumption

Local cereals flours produced in Côte d'Ivoire and consumed by the surveyed population of Abidjan are depicted in Table 2. On the 7 types of flours listed, millet (67.48%) and white maize (65.07%) flours were by far the most consumed ($P < 0.05$), and statistically in the same

proportion. Yellow maize flour consumption is also important (41.04%) but to a lesser extent than the latter. The consumptions of the flours of rice (4.44%), white and red sorghum (3 and 1.78%, respectively) and fonio (0%) were equally marginal to non-existent (Table 2).

Table 2.

Local cereal flours consumption in areas of the District of Abidjan

Types of flour	Means of consumers surveyed	Rate of consumption (%)
Millet	205.40 ^a ± 61.55	68.47
White maize	195.22 ^a ± 50.44	65.07
Yellow maize	123.13 ^b ± 54.39	41.04
Rice	13.33 ^c ± 11.38	4.44
White sorghum	9.00 ^c ± 10.54	3.00
Red sorghum	5.33 ^c ± 06.46	1.78
Fonio	0.00 ^c ± 00.00	0.00

*Means values having different superscript letters are significantly different at 5% level according to the Fisher's least significant difference (LSD).

Consumers were also questioned to evaluate their general appreciation of fonio and sorghum (Table 3). The Pearson Chi² test failed to show significant correlation

between origins and consumption of red sorghum ($P > 0.05$). For fonio and white sorghum appreciation, the Chi² test showed that ethnic origin had significant influence ($P < 0.05$, Table 3)

Table 3.

Influence of ethnic origin on the general appreciation of sorghum and fonio.

Ethnic origin	Red sorghum(%)	White sorghum(%)	Fonio(%)
Midland	0.52	0.58	0.77
Eastern	0.56	0.37	0.81
Northern	3.91	5.39	13.61
Western	0.33	0.66	2.95
Southern	0.00	0.00	0.39
Foreigner	24.16	17.63	2.4
Pearson Chi 2 values	0.284	0.014	0.000

The respondents have identified 4 forms of maize flours (Figure 2) which were the pure white and yellow maize in one hand and potash-containing white and yellow maize on the other hand. Potash is an alkaline ash sold in the form of crystals. White maize was appreciated by 51% of respondents represents the dominant form

at linkage distance varying from 30 to 32.8. Potash-containing yellow maize (33%) is the second prevalent form pure yellow maize (7%) and potash-containing white maize (9%) are equally marginal. They are not commonly sold on market places.

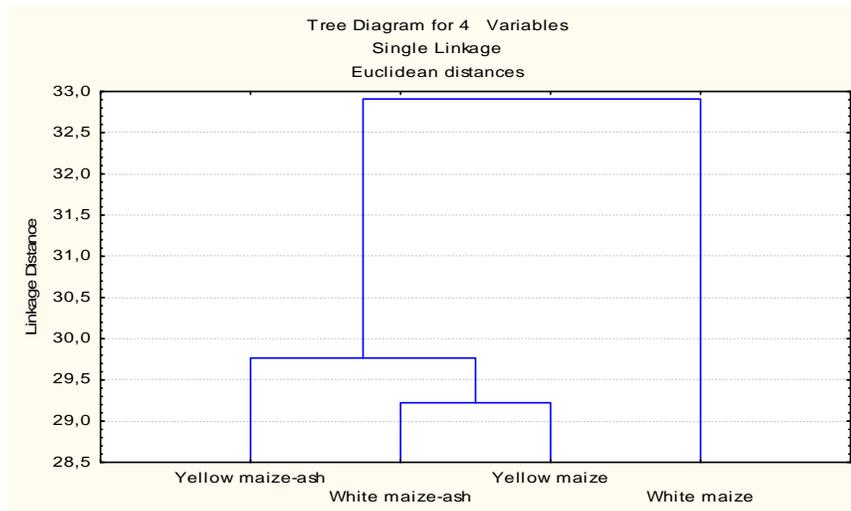


Fig.1. Tree diagram of the different forms of white and yellow maize consumption.

Origins of local cereals consumers

These results bear out the fact that millet, white maize and yellow maize flours are the most known local cereal flours, and

therefore the most consumed in Abidjan districts. In view of the insignificant results of rice, sorghum and fonio flours

consumption, only maize and millet flours were considered for further analysis. The figure 2 illustrates proportion of foreigners and ethnic origin of Ivorian consumers of local cereal flours. These results are reinforced by the Pearson's Chi2 correlation test bearing out significant correlation ($P < 0.05$) between the ethnic group and the kind of cereal flours consumed (Table 4). For white maize flours consumption, the foreigners (81.9%) were most numerous followed by northerners (72.5%) and easterners (68.5%); consumers originating from southern (58.1%) midland (52.1%) and

western (47.2%) areas of Côte d'Ivoire were also quite important. The major consumers of millet flours are recruited among Ivoirians, namely, northerners (81.5%) and southerners (71.9%); the foreigners (68.4%) are closely followed by persons from the midland (67.3%), eastern (64%) and western (62%) regions. The level of consumption of yellow maize flour is consistently below 50% for all the respondents regardless of their origins (Table 4): the proportions range from 47.4% (northerners) to 20.5% (southerners).

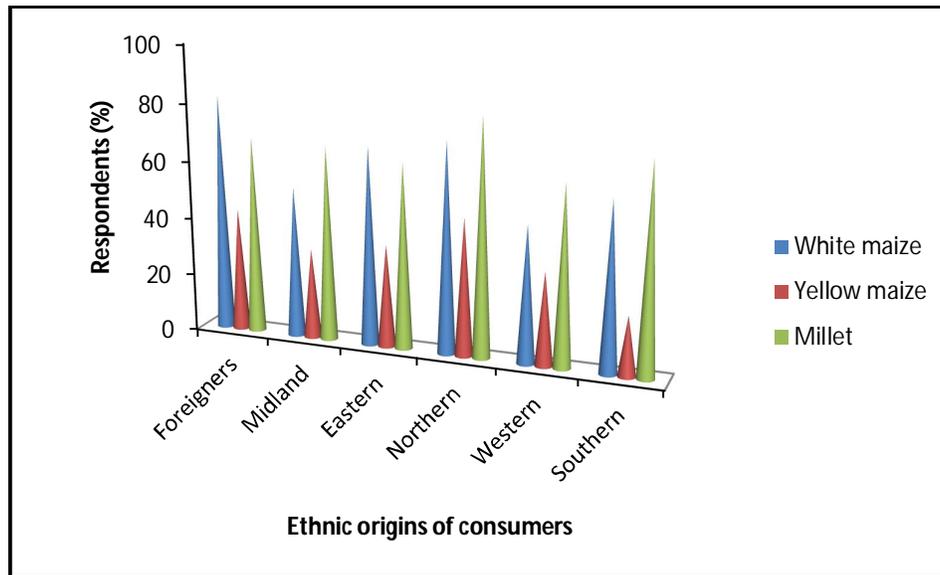


Fig.2. Local cereal flours consumption and ethnic origins of respondents.

Table 4.
Influence of consumers' ethnic origins and consumption of maize and millet flours

Origin of respondents	White maize (%)	Yellowmaize (%)	Millet (%)
Midland	52.10	31.20	67.30
Eastern	68.50	31.20	64.00
Northern	72.50	47.40	81.50
Western	47.20	32.10	62.00
Southern	58.10	20.50	71.90
Foreigners	81.90	42.80	68.40
Pearson'Chi2 values	0.000	0.000	0.000

Respondents common cereal flour dishes and frequency

Inventory of cereal flour dishes among the consumers surveyed has established that the most common traditional meals prepared from maize and millet flours were: thick porridge also known as *tô* in vernacular tongues, porridges, couscous, beverages, crumpets and infant meals (Figure 3). *Tô* and porridge represent the major forms of consumption of these local cereals because they clump together at the highest linkage distance (35) of the tree diagram. The *tô* made of white and yellow maize along with millet porridge consumers were more numerous with values of about 65% of the persons surveyed (Table 5).

At distance 15, the minor forms of consumption ranged from 10.04% to 21.52% and concern millet flours derived products such as couscous, crumpet, beverage and *tô*. White maize porridge and infant meals as well as yellow maize porridge are also classified in the same category. Contrary to the previous group, most of the yellow maize meals consumption is met at the lowest distance (7), demonstrating a very marginal appreciation of this cereal in general (Table 5).

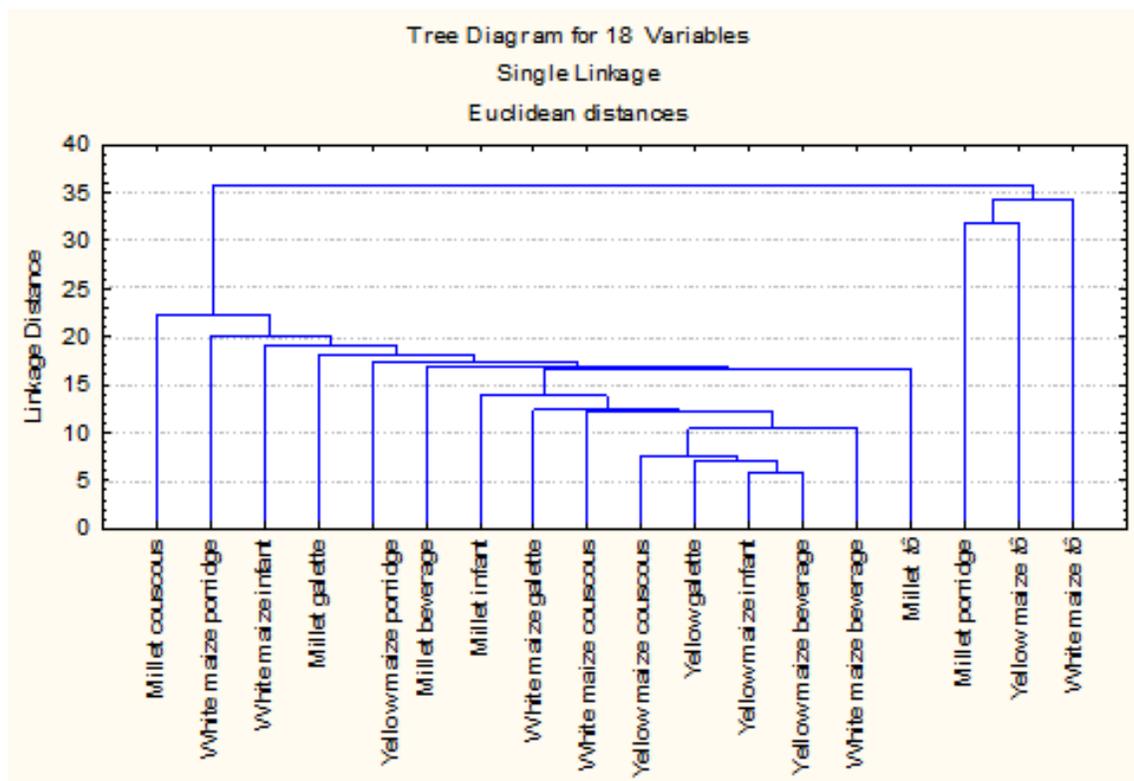


Fig. 3. Tree diagram of consumption of traditional dishes from maize and millet flours.

Table 5.

Forms of millet and maize flours consumption

Forms of consumption	Tô	Porridge	Beverage	Couscous	Infant meal	Crumpet
White maize	65.59%	19.89%	03.96%	05.41%	13.78%	06.96%
Yellowmaize	65.26%	11.11%	00.48%	01.81%	00.85%	01.56%
Millet	10.19%	65.22%	10.04%	21.52%	07.30%	12.59%

The frequency of consumption of traditional dishes of millet and maize flours is presented in a tree diagram (Figure 5). The weekly consumption of millet, white and yellow flours dishes is preponderant by considering the linkage

distance around 34. On the daily frequency, millet consumption is quite important (linkage distance 33) while maize is less preponderant at linkage distance 20.

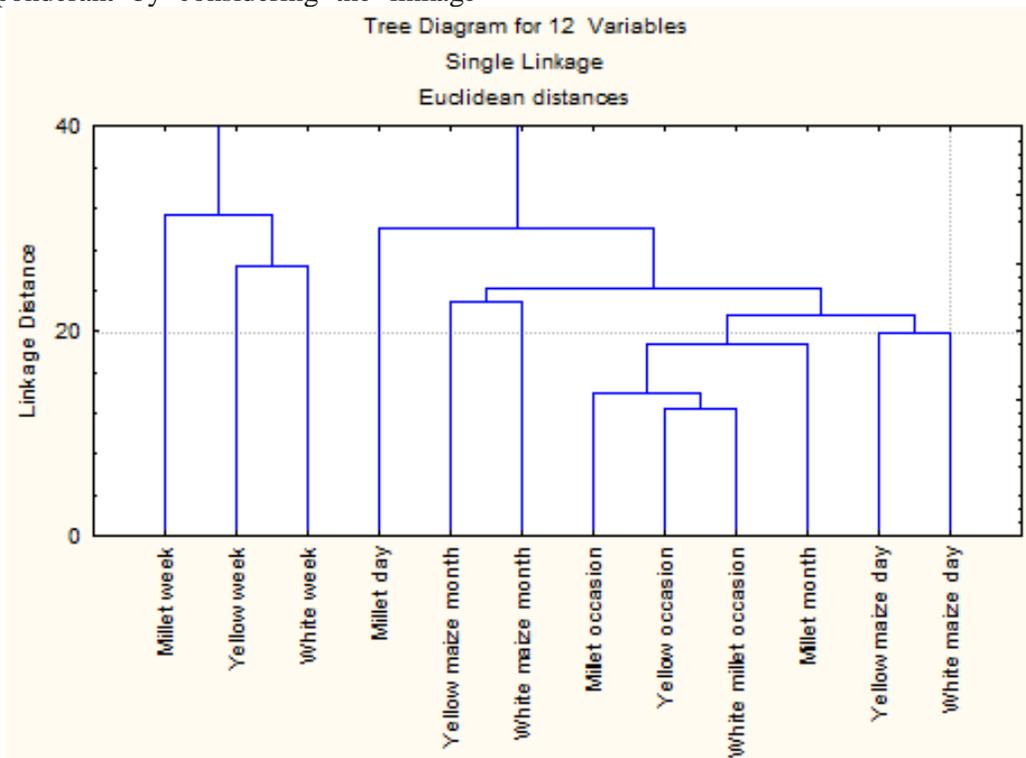


Fig. 4. Tree diagram of the frequency of traditional maize and millet flour foods consumption.

Preferred buying forms of local cereals (raw grains or flours)

The choice between raw grains and flours on the markets of Abidjan is depicted in Figure 5. At linkage distance 30, the tree diagram is divided into 2 groups with the

dominant form being flours. Consumers concerned with buying processed cereals were in the proportion of 67% for millet, 72% for white maize and 77% for yellow

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maize. The Chi2 test showed significant correlation between marital status, educational background and buying processed grains ($p < 0.05$, Table 6).

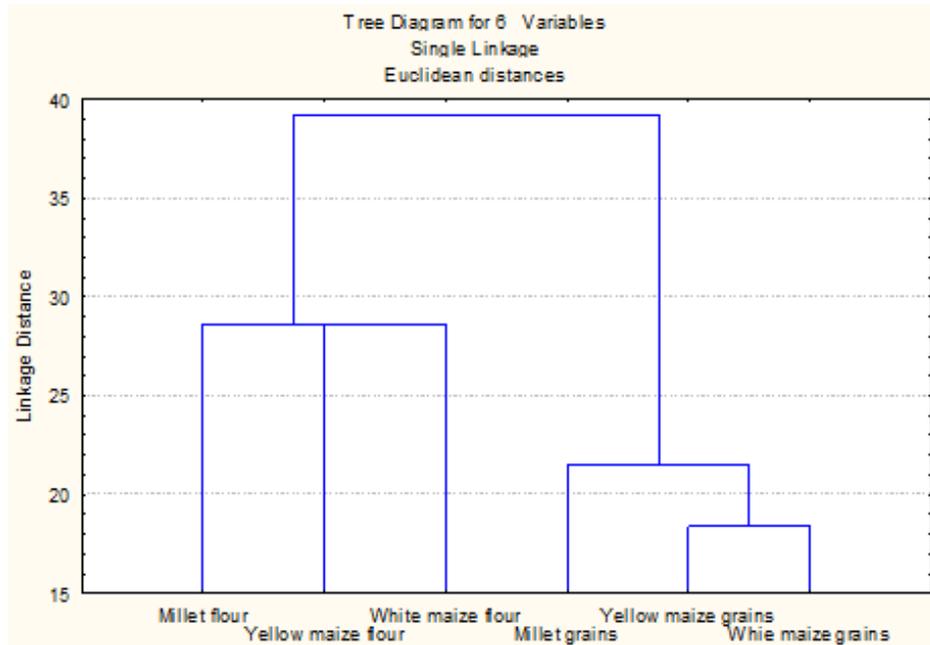


Fig. 5. Tree diagram of forms of buying cereals by the consumers surveyed in the districts of Abidjan.

Table 6.
 Chi2 values on the preferred forms of local cereal crossed with education level and marital status of the surveyed consumers

Crossed parameters	Types of cereals	Cereal forms	
		Grain	Flour
Educational level	White maize	0.000	0.028
	Yellow maize	0.002	0.031
	Millet	0.024	0.006
Marital status	White maize	0.000	0.000
	Yellow maize	0.000	0.000
	Millet	0.000	0.000

Purchasing places of local cereal flours and choice criteria

The main places identified were: market places, supermarkets and areas of growth referring to the tree diagram below (Figure 6). Market places are the first choice of the

consumers surveyed (highest linkage distance, above 30). Areas of production and supermarkets are marginal choices, at distance 5, in this study.

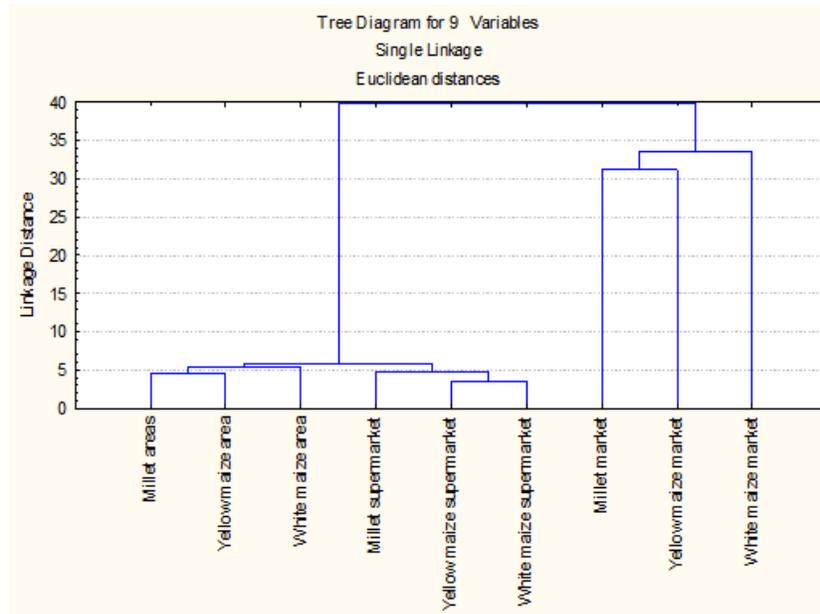


Fig. 6. Buying places of local cereal flours.

Consumers' motivation at the time of buying is recorded in Figure 7. It takes into account trust in sellers and flours

characteristics such as odour, colour, texture, price and availability.

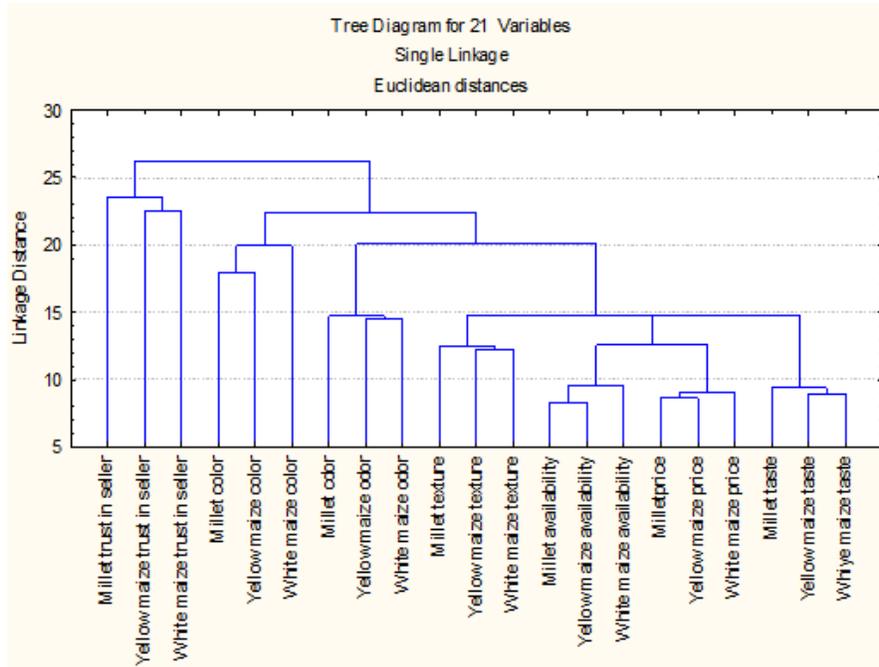


Fig.7. Purchasing criteria of local cereal flours in the market places.

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The criterion trust in sellers is distinctly separated from the others and is preeminent for the three types of cereals (aggregation distance about 23). Colour is the next distinctive character, at 20, followed by odour. Texture, availability price and taste clump together at distance 15; they are therefore minor criteria according to the survey.

4. Discussion

On the seven types of local cereal identified in Cote d'Ivoire, it appears from this survey that mainly maize and millet flours were more familiar to the consumers surveyed. If rice flour is not commonly used, sorghum and fonio, on the other side, are not generally named in the dietary habits of Ivoirians [23]. Sorghum and fonio, like millet, are staple foods in typical areas of Côte d'Ivoire, savannah regions, where they are traditionally grown [24, 25]. This study confirmed that fonio (in the form of hulled grain) and sorghum are more familiar to northerners and foreigners because of their background origins. However, sorghum and fonio, along with millet have potent nutritional and health benefits that are now being recognized [6, 26]. These local cereals could in fact be promoted on the basis of health claims. The availability of millet in the form of flours on market places is justified by consumer's preference. Actually millet is described as being tastier and more digestible than sorghum [27]. The popularity of maize flours may come from the agricultural performances of maize as well as its successful commercialization that both have contributed to the marginalization of sorghum and millet production [7]. Indeed, Maize is a nontraditional cereal which has been widely disseminated in savannah zones because of productivity and

precocity [14, 28]. In Côte d'Ivoire, maize ranks 7th in agricultural production (over 500,000 tons) and 2nd behind rice in cereal production [29]. Four types of maize flours were identified by respondents. The preferred maize flours were white maize followed by potash-containing yellow maize. Potash is reported to improve texture and digestibility of yellow maize according to respondents. The preference of the surveyed consumers for white maize, is in accordance with a general trend observed in West Africa, that is, white maize being more desirable for direct human food [30].

Yellow maize is reportedly preferred for animal feed in many regions as it gives a yellow color to poultry, egg yolks and animal fat [31].

The persons surveyed in the districts of Abidjan, all ethnic group combined, were concerned with local cereal flours consumption. There is no ethnical discrimination because the respondents demonstrated the same consumption pattern, meaning, important consumption of millet and white maize and lesser interest in yellow maize flour.

This survey, even though led in an urban context, may indeed be revealing of an appreciable caloric contribution of millet which had been classified as not having any relevant importance in the Ivoirians eating habits [23]. Concerning the transformation of local cereal flours into dishes, the main forms were porridge for millet and *tô* for white and potash-containing yellow maize. Beside porridge consumption, millet is also much appreciated under the form of *Dèguè* (data not shown). The range of recipes of the local cereal flours is very narrow and can be a major obstacle to their valorization [32]. Maize utilization in Côte d'Ivoire, as shown in this survey, is comparative to eating habits of the neighboring Sahelian

countries. In these regions, the meals from maize are mainly adaptation of dishes from traditional cereals like millet and sorghum [14]. In contrary, coastal countries, like Benin, have developed about forty maize flours derived recipes [33]. Such level of valorization has been described as the result of a satisfactory cultural integration of maize [34]. Studies to develop new maize flours derived products that will better respond to consumers' preferences for convenience, safety and improved nutritional values are possible. It was in this context that nixtamalization has been considered in Senegal [35]. It is a process of cooking maize in a solution of limewater originating from Latin America to produce staple breads called *tortillas* [36]. Popularization of maize recipes from Benin can also be a valuable option. The survey shows that millet and maize traditional meals are regularly consumed. However, when it comes to the daily to weekly consumption, millet is more important. This rate of consumption of millet food, in the form of porridge, may come from its availability as convenience foods (ready to eat) everywhere in the District of Abidjan [37]. Millet porridge is eaten as a breakfast, afternoon snack and is highly prized during Ramadan. Maize meals are eaten just as regularly, but at a more moderate level. As far as the main traditional dish of maize namely *tô* is concerned, it is commonly consumed in the family circle and this aspect maybe an inconvenient in the urban context where people increasingly consume meals outside of the home. The availability of local cereals under processed form is rather attractive to the consumers surveyed. Respondents, in majority women, regardless of the educational background and marital status buy cereal flours because of gain of times provide by ease of cooking. Buying local cereals flours at

market places is self-evident for the majority of the consumers surveyed for it is a matter of habits, convenience and price for them. The informal way of selling local cereal flours limits the criteria of consumers' choice to organoleptic considerations and mainly to trust in sellers. Those who preferred raw cereals grains were preoccupied with the lack of hygiene and purity of the local cereal flours. They claimed that fresh flours are mixed with fermented and rancid flours. Indeed, management quality with regards to local cereals products, mainly maize and millet, deserve particular attention giving their importance in the human daily consumption. Some supermarkets of the districts of Abidjan offer a variety of manufactured local dried cereal flours, well-conditioned. However it appears from the survey that most of the respondents are ignorant of local cereal flours being sold in supermarkets because of the lack of marketing policy from the processors.

5. Conclusion

Flours of local cereals such as sorghum and fonio are not familiar to the population surveyed in the districts of Abidjan. Their consumption is rather localised to areas of growth. This survey have shown that local cereal flours of millet, pure white maize and potash-containing yellow maize are the most consumed in the districts of Abidjan. The respondents, all ethnic origins combined, appreciate the three cereals in the same way, meaning, white maize and millet flours being the most prized. The main traditional dishes made out of millet and maize flours are respectively porridge and *tô*. The availability of the local cereals as convenient foods, easy to cook and ready to eat, is very attractive to the urban consumers surveyed.

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