

*Full Length Research Paper*

# Typology of Côte d'Ivoire dishes integrating Néré pulp (*Parkia biglobosa* L.) into the preparation process

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The Néré (*Parkia biglobosa* L.) is a tree of the Mimosaceae family, typical of the semi-arid and sub-humid zones of West Africa generally found in the northern of Côte d'Ivoire. The yellow pulp on the seeds of Néré is consumed raw or used for the preparation of drinks or enters into the composition of many cereal foods. The objective of the present study was to identify the dishes integrating Néré pulp in the formulation, the process and the food habits based on its consumption. Thus, a food consumption survey was carried out in 135 households per department (Korhogo, Séguéla and Bouna) in the northern of Côte d'Ivoire. Data revealed that five cereals dishes and a beverage based on Néré pulp were consumed in investigated areas. The process and the consumption form of foods depend on consumers' ethnic group and their origin region. Most people consume foods based on Néré pulp to have a good health. Among dishes, *Nammigue* was the most known and consumed food (36.79%) as a lunch with a consumption frequency of two times per month. Six foods based on Néré were identified and their processes were described.

**Key words:** Pulp, Néré, foods typology, consumption practices, household survey, Côte d'Ivoire.

## INTRODUCTION

Néré (*Parkia biglobosa* L.) is a tree of the Mimosaceae family, typical of the semi-arid and sub-humid zones of West Africa. It is a wild edible fruit tree generally found in the North where it occupies a prominent place in people's lives (Kouamé et al., 2015; Arbonnier, 2009). The wild fruit tree *Parkia biglobosa* L (Néré) is widely distributed and consumed in the Poro (Korhogo), Worodougou (Séguéla) and Bounkani (Bouna) regions (Kouakou et al., 2020; Ambé, 2001). The fruits of *P. biglobosa* are long pods of about 45 cm, 2 cm wide, slightly arched, hanging

in clusters on the club-shaped flower. During the ripening, the endocarp constantly fills the cavity between the seeds of the whole pod, which becomes powdery and light yellow at maturity. At maturity the flattened black seeds are embedded in a yellow pulp rich in sucrose (Mabetty, 2018). According to Touré (2020), the pulp of Néré is the sweet and yellow floury substance surrounding the seeds. It is rich in energy value and consumed raw or processed into a refreshing drink. The pulp of *P. biglobosa* constitutes a means of subsistence for local

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populations. The harvested mature fruits are used as food in the dearth season (Nyadanu et al., 2017). The pulp of the Néré has an interesting nutritional value, rich in sodium, potassium, calcium, zinc, b-carotene, ascorbic acid, riboflavin and also phenolic compounds. This pulp could therefore contribute to reducing malnutrition caused by micronutrient deficiencies and extreme hunger in developing countries (Bamigboye et al., 2012; Kouassi et al., 2018a). In addition, Néré pulp contains high dietary fibre content, making it essential for intestinal transit, prevention of obesity, intestinal diseases such as colon cancer and other gastrointestinal conditions and helps prevent diabetes (Nyadanu et al., 2017). *Parkia biglobosa* pulp can therefore contribute to human nutritional needs and be a good source of energy due to its high carbohydrate content. It can be used as a nutritional supplement (Aja et al., 2015). Thus, this pulp could fill micronutrient deficiencies in Côte d'Ivoire where malnutrition is a real public health problem. Indeed, some areas in Côte d'Ivoire can reach up to 40% for global acute malnutrition and over 5% for severe acute malnutrition. These deficiencies mainly affect women of childbearing age and children (N'goran, 2014; Schwartz and Grellety, 2010; WHO, 2009; FAO, 2008). An alternative to this situation could be the valorization of traditional wild fruit dishes such as Néré. The yellow pulp surrounding the seeds is eaten raw or used to make cold drinks (Andon et al., 2018) or used in many other cereal foods such as fritters and cakes (Lamien et al., 2011). There is very little data on dishes incorporating Néré pulp. Only recent studies (N'goran, 2014; Kouassi et al., 2018b) based on juices derived from Néré were available. There is a lack of literature on cereal foods made from Néré. Thus, in order to promote their access to consumers, the objective of this study was to inventory dishes incorporating Néré pulp in the formulation and determine their characteristics, that is, process, dietary habits and food consumption.

## MATERIALS AND METHODS

The technical material consists of a household survey form with consumption practices sections such as food modes, food forms, consumption frequencies, and production processes of Néré-based dishes.

### Survey areas

In each Néré widely distributed zone (Korhogo, Séguéla and Bouna), three villages were selected after a pre-survey based on the consumption of Néré pulp. Thus, the villages of Nahouokaha, Lataha and Kotchiéri (Korhogo), Sifié, Sélakoro and Bobi (Séguéla) and Niandégué, Bouko and Panzarani (Bouna) were surveyed.

### Selection of surveyed households

Households were selected using the snowball technique. The size (n) of the households surveyed was calculated according to

Dagnelie (1998) formula for an independent non-exhaustive sample based on Côte d'Ivoire population and housing census (RGPH, 2014):

$$n = t^2 \cdot \frac{p \cdot (1 - p)}{m^2}$$

Where, n = minimum sample size sought; t = 95% confidence level (standard value of 1.96); P = proportion of the target population in the study area; p estimated at 50% due to lack of knowledge of the number of households processing wild fruit; m = margin of error at 5%.

Thus, the minimum sample size (n) was:

$$n = \frac{1.96^2 \times 0.5(1 - 0.5)}{0.05^2} \approx 385 \text{ individuals}$$

To compensate errors in questionnaires that were incorrectly filled out, 20 additional households were added to calculate sample size (n). Thus, a total of 405 households were surveyed with 135 per department (Table 1).

## Statistical processing

Data were entered using SPHINX Plus<sup>2</sup> (V5) software and then exported to SPSS 20.0 software for database. Statistical analyses were performed using XLSTAT 2016 software. The relationship between the dependent variables was assessed by Chi-square test and Z test at 5% threshold. Correspondence factor analyses (CFA) were performed for the comparison of more than 3 variables. Excel software was used to produce graphs of periods, consumption frequencies and level of knowledge of foods.

## RESULTS AND DISCUSSION

### Collection of Néré

In all the departments, most of consumers prefer to collect Néré in field (92.86-98.25%) than the payment into the market (2.63-8.33%) (Table 2). Néré is generally collected in pod (92.86 - 98.25%) than those of powder (1.75 - 7.14%) and pulp (0 - 1.19%) (Table 3). In Séguéla, consumers do not use Néré in pod form.

### Reasons of Néré consumption

Data showed that Néré is mainly consumed in the three different localities for its health benefits and then for its taste. However, Néré is also consumed as a soldering food (Figure 1).

### Dishes based on Néré

Six different Néré based dishes were identified. These dishes encountered in the different departments are corn or millet couscous with Néré, corn cake with Néré, Néré cerelac, wafer, Néré beverage and Néré cake. These dishes were called in different names depending on the

**Table 1.** Number of households surveyed per zone and per village.

Department	Village	Respondents	Total
Korhogo	Nahouokaha	48	135
	Lataha	51	
	Kohotiéri	36	
Séguéla	Sifié	41	135
	Sélakoro	44	
	Bobi	50	
Bouna	Niandégué	18	135
	Bouko	62	
	Panzarani	55	
Total		405	

Source: Authors

**Table 2.** Places of supply of Néré.

Place	Bouna	Séguéla	Korhogo
Market (%)	8.33 <sup>a</sup>	6.25 <sup>a</sup>	2.63 <sup>a</sup>
Field (%)	92.86 <sup>b</sup>	95 <sup>b</sup>	98.25 <sup>b</sup>
<i>z</i>	-20.217	-24.027	-48.859
<i>P</i>	<0.001	<0.001	<0.001

The values of column with the same letters are not significantly different at the 5% threshold.

Source: Authors

**Table 3.** Forms of procuration of the Néré.

Form	Bouna	Séguéla	Korhogo
Pulp (%)	1.19 <sup>a</sup>	0.00 <sup>a</sup>	0.88 <sup>a</sup>
Powder (%)	7.14 <sup>a</sup>	5.00 <sup>a</sup>	1.75 <sup>a</sup>
Pod (%)	92.86 <sup>b</sup>	95 <sup>b</sup>	98.25 <sup>b</sup>
$\chi^2$	197.73	205.8	233.82
<i>dl</i>	2	2	2
<i>P</i>	<0.001	<0.001	<0.001

The values of column with the same letters are not significantly different at the 5% threshold.

Source: Authors

locality or ethnicity (Table 4).

### Production process of Néré based dishes

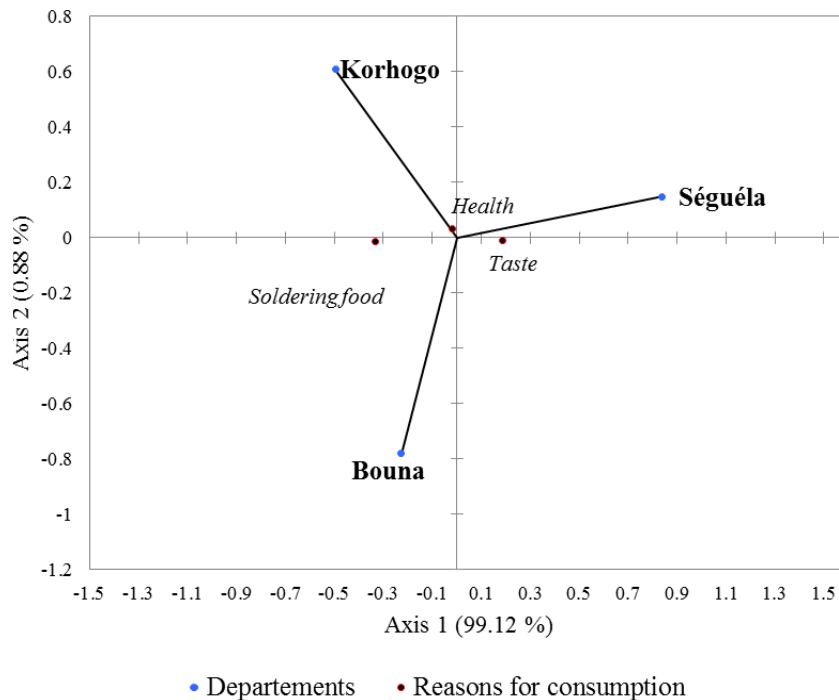
#### *Production of Wasséra*

*Wasséra* is a corn couscous with Néré. For its production, 1 kg of corn flour is mixed with 1 kg of Néré pulp powder. After homogenization, two processes can be applied: either the mixture of flours is directly overturned in a pot on soft fire containing 100 to 200 g of shea butter for a cooking of 5 to 10 min during which the whole is constantly stirred to obtain the floury *Wasséra* or

the mixture of flours is sprinkled with water for the formulation of granules for 10 to 20 min steam cooking. After cooking, the granules are relayed in 100 g of melted butter or 100 mL of refined vegetable oil to obtain the granular *Wasséra* (Figure 2).

#### *Production of Nammigue*

Two processes are used to obtain *Nammigue*. On the first hand, a kilogram (83 g) of millet is roasted, ground and sifted to produce flour. This flour was mixed with 17 g of Néré powder then the whole was relayed in 300 mL of water. On another hand, 100 g of Néré powder was



**Figure 1.** Reasons for consumption of Néré per locality.  
Source: Authors

**Table 4.** Description and vernacular names of Néré-based foods.

Food	Locality	Consumers	Vernacular names
Corn couscous with Néré	Bouna	Lobi	<i>Wasséra ou Pia-pia</i>
	Séguéla	Niaraforo	<i>Tawigué nammiguin</i>
Corn cake with Néré	Bouna	Malinké	<i>Sakoula</i>
	Korhogo	Sénoufo	<i>Kawarague</i>
	Séguéla	Woroudougou	<i>Faléni-nèrèho</i>
Néré Cerelac	Bouna	Lobi	<i>Miyéh</i>
	Korhogo	Sénoufo	<i>Nammigue</i>
	Séguéla	Woroudougou	<i>Nèrèdji</i>
Néré beverage	Bouna	Lobi	<i>Doun-gnon</i>
	Korhogo	Sénoufo	<i>Nammigue -lor</i>
Baobab and néré donut	Bouna	Peulh	<i>Bafouratou</i>
Néré cake	Bouna	Wolof	<i>Cake au Oul</i>

Source: Authors

directly relayed in 300 mL of water. In both cases, the slurry was consumed sweetened or spiced with chili powder (Figure 3).

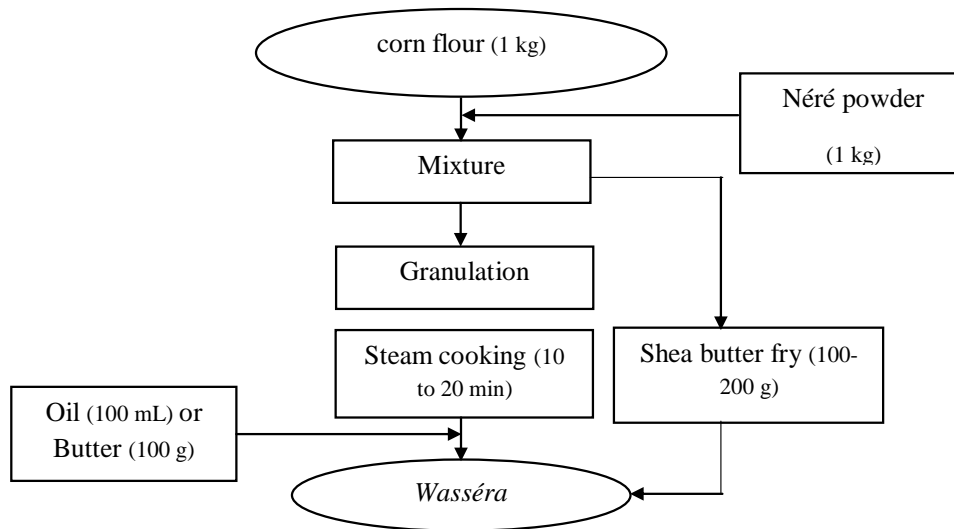
#### **Production of Kawarague**

One kilogram of Néré powder was mixed with 1 kg of corn flour and 30 g of salt. 1.5 L of water was gradually added for the homogenized mixture. The mixture was

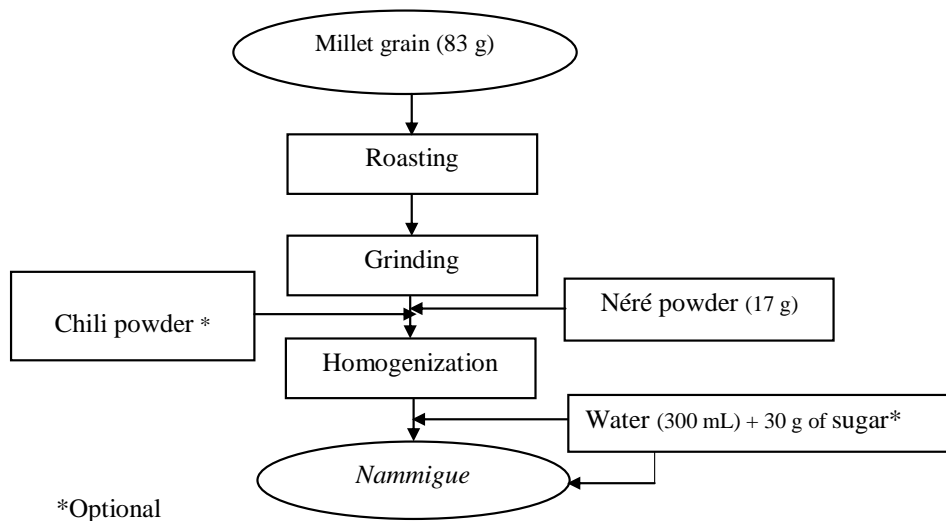
kneaded and the dough obtained was kneaded by hand for 10 to 15 min before frying to obtain doughnuts in the form of patties (Figure 4).

#### **Production of Bafouratou**

One kilogram of Néré powder was mixed with 1 kg of baobab powder and 1 kg of millet flour to constitute a homogeneous medium. To the mixture obtained, 1.5 L of



**Figure 2.** Production diagram of *Wasséra*.  
Source: Authors



**Figure 3.** Production diagram of *Nammigue*.  
Source: Authors

water was added and the whole was mixed and kneaded by hand for 10 to 15 min. The resulting dough was fried to obtain fritters in the form of patties (Figure 5).

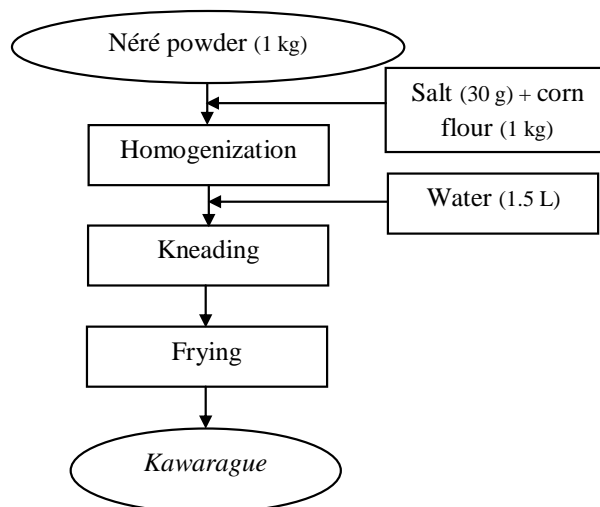
### **Production of Cake au Oul**

A mass of 700 g of butter was melted and mixed with 250 g of sugar and 5 to 10 g of baker's yeast. To this mixture, 6 to 7 fresh eggs and 0.5 L of water were added and the whole was stirred until homogeneous medium was obtained. To this medium, 1 kg of Néré powder and 500 g

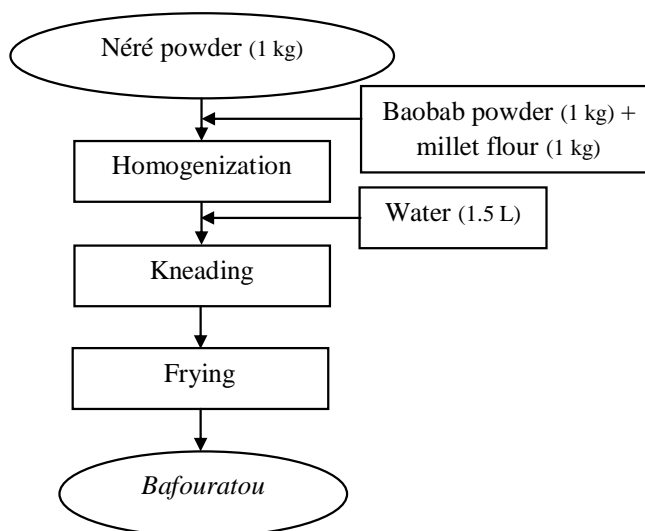
of durum wheat flour were gradually added. The final dough obtained was kneaded by hand for 10 to 15 min and then left to rest (incubation of 5 to 10 min) before cooking in the oven for 20 to 30 min (Figure 6).

### **Production of Nèrèdji**

The production process of *Nèrèdji* is described in Figure 7. Ten grams of yellow Néré powder were diluted in 100 ml of water or milk and the mixture was homogenized. The resulting solution was consumed by adding a



**Figure 4.** Production diagram of *Kawarague*.  
Source: Authors



**Figure 5.** Production diagram of *Bafouratou*.  
Source: Authors

tablespoon of honey or 5 g of sugar.

**Classification of Néré-based foods**

Among foods based on Néré, PCA showed that *Nammigue* and *Kawarague* are specific to Korhogo, Séguéla and Bouna consumers. *Wasséra*, *Bafouratou* and *Cake au Oul* are specific to Bouna, while *Nérédji* is specific to Korhogo than Séguéla and Bouna (Figure 8).

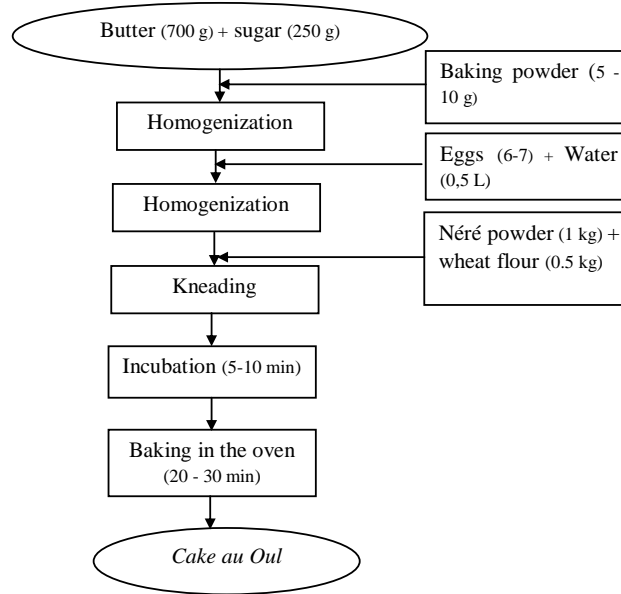
**Level of knowledge of Néré-based dishes**

With a proportion of 36.79% *Nammigue* is a food that is

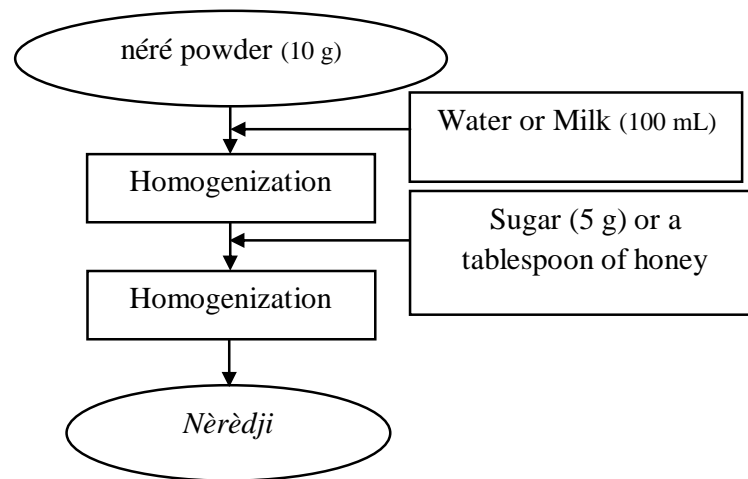
moderately known in all the investigated localities where *Wasséra* (8.89%) tops the list of little-known foods (Table 5).

**Periods and frequencies consumption**

Data in Figure 9 reveal that *Nammigue* is the most consumed food with a frequency of 2 times/month followed by *Wasséra* with a frequency of consumption of 1 time/month. All dishes are consumed at any time except *Cake au Oul* which is consumed at breakfast. *Nammigue* (32.59%) is more consumed at lunch (Figure 10).



**Figure 6.** Production diagram of *Cake au Oul*.  
Source: Authors

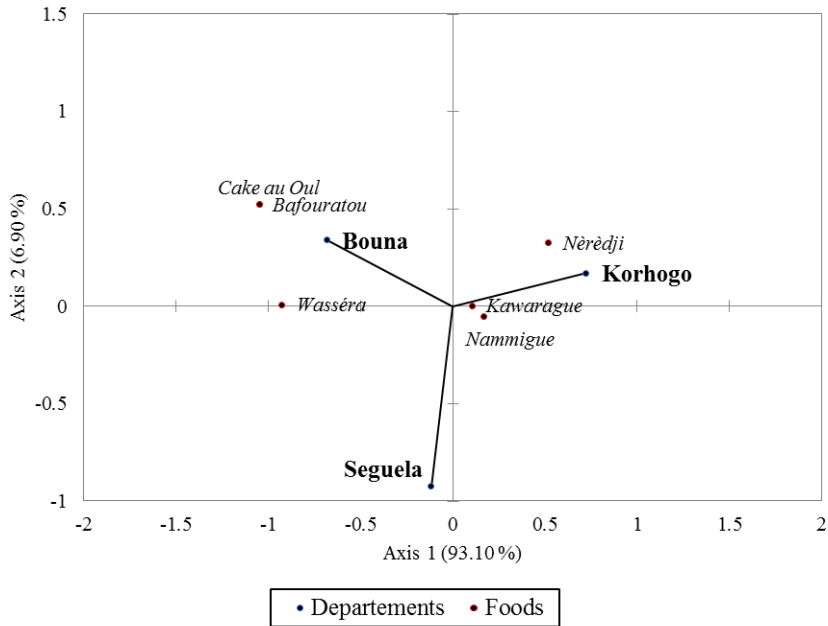


**Figure 7.** Production diagram of Nèrèdji.  
Source: Authors

## DISCUSSION

The study was conducted to identify the consumption practices of Néré pulp (*Parkia biglobosa* L.) in the departments of Korhogo, Séguéla and Bouna in northern Côte d'Ivoire. The data showed that six Néré-based dishes were identified (maize or millet couscous in Néré, maize fritters in Néré, cerelac in Néré, fritters in Néré, drinks in Néré and cakes in Néré) in the localities studied. However, the names of these foods differ according to locality/ethnic group. This diversity of foods produced from Néré pulp could reflect the importance of this fruit in the diet of rural populations. These foods would therefore

contribute to the food security of these populations. These results corroborate the studies of Ouattara et al. (2016) which revealed the importance of wild fruits in human nutrition. Nyadanu et al. (2017) also confirmed the importance of *P. biglobosa* pulp in the diet of rural populations. According to these authors, Néré pulp is used as a subsistence food in times of food scarcity and is also used as infant food. While according to studies of Sackou et al. (2020) on food insecurity in the city of Abidjan, only 3.8% of households were food secure. Thus, the popularisation of these foods could contribute to the reduction of food insecurity in developing countries, particularly in Côte d'Ivoire. The identified Néré pulp-

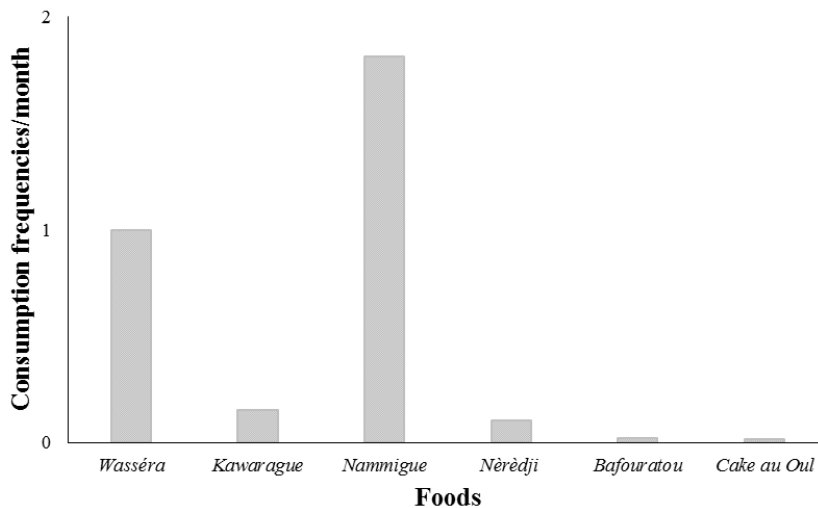


**Figure 8.** Factor analysis of Néré-based dishes.  
Source: Authors

**Table 5.** Level of knowledge of Néré-based dishes.

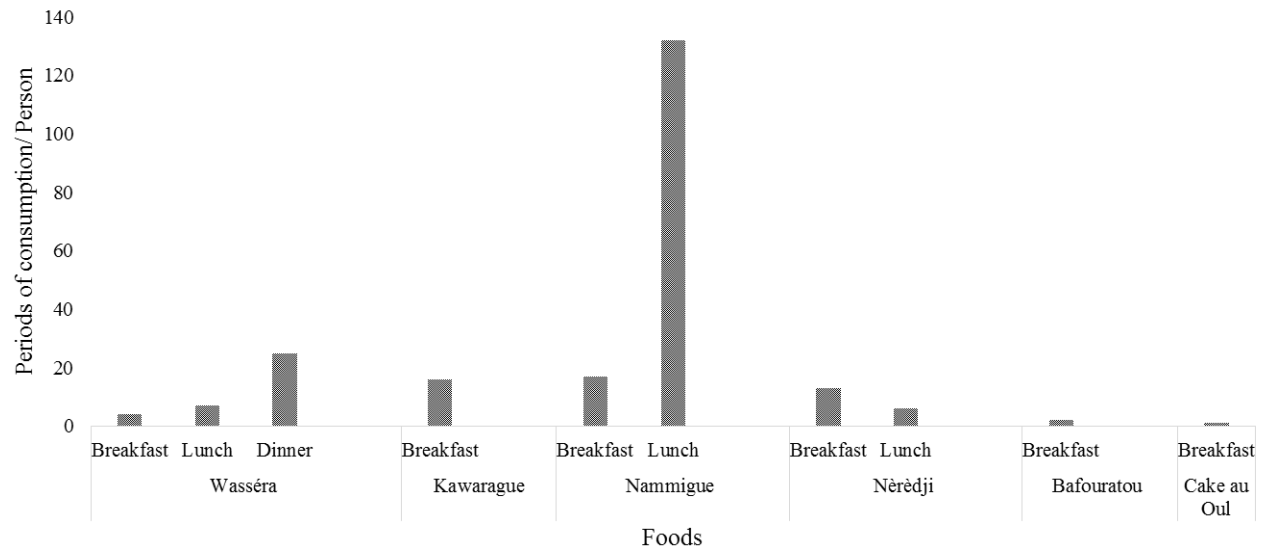
Cowpea-based dish	Korhogo	Séguéla	Bouna	Number	Proportion (%)	Level of knowledge
<i>Nammigue</i>	78	21	50	149	36.79	Moderately known
<i>Wasséra</i>	0	6	30	36	8.89	Less known
<i>Nèrèdji</i>	14	0	5	19	4.69	
<i>Kawarague</i>	8	2	6	16	3.95	
<i>Bafouratou</i>	0	0	2	2	0.49	
<i>Cake au Oul</i>	0	0	1	1	0.25	

Source: Authors



**Figure 9.** Consumption frequencies of Néré-based dishes.  
Source: Authors





**Figure 10.** Periods of consumption of Néré-based foods.  
Source: Authors

based foods are consumed more as meals than as drinks, with a meal/drink ratio of 5:1. Néré pulp is consumed as fritters, cakes, cereals and drinks. These different forms of food use in the form of drinks or meals are in line with those described by several authors such as Toure et al. (2020) and Vivien and Faure (2011). These authors confirm that the mealy pulp of the Néré fruit can be consumed raw, in jam or diluted in a liquid to prepare a sweet and refreshing drink. Similarly, Touré (2018) and Lamien et al. (2011) found that the flour of Néré fruit pulp mixed with cereal flour can be consumed in couscous, porridge, fritters and cakes. Studies of Arinola et al. (2019) also revealed that Néré pulp has appreciable dietary and functional properties, both in oil and water, that may qualify it for use in food. Five of the six foods identified are specific to each locality studied. It is believed that the specificity of these foods in each locality is related to differences in culture, customs and also eating habits of the populations. Al-Fatimi (2021) state that there is a strong relationship between local people and their environment, and that traditional knowledge is therefore passed on from generation to generation. Kruger and Gericke (2002) and Thurber et al. (2016) with a meal/drink ratio of 5:1. Cowpea pulp is consumed as fritters, cakes, cereals and drinks. These different forms of food use in the form of drinks or meals are in line with those described by several authors such as Touré (2020) and Vivien and Faure (2011). These authors confirm that the mealy pulp of the cowpea fruit can be consumed raw, in jam or diluted in a liquid to prepare a sweet and refreshing drink. Similarly, Touré (2018) and Lamien continue this same view by stating that it is evident that there is a divergence in the foods consumed, as culture is one of the important factors that influence consumer attitudes towards a given food. For

the preparation of all these dishes, wild fruits are mainly collected in the field (92.86 to 98.25%). This result is explained by the fact that the surveys were conducted in rural areas and the abundance of this fruit in these localities. Indeed, Avana-Tientcheu et al. (2019) and Koura et al. (2013) confirm that in Côte d'Ivoire, savannah populations preserve the dwarf tree for its numerous virtues. Koné et al. (2020) make a similar observation on the biodiversity of plant species in the north of Côte d'Ivoire, showing that wild fruit trees such as the dwarf tree are protected by local populations because of their high ethnobotanical value. The use of the dwarf tree in the preparation of dishes is explained by the satisfaction of health problems and the search for particular tastes. In addition, the dwarf tree is considered an emergency food. This diversity in the reasons for consumption of this fruit in different localities could be related to the low level of information about the importance of this fruit. According to Soma Massieke et al. (2017), the lack of knowledge of all the benefits of the fruit may influence food uses. Indeed, as a health product, Néré pulp is used as a mild diuretic and purgative (Arbonnier, 2009; Vivien and Faure, 2011; Aubréville, 1950). It also has a beneficial effect on health due to its high content of flavonoids, which have antioxidant activity on hydroxyl radicals and free radicals. It can also prevent congestive heart failure due to its composition of cardiac glycosides (Arinola et al., 2019). These foods developed by these populations are most often consumed at any time of the day. However, with a consumption rate of 36.79%, Nammigue appears to be the best known and most consumed food in Néré, with a consumption frequency of about 2 times per month. This low consumption rate of the main staple food of Néré could be explained by the fact that Néré is not a food of

choice for consumers. This hypothesis is supported by the results of Lamien et al. (2011) which reveal that yellow Néré pulp is much more used only to cover the food deficit of some families during the lean season. This result could also be explained by the modernisation of the rural areas surveyed. It is in this vein that Muhammad et al. (2015) argue that modernisation disrupts and creates conflicts with the cultural traits of rural people by changing their lifestyles. According to Oryema et al. (2015), changing lifestyles promote neglect of wild food resources, thereby reducing their use. It is therefore important to encourage rural populations to consume these foods in order to reduce the rate of food insecurity in Côte d'Ivoire.

## Conclusion

At the end of this study, six foods based on Néré were identified. The production processes and consumption patterns of these foods are largely cultural, with a clear preference for *Nammigue*, which is consumed more during the lean season. However, beyond their overall use during the lean season, the lack of knowledge of the biochemical composition of these foods is an obstacle to better dissemination.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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