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Typology of Fermented Porridges and Socio-demographic Characteristics of Respondents in the Northern Part of Benin

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Fermentation is an ancestral process and one of the most used economic methods in the preservation and transformation of cereal-based food raw materials. They are essentially rich in carbohydrates, but they can also be a source of micronutrients such as iron and are used in many traditional culinary preparations, in particular fermented porridges. The aim of this study is to identify the variability of fermented cereal-based porridges produced and consumed in northern Benin. Thus, 315 producers and consumers were randomly interviewed in nine localities of northern Benin. First, field surveys were carried out in the traditional areas of porridge production and consumption in the northern region of Benin in order to establish the consumption map of fermented porridges. Secondly, interviews and occasional conversations were used for sample collection as well as occasional interviews (individual survey). During our investigation, eight (*koko*, *bobossou*, *gbangba*, *apkan*, *sagagnega*, *akloui*, *bita* and *fourra*) porridge were reported. Corn, millet and sorghum are cereals that are used for proceeding those porridges. The interviewed people are predominantly (35.53%) between 18 and 25 years old of age followed by those aged between 25 and 31 years old (30.82%). Mostly (63.21%) women were interviewed with a sex ratio (M/F = 0.58) and involved in the production of traditional porridge. More than 36% of respondents had at least secondary education, 30.82% are uneducated, 22.64% have primary education and 10.06% had at least university level. A significant association was observed between the cereal used and the type of porridge ($p<0.001$). It can be seen that the marketing and consumption of different porridges is associated with different communes in northern Benin. The method of preserving these porridges and their processing differs from one producer to another or from one consumer to another. It also differs from one municipality to another.

Keywords: Cereals; porridge; endogenous knowledge; fermentation; Northern Benin.

1. INTRODUCTION

In sub-Saharan Africa, cereals are considered as one of the most important sources of nutrients, and cereal-based porridges are often given to children under 5 years as a complementary food to breastfeeding [1]. Thus, cereals used for the production of fermented products such as porridges through various traditional processes are frequently millet, sorghum, maize and rice [2]. These cereals, transformed to foods such as fermented porridge, occupy a prominent place [3] and are considered to be one of the most important sources of nutrients [1] and energy [4].

In addition, studies have shown that fermented foods and probiotics are indigenous foods that have been shown to improve the nutritional value of food products such as corn and sorghum and thus confer nutritional and health benefits on young children. Indeed, fermented foods have been shown to reduce childhood illnesses such as diarrhea in hospitalized children, as they are effective in suppressing the growth of diarrheal viruses and bacteria [5].

Nowadays, new technological tools are driving significant transformations in nutritional science and scientific approaches to new product design. As a result, fermentation is being challenged because it provides the fore as it provides a solid foundation for the development of safe food products with specific nutritional and functional attributes [6]. Thus, indigenous fermented foods are often used as part of the daily feeding program [7]. However, some authors reported a limited use of fermented foods because of its low availability, lack of its knowledge and vulgarization [8].

Despite their contribution to the fight against hunger and malnutrition [9], few studies in Benin have evaluated the processing of fermented foods at the household level as a means of adding value and improving nutrition, while triggering a process of transformation, two crucial dimensions on which food systems are built [10]. However, before any vulgarization, it important to better know the traditional production and uses of fermented cereal-based porridge. Thus, the aim of the present study was to evaluate endogenous knowledge of the production of fermented cereals-based porridges produced in northern Benin, west Africa.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in 09 traditional areas (Kandi, Banikoara, Djougou, Copargo, Ouaké, N'Dali, Parakou, Cobly and Matéri) of production and consumption of fermented cereal-based porridges in northern Benin (Fig. 1). In each target place, the survey was carried out in the neighboring town and village.

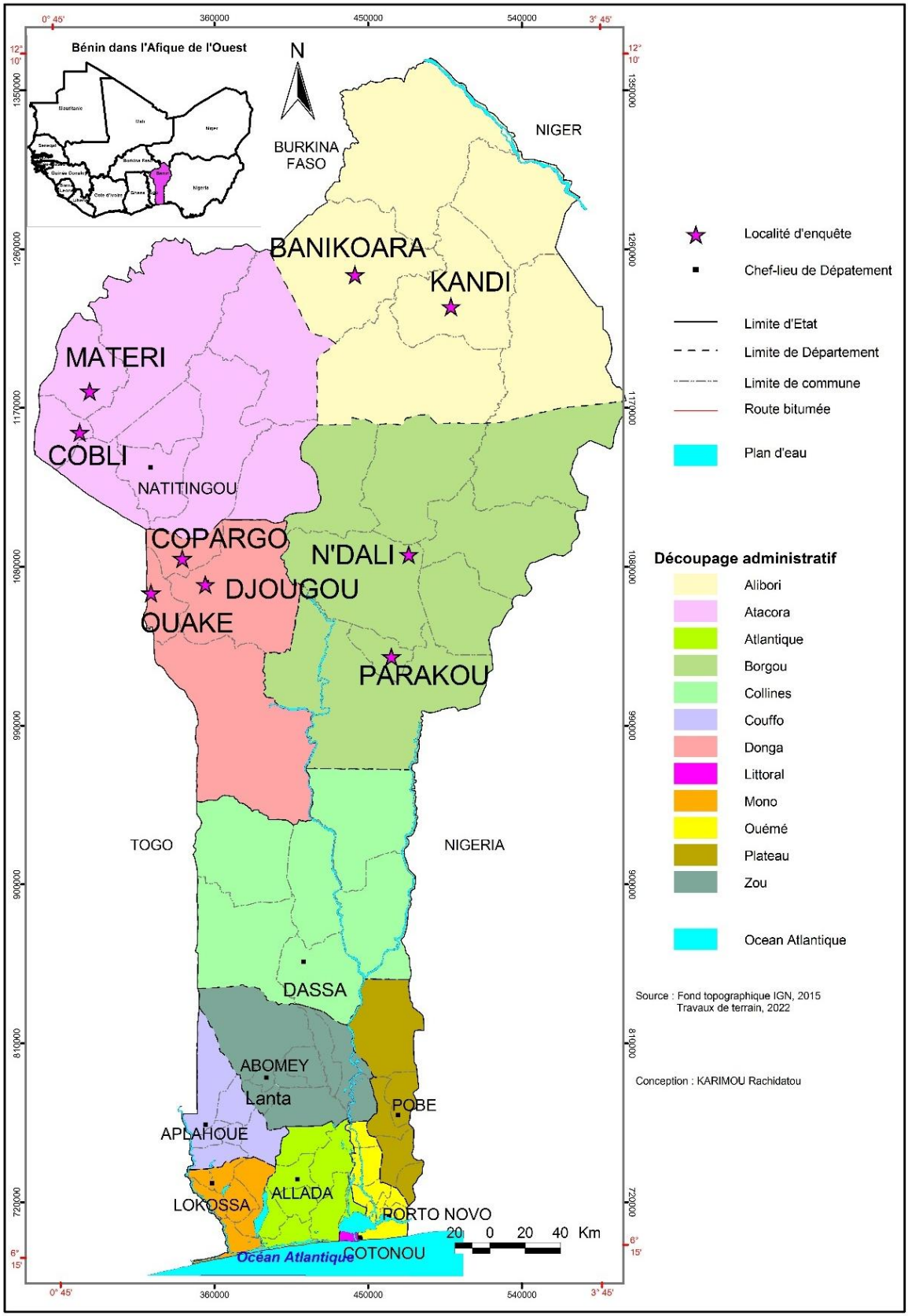

Fig. 1. Map of the study area showing the surveyed area

2.2 Sampling

To establish the cereal porridge consumption map in northern Benin, field surveys were carried out in the above-mentioned traditional areas of production and consumption of porridge in Benin in the northern region of Benin. Men, women and children at least 10 years old were dismayed by the interview. In total, around 315 producers and consumers were randomly interviewed (35 respondents per municipality).

2.3 Data Collection

Interviews and occasional conversations were used for information collection. Interviews based on a previously defined list of themes or questions were carried out in the selected areas. The individual interviews were used both to estimate knowledge and to solicit responses. The interviews were conducted first with the porridge sellers to find out the age, the type of porridge sold, the type of cereal used, the method used to obtain the porridge and the method of conservation. Secondly, with the buyers present who are consumers of this porridge. At their midpoint, information such as age, types of porridge he or she knows, method of consumption, preference and the reason for this preference were sought. Then in houses where production and consumption are domestic. Here, we also looked for the age of the respondent, the types of porridge, the preference and the well-made ones, the method of production, consumption and also conservation. The data collected relate to endogenous peasant knowledge, the history of consumption, the socio-economic and cultural value of the environment, the benefits of this porridge on the consumer's organism.

2.4 Data Analyzes

Statistical analysis of recorded data was done using descriptive statistics and statistical tests. The relative frequencies were calculated for collected variables. These calculated frequencies were represented by means of histograms. In order to see if there are any association relationships between types of porridge and the cereals used, the ethnic group of the respondent, the sex of the respondent, the age of the respondent, the level of education of the respondent, the municipality of the respondent, chi-2 tests were carried out. Mosaic charts were used to represent these association relationships when significant. The significance threshold retained is 5% and the various tests were carried out in the R 4.1.2 software [11].

3. RESULTS

3.1 Socio-demographic Characteristics of the Respondents

The people present and interviewed throughout our field survey are predominantly (35.53%) young (between 18 and 25 years) population followed by age group between 25 and 31 years old (30.82%). The population interviewed is mostly women 63.21% (sex ratio M/F = 0.58). About 36.48% of respondents had at least secondary education, 30.82% are uneducated, 22.64% have primary education and 10.06% had at least university level. Interviewed people are mostly porridge vendors (32.70%), students (18.55%) and civil servants (0.94%) (Table 1).

3.2 Typology of Porridge Marketed

The different porridges marketed in some municipalities of northern Benin are presented in Fig. 2. Eight types of porridge (*akloui*, *apkan*, *bita*, *bobossou*, *fourra*, *gbangba*, *koko*, and *sagagnega*) were identified in the different municipalities investigated.

No association is observed between the type of porridge and the sex of the respondent (p-value = 0.606), the age of the respondent (p-value = 0.116), the level of education of the respondent (p-value = 0.064) (Fig. 3).

These eight types of porridge listed in the nine municipalities of northern Benin can be classified as smooth (*koko*, *bobossou*, *gbangba*, *apkan*, and *sagagnega*) and lumpy (*akloui*, *bita* and *fourra*) porridges. The smooth porridges are porridges made up of all kinds of fermented porridges with a smooth appearance whereas the lumpy porridges are those containing lumps and whose appearance is not smooth. Those porridges can be eaten hot (*koko*, *bobossou*, *gbangba*, *akloui*, and *bita*) or cold (*apkan*, *sagagnega* and *fourra*).

There is an unequal distribution of these porridges in the communes. Thus, the Fig. 4 presents the different types of fermented porridge in the municipalities of northern Benin. Indeed, the municipality with the greatest diversity of porridges is that of Djougou (8 types of porridges). While the municipalities of Copargo, N'dali and Ouake have a diversity of seven types of porridge. The municipalities of

Table 1. Frequency (%) of socio-demographic characteristics by parameter according to the municipality

	TOWNS									Total proportion of the respondents (%)
	BANIKOARA	**COBLY**	**COPARGO**	**DJOUGOU**	**KANDI**	**MATERI**	**N'DALI**	**OUAKE**	**PARAKOU**	
Age class										
[12-18]	8.33	8.33	11.43	2.86	2.86	5.56	2.86	5.71	2.86	5.66
[18-25]	47.22	19.44	37.14	37.14	8.57	47.22	42.86	40.00	40.00	**35.53**
[25-31]	22.22	63.89	20.00	31.43	31.43	30.56	28.57	20.00	28.57	**30.82**
[31-38]	16.67	5.56	17.14	20.00	31.43	5.56	11.43	22.86	22.86	16.98
[38-42]	2.78		5.71	2.86	14.29	5.56	2.86	5.71	-	4.40
[42-48]	-	-	5.71	5.71	5.71	2.78	5.71	5.71	2.86	3.77
[48-54]	2.78	-	-	-	5.71	2.78	-	-	-	1.26
[54-60]	-	-	-	-	-	-	2.86	-	2.86	0.63
[60-66]	-	2.78	2.86	-	-	-	2.86	-	-	0.94
Gender										
Female	69.44	69.44	65.71	42.86	45.71	75.00	74.29	65.71	60.00	**63.21**
Male	30.56	30.56	34.29	57.14	54.29	25.00	25.71	34.29	40.00	36.79
Educational level										
None	11.11	11.11	48.57	28.57	48.57	22.22	42.86	40.00	25.71	**30.82**
Primary	36.11	44.44	8.57	11.43	37.14	27.78	5.71	22.86	8.57	22.64
Secondary	52.78	44.44	37.14	40.00	14.29	33.33	25.71	37.14	42.86	**36.48**
University	-	-	5.71	20.00	-	16.67	25.71	-	22.86	10.06
Respondent's occupation										
Farmer	-	13.89	11.43	8.57	25.71	13.89	-	17.14	2.86	10.38
Artisan	5.56	-	5.71	14.29	22.86	-	14.29	8.57	8.57	8.81
Driver	-	-	-	2.86	5.71	-	-	-	-	0.94
Trader	13.89	-	-	-	2.86	-	37.14	-	22.86	8.49
Pupil	33.33	11.11	22.86	22.86	-	27.78	-	25.71	22.86	**18.55**
Teacher	-	-	5.71	8.57	2.86	-	-	-	-	1.89
Student	11.11	8.33	2.86	8.57	-	16.67	2.86	5.71	25.71	9.12
Household	5.56	-	17.14	5.71	8.57	2.78	-	22.86	2.86	7.23
Health professional	2.78	2.78	-	-	-	-	-	-	2.86	0.94
Secretary	-	-	-	-	-	-	5.71	-	2.86	0.94
Saleswoman	27.78	63.89	34.29	28.57	31.43	38.89	40.00	20.00	8.57	**32.70**

Fig. 2. Picture of the eight identified porridge in the northern Benin

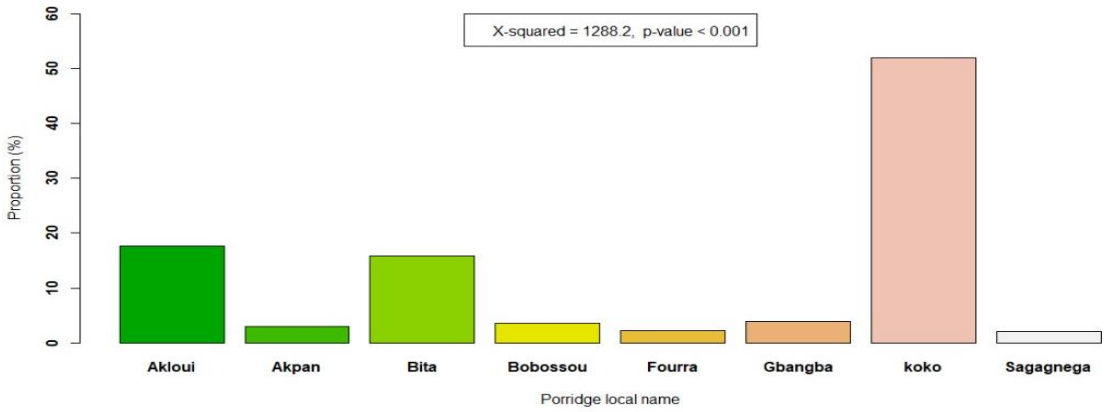

Fig. 3. Proportion the types of porridge in northern Benin

Cobly and Materi are the least diversified with three types of porridge marketed. The associations tested show that there is a relationship of dependence between the type of porridge and the type of cereal used as well as the municipalities (Fig. 4).

Indeed, a significant association is observed between the cereal (Fig. 5) used and the type of porridge (p-value < 0.001). This relationship is presented in Fig. 6. This relationship shows that *akloui* are almost exclusively made from maize, even if an under-representation of production of this sorghum-based porridge is noted. The *bobossou* porridge is made exclusively from "maize" while that called *fourra* is made from millet. The *koko* and *sagagnega* porridges are made from all cereals or even a mixture of two cereals.

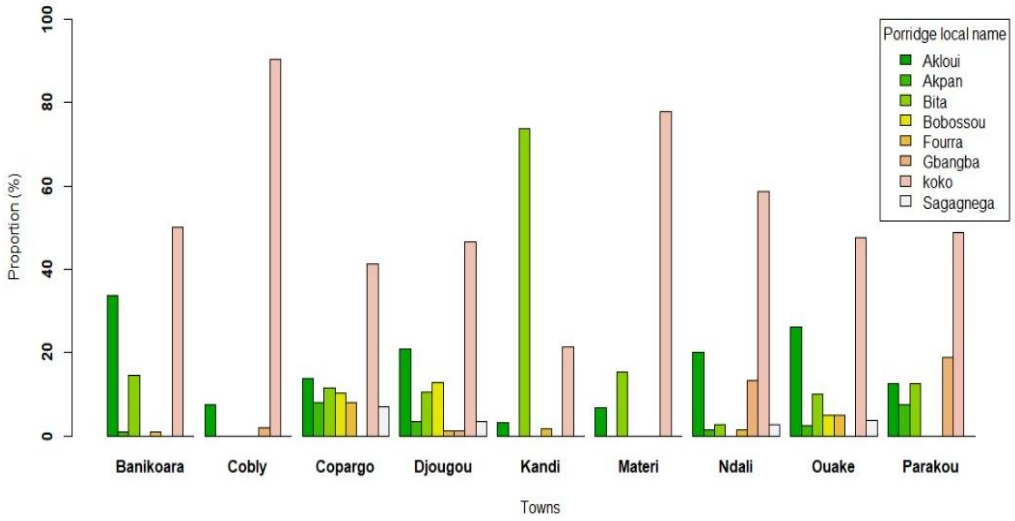

Fig. 4. Distribution fermented porridges in the municipalities of northern Benin

Maize **Millet** **Sorghum**

Fig. 5. Pictures of the cereals used process porridge in northern Benin

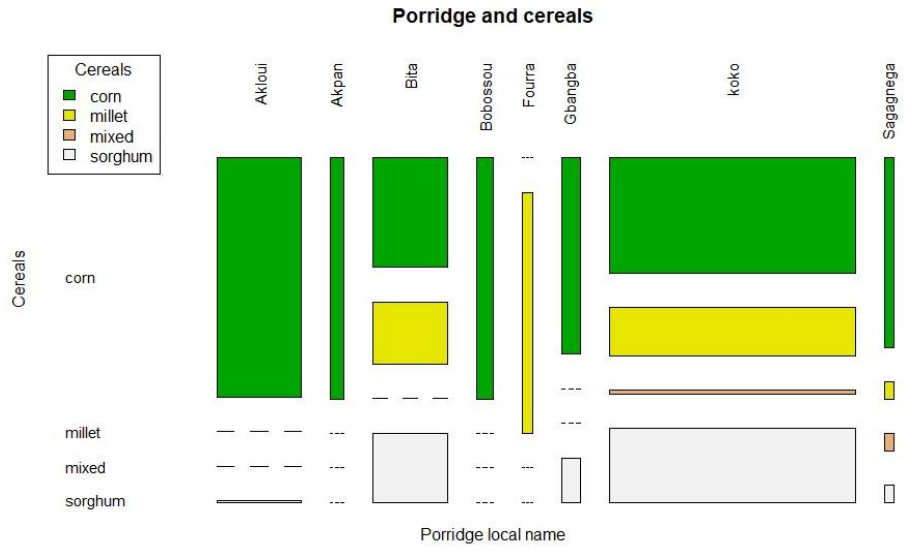

Fig. 6. Association between the type of fermented porridge and the type of cereal for processing

Fig. 7 presents the associations between the type of fermented porridge and the municipality. This figure shows that the marketing and consumption of *akloui* porridge is more associated with the municipalities of Banikoara and Ouake. The communes of Copargo and Parakou are those most associated with the *akpan* while the *bita* is more associated with the commune of Kandi. Strong marketing of *fourra* and *sagagnega* is observed in the commune of Copargo. Concerning *gbangba*, it is associated with the municipalities of N'dali and Parakou. It is noted that *koko* is not associated with a particular municipality. It is marketed and consumed in all the towns covered.

3.3 Method of Porridge Preserving

The method of preserving porridge differs from one producer to another or from one consumer to another. It also differs from one municipality to another. Table 2 summarizes the storage methods for fermented porridge by department and by municipality. These conservation methods vary from one municipality to another. In addition, in the municipality of Parakou, we have: preservation by thermos, the aluminum container immersed in water, the container in the open air in a clean place, the cooler, the reheating, the container in hermetically sealed plastic, refrigeration but reheating is the most used method with 33.33%. In N'Dali, we have: preservation by the thermos, the aluminum container immersed in water, the container in the open air in a clean place, the cooler, the reheating, the hermetically sealed plastic container and the balls in a basket and cover with a loincloth. The cooler is the most used preservation method in N'Dali (60.27%), Materi (66.1%), Cobly (52%), Copargo (50.65%), Ouaké (46.06%) and Djougou (33.82%). In Kandi, preservation by the thermos, the container in the open air in a clean place, the cooler, the reheating, the hermetically sealed plastic container, the refrigeration, the partially closed plastic container, the balls in the air free are used with 15.69% of the population who do not keep porridge. Preservation by the hermetically sealed plastic container were much used in the commune of Kandi (49.02%) and Banikora (50.78%).

4. DISCUSSION

Today, many efforts to eradicate hunger include increasing agricultural production, processing raw materials, and supplementing and fortifying foods. Locally produced foods are an important part of food systems because they help fight hunger and malnutrition. To effectively contribute to this mission, we evaluated the endogenous knowledge of the production of fermented porridges produced in northern Benin from cereals.

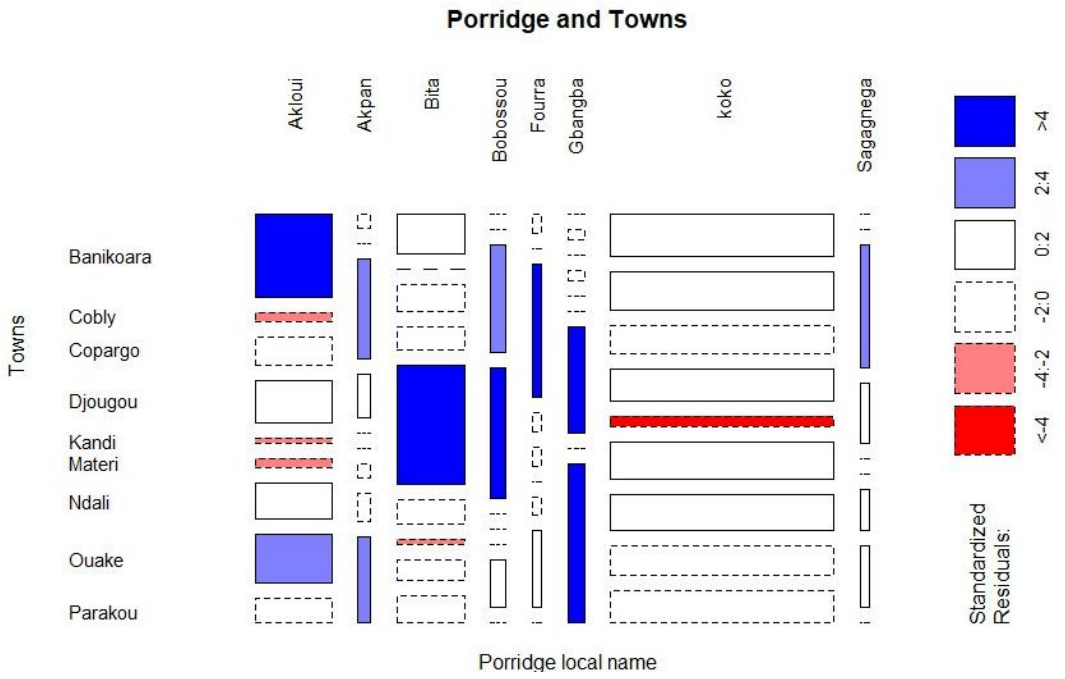

Fig. 7. Association between type of fermented porridge and municipality

Table 2. Methods of preserving fermented porridge by department and by municipality

Mode de conservation	Proportion (%) by municipality								
	Parakou	**N'Dali**	**Kandi**	**Banikoara**	**Djougou**	**Copargo**	**Ouaké**	**Matéri**	**Cobly**
Thermos	10.04	19.18	1.96		2.94		1.32	18.64	
Aluminum container immersed in water	26.20	10.96							2
Container in the open air in a clean place	4.57	1.37	13.72	1.59		9.09	3.95		42
Cooler	15.60	60.27	1.96		33.82	50.65	46.06	66.1	52
Reheating	33.33	5.48	3.92		23.53	16.88	22.37		
Hermetically sealed plastic container	2.56	1.37	49.02	50.78	16.18	16.88	17.11	13.56	4
Lemon in the dough for the fermentation of the *sagagnega*, and its conservation							1.32		
Refrigeration	7.69		1.96		7.35	6.49	2.63		
Partially closed plastic container			9.80	9.52	10.29		5.26	1.69	
Balls in a basket and cover with a loincloth		1.37		1.59					
Balls in the open air			1.96		1.47				
Without conservation			15.69		2.94				
Plastic in a bag of rice or sugar				36.52	1.47				

This study revealed that the population surveyed in North Benin is a young population (18 and 25 years) at 35.53% and then group aged between 25 and 31 years (30.82%). This can be explained by the fact that the porridges listed are not specifically infant porridges. Meanwhile, our results are lower than those obtained in Ouagadougou [12]. by more than 40% of surveyed households and especially by nearly 3/4 of the children under 2 years of these households Thus, in their study, the author has shown that the fermented millet porridges, called in Moré *Binkida* and *Binsaalga*, marketed are widely consumed. In our study, women are predominant with a percentage of 63.21% against 36.79% for men. This could be explained by the fact that household chores are performed by women. In addition, this may be due to the fact that most men are only porridge consumers. Only women are producers and also consumers so they had more information to provide as part of our survey.

In our study, there is a diversity of fermented porridges. Eight types of fermented porridge were identified in the nine investigated municipalities in northern Benin. These eight porridges are unevenly distributed in the communes of northern Benin. We obtain all eight porridges in the commune of Djougou followed by the commune of Copargo, N'dali and Ouaké which have seven types of fermented porridge. The municipalities of Cobly and Matéri are the least diversified with three types of fermented porridge. This diversity lies at the level of the raw material used, the social, cultural, religious aspect and the technological transformation processes used [13]. However, a dependency relationship exists between the type of porridge and the type of cereal used as well as the communes. Also, there is a significant association between the cereal used and the type of porridge (p-value < 0.001). Indeed, the type of *akloui* porridge is mainly associated with the type of corn cereal. An under-representation of production of this sorghum-based porridge was noted. The *bobossou* is made exclusively from corn, the *fourra* is made from millet, while the *koko* and the *sagagnega* are produced from all kinds of cereals. A mix of cereals is also possible at this level. *Akloui* porridge is consumed more in the communes of Banikoara and Ouake. The communes of Copargo and Parakou are those most associated with *akpan* porridge while *bita* porridge is more associated with the commune of Kandi. A strong commercialization of *fourra* and *sagagnega* porridges is observed in the commune of Copargo. The *gbangba* is associated with the communes of N'Dali and Parakou. It is noted that the *koko* is not associated with a particular municipality. It is marketed and consumed in all the towns covered. No association is observed between the type of porridge and the sex of the respondent (p-value = 0.606), the age of the respondent (p-value = 0.116), the level of education of the respondent (p-value = 0.064). These results could be explained by the fact that traditional fermented foods are processed at the household level for home consumption using locally available raw materials [14]. Surplus products are sold in local markets by some processors [14]. Traditional fermentation helps prevent food loss and extend the shelf life of raw materials, which can increase seasonal food availability and the range of food options available to individuals [15] also during difficult, high-risk climate and conflict zones [16]. Therefore, fermented foods provide benefits to both sellers and consumers by improving diets and health, thereby contributing to food security and local livelihoods [16]. But the technological diversity can have an impact on the quality of the mixtures in general. Granulated porridges such as *bita*, *akloui* are obtained from corn, millet or sorghum. Corn-based *akloui* porridge is the most produced and consumed in northern Benin. This is explained by the fact that millet and sorghum are more expensive than maize and also the color that *akloui* presents with other cereals other than maize. Akloui has always been made with corn and has a white color.

Sometimes, after production of fermented porridge, to keep the rest of the porridge, several methods are used by producers and consumers. In our study, the reported methods were: preservation by the thermos, the aluminum container immersed in water, the container in the open air in a clean place, the cooler, the reheating, the hermetically sealed plastic container, the lemon in the dough for the fermentation of the sagagnèga and its conservation, the refrigeration, the partially closed plastic container, the balls in a basket and cover with a loincloth, the balls in the open air, plastic in a bag of rice or sugar. The use of the cooler is the most used in the municipalities followed by the use of hermetically sealed plastic containers. On the other hand, the use of lemon in the dough for the fermentation of sagagnèga and its preservation, the non-preservation of porridges is very little used by consumers and producers of these porridges. We can say that

the preservation methods are in relation of localities habits.

5. CONCLUSION

This study carried out in the North of Benin, made it possible to develop the typology of marketed porridges and their technological diagrams. Among the eight porridges (*akloui*, *apkan*, *bita*, *bobossou*, *fourra*, *gbangba*, *koko* and *sagagnega*), some are smooth, those lumpy. Porridges can be are eaten cold or hot depending to the kind. Only women produce porridge in northern Benin. The fermentation processes of the eight listed porridge are spontaneous and traditional. Traditional fermented porridges in northern Benin are culturally embedded in society and are generally well accepted by consumers. This offers potential for local processor entrepreneurship, value chains to be built and food security to be promoted locally. This should be taken into account when developing policies and research programs aimed at promoting food and nutrition security based on the development of livelihoods for smallholder farmers, processors and local consumers, both in urban and rural areas.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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