Tropentag, September 15-17, 2021, hybrid conference
"Towards shifting paradigms in agriculture
for a healthy and sustainable future"

Assessment of Traditional Processing Technologies of *Tamarindus indica* in Northern Benin

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Abstract: Native plants and fruits have recently gained a lot of attention due to their nutritional and functional potential. This is the case with *Tamarindus indica* which is a nutritious fruit with a variety of uses. It has several appellations depending on the region. The pulp of *Tamarindus indica* remains the most used organ of the species well processed by local populations. The objective of this study is to assess traditional technologies for processing *Tamarindus indica* pulp in the municipalities of Bassila, Djougou and Matéri in northern Benin. Data were collected through a semi-structured survey and sixty-five tamarind processors belonging to nine socio-linguistic groups were interviewed. Descriptive statistics and correspondance analyses were used to link ethnofood knowledge to processes and derived foods. It arises from the investigations that, out of the three municipalities surveyed, the ethnic groups processing tamarind are mostly Yoa-Lokpa (42.86 %), Ottamari (28.57 %) followed by the Dendi and Yoruba (10 %) of which fifty percent are women. Main derived products from tamarind were nectar, powder and syrup. Citation frequencies from informants showed that tamarind nectar is mainly produced by Yoa -Lokpa ethnic group (58.79 %) followed by Dendi (16.28 %) while tamarind powder is processed only by Ottamari groups. Tamarind syrup is a product specific to the Yoruba groups of the municipality of Bassila .It is suggested that further characterization of the identified product is performed for their better valorization.

Keywords: Benin, tamarind pulp, tamarind drinks, traditional technologies

Introduction

Since the moon of time, humans have depended on plants to meet their needs. This is the case of *Tamarindus indica* (Figure 1) whose fruits are nutritious with a variety of uses (Fandohan *et al.*, 2010). Its pulp remains the most used organ of the tree but still remains poorly exploited despite its richness in macro and micronutrients essential for humans (Ahodègnon *et al*., 2018). In Africa, it is collected by rural populations in order to sell them to support themselves and to integrate them into their diet (Fandohan *et al.*, 2010). It could contribute to the fight against hunger, poverty and food insecurity, which is one of the major development issues in Benin (UNDP, 2017). Highly appreciated, the great perishability of the pulp

makes it mandatory to process it into various products. Since ethnic variability in Benin is a known source of cult richness and food practices how are the traditional knowledge and skills on the food processing of *T. indica* diversified in rural areas? This study aims to evaluate the different traditional technologies for processing tamarind pulp in northern Benin.

Figure 1*: Tamarind tree (a), pods (b) and its fruits (c)*
Source: Picture, Kanfon, Bassila, February 2020

Methodology

The data were collected through a semi-structured survey in local language among 143 randomly selected tamarind processors belonging to nine socio-linguistic groups in the minicipalities of Matéri, Bassila and Djougou in north-eastern Benin (Figure 2). These municipalities were chosen because they have and use the species as a food plant. A Multiple Correspondence Analysis (MCA) provided a representation of the processers. An ascending hierarchical classification (AHC) according to Ward's method, using Euclidean distance was adopted to distinguish the groups of transformers. A discriminating analysis was carried out to assess the relevance of the groups. All statistical analyses were carried out with R 3.6.3 software.

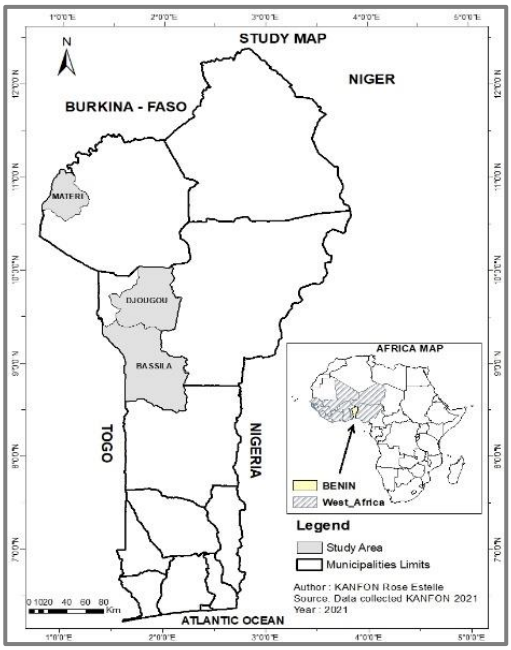

Figure 2 : Study areas
Source: Kanfon, February 2021

Results and Discussions

Traditional processes for processing tamarind and its derived products

Six (06) traditional know-how corresponding to six (06) derived products have been listed (Figure 3) in the municipalities prospected. These endogenous processes differ from each other in terms of formulation and have allowed the identification of sixteen (16) technological variants (Table 1) including eight (08) for nectar, two (02) for powder, three for concentrate, one (01) for syrup, one for jam and (01) for diluted tamarind nectar. The latter is used to prepare porridges and acid sauces. The water used for maceration of the pulp in the case of tamarind concentrate and jam is boiling water. For nectar, the processing of tamarind differ in number, the order of the unit operations and the formulation of derived product. Apart from the powder technology n°2 (TP2), at least the first three unit operations for the others the processing processes of *T. indica* are identical. Technology of Jam (TConf) is the longest technology.

Table 1 : *Traditional processes for processing tamarind and its derived products*

Derived products		Unit operations							
'Diluted nectar'		Washing	Soaking	Maceration	Dilution	Filtering	Conditioning		
Nectar	TN1	Washing	Soaking	Maceration	Dilution	Sugaring	Filtering	Conditioning	
	TN2				Boiling	Dilution	Sugaring	Filtering	Conditioning
	TN3				Spicing	Dilution	Filtering	Sugaring	Conditioning
	TN4				Spicing	Dilution	Sugaring	Filtering	Conditioning
	TN5				Spicing	Boiling	Dilution	Sugaring and Filtering	Conditioning
	TN6				Spicing	Filtering	Dilution	Sugaring	Conditioning
	TN7				Filtering	Dilution	Conditioning	-	-
	TN8				Filtering	Dilution	Sugaring	Conditioning	-
Concentrate	TC1	Washing	Soaking (boiling water)	Cooling	Maceration	Filtering	Concentration	cold pack	-
	TC2						Spicing	Concentration	Conditioning
	TC3						Spicing	Filtering and Concentration	Conditioning
Jam	TConf	Washing	Soaking (boiling water)	Cooling	Maceration	Filtering and Concentration	Sugaring and Cooking (low heat)	Sugar test and Adding pectin	Conditioning (at room temperature)
Syrup	TS	Washing	Soaking	Maceration	Filtering	Sugaring	Cooking	skimming	Conditioning
Powder	TP1	Washing	Soaking (boiling water)	Cooling	Maceration	Filtering and Concentration	Drying	Grinding	Conditioning
	TP2	Pulping	Ginning	Drying	Grinding	Conditioning		-	-

Legend: TN = Technologies of nectar; **TC =** Technologies of Concentrate; **TP** = Technologies of powder; **TConf** = Technology of Jam; **TS** = Technology of syrup, **TET** = Technology of tamarind diluted nectar.

Classes and characteristics of tamarind processors in the three municipalities

MCA made it possible to have 3 dimensions representing 33.69% of inertia (Table 2), which is acceptable for an MCA. An AHC made it possible to distinguish 3 clusters (groups) of processors represented by the factor map of the transformers (Figure 3).

Table 2 : *Model Summary*

	Eigenvalue	% of Variance	% Cumulative of variance
Dim.1	0.434	12.40	12.397
Dim 2	0.416	11.89	24.287
Dim 3	0.329	9.401	33.692

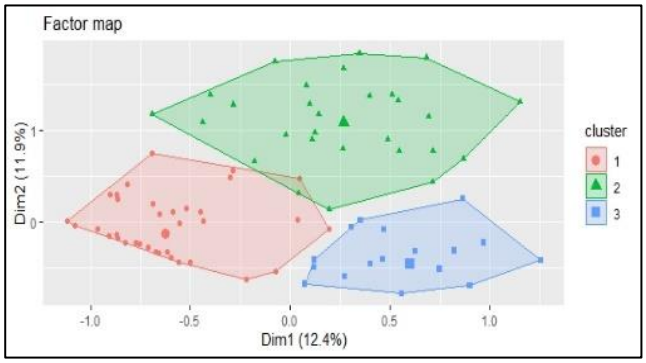

Figure 3: Factor map of the transformers

Analysis of the distribution of groups on the AHC and MCA graphs revealed the characteristics of each group (Table 3). At the risk of 5%, the results obtained is statistically significant.

Relationship between processing technologies and socio-linguistic groups of processors

The traditional processing according to sociolinguistic groups is represented by figure 4. TP1 technology for the production of tamarind powder by drying and grinding the pulp is more adopted by Bariba from group 1. On the other hand, Yoruba and some Bariba adopt TN8 and Yoa-Lokpa and Dendi practiced TN4 technology respectively for nectar production.

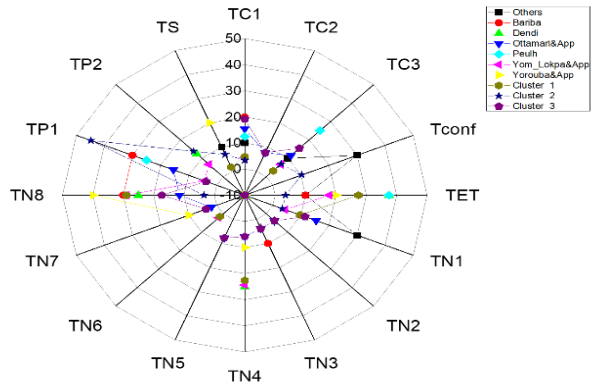

Figure 4: Hierarchical Classification Graph

TC1 is practiced by the Bariba of group 3 while the Yoa-lokpa of group 2. It should be noted that the jam obtained by the TConf technology and the syrup (TS technology) are specific to the groups designated by others (in this study represents Adja, Fon and Mahi ethnic groups). Tamarind diluted nectar (TET) is produced by all in the three municipalities.

Table 3: *Characteristics of typological clusters*

		clusters			Total	Statistiques	
		1 (43.4%)	2 (20.3%)	3 (36.4%)		Chi carré	p-Value
Derived products	Concentrate	8.10	10.30	42.30	21.00	121.34	< 0.05
	Jam	-	10.30	-	2.10		
	Diluted nectar	27.40	3.40	-	12.60		
	Nectar	62.90	10.30	53.80	49.00		
	Powder	-	58.60	3.80	13.30		
	Syrup	1.60	6.90	-	2.10		
Socio-lingustic groups	Others	6.50	20.70	-	7.00	121.60	< 0.05
	Bariba	1.60	13.80	9.60	7.00		
	Dendi	11.30	3.40	-	5.60		
	Ottamari	1.60	24.10	84.60	36.40		
	Peulh	4.80	13.80	1.90	5.60		
	Yom-Lokpa	61.30	20.70	1.90	31.50		
	Yorouba	12.90	3.40	1.90	7.00		
Municipalities	Bassila	56.50	31.00	-	30.80	106.24	< 0.05
	Djougou	43.50	20.70	3.80	24.50		
	Materi	-	48.30	96.20	44.80		

Conclusion

Traditional tamarind processing methods are dependent on the socio-linguistics groups diversity of rural populations. For a better valuation of the tamarind tree, it is essential to carry out studies on the nutritional and functional characterization of products derived from the species resulting from each traditional process.

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