

ENDOGENOUS KNOWLEDGE AND USES OF THE FRUITS OF *PTEROCARPUS SANTALINOIDES* L'HER. EX OF (PAPILLIONOIDAE), SPONTANEOUS FOOD PLANT FOUND IN COTE D'IVOIRE**Pierre Etche Etche¹, Irene Ahou Kouadio², Yolande Dogore Digbeu³ and Edmond Ahipo Due^{1*}**¹Laboratory of Biocatalysis and Bioprocessing, Nangui Abrogoua University, 02 BP801 Abidjan 02, Côté d'Ivoire.²Laboratory of Biotechnology Agriculture and biological Resources, Felix Houphouët Boigny University, 22 BP 582, Abidjan 22, Côte d'Ivoire.³Laboratory of Nutrition and Food Security, Nangui Abrogoua University, 02 BP 801 Abidjan 02, Côte d'Ivoire.***Corresponding Author: Edmond Ahipo Due**

Laboratory of Biocatalysis and Bioprocessing, Nangui Abrogoua University, 02 BP801 Abidjan 02, Côté d'Ivoire.

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ABSTRACT

The ethnobotanical study carried out on the fruits of *Pterocarpus santalinoides* in the districts of Agboville, Alépé and Gagnoa located respectively in the South, South-East and Center-West of Côte d'Ivoire was intended to assess the knowledge and use of these fruits by the populations of these localities. The survey areas were chosen on the basis of the results of a pre-survey and the respondents were met in places of large gatherings. The questions asked were closed and open. A total of 609 inhabitants including 230 men and 379 women were interviewed. The results revealed that parameters, age group, ethnicity and locality influence the level of knowledge, which is far from the case with parameters, gender and level of education. People aged 60 and over were more familiar (69.3%) with fruits than those under 60. Also, the male gender had a higher knowledge rate (64.3%) than the female gender (57.8%). The Abbey ethnic group had a high knowledge rate compared to other ethnicities, and the vernacular names collected differ from one ethnic group to another. In addition, the fruits were better known in Adahou (100%) and Alépé (90.1%) than in other localities. When it comes to educational attainment the results indicated that the uneducated had the highest rate (65.7%). Subsequently, the study reported that the fruits were obtained by collecting and were used mainly for food. Most almonds were eaten in the fresh form and only 2% of respondents said the almonds from these fruits could be used in the treatment of ulcer.

KEYWORDS: ethnobotanical knowledge, *Pterocarpus santalinoides*, local appellation.**1. INTRODUCTION**

Africa is one of the richest continents in biodiversity and many rural populations benefit from this biodiversity for their food, income and other functions (Kébenzikato *et al.*, 2015). Despite these assets, this continent remains poor and undernourished (PNUD, 2013). However, valuation of edible wild plants through an ethnobotanical study could be a solution. Indeed, edible wild plants or spontaneous food plants are plants that grow on their own, naturally and produce food or organs consumed by humans (Marouf, 2000 ; Tshidibi, 2012). These little-known plants hold cultural significance and great economic potential for medicine, food, energy, construction and crafts (Ayena *et al.*, 2016). Musinguzi *et al.* (2007) indicated that plants such as *Carissaspinarum* L. and *Physalis minima* L. found in Uganda would be able to complement cultivated exotic plants, to reduce vitamin A deficiency. In addition, to possessing a high level of antioxidant activities, these plants serve as welding food in countries such as Burkina Faso and Senegal (Ayessou *et al.*, 2008 ; Lamien-Meda *et*

al., 2008 ; Thiombiano *et al.*, 2010). Numerous scientific studies relating to the ethnobotanical study of edible wild plants in developing African countries have been carried out (Saraka *et al.*, 2018). However, these studies are only in their early stages in parts of Africa. In Côte d'Ivoire, studies on the knowledge of useful plants have made it possible to highlight the uses linked to these species taken by local populations (N'zebo *et al.*, 2018). However, the uses made of *Pterocarpus santalinoides* as well as the level of knowledge are hardly known. In Bénin *P. santalinoides* is recognized as a medicinal, food and economic species. Gbègbètin (fon), Gbèngbèn, EwèAègbè, Tigbi (yoruba, nago) are the vernacular names attributed to it and the seeds of the fruits are eaten like peanut seeds (Ayéna *et Tchibo*, 2015).

This work was carried out in order to assess the ethnobotanical knowledge of *P. santalinoides* among rural populations and to identify the uses of this spontaneous plant for a contribution to the enhancement of it.

2. MATERIAL AND METHODS

2. 1. Plant material

The plant material consists of the fruits of *Pterocarpus santalinoides* (figure 1).



Figure 1 : Mature fruits of *P. santalinoides*.

2. 2. Methods

2. 2. 1. Choice of survey sites

The survey areas were chosen on the basis of the results of a pre-survey. In fact, during the pre-investigation, the respondents indicated that the fruits of *Pterocarpus santalinoides* were found in marshy areas and at the edge of rivers. Thus the results of the pre-survey indicated the

departments of Agboville, Alépé and Gagnoa as the places where its fruits could be found. The results of this pre-survey also showed that these fruits were known but increasingly neglected

2. 2. 1. 1. Study area

The study was carried out in three departments located in the South, South-East and Center-West of Côte d'Ivoire. These are the departments of Agboville, Alépé and Gagnoa (Figure 1). These departments are located between 5°55'41" North latitude and 4°13'01" West longitude, 5°29'46" North latitude and 3°39'49" West longitude, 6°08'00" North latitude and 5°56'00" West longitude respectively for the departments of Agboville, Alépé and Gagnoa. Their climate is subequatorial with two rainy seasons alternated by two dry seasons. Rainfall fluctuates between 1400 and 2500 mm per year and the soil is mostly ferrallitic.

The department of Agboville as well as the localities of Adahou and Grand-Moutcho were visited. The localities of Monga, Ingrakon as well as the department of Alépé were explored. The department of Gagnoa as well as the localities of Maguéhio and Zokrobouo were surveyed.

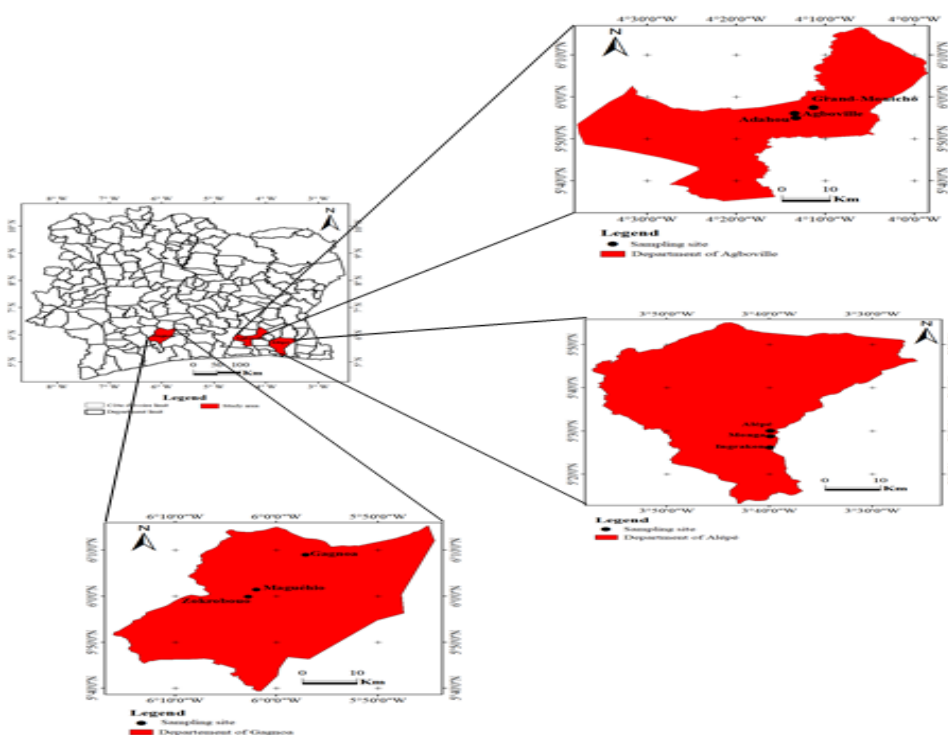


Figure 2: Geographical location of the study sites (Department of Agboville, Alépé and Gagnoa).

2. 2. 1. 2. Survey plan

2. 2. 1. 2. 1. Determination of the sample size

Given the spatial organization and the extent of the study area, a division was necessary. The sample size was calculated using the formula of Dagnelie (1998). The formula is as follows :

$$n = t^2 \times p (1-p) / m^2$$

With :

n = sample size required,

t = 1.96 at 95% confidence level,

m = margin of error set at 3.97 %,

p = estimated proportion of the population (p being unknown, we use $p = 0.5$).

2. 2. 1. 2. 2. Survey technique

In this study, the sample was developed from a random sampling mode. The study areas were chosen on the basis of the results obtained from the pre-survey. In total, three (03) departments and six (06) sub-prefectures were chosen. The number of respondents stands at 51 per sub-prefecture and 101 per department, for a total of 609 people surveyed. The survey carried out was a direct interview based on a survey sheet. The questionnaire sent to the respondents was improved using the pre-survey. Also, the survey led to the evaluation of the type of people interviewed, their ethnicities, the state of knowledge, the local name as well as the method of obtaining the fruits of *Pterocarpus santalinoides*. The part consumed and the forms of consumption were also indicated. The questions asked to the respondents were of the closed type (answer by yes or no) and open (giving the interviewee the latitude to express his point of view). The people were met in places of large gatherings, namely urban transport stations, markets and households. Each interviewee represents a member of a given household in the rural or urban area.

2. 2. 2. Statistical analyzes

Analysis of survey data was performed using Sphinx Plus2 (V5) and SPPSS 22.0 software. These software were used respectively for data entry and processing. The Chi-square test of independence (χ^2) was used to determine a possible dependence between the categorical variables (Age group, Gender, Ethnicity, Locality and Level of education) and the dichotomous variable, Level of knowledge. In addition, the chi-square test was used to verify a possible link between the method of obtaining fruits, the use of fruits, the form of fruit consumption and the locality variable. Also, the significance level for all statistical tests was set at $p \leq 0.05$.

3. RESULTS

3. 1. Sociodemographic profile of the people surveyed

The socio-demographic profile of the respondents (609) focused on gender, ethnicity, age group and level of education (Table 1). The female gender presented significant percentages (62.23%) in almost all of the localities visited. Regarding the ethnicity of the respondents, the other ethnicities parameter showed a higher percentage (30.54%) than those of the Bété (21.35%) and Abbey (18.55%) ethnic groups. As for the Gwa, they were only found in the departments of Alépé, while the Baoulé were found in the majority of the localities. As for the age group, that between 40 and 60 years old was strongly represented with a rate of 42.53% followed by the age group between 30 and 40 years (35.96%) which whatever the locality. The uneducated respondents were those who had a large percentage (33.5%) of the respondents. The localities of Agboville and Alépé had the largest numbers, with 47 and 33 respondents respectively.

Table1 :Sociodemographic profile of the people surveyed.

Modalities	Localities									Total	Percentage (%)
	Agboville	Alépé	Gagnoa	Adahou	Grand-moutcho	Ingrakon	Monga	Maguéhio	Zokrobouo		
Gender											
Male	32	38	31	19	24	30	13	18	25	230	37,77
Feminine	69	63	70	32	27	21	38	33	26	379	62,23
Ethnic group											
Bété	6	4	46	1	1	3	-	32	37	130	21,35
Abbey	45	5	3	28	29	1	2	-	-	113	18,55
Attié	6	30	2	5	2	26	22	-	-	93	15,27
Gwa	-	31	-	-	-	11	18	-	-	60	9,85
Baoulé	2	5	2	1	3	-	2	3	2	20	3,28
Otherethnicities	39	25	48	16	15	10	7	14	12	186	30,54
Non-Ivoirian	3	1	-	-	1	-	-	2	-	7	1,15
Age range											
[18-30[	5	7	8	-	6	6	9	5	10	56	9,2
[30-40[	30	49	33	12	22	23	18	18	14	219	35,96
[40-60[	48	34	49	28	20	18	18	21	23	259	42,53
≥ 60	18	11	11	11	3	4	6	7	4	75	12,32
Educationallevel											
Uneducated	47	33	32	15	21	6	14	24	12	204	33,5
Primary	31	24	33	21	16	11	14	16	15	181	29,72
Secondary	16	26	16	11	10	11	11	6	17	124	20,36
Superior	7	18	20	4	4	23	12	5	7	100	16,42

3. 2. Level of knowledge of the fruits of *Pterocarpus santalinoides*

3. 2. 1. Distribution of the level of knowledge of the fruits of *P. santalinoides* according to age group

The level of knowledge of the fruits of *P. santalinoides* differed according to the age group (Table 2). People aged at least 60 have the highest level of knowledge (69.3%) while respondents whose age range varies between 18 and 30 years have a low level of knowledge (44.6%) of the fruit. The Chi-square test was significant at the 5% level. Therefore, there was a dependence between the level of knowledge of the fruits and the age range.

3. 2. 2. Distribution of the level of knowledge of the fruits of *P. santalinoides* according to the gender

The level of knowledge of the fruits of *P. santalinoides* varies according to the gender (Table 2). The male gender seemed to have a higher level of knowledge of *P. santalinoides* fruits (64.3%) than the feminine gender (57.8%). However, the Chi-square test revealed that there was no significant difference ($p > 0.05$). Consequently, the level of knowledge of fruits was not a function of the age group.

3. 2. 3. Distribution of the level of knowledge of the fruits of *P. santalinoides* according to ethnicity

The level of knowledge of the fruits of *P. santalinoides* varies from one ethnic group to another (Table 2). The non-Ivorians (Ashanti, Nounouma and Peul) interviewed stand out for the highest knowledge rate of *P.*

santalinoides fruits (100%) followed by the Abbey (82.3%) and Gwa (65%) ethnic groups. The Chi-square test of independence showed significance at the 5% level. Thus, there is a dependence between the level of knowledge of the fruits and the ethnicity.

3. 2. 4. Distribution of the level of knowledge of the fruits of *P. santalinoides* according to the locality

Knowledge of the fruits of *P. santalinoides* was very high in the localities of Adahou (100%), Alépé (90.1%), Agboville (75.2%) and Ingrakon (70.6%). The locality of Adahou records a remarkable knowledge rate, unlike the locality of Monga which had the lowest rate (9.8%).

Furthermore, the statistical analysis relating to the Chi-square test showed a dependence between the characteristics level of knowledge of fruits and locality, the significance being at the 5% threshold (Table 2).

3. 2. 5. Distribution of the level of knowledge of the fruits of *P. santalinoides* according to the level of education

The level of knowledge of fruits was different depending on whether we move from one level of education to another (Table 2). Indeed, the uneducated had the highest level of knowledge, the other levels having approximate rates. In addition, the Chi-square test of independence revealed that there was no significance at the 5% level. It therefore appeared that the level of knowledge of fruits did not depend on the level of education

Table I :Level of knowledge of the fruits of *Pterocarpus santalinoides*.

Modalities	Knowledge of the fruit (%)		Statistical parameters of Chi-square		
	Yes	No	dl	χ^2	p
Age range					
[18-30[(n=56)	44.6	55.4	3	8.66	≤ 0.05
[30-40[(n=219)	62.1	37.9			
[40-60[(n=259)	59.5	40.5			
≥ 60 (n=75)	69.3	30.7			
Total (n=609)					
Gender					
Male (n=230)	64.3	35.7	1	2.58	>0.05
Feminine (n=379)	57.8	42.2			
Total (n=609)					
Ethnic group					
Bété (n=130)	51.5	48.5			
Abbey (n=113)	82.3	17.7			
Attié (n=93)	60.2	39.8			
Gwa (n=60)	65.0	35.0	6	39.66	≤ 0.05
Baoulé (n=20)	50.0	50.0			
Otherethnicities (n=186)	51.1	48.9			
Non-Ivorian (n=7)	100.0	-			
Total (n=609)					
Locality					
Agboville (n=101)	75.2	24.8			
Alépé (n=101)	90.1	9.9			
Gagnoa (n=101)	46.5	53.5			
Adahou (n=51)	100.0	-			

Grand-moutcho (n=51)	51.0	49.0	8	175.98	≤ 0.05
Ingrakon (n=51)	70.6	29.4			
Monga (n=51)	9.8	90.2			
Maguéhio (n=51)	37.3	62.7			
Zokrobouo (n=51)	31.4	68.6			
Total (n=609)					
Educational level					
Uneducated (n=204)	65.7	34.3			
Primary (n=181)	57.5	42.5			
Secondary (n=124)	58.1	41.9	3	3.8	> 0.05
Superior (n=100)	57.0	43.0			
Total (n=609)					

3. 2. 6. Method of obtaining the fruits of *P. santalinoides*

The fruits of *P. santalinoides* were obtained in two (02) different ways namely pickup and picking. Sometimes both forms of obtaining exist in the same locality, which was not the case in some localities where there was only

one form of obtaining. Also, pickup was the form with a high percentage (91.1 to 100%) whatever the locality. The Chi-square test of independence was not significant at the 5% level. There was a link between the localities surveyed. The method of obtaining the fruits therefore not depended on the locality.

Table3: Method of obtaining the fruits of *P. santalinoides*.

Modalities	Method of obtaining the fruits (%)		Statistical parameters of Chi-square		
	Pickup	Picking	dl	χ^2	p
Locality					
Agboville (n=76)	98.7	1.3			
Alépé (n=91)	98.9	1.1			
Gagnoa (n=47)	100.0	-			
Adahou (n=51)	96.1	3.9			
Grand-moutcho (n=19)	100.0	-	8	5.42	> 0.05
Ingrakon (n=36)	100.0	-			
Monga (n=5)	100.0	-			
Maguéhio (n=24)	100.0	-			
Zokrobouo (n=16)	100.0	-			
Total (n=365)					

3. 2. 7. Use of *P. santalinoides* seeds

The seeds of *P. santalinoides* were used for food in all the localities visited, only 2% of the people questioned in the locality of Adahou used the almonds for medicinal purposes (Table 4). In this regard, the statistical analysis

relating to the Chi-square test did not shown any significance at the 5% level. There was a link between the localities visited. The use of the seeds therefore did not depended on the locality.

Table 4: Use of *P. santalinoides* seeds.

Modalities	Seeds uses (%)		Statistical parameters of Chi-square		
	Food	Medicinal	dl	χ^2	p
Locality					
Agboville (n=76)	100.0	-			
Alépé (n=91)	100.0	-			
Gagnoa (n=46)	100.0	-			
Adahou (n=51)	98.0	2.0			
Grand-moutcho (n=19)	100.0	-	8	6.10	> 0.05
Ingrakon (n=34)	100.0	-			
Monga (n=3)	100.0	-			
Maguéhio (n=24)	100.0	-			
Zokrobouo (n=16)	100.0	-			
Total (n=360)					

3. 2. 8. Forms of seed consumption

Only the seeds of *P. santalinoides* were eaten. They were consumed in three (03) forms: fresh, braised and cooked in water. Overall, the fresh form is the one with a high preference rate followed by the braised form and then the

boiled form (Table 5). A significant difference ($\chi^2 = 101.12$; $p \leq 0.05$) is observed between the different forms of consumption. Thus, there is a dependence between the form of consumption of the seeds and the locality.

Table5 : Forms of seed consumption.

Modalities	Form of seed consumption (%)			Statistical parameters of Chi-square		
	Fresh	Braised	Cooked in water	dl	χ^2	p
Locality						
Agboville (n=73)	90.4	8.2	1.4			
Alépé (n=90)	97.8	2.2	-			
Gagnoa (n=45)	97.8	2.2	-			
Adahou (n=47)	87.2	12.8	-			
Grand-moutcho (n=18)	100.0	-	-	16	101.12	≤ 0.05
Ingrakon (n=34)	100.0	-	-			
Monga (n=3)	-	100.0	-			
Maguéhio (n=23)	65.2	17.4	17.4			
Zokrobouo (n=15)	66.7	26.7	6.7			
Total (n=348)						

3. 2. 9. Local names of the fruits of *P. santalinoides*

The survey identified 21 vernacular names of the fruits of *P. santalinoides*, including 17 Ivorian names, 02 Burkinabe names and 02 Malian names. These names

were generally different from each other. It should also be noted that certain ethnic groups have more than one local name (Table 6).

Table6: Some local names of the fruits of *P. santalinoides*.

Ethnic groups	Ethnicities	Vernacular names
Akan	Abbey	N'tisô ; Moutisô ; N'tisôrô
	Andôh	Koumannou n'gatiè
	Abidji	Dikpè n'gatê
	Baoulé	Blo n'gatê
	Avikam	Êthô
	Gwa	achadodo
	Sénoufo	Ségmanzaow
	Bambara	Somôdê
Mandé	Yacouba	Nangbé
	Koyaka	Tcha
	Mahou	Kotiya
	Guéré	Gnini-zahan
Krou	Bété	Gnoubêh ; Gnibêh ; Gnoufo
Non-Ivoirians	Ethnicities	Vernacular names
Burkinabés	Nunuma	Dalcôra ; Bekama
Maliens	Peûl	Gnéki ; Kôdjakô

4. DISCUSSION

The ethnobotanical study carried out on the fruits of *P. santalinoides*, a spontaneous plant, made it possible to record some socio-food data relating to this plant. The study took into account populations in their diversity in terms of gender, age, level of education and ethnicity. However, the number of people has varied greatly depending on whether we go from one parameter to another. Regarding gender, the number of women surveyed was higher than that of men. This is said to be due to the fact that women were more available than men, as the survey took place mostly in markets, households and bus stations. These statements are in agreement with those of Lazo *et al.* (2015) who obtained

a high number of women during their studies in the Philippines and who justified this high rate by the fact that the survey would have taken place in the middle of the morning when the men went about their business. Regarding ethnicity, the high percentage of the other ethnicity parameter (30.54%) was explained on the one hand by the ethnic diversity observed in Côte d'Ivoire and on the other hand by the displacement of people from one locality to another for reasons of convenience (Beauchemin, 2000; Delanne *et al.*, 2017). The rate of respondents for the age group between 18 and 30 years was 9.2%. This low proportion would be linked to the fact that the occupants of the informal sector as well as the people questioned in the households of the visited

localities were mainly people whose age was over 30 years. In addition, the high rate of uneducated people reflects the lack of income as well as the expenses related to the education of children encountered by households (INS, 2015). The results of the ethnobotanical survey relating to the level of knowledge of the fruits of *P. santalinoides* indicated that there was a dependence between the dichotomous variable level of knowledge and the age group, ethnicity and locality variables. While no dependence exists, was observed with the variables gender and level of education. In addition, the results of the study showed that the elderly are those most familiar with the fruits of *P. santalinoides*. Indeed, people of advanced age regardless of their level of education are expected to provide more reliable information, since they hold much of the endogenous knowledge that was part of the oral tradition (Gbesso *et al.*, 2017). The results obtained were in agreement with those reported by Lougbégnon *et al.* (2015) who indicated that the age of the individual was a factor influencing the level of knowledge of plants. In terms of gender, the male gender was the one with the highest rate. *P. santalinoides* trees, like other spontaneous plants, were mostly found in forests. Certainly, men were the ones who known these fruits best because they devote the most to forestry work. Djihounouck *et al.* (2019) justified this assertion when they stated after their work with the Diola ethnic group in Senegal that their surveys were conducted mainly with men because they were in charge of forestry work while women were mainly concerned about housework and rice paddies. It emerges from this study that of all the ethnic groups encountered, the Abbey had a good knowledge of the fruits of *P. santalinoides*. Non-Ivorians (Burkinabés, Ghanaians and Malians) had a perfect knowledge of these fruits. Furthermore, the differences noted between the levels of knowledge of different ethnic groups could be attributed to cultural heritage, with knowledge being transmitted from generation to generation within the same ethnic group (N'zebo *et al.*, 2018). In fact, ethnicity remained one of the major elements of differences in the uses and knowledge of plants between communities. Of all the places visited, some showed a considerable number of people knowing the fruit while others showed a percentage below average. The locality of Monga was the one with the lowest level of knowledge. Indeed, this situation was linked to the fact that these fruits were unknown in these localities. This could be explained by the massive destruction of forests to the detriment of cash crops, of which these localities remain a major producer (Bédiakon *et al.*, 2018). The survey also revealed in terms of educational attainment that uneducated people have better knowledge of the fruits of *P. santalinoides* (65.7%). This result suggests that the educated fringe of the local population makes little use of the fruits of *P. santalinoides*. During the investigation, two (02) methods of obtaining fruits were recorded regardless of the locality. It was about picking up and picking up. According to the respondents, the fruits were most of the time obtained by collecting because of the large size of

the trees. However, collecting seemed to be the simplest method of obtaining and above all, guarantees the maturity of the fruits. Also, it should be noted that the fruits were mainly recognized for food interests, only (2%) of respondents from the town of Adahou informed of a possible medicinal use. Certainly, the fruits of *P. santalinoides* remained underexploited. This thesis is supported by that of Bédiakon *et al.* (2018) when they claim that there is still a wide variety of volunteer plants that remain largely underexploited. According to the results of the study, there were several ways of consuming the almonds in the fruits of *P. santalinoides*. The fresh form was the one with the highest rate. After the fresh form follows the braised form. The boiled form, on the other hand, has the lowest rates. Respondents who cited the braised or boiled form were those who known more than one form of consumption. They said they practiced these forms because they made it easy to obtain almonds, obtaining almonds in the case of the fresh form was not easy.

5. CONCLUSION

The ethnobotanical study of the fruits of *Pterocarpus santalinoides* made it possible to gauge the level of knowledge as well as the use of these fruits by the populations surveyed. It followed from the investigations carried out that the fruits of *P. santalinoides* were little known by all of the respondents. According to the information collected, the uneducated as well as those aged 60 and over were those most familiar with these fruits and their uses. Furthermore, it had been reported that the fruits were obtained mainly by collecting and were sold only at the request of the person concerned. Almonds were used for food and were mostly consumed in the fresh form. Only 2% of those questioned mentioned a possible use of almonds in the treatment of ulcer. Also, the respondents ignore all forms of fruit preservation. Thus, more in-depth investigations would be necessary for a better valuation of the almonds of this spontaneous food plant.

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