



# **State of Knowledge and Phytochemical Analysis of Chilli Fruits (*Capsicum annum* L.), "Ahalimancou" Type Consumed in the Indénié-Juablin Region (East of Côte D'ivoire)**

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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**

The ethnobotanical study carried out on the fruits of chilli (*Capsicum annum* L.), type "Ahalimancou" in the localities of Aniassué, Affalikro, Sankadiokro and the town of Abengourou located in the east of the Côte d'Ivoire had for main objective to assess the levels of knowledge, the mode of use of this pepper by the local populations, as well as the phytochemical analysis of said chilli. Discussion groups and semi-structured individual interviews were carried out in 4 localities to collect information from 650 inhabitants, including 511 women and 139 men. The results showed that the variables gender, age group, ethnicity and level of education significantly influence ( $p \leq 0.05$ ) the levels of knowledge and the mode of use, except the independence between the locality, the level of knowledge and mode of use. In addition, women know more about this type of pepper (80.82%) and use it much more in food (99.41%), as well as in the treatment of diseases (95.69%). People aged 60 and over have higher use levels (81.30%) in therapeutic use. The study also revealed that the Agni ethnic group is distinguished from other ethnic groups (Baoulé, Malinké,

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Attié) by a greater level of knowledge and use in pathology. Depending on the level of education, it appears that people without education know better (71.63%) and use this type of pepper more in the treatment of pathologies (85.39%). In addition, the study showed that the fresh form remains the only form used. With the exception of quinones, phytochemical analysis revealed that this type of pepper contains several pharmacological components depending on the stages of ripeness. Orange and red fruits had a higher content of alkaloids, polyphenols, flavonoids. The green and yellow fruits were highly rich in sterols and polyterpenes. Catechetical tannins were only present in green fruits. The data from our study could strengthen clinical research on the nutritional and pharmacological properties of this type of "Ahalimancou" chilli.

**Keywords:** State of knowledge; phytochemicals; *Capsicum annum L.*; eastern Côte d'Ivoire.

## 1. INTRODUCTION

Chili is a vegetable plant belonging to the genus *Capsicum*, of the nightshade family [1]. It is native to tropical and temperate regions of America (South and Central), then distributed in Europe, Africa and Asia [2]. Studies have shown that the genus *Capsicum* includes 35 species [3]. Of these, the most economically important species are *C. chinense*, *C. frutescens*, *Cbaccatum*, *C. pubescens* and *C. annum* [4]. The latter remains the most widespread and cultivated species in temperate and subtropical countries [5]. From a production point of view, China remains the world's largest producer of chili peppers with 18 million tonnes of fruit per year. According to FAO [6], Asia produces 67.3% of chili fruit in the world, followed by America (13.3%), Africa (10%), Europe (9, 2%) and Oceania (0.2%).

In addition, chilli is not only a spice, but also a fruit and a vegetable whose importance in the human diet is of the utmost importance [7]. In recent decades, there has been an increase in consumer interest in a varied diet consisting of fruits and vegetables of high nutritional quality. The daily and sufficient consumption of fruits and vegetables, especially chilli, helps prevent cardiovascular disease and certain cancers, among other things [8]. In fact, chili is essential in the dishes of many African countries and even the Ivory Coast, because it spices the dishes in a subtle or strong way depending on the variety [9]. Chilli fruits are consumed in different forms, namely fresh, dried or processed for seasoning and to stimulate appetite.

Thus, when fresh, peppers are used directly or as condiments often combined in a mixture with various other vegetables. They are used in the form of processed products such as chili powder for seasoning dishes. Also, as a pepper

juice or jam, in the manufacture of liqueurs, to accompany cheeses and dishes [10]. In addition, peppers are used as natural colors in food and cosmetics [11]. In addition to its dietary use, the consumption of *Capsicum* fruits has beneficial effects on health. Indeed, peppers have various medicinal properties: stomachics, diuretics, stimulants, digestives and antiseptics, antioxidants, anticancer and anti-inflammatory [12]. Peppers have a high water content (83%) and are an important source of secondary metabolites such as: flavonoids, capsaicinoids, carotenoids, tocopherols, ascorbic acid and volatile compounds [13].

Despite all the advantages available to the fruits of *Capsicum annum L.*, there is very little scientific data relating to the state of knowledge, the modes of use and consumption and the phytochemical composition consumed east of the Côte d'Ivoire. Therefore, we set out to assess the state of ethnobotanical knowledge of rural populations and the phytochemical composition of "Ahalimancou" fruits of *Capsicum annum L.*

## 2. MATERIALS AND METHODS

### 2.1 Biological Material

The plant material consists of fruits of (Fig. 1). the chilli "Ahalimancou" type of *Capsicum annum L.*

### 2.2 Study Site

The study was carried out in four localities (Aniassué, Affalikro, Sankadiokro and town of Abengourou) in the Indénié-Djuablin region (Fig. 2). This region of Indénié-Djuablin is located between the latitude of 5 ° 53 'and 7 ° 21' north and the longitude 3 ° 48 'and 3 ° 4' 3 ° 29 'west, east of the Côte d'Ivoire. This region enjoys a

subtropical tropical climate with two seasons, an ecologically dry season and a rainy season. The average rainfall is 1300mm per year and the soil is ferralitic. The different localities were chosen on the basis of a preliminary investigation into the origin of the pepper, carried out in markets in Abidjan.

### 2.3 Investigation Procedure

The ethnobotanical survey was carried out over three (3) months, from September to November 2018, using a survey sheet. The questions asked were of the closed type (answer by yes or no) and open (giving the interviewee the latitude to express his point of view). They concerned the request for information on the profile of the consumer, the level of knowledge, the mode of use and the state of use of the fruits of the "Ahalimancou" type pepper. The respondents were drawn at random from men and women aged 15 and over. The interviewee's data were collected in large gathering places, namely markets, train stations and also in households.

### 2.4 Sample Size

The sample size was determined according to the formula [14]:

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

With:

n: Minimum sample size,

t: 1.96 at a confidence level of 95%,

p: estimated proportion of the population (p being unknown, we use  $p = 0.5$ ), m: margin of error set at 4%,

The resulting sample size for the survey is 650 individuals. The survey covered a total of 650 individuals which corresponds to the sample size obtained. This number was distributed as follows: 200 individuals for the town of Abengourou and 150 individuals for the other three localities.

### 2.5 Data Analyzes

#### 2.5.1 Level of knowledge

The level of knowledge of the fruits of the "Ahalimancou" type pepper was obtained using the following mathematical expression:

$$NC (\%) = N/Nt \times 100$$

With:

NC: Confidence level,

N: Number of individuals knowing the fruits, Nt: Total number of individuals interviewed.

#### 2.5.2 Mode of use rate

The rate of the mode of use (Mu) of the fruits of the "Ahalimancou" type chilli was obtained according to the following mathematical relationship:

$$Mu (\%) = M/Nt \times 100$$

With:

Mu: Rate of use mode,

M: Number of individuals according to their mode of use, Nt: Total number of individuals interviewed.

### 2.6 Study of the Phytochemical Composition of Chilli Peppers at Different Stages of Ripening

The phytochemical sorting of the pharmacological substances was carried out according to the method described by Nemlin *et al.* [15]. The extraction of the substances was carried out with methanol as a solvent. Sterols and polyterpenes have been demonstrated by the Libermann reaction. Polyphenols were identified by reaction with iron chloride (FeCl<sub>3</sub>). The demonstration of flavonoids was made by the reaction to cyanidin. Tannins were detected with the reaction using Stiasny's reagent. The search for gallic tannins was carried out by reaction with sodium acetate. Quinonic substances were investigated with the Bornsträeger reagent. Alkaloids have been demonstrated using reagents from Bourchardat, Dragendorff and Mayer-Valser. Saponins were identified by observing the moss. Detection of coumarins was carried out by reaction with sodium hydroxide.

### 2.7 Statistical Analyzes

Sphinx Plus 2 (V5) and SPSS 22.0 software were used for data entry and processing, respectively. The chi-square test of independence ( $\chi^2$ ) made it possible to study the link between categorical variables (gender, age group, ethnicity and level of education) and dichotomous variables (Levels of knowledge and use). The level of significance was considered to be  $p \leq 0.05$ .



Fig. 1. Fresh fruits of the "Ahalimancou" type of *Capsicum annum* L. at different stages of ripening: green (A), yellow (B), orange (C) and red (D)

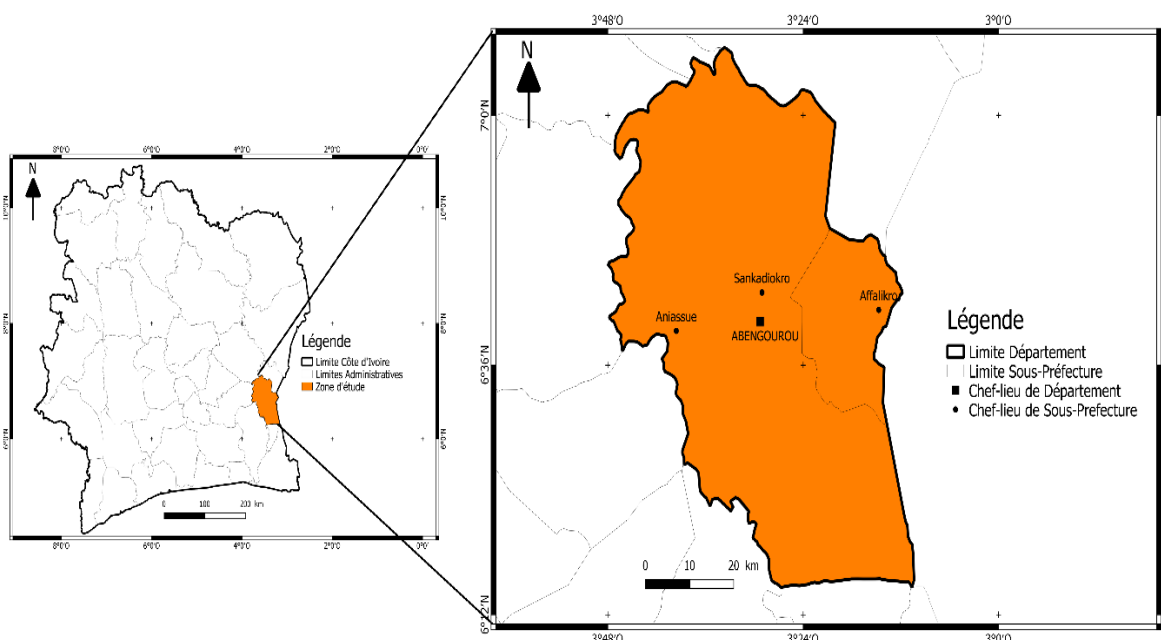


Fig. 2. Geographical location of the study site (Abengourou, Aniasué, Sankadiokro et Affalikro)

### 3. RESULTS

#### 3.1 Sociodemographic Characteristics of the Respondents

The socio-demographic characteristics of the respondents focused on gender, ethnicity, age group and level of education (Table 1). Women were the most numerous with a total of 511 individuals or 78.6% of respondents regardless of the locality surveyed. Regarding the age group, a predominance was observed for the group ranging from 36 years to 60 years with a rate of 63.5%. The locality of Abengourou recorded the largest number of people surveyed with more women (136). Regarding ethnicity, it appears that the Agni have the highest

proportion in all localities. So the unschooled people had the highest number of people with 356 people, ie a rate of 54.80% of respondents regardless of the locality.

#### 3.2 Distribution of the Level of Knowledge of the Fruits of the "Ahalimancou" Type Chilli (*Capsicum annum* L.) According to gender (a), Age Group (b), Ethnicity (c), Level of Education (D), The Locality (e)

The level of knowledge of the fruits of the "Ahalimancou" type chilli (*Capsicum annum* L.) varies according to the genus (Fig. 3a). Indeed, the female gender has the highest level of knowledge with a rate of 80.82%. The chi-

square homogeneity test revealed the level of knowledge of the female gender differs significantly ( $p < 0.05$ ) from that of the masculine gender. On the other hand, the chi-square test of independence showed that the calculated chi-square value (67.36) is greater than the theoretical chi-square (3.84). Therefore, there is a link between knowledge level and gender.

The level of knowledge of the fruits of the "Ahalimancou" type chilli (*Capsicum annum* L.) differs from one age group to another (Fig. 3b). Indeed, people whose age is between 60 years and over have the highest level of knowledge (92.52%) of the fruits of the pepper (*Capsicum annum* L.) type "Ahalimancou" followed by people whose age fluctuates between 36 years and 60 years who have the knowledge level of (77.75%). While the age group between 15 years and 25 years is very low (12.50%) However, the chi-square test of independence revealed that the calculated chi-square value (76.91) is higher to that of theoretical chi-square (7,81). So there appears to be a link between the level of knowledge and the age group. Also, the homogeneity test showed that at least two levels of knowledge of age groups vary significantly ( $p \leq 0.05$ ). Indeed, the Marascuilo procedure indicated that all levels of knowledge of age groups differ significantly ( $p \leq 0.05$ ).

The level of knowledge of the fruits of the "Ahalimancou" type chilli (*Capsicum annum* L.) differs from one ethnic group to another (Fig. 3c). Indeed, the Agni stand out from other ethnic groups by their higher level of knowledge (90.17%). The lowest level of knowledge (35.71%) is obtained with the Malinké. On the other hand, the chi-square test of independence indicated that the calculated chi-square value (44.89) is higher than the theoretical chi-square (7.81). Consequently, there is a link between the variables level of knowledge of the fruits and the ethnic groups. In addition, the chi-square homogeneity test showed that there was at least one significant difference ( $p < 0.05$ ) between the knowledge levels of different ethnicities. Indeed, the Marascuilo procedure revealed significant differences ( $p \leq 0.05$ ) between the levels of knowledge of the Agni, Baoulé ethnic groups and those of the Malinké and Attié ethnic groups.

The level of knowledge of the fruits of the "Ahalimancou" type pepper (*Capsicum annum* L.) varies according to the level of education (Fig. 3d). Indeed, the level of knowledge of fruits

is higher among uneducated people with a rate of 71.63%, while the level of knowledge of people with secondary education is low (45.23%). Additionally, the chi-square test of independence showed that the calculated chi-square value (88.77) is higher than the theoretical chi-square (7.81). Thus, there is a link between the variables level of knowledge and level of education. In addition, the Marascuilo test showed significant differences ( $p \leq 0.05$ ) between the levels of knowledge of the different levels of education.

The level of knowledge of chilli fruits is high in the 3 localities (Fig. 3e). It ranges from 66.67% to 93.33%. Indeed, the highest level of knowledge is recorded in the locality of Sankadiokro while the lowest is obtained in the locality of Affalikro. Moreover, statistical analysis relating to the chi-square test showed that the calculated chi-square value (42.96) is higher than that of the theoretical chi-square (7.81). There is therefore a dependence between the characters level of knowledge of the fruits of the chilli and the locality. In addition, the chi-square homogeneity test revealed that at least two levels of locality knowledge differ significantly ( $p \leq 0.05$ ). In addition, the Marascuilo test showed significant differences ( $p \leq 0.05$ ) between the knowledge levels of the different localities.

### **3.3 Distribution of the Method of use of Chilli (*Capsicum annum* L.) Type "Ahalimancou " Fruits According to Gender (a), Age Group (b), Ethnicity (c), Level of Education (d), the Locality (e)**

The method of using the fruits of the "Ahalimancou" type chilli (*Capsicum annum* L.) differs from one genus to another (Fig. 4a). Indeed, women have higher use patterns with rates of 99.41% and 95.69% compared to men who have lower use patterns with rates of 25.9% and 68.67% respectively in food and in the treatment of pathologies. In addition, the Chi-square independence test showed that the calculated chi-square values (75.76 and 24.21) respectively for the diet and treatment of pathologies are greater than that of theoretical chi-square (3.84). Therefore, there is a link between the categorical variables mode of use of chilli fruits and gender. In addition, the chi-square test revealed that female and male levels of chili fruit use pattern differ significantly ( $p \leq 0.05$ ).

The method of using the fruits of the "Ahalimancou" type chilli (*Capsicum annuum* L.) differs according to the age group (Fig. 4b). Indeed, the highest rate (81.30%) is observed in people whose age varies between 60 years and over. These people use the fruits of the chilli more in the treatment of pathologies. On the other hand, people whose age varies between 15 and 20 years do not use the chilli fruits in the treatment of pathologies (0%). Regarding the food use, these chili fruits are much more used by people whose age varies between 36 years and 60 years (61.74%) while those whose age varies between 61 years and over have a low rate (22.43%). The chi-square independence test indicated that the calculated chi-square values (88.59 and 12.65) respectively for the diet and treatment of pathologies are higher than that of the theoretical chi-square (7.81). There is therefore a link between the fruit use mode and age group variables. In addition, the chi-square homogeneity test showed that there is at least one significant difference ( $p \leq 0.05$ ) between the modes of use of the fruits recorded in the different age groups. Indeed, the Marascuilo procedure indicated that all the modes of use of aged chili fruits differ significantly ( $p \leq 0.05$ ) between them on both sides.

The method of using the fruits of the "Ahalimancou" type chilli (*Capsicum annuum* L.) differs from one method of use to another regardless of the ethnic group (Fig. 4c). In fact, the agni use chilli fruits more both in food and in the treatment of pathologies with respective use rates of 79.57% and 81.14%. Therefore, the lowest rate of people who use these fruits in food is obtained among the Malinké (35.71%). On the other hand, Malinkés and Attiés do not use this chilli type "Ahalimancou" in the treatment of pathologies. In addition, the chi-square independence test showed that the calculated chi-square values (56.70 and 15.05) respectively for the diet and treatment of pathologies are greater than that of theoretical chi-square (7.81). Therefore, there is independence between the usage patterns and ethnicities variables. In addition, the Chi-square homogeneity test indicated that there is a significant difference ( $p \leq 0.05$ ) between the way in which "Ahalimancou" type chilli fruits are used in the diet of different ethnic groups. agni, baoulé, malinké and attié, but also between the mode of use of the fruits of chilli "Ahalimancou" type in the treatment of pathologies of the

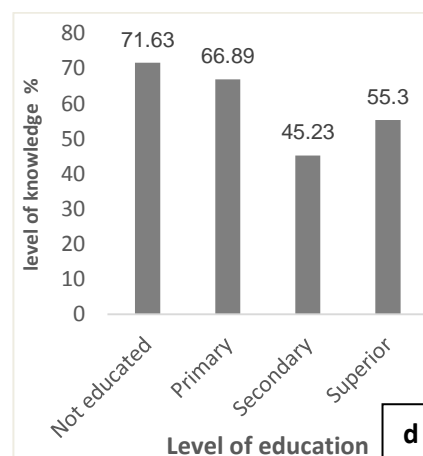
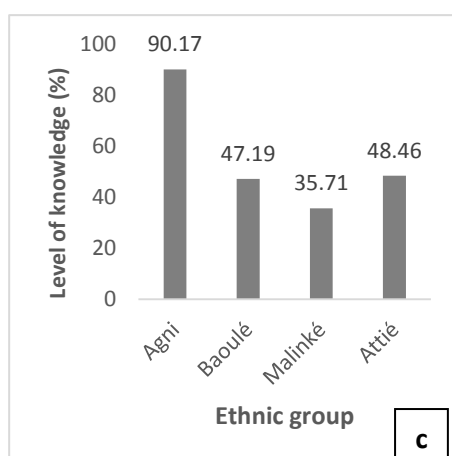
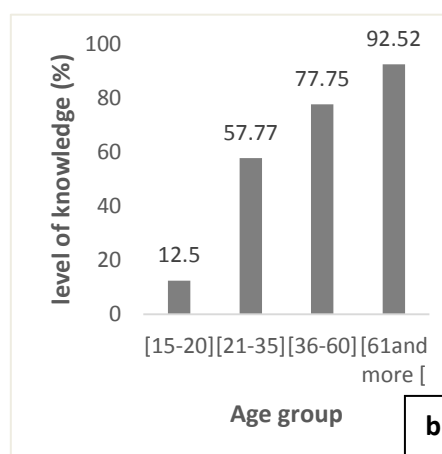
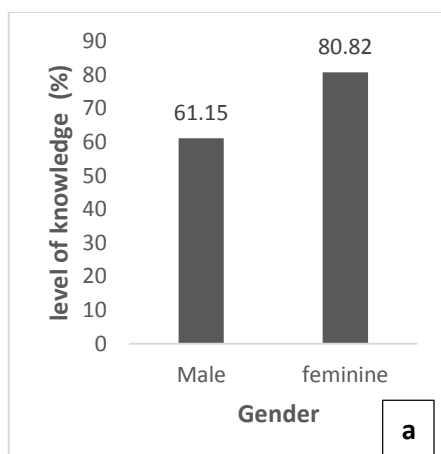
different agni and baoulé ethnic groups.

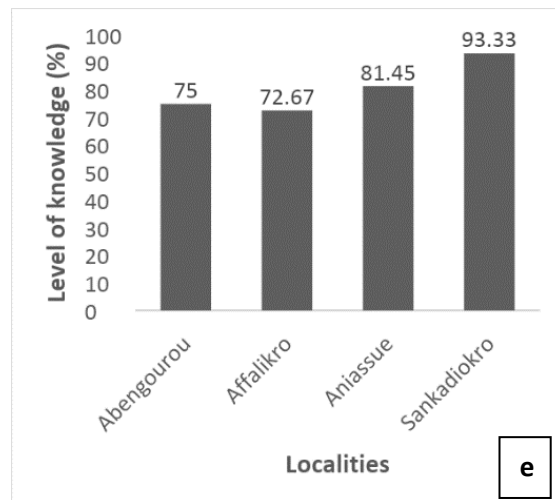
The method of using the fruits of the "Ahalimancou" type chilli (*Capsicum annuum* L.) varies regardless of the level of education (Fig. 4d). In fact, uneducated people predominate in the use of chilli, both in food (94.55%) and in the treatment of pathologies (85.39%). However, the low rate of the mode of use are obtained in people with a higher level of education with a rate of 11.28% in the treatment of pathologies. In addition, the chi-square test of independence revealed that the calculated chi-square value (55.78) for the pathology treatment variable is greater than that of the theoretical chi-square (7.81). There is therefore a dependence between the characters mode of use and level of education. In addition, the chi-square homogeneity test showed that there is at least one significant difference ( $p \leq 0.05$ ) between the modes of use in the treatment of pathologies of different levels of education. Indeed, the Marascuilo procedure revealed significant differences ( $p \leq 0.05$ ) between the modes of use of the levels of education. Regarding the variable of the level of the mode of use in food, the chi-square test of independence showed that the calculated chi-square value (2.53) is lower than that of chi-square theoretical (7.81). Therefore, there is an independence between the variable level of use in food and the level of education. In addition, the chi-square homogeneity test indicated that there was no significant difference ( $p > 0.05$ ).

The rate of use of the fruits of the "Ahalimancou" type chilli (*Capsicum annuum* L.) differs from one locality to another (Fig. 4e). The highest mode of use is obtained with the locality of Sankadiokro with the values of 94.97% in food and 96.67% in the treatment of pathologies while the locality of Abengourou recorded a rate of the mode the lowest use (51.5% and 44.50%) respectively in food and in the treatment of pathologies. In addition, the chi-square test of independence showed that the calculated chi-square values (8.56 and 25.63) are higher than the theoretical chi-square values (7.81). Therefore, there is a dependency between the mode of use and locality variables. In addition, the Chi-square homogeneity test indicated that there appears at least one significant difference ( $p \leq 0.05$ ) between the variables of the modes of use of chilli fruits from the different localities Affalikro, Aniassue, Sankadiokro and Abengourou.

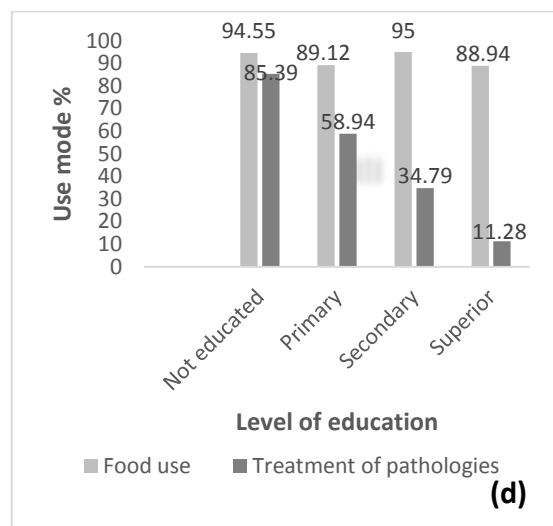
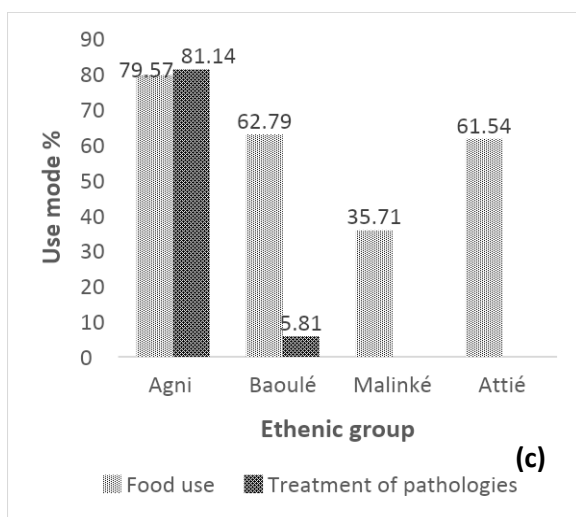
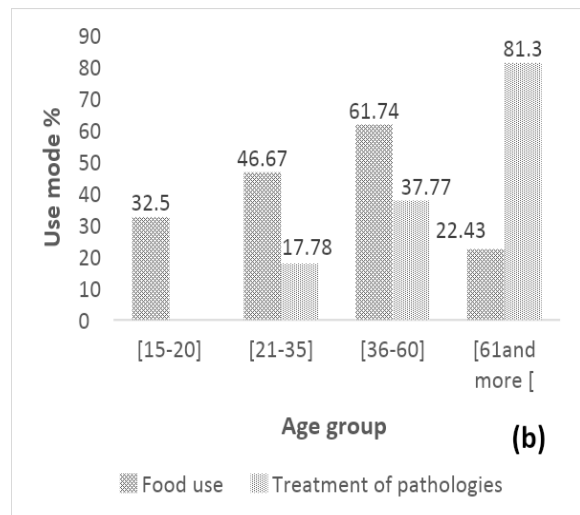
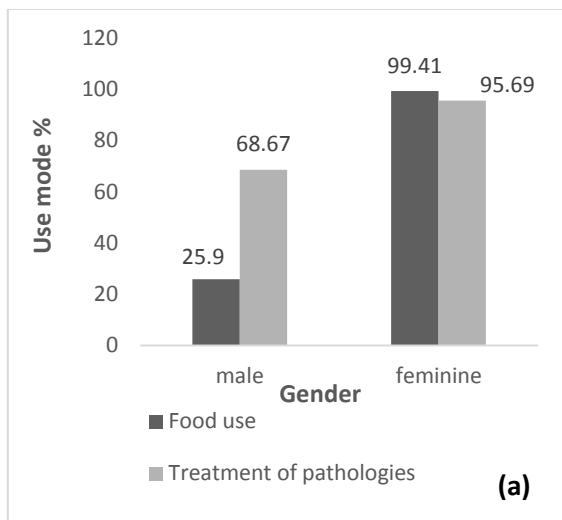
**Table 1. Sociodemographic characteristics of the respondents**

Parameters	Localities				Total	Percentage (%)
	Abengourou	Affalikro	Aniassue	Sankadiokro		
<b>Gender</b>						
Male	64	20	26	29	139	21,40
Feminine	136	130	124	121	511	78,60
<b>Age range</b>						
[15-20]	20	6	5	9	40	6,2
[21-35]	35	18	15	22	90	13,8
[36-60]	125	93	102	93	413	63,5
[61and more [	20	33	28	26	107	16,5
<b>Ethnic group</b>						
Agni	143	100	130	136	509	78,3
Baoulé	29	30	15	12	86	13,2
Malinké	17	20	3	2	42	6,5
Attié	11	0	2	0	13	2,0
<b>Educational level</b>						
Not educated	114	86	87	73	356	54,8
Primary	15	50	39	47	151	23,2
Secondary	50	10	16	20	96	14,8
Superior	21	4	8	10	47	7,2

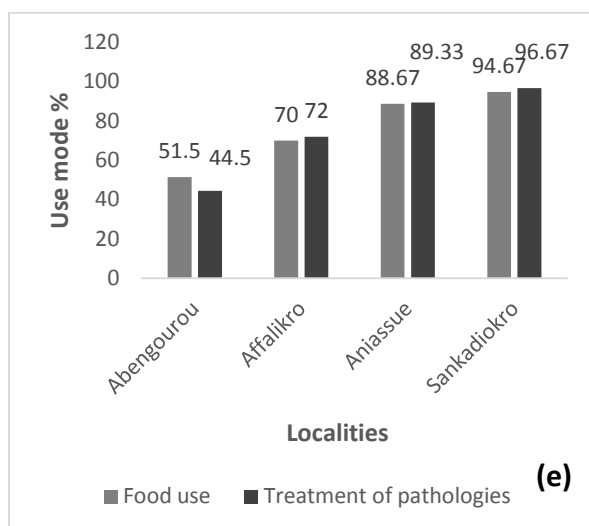




**Fig. 3. Distribution of the level of knowledge of the fruits of the "Ahalimancou" type chilli (*Capsicum annuum* L.) according to gender (a), age group (b), ethnicity (c), level of education (d), the locality (e)**







**Fig. 4. Distribution of the method of using the fruits of the "Ahalimancou" type chilli (*Capsicum annum* L.) according to the gender (a); age group (b); ethnicity (c) and level of education (d), the localities (e)**

**Table 2. Phytochemical sorting of chilli (*Capsicum annum* L.) at different stages of ripening**

Parameters	Extracts			
	PV	PJ	PO	PR
Alkaloids	++	++	+++	+++
Polyphenols	++	++	+++	+++
Flavonoids	++	++	+++	++
Sterols and polyterpenes	+++	+++	++	++
Catechetical tannins	+	-	-	-
Gallic tannins	++	++	++	+
Saponosides	+	-	-	-
Quinones	-	-	-	-
Coumarins	++	+	+	+

*Alkaloids: ++ presence of tint, +++ very marked tint Polyphenols: ++ blackish blue coloration; +++ more pronounced blackish-blue coloration Sterols and polyterpenes: ++ purple ring turning blue; +++ purple ring turning towards more marked blue, Flavonoids: + weak purplish color; ++ purplish color; +++ more marked purplish color, Gallic tannins: ++ black blue coloring Catechetical tannins: + low presence of flakes Saponins: + presence of weak foam, Quinones: No red coloration, Coumarins: + + transparent alkaline solution*

### 3.4 Qualitative Study of the Phytochemicals of the Fruits of the Chilli (*Capsicum annum* L.) type "Ahalimancou" at Different Stages of Ripening

The phytochemical study of the extracts revealed compounds such as alkaloids, polyphenols, flavonoids, sterols and polyterpenes, gallic tannins and coumarins. On the other hand, a total absence of quinones was observed in all the extracts of the fruits of the chilli (*Capsicum annum* L.) type "Ahalimancou" at different stages of ripening. Regarding

catechism tannins and saponins, they were only detected in green chilli extracts. In addition, there is a strong presence of alkaloids, flavonoids and polyphenols in orange and red pepper extracts. On the other hand, sterols and polyterpenes are strongly present in green and yellow chilli extracts.

## 4. DISCUSSION

The socio-demographic study of the respondents showed that there is a relationship between the categorical variables (gender, age group, ethnicity, level of education and locality)

and the level of knowledge variable. This result can be explained by the fact that these categorical variables have a significant effect ( $p \leq 0.05$ ) on the level of knowledge. Concerning the genus, of the 650 the fruits of the pepper (*Capsicum annum* L.) type "Ahalimancou". The level of knowledge is higher among women than among men. This observation is reflected in the fact that women are very involved in the cultivation of market garden products, particularly for their families, but also in trade compared to men. The results are in agreement with those obtained by Sraboni *et al.* [16] in the study on the role of women in market gardening which states that market gardening in Africa is more a typically female activity for family consumption. Studies by Kouassi *et al.*, [17], support this information under which, chilli is consumed more by women than by men. This observation is confirmed by the study which revealed a dependence between level of knowledge and gender. In addition, the results of the ethnobotanical study showed that people whose age varies between 60 years and over are more familiar with the fruits of the pepper (*Capsicum annum* L.) type "Ahalimancou". This indicates that the elderly are likely to provide more reliable information because they hold a good part of the endogenous knowledge which is part of the oral tradition. Previous studies on other plant species have come to the same conclusion and have shown that the elderly have endogenous knowledge for traditional uses of plants and recipes for their implementation [18,19]. Conversely, people whose age is between 15 and 25 years have a lower frequency of acquaintance with a rate of 6.2%. The predominantly adult population could explain this result. The young people are for the most part educated and are not interested in the knowledge of vegetable plants, in favor of various hobbies. Consequently, they decrease the flow of knowledge between adults and their generation. This result supports the hypothesis of age-dependent knowledge [20]. In addition, the results showed that the agni are more familiar with the fruits of the pepper (*Capsicum annum* L.) type "Ahalimancou". An expected result because this region is strongly represented by this ethnic group which constitutes the indigenous population of the study area, moreover this pepper is very popular with this ethnic group. Regarding the level of education, the survey showed that uneducated people are more familiar with the "Ahalimancou" type pepper. This result could be explained by the fact that households with a low standard of

living consume this variety of pepper more given their knowledge of this variety than those at a high level. This is due to the fact that according to Tchiégang and Kitikil [21], people without education remain more attached to their cultural values. While those with a high standard of living tend to adopt Western lifestyles [22].

The characters gender, age group, ethnicity, level of education and location have a significant influence ( $p \leq 0.05$ ) regardless of the mode of use of the chilli "Ahalimancou". Regarding gender, women have high levels both in food and in the treatment of pathologies. Indeed, these women use this chilli in food for its spice side to give a good flavor to their culinary preparation. But also, they use it in the treatment of pathologies because the health benefit is the key criterion of preference for this chilli pepper. Thus, these results are similar to the authors who report that chilli is used in food [23] and in traditional medicine [24] by populations for its high capsaicin content. Regarding the age group, the predominance observed for adults whose age is between 36 years and 60 years more use this variety of pepper in the diet, while the elderly whose age is between 60 and more use it in the treatment of pathologies. This result could be explained by the fact that these people recognize the therapeutic virtues because, according to them, "Ahalimancou" type chilli fruits (*Capsicum annum* L.) are used in the composition of recipes for the that women are very involved in the cultivation of market garden products, particularly for their families, but also in trade compared to men. The results are in agreement with those obtained by Sraboni *et al.* [16] in the study on the role of women in market gardening which states that market gardening in Africa is more a typically female activity for family consumption. Studies by Kouassi *et al.*, [17], support this information under which, chilli is consumed more by women than by men. This observation is confirmed by the study which revealed a dependence between level of knowledge and gender. In addition, the results of the ethnobotanical study showed that people whose age varies between 60 years and over are more familiar with the fruits of the pepper (*Capsicum annum* L.) type "Ahalimancou". This indicates that the elderly are likely to provide more reliable information because they hold a good part of the endogenous knowledge which is part of the oral tradition. Previous studies on other plant species have come to the same

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therapeutic virtues because, according to them, "Ahalimancou" type chilli fruits (*Capsicum annuum* L.) are used in the composition of recipes for the treatment of certain ailments. Regarding the ethnicity, the majority of Agni people use the chilli type "Ahalimancou" in food and for the treatment of certain pathologies unlike other ethnic groups who use it only in food. This result could be explained by the fact that the agni have a deep knowledge about the benefits of the fruit of this pepper. The fruits of this type of chilli could be an important source of antioxidants or dietary fiber known to have a positive effect on certain conditions. The level of education of users of the "Ahalimancou" type chilli fruit (*Capsicum annuum* L.) varies according to their level of instruction. Most of the users of the fruit of this chilli are those who are not educated. This observation is said to be due to the fact that people without schooling did not abandon their eating habits of their grandparents who used this fruit much more. The same observations were made on other aromatic plant species in Benin, where traditional technologies of use were passed down from generation to generation [25]. In general, fresh fruits are used in the preparation of cooked meals. However, the women who owned this pepper are very conservative, they sell the fresh fruit precisely at the green ripening stage while at the red stage these women use the dried form for new seeds. While, most men use this chilli in decoction with other plants for the treatment of certain conditions. According to the interviewees, when these chilli fruits are in the market, they are quickly sold because of the low production rate of this chilli. The cultivation of this pepper is not very encouraged because the women farmers give themselves more to the cash crops. But also because of the absence of seed.

## 5. CONCLUSION

This study made it possible to know that the level of knowledge, the mode of use as well as the level of the state of use are strongly influenced by characters such as gender, age group, ethnicity, educational level and locality. In addition, this study indicates that the "Ahalimancou" type pepper is widely known by women. In addition to its food use, it is widely used in the treatment of pathologies. And, this strain is used much more in the elderly whose age varies between 60 years and more in the treatment of pathologies. Therefore, considering its low productivity, it is

widely used in its fresh form. Subsequently, the qualitative study showed that the chilli (*Capsicum annuum* L.) type "Ahalimancou" contains phytochemicals with antioxidant properties. More in-depth studies (using a quantitative approach) are to be considered on the "Ahalimancou" type pepper (*Capsicum annuum* L.), for large-scale popularization, would make it possible to justify this qualitative study. In addition, this study will allow this type to be included in the database of chilli cultivated in Côte d'Ivoire.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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