International Journal of Food Science and Nutrition
ISSN: 2455-4898, Impact Factor: (RJIF 5.14)
www.foodsciencejournal.com
Volume 1; Issue 2; March 2016; Page No. 21-29

Variability in the spice compositions of *nkwi* in Western Cameroon: Difficulties in local formulations

[1] Djiazet Stève, [2*] Mezajoug Kenfack Laurette Blandine, [3] Linder Michel, [4]Tchiégang Clergé

[1, 2, 4] Department of Food Sciences and Nutrition, National Advanced School of Agro-Industrial Sciences (ENSAI), University of Ngaoundere, Cameroon PO Box 455 Ngaoundere

[3] Laboratory of Biomolecular Engineering, National Advanced School of Agronomy and Industrial Food (ENSAIA) National Institute of Polytechnic of Lorraine (INPL), 54500 Vandoeuvre-lès-Nancy, France

Abstract
Food habits in Western Cameroon are characterised by highly spiced meals, including *nkwi*. Preliminary investigations revealed differences in the spice composition of this soup in Nde and Mifi divisions. The aim of the present sturdy was to evaluate the variability in the types and quantities of spices for this soup in Western Cameroon, where it is part of the food habits of the populations. A survey was carried out; women were questioned individually on local spice samples that were presented to them. Not all of the spice types could be used for the preparation of *nkwi*. The common most essential spices of the soup were *F. xanthozyloïdes*, *S. melongena*, *M. whitei*, and *S. zenkeri* fruit. Their quantities for a litre of *nkwi* varied between 0.79g for *S. melongena* to 18.27g for *M. whitei*. This variability was elucidated with the differences in the mean weights of spices from a division to the other, and their standard deviations which were too high. This study revealed that the spices were well known and there were differences, regarding the spice composition of *nkwi* with respect to the different divisions. The variability was mostly at the level of the choice of the spices utilised for the odour.

Keywords: *nkwi*, Preparation, Local spices, Variability, Western Cameroon

1. Introduction
In every society worldwide, people have diverse feeding habits that have been inherited from generations to generations. Food habits flourish as an understanding of the food environment and the relationship between food choice and health status improves. The choice of food is influenced by its availability, economy, cultural and social habits, physiological and psychological status among others. In this regard, the cultural background determines what is eaten, as well as when and how it is eaten [1]. African community had with time developed diets that maximize the use of local food products. Unfortunately, during the past decades, sub-Saharan Africa has been experiencing a nutrition transition. Traditional foods and food habits have progressively been replaced by the globalized food culture, putting aside their own traditional food habits [2, 3]. Fundamentally, the foods and food habits of sub-Saharan Africa cultural groups are characterised by foods prepared according to the traditional ancient practices. In Cameroon, precisely in the Western Regions, there exist some traditional soups that were inherited from the ancestral know-how among which *nkwi*. It is a sticky soup obtained from maceration of the bark of *Triumfetta pentandra* in hot water, in which a certain number of ground spices is added. This soup is eaten with maize *fufu*. Maize *fufu* eaten with *nkwi* is of great socio-cultural importance, and is usually required for the nutritional and health care of women after birth giving, among others. It requires spices that are either harvested from the local forests or cultivated by the indigenous population. Over fourteen (14) different spices are used for its preparation [4]. The chemical composition reveals that these spices contain substantial quantities of minerals, essential amino acids and fatty acids, vitamins and phytonutrients which may have an impact on the nutritional wellbeing of the consumers [4, 5, 6]. From a locality to the other in Nde and Mifi divisions, the spice composition of *nkwi* differs. In the same locality, it varies from a housekeeper to the other. As time goes on, young housekeepers are no more able to make the right spice composition of this soup using ancestral culinary practices, due to the high number of spices employed for this purpose [7]. The perpetuation of this traditional know-how could be made possible through the development of a standardised ready-to-use local spice formulation. But none of the studies mentioned above have been interested in the way these spices are used at the traditional level for the seasoning of *nkwi* in the localities of all the divisions and regions where the meal originated in Western Cameroon. Moreover, progresses in the field of food tend to encourage ready-to-use food products. This study intends to evaluate the use of these spices in the three regions of Western Cameroon for the preparation of *nkwi*, in order to raise existing difficulties in making a standard ready-to-use and acceptable spice formulation for the consumers.

2. Material and methods
2.2 Material
The samples of the 24 spices used for this study were bought in *marché B* Bafoussam and Food market in Bamenda, West and North-west regions of Cameroon respectively. They were all in a dried state as they are often commercialized. The samples of the spices included fruits, roots and bark of trees. Their names in various languages and respective abbreviation in brackets are found in table1:

Table 1: Names in different languages, abbreviations and parts of the plants samples

Scientific names	English names	Local names Bangangte	Abbreviations	Parts of plant used
-*Aframomumdaniellii* (Hook. F) K. Schum	Bastred melegueta	*ketcho*	(Ad)	Fruits
-*Aframomum sp.*	-	*tcho-nko*		
-*Capsicum frutescens* L.	Small size bird pepper	*sisohk-sing*	(As)	
-*Dichrostachys glomerata* (Forsk.) Hutch.	Sickle bush	*tohn-poh*	(Cf)	
-*Fagara leprierii* Guill. and Perr.	Prickly ash		(Dg)	
-*Fagara xanthozyloïdes* Watern.	-	*manyadjieu*	(Fl)	
-*Hua gabonii* Pierre	Garlic tree	*nga-chu*	(Fx)	
-*Monodora myristica* Gaertn.	Calabash nutmeg	*dum-tà*	(Hg)	
-*Piper capense* Wild	Cordoncillo	*madanda*	(Mm)	
-*Piper guineense* Schun and Thonn.	Black pepper (Ashandi)	-	(Pc)	
-*Scorodophloeus zenkeri* Harms.	Divida (African)	*nsop*	(Pg)	
-*Solanum melongena* L. Var Inerme D. C. Hlern	Aubergine	*dum nka*	(Sz)	
-*Tetrapleura tetraptera* Schun and Thonn Thaub		*seupoh*	(Sm)	
-*Xylopia aethiopica* Dunal A. Rich	-	*neutcham*	(Tt)	
-*Xylopia africana* (Benth.) Oliv	Ethiopian pepper (African)	*nzeu tchuk*	(Xae)	
-*Xylopia parviflora* (A. Rich) Benthane	-		(Xa)	
	-	*keehn* (Ngemba)	(Xp)	
		kee-nah		
-*Dorstenia psilurus* Welw.	-	*fuh nuh*	(Dp)	Roots
-*Echinops giganteus* A. Rich.	Giant Japanese butterbur	*tshweunga*	(Eg)	
-*Mondia whitei* (Hook F). Skell.	White ginger	*dimte*	(Mw)	
-*Pentadiplandra brazzeana* Var Brazzeana	Joy perfume tree	*di feu*	(Pb)	
-*Scleria striatinux* De Wild.	-	*ngan-gnih*	(Ss)	
-*Hua gabonii* Pierre	Garlic tree	*kup dum*	Hgb	Bark of plants
-*Hypodaphnis zenkeri* (Engler) Stapf	-	*kup-poh*	Hz	
-*Scorodoploeus zenkeri* Harms	Divida (African)	*kup dum nka*	Szf	

2.2-Localities of interviews

The survey was carried out in the West, North-west and South-west regions of Cameroon. Table 2 gives the names of the regions, divisions, localities, geographical coordinates and the number of people interviewed, while figure 1 shows the locations of the study area.

Table 2: Places where the survey was carried out and number of interviews

Regions	Divisions	Localities	Geographical coordinates	Number of people interviewed
	Upper-Nkam (UN)	Bafang, Banka	5° 09’ 00’’N/10° 10’ 60’’ E	30
	Upper-plateau (Up)	Baham, Bangou	5° 20’ 04’’N/10° 22’ 08’’ E	34
	Koung-khi (KKi)	Bandjoun	5° 22’ 31’’N/10° 24’ 44’’ E	32
West	Nde (N)	Bangangte	5° 09’ 00’’N/10° 31’ 00’’ E	40
	Bamboutos (Bam)	Bangang, Mbouda, Balatchi	5° 37’ 60’’N/10° 15’ 00’’ E	85
	Mifi (Mi)	Bamegoum, Baleng Bafoussam	5° 28’ 60’’N/10° 24’ 00’’ E	54
	Menoua (Me)	Bansoa, Bafou, Dschang	5° 27’ 00’’N/10° 04’ 00’’ E	80
	Mezam (Mez)	Nkwen	5° 58’ 43’’N/10° 08’ 52’’ E	30
North West		Santa		30
		Bafut		30
		Mankon		30
South-West	Lebialem (Le)	M’Muock-Fosimundi, M’ Muock-Leteh	5° 42’ 47’’N/10° 03’ 54’’ E	42
Total				517

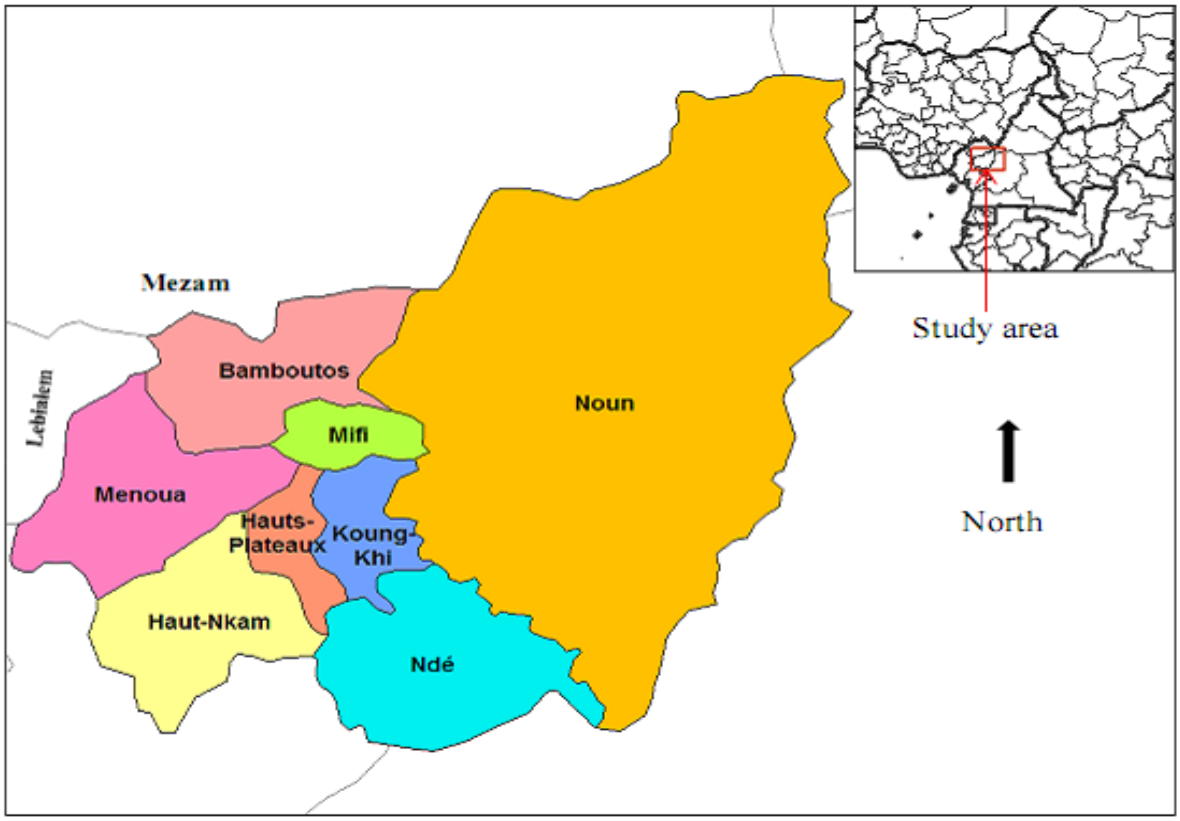

Fig 1: The study area

2.3 Questionnaire

The whole study was a questionnaire made up of eight sections. The sections which were exploited to obtain the present data were a sequence of thirty questions. Information collected was: the utilization frequency of each local spice, qualitative and quantitative facts related to the use of each of the spices in *nkwi*. This aspect took into consideration the identification of essential and non-essential spices, as well as those responsible of the taste and odour of *nkwi*.

2.4 Methods

The survey was carried out between the 12 of August to the 16 of October 2013. A total of 517 women and girls between 30-80 years of age were questioned following the methodology used by Badau *et* al. [8] and Nana Ngassam [7]. The questions concerned the following aspects:

- Acknowledgment frequency of each local spice

The acknowledgment frequency of each local spice is the number of people who knows a particular spice over the number of people interviewed times 100.

$$Af = \frac{Nk}{Ni} \times 100$$

Af: acknowledgment frequency

Nk: number of people who knows a particular spice

Ni: the number of people interviewed

All the spice samples were presented to each woman interviewed to remove the spices that she knows.

- Spices used for the preparation of *nkwi*

Each person interviewed was asked to remove the spices that she knows and uses to prepare *nkwi* following the outlines below:

- Essential spices of *nkwi*
- Spices responsible of the taste of *nkwi*
- Spices responsible of the odour of *nkwi*

Essential spices of *nkwi* are spices without which the soup obtained cannot meet the required sensorial characteristics expected. Each person interviewed was asked to select the spices she employs as essentials for the preparation of *nkwi* as well as those that she uses to provide the taste and odour of *nkwi* respectively.

- Quantities of each essential spices used for the preparation of *nkwi*

Each person interviewed was asked to remove from each of the sample she uses, the quantity necessary for the preparation of one litre of *nkwi*. The quantity proposed was immediately weighed and the value recorded, for each sample.

3. Statistical analysis of data

Data collected were introduced in Sphinx v5 Plus [2] Lexica Edition. This software was used for tabulation of recorded data, which consisted to automatically determine the number of occurrence of each modality. The software was also used to calculate the mean weights of each spice utilised for the preparation of a litre of *nkwi*. Tabulated data were introduced in XL STAT 2014 version to perform the principal components analysis, which gives correlations between each of the local spice samples and the different divisions.

3 Results and discussion

3.1 Acknowledgement frequencies of spices with respect to the divisions

Table 3 presents the results of acknowledgment frequencies in percentage (%) of each of the local spices with respect to the divisions of the study area.

Table 3: Acknowledgment frequency of each spice (%) with respect to the divisions

Acknowledgment frequencies											
Spices	**UN**	**Mi**	**UP**	**Mez**	**KKi**	**N**	**Ba**	**Me**	**Le**	**Bam**	**Total**
Ad	100	100	100	75.6	100	100	100	100	87	100	93.4
As	**12.9**	**17**	**18.8**	**5.0**	**12.5**	**2.5**	**0**	**2.1**	**2.6**	**2.4**	**6.8**
Cf	100	100	100	96.6	100	100	100	100	97	100	99
Dg	100	97	100	89.9	100	100	97.1	98	79	100	95.4
Dp	100	98	100	89.1	100	100	94.1	96	76	98.8	94.6
Eg	100	98	100	48.7	100	100	91.2	94	71	92.9	83.6
Fl	100	100	100	96.6	100	100	100	100	84	100	98.1
Fx	100	100	100	80.7	100	100	100	100	90	100	94.8
Hgb	100	98	100	91.6	100	100	100	100	100	100	97.9
Hgf	100	100	100	97.5	100	100	100	100	92	100	98.8
Hz	90.3	100	100	31.9	93.8	98	88.2	96	71	92.9	78.7
Mw	100	100	100	83.2	100	100	100	100	76	100	94.4
Mm	100	100	96.9	99.2	100	100	100	100	97	98.8	99.2
Pb	100	100	100	94.1	100	100	97.1	100	79	98.8	96.7
Pc	**67.7**	**88**	**96.9**	**31.1**	**90.6**	**85**	**79.4**	**64**	**50**	**66.7**	**65.2**
Pg	100	100	100	96.6	100	100	100	100	97	98.8	98.8
Ss	100	100	100	89.9	100	100	100	100	76	98.8	95.7
Szb	**3.2**	**6.8**	**0**	**1.7**	**0**	**0**	**2.9**	**2.1**	**0**	**10.7**	**3.5**
Szf	100	100	100	97.5	100	100	100	100	97	98.8	99
Sm	100	100	100	79.8	100	100	100	100	84	100	94.2
Tt	100	100	100	95	100	100	100	100	84	100	97.7
Xae	100	98	100	88.2	100	100	100	100	84	100	95.9
Xa	**6.5**	**1.7**	**0**	**94.1**	**3.1**	**0**	**0**	**0**	**34**	**0**	**25**
Xp	100	98	100	91.6	100	100	97.1	98	66	98.8	94.8

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa Ad:
A. daniellii; As: *Aframomum* Sp. ; Cf: *C. frutescens*; Dg: *D. glomerata*; Dp: *D. psilurus*; Eg: *E. giganteus*; Fl: *F. leprierii*; Fx*: F. xanthozyloides*; Hgb: *H.gabonii* bark; Hgf: *H. gabonii* fruits; Hz*: H. zenkeri*; Mw: *M. whitei*; Mm: *M. myristica*; Pb: *P. brazzeana*; Pc: *P. capense*; Pg: *P. guineense*; Ss: *S. striatinux*; Szf: *S. zenkeri* fruit; Szb: *S. zenkeri* bark; Sm: *S. melongena*; Tt: *T. tetraptera*: Xae: *X. aethiopica*; Xa: *X. africana*; Xp: *X. parviflora*

Table 3 shows that these spices are well known by the populations of the West region than those of the North-west and the South-west regions of Cameroon. Four of these spices were generally not well known; namely *X. africana, S. zenkeri* bark, *Aframomum* sp. and *P. capense*. Nevertheless, *X. africana* is well known in Mezam (94.1%) division meanwhile it is almost not known in the rest of divisions. *Aframomum* sp. is known better in some divisions of the West region than Mezam and Lebialem divisions. According to the spice sellers, *X. africana* plants are found in Mezam division meanwhile *Aframomum* sp. and *P. capense* grow in some localities of the West region. *X. africana* is a protected plant densely found in the Bali-Ngemba Forest Reserve in the North West region of Cameroon. It was once common throughout the *Bamileke* plateau and Bamenda highlands where it is now almost extinct. On Mount Cameroon, it appears rare being found only twice in the surveys conducted between 1992 and 1994. *X. africana* has been found in Mount Kupe, the Bakossi Mounts, Rumpi hills, Fosimondi and in the Gulf of Guinea (Bioko) in the South-west region of Cameroon, but in few numbers.[10, 9]. Each of these spices is part of the food habits of the population living where the plant grows. There is confusion between *S. zenkeri* bark and *H. gabonii* bark. *S. zenkeri* plant is mostly exploited for its fruits meanwhile *H. gabonii* trees are said not to bear fruit in some localities and are exploited for their bark.

3.2 Spices used for the preparation of *nkwi*

Figure 2 is the principal components analysis (PCA) which groups the different spices with respect to the divisions of the study area and gives an idea of how frequent they are used there as spices for the preparation of *nkwi*. The red lines and points represent the different divisions and the blue points represent the spices. The horizontal axis is the F2 axis while the vertical axis is the F1 axis.

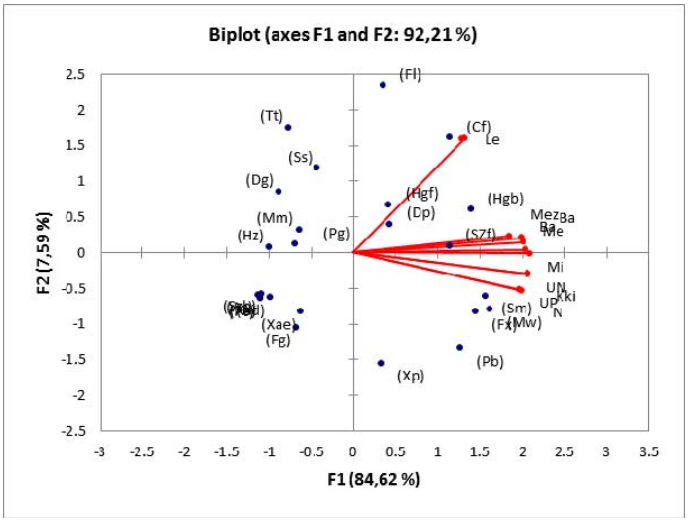

Fig 2: PCA representation of spices used for the preparation of *nkwi* with respect to the different divisions

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa

Ad: *A. daniellii*; As: *Aframomum* Sp. ; Cf: *C. frutescens*; Dg: *D. glomerata*; Dp: *D. psilurus*; Eg: *E. giganteus*; Fl: *F. leprierii*; Fx: *F. xanthozyloides*; Hgb: *H.gabonii* bark; Hgf: *H. gabonii* fruits; Hz*: H. zenkeri*; Mw: *M. whitei*; Mm: *M. myristica*; Pb: *P. brazzeana*; Pc: *P. capense*; Pg: *P. guineense*; Ss: *S. striatinux*; Szf: *S. zenkeri* fruit; Szb: *S. zenkeri* bark; Sm: *S. melongena*; Tt: *T. tetraptera*: Xae: *X. aethiopica*; Xa: *X. africana*; Xp: *X. parviflora*

There were two different ways of making the spice composition of *nkwi* in the Western Regions of Cameroon. Lebialem has its way of making the spices composition, using some spices that make their composition to be different from that of others: *H. gabonii* fruits, *H. gabonii* bark, *F. leprierii*, *F. xanthozyloïdes*, *S. melongena*, *T. tetraptera D. psilurus*, *S. striatinux* and *M. whitei*. The people of the various divisions of the West region have their own way of making the spice composition of this soup. Considering the different divisions of the Western Regions, the way of making the spice composition in Nde, Upper-plateau and Koung-Khi is similar, compared to Mifi, Menoua, and Bamboutos; thus the different correlations between the red lines representing the different divisions. The spices that are found on the right of F1 axis, that is along the positive side of F2 axis are spices that are often used for the preparation of *nkwi* in the various divisions of the West region. They include: *C. frutescens*, *F. leprierii*, *F. xanthozyloïdes*, *S. melongena*, *X. parviflora*. *M. whitei*, *P. brazzeana*, *H. gabonii* fruits, *X. aethiopica*, *D. psilurus*, and *H. gabonii* bark. Those that are found on the left of F1 axis are spices that are not often used for the preparation of *nkwi*, especially by the populations of the West region. They include: *D. glomerata*, *M. myristica*, *P. guineense*, *T. tetraptera*, *X. aethiopica*, *E. giganteus*, *S. striatinux*, *H. zenkeri* bark and *S. zenkeri* bark. Spices like *M. myristica*, *P. guineense*, *T. tetraptera*, *X. aethiopica*, *D. glomerata*, *E. giganteus*, *S. striatinux* are used by most people in Lebialem meanwhile they are used by very few people in the West region; thus their isolation from the black spot of figure 2. The black spot represents spices that are not used at all for the preparation of *nkwi*. *M. myristica* is appreciated for the preparation of *nkwi* in Bamboutos and Menoua divisions. Its position on figure 2 that is at the same high with Bamboutos and Menoua divisions justifies its use in these two divisions. The local name of *M. myristica* in these two divisions (*bian-mfeu*), meaning groundnut of *nkwi* explains its use for the preparation of this soup in Menoua and Bamboutos divisions.

3.3 Essential spices of *nkwi*

Essential spices of *nkwi* are spices without which the expected sensorial properties of *nkwi* cannot be obtained. Figures 3 and 4 are respectively the simple representation of essential spices of *nkwi* on the principal components analysis diagram and the representation of essential spices of *nkwi* with respect to the divisions on the principal components analysis diagram.

3.3.1 Spices generally considered as essentials for *nkwi*

Figure 3 shows the spices that are considered by everyone as essentials for the preparation of *nkwi* irrespective of the divisions.

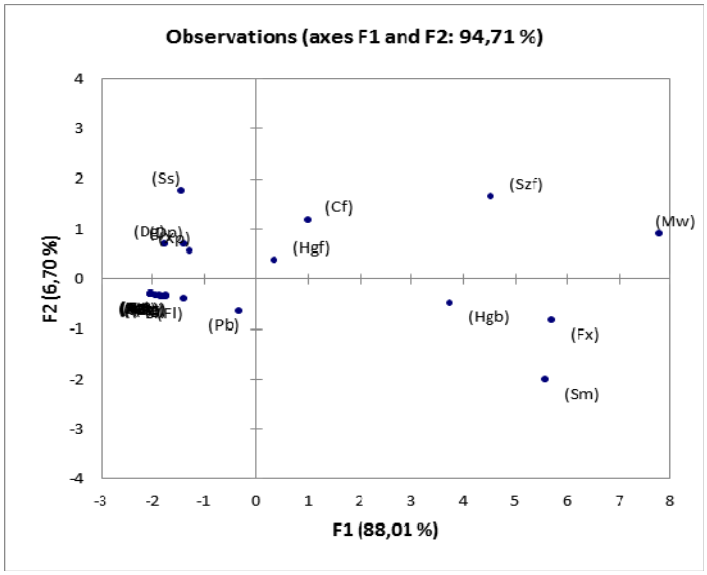

Fig 3: PCA representation of essential spices of *nkwi* irrespective of the division of residence

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa:

Cf: *C. frutescens*; Dg: *D. glomerata*; Dp: *D. psilurus*; Eg: *E. giganteus*; Fx: *F. xanthozyloides*; Hgb: *H. gabonii* bark; Hgf: *H. gabonii* fruits; Mw: *M. whitei*; Pb: *P. brazzeana*; Ss: *S. striatinux*; Szf: *S. zenkeri* fruit; Szb: *S. zenkeri* bark; Sm: *S. melongena*

Figure 3 presents essential spices utilised for the preparation of *nkwi*. They are: *F. xanthozyloïdes*, *S. melongena*, *M. whitei*, *S. zenkeri* fruit *C. frutescens*, *H. gabonii* bark and *H. gabonii* fruits. *M. whitei*, *F. xanthozyloïdes*, *S. zenkeri* fruit and *S. melongena* are the most essentials in the spice composition of *nkwi*, looking at their position when projected on F2 axis.

3.3.2 Relationship between essential spices of *nkwi* and the divisions

Figure 4 presents the relationship between essential local spices of *nkwi* and the divisions of residence. The aim of this representation is to determine the spices that are considered essential in each of the divisions.

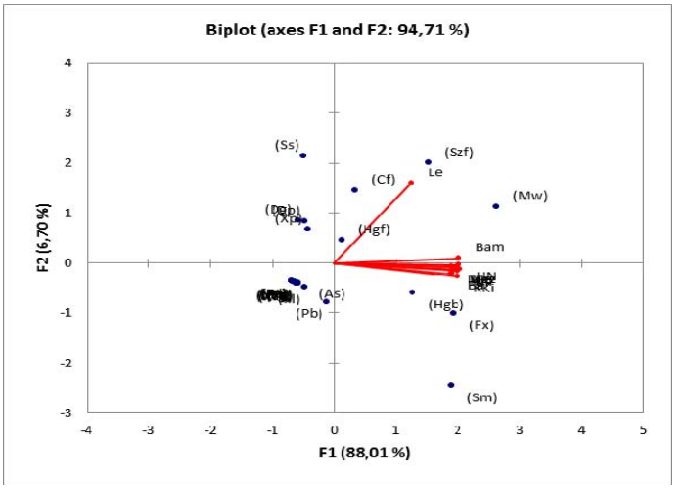

Fig 4: PCA representation of essential spices of *nkwi* with respect to the divisions

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa:
Cf: *C. frutescens*; Dg: *D. glomerata*; Dp: *D. psilurus*; Eg: *E. giganteus*; Fx: *F. xanthozyloides*; Hgb: *H. gabonii* bark; Hgf: *H. gabonii* fruits; Mw: *M. whitei*; Pb: *P. brazzeana*; Ss: *S. striatinux*; Szf: *S. zenkeri* fruit; Szb: *S. zenkeri* bark; Sm: *S. melongena*

Looking at Figure 4, essential spices for the preparation of *nkwi* could be divided into two groups: The way they are used in Lebialem and the way they are used in the rest of the divisions of the West region. In Mezam division, the population is almost not interested with *nkwi*. In the course of this sturdy, very few people were willing to answer to the questions concerning *nkwi* which they qualified it as a *Bamileké* meal. *Nkwi* was found to be consumed by the populations of Lebialem than those of Mezam, no matter the fact that they share boarders. Nana Ngassam[7] showed that *nkwi* had five essential spices in Nde division: *F. xanthozyloïdes, S. melongena, M. whitei, S. zenkeri* fruit and *P. brazzeana* and three essential spices in Mifi division: *F. xanthozyloïdes, S. melongena, M. whitei*. The extension of the geographical area in this study, and the approach used: that is asking the person interviewed to select the essential spices herself, confirm that *F. xanthozyloïdes, S. melongena, M. whitei,* and *S. zenkeri* fruit are the essential spices for the preparation of *nkwi*. Nana Ngassam [8] determined essential spices of *nkwi* based on the statistics; that is the spices that were used by 100% of people of those he interviewed; meanwhile in this study, it is each consumer who freely selected the spices that she considered essential, from a collection of twenty four (24) different local spices samples.

3.4 Spices responsible of the taste of *nkwi*

The quality of a meal is determined by its taste, which in turn depends on the ingredients used [6]. In the case of *nkwi*, a certain number of spices are used for this purpose. Figure 5 shows the spices used to provide the taste of *nkwi* with respect to the divisions of residence.

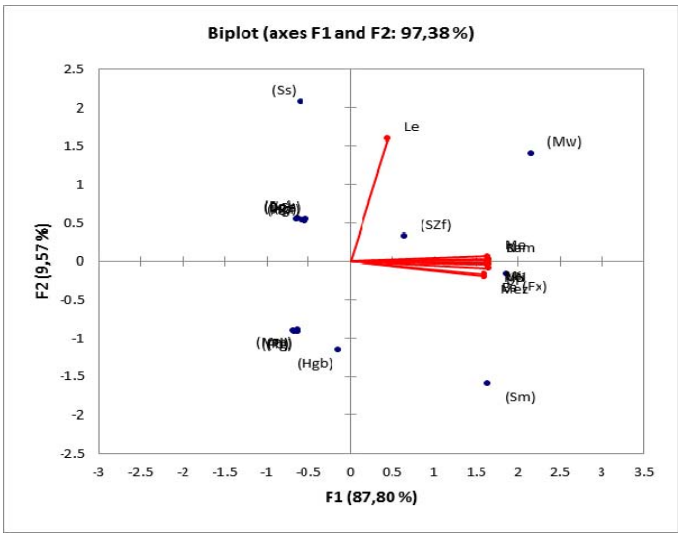

Fig 5: PCA representation of spice responsible of the taste of *nkwi* with respect to the divisions

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa
Fx: *F. xanthozyloides*; Mw: *M. whiteic*; Ss: *S. striatinux*; Szf: *S. zenkeri* fruit; *S. zenkeri* bark; Sm: *S. melongena*

Among essential spices for the preparation of *nkwi*, those responsible of the taste are *F. xanthozyloïdes, S. melongena* and *M. whitei*, as it could be seen on figure 5. This result was in line with the popular assertion given by those who responded to the questionnaire. They said that a good *nkwi* is determined by the use of appropriate quantities of *S. melongena* and *M. whitei*. Depending on these two spices, sweet *nkwi* could be prepared for those who like the sweet taste by increasing the quantity of *M. whitei*. All the same *nkwi* with bitter taste could be prepared for those who like bitter taste, by adding the quantity of *S. melongena.* In the West region, some consumers used *S. zenkeri* fruit and *H. gabonii* bark for the taste.

3.5 Spices responsible of the odour of *nkwi*

Attraction towards a meal is partially due to its aroma. The scent of food is a result of the odour released by the flavouring constituents employed for its preparation [11]. The spices responsible of the odour of *nkwi* with respect to the division of residence of the study area are presented in table 4 and on Figure 6. Spices that are said to be responsible of the odour of *nkwi* were *S. zenkeri* fruit, *H. gabonii* bark and *H. gabonii* fruit. There is a strong debate concerning the use of *H. gabonii* fruit and *S. zenkeri* fruit for the preparation of *nkwi*. According to some people, *H. gabonii* fruit is the right spice used to provide the odour of *nkwi* while according to others, *S. zenkeri* fruit is the right spice to be employed for this purpose. *H. gabonii* fruit was utilised by 21.5% of people for the odour of *nkwi* while *S. zenkeri* fruit was appreciated by 49.1% of participants as spice responsible of the odour of *nkwi*. The rest of percentages were provided by the barks of the trees of these two spices, and other minor spices that were said to provide the odour of this soup as shown in table 4.

Table 4: Spices responsible of the odour of *nkwi* with respect to the divisions

Spices responsible of the odour of *nkwi* with respect to the division of residence (%)											
Spices	UN	Mi	UP	Mez	KKi	N	Ba	Me	Le	Bam	Total
(Cf)	0	0	0	0	0	0	0	2.1	0	0	0.2
(Fx)	0	0	0	0.8	3.1	10	0	14.9	0	1.2	2.7
(Hgb)	**61.3**	**74.6**	**84.4**	**1.7**	**59.4**	**42.5**	**91.2**	**61.7**	**7.9**	**44.1**	**44.3**
(Hgf)	**32.3**	**40.7**	**21.9**	**1.7**	**18.8**	**20**	**23.5**	**44.7**	**5.3**	**27.4**	**21.5**
(Mw)	0	0	0	0	3.1	10	0	4.3	0	2.4	1.7
(Pb)	0	1.7	0	0	0	0	0	6.4	0	0	0.8
(Szb)	3.2	0	0	0	0	0	0	0	0	0	0.2
(Szf)	**74.2**	**79.7**	**75**	**2.5**	**68.8**	**72.5**	**55.9**	**70.2**	**7.9**	**59.5**	**49.1**
(Sm)	0	1.7	0	0	0	5	0	2.1	0	2.4	1.2
(Xp)	0	0	0	0	0	2.5	0	0	0	0	0.2

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa
Cf: *C. frutescens* Fx*: F. xanthozyloides* Hgb: *H. gabonii* bark; Hgf: *H. gabonii* fruit; *M. whitei*; *P. brazzeana*; Szf: *S. zenkeri* fruit; *S. melongena; X. parviflora*

A good number of people do not make this difference between the use of *S. zenkeri* fruit and that of *H. gabonii* fruit while the majority of people prefer *S. zenkeri* fruit to provide the odour of *nkwi* over *H. gabonii* fruit. Figure 6 highlights this variability by presenting widely spread red lines in the form of a broom, representing the different divisions. It clearly shows that *S. zenkeri* fruit was preferred over *H. gabonii* fruit as spice to provide the right odour of *nkwi*, when projected on F2 axis. The divergence of the red lines representing the different divisions expresses the variability in the use of *S. zenkeri* fruit, *H. gabonii* bark and *H. gabonii* fruit to provide the odour of *nkwi*. Menoua and Bamboutos divisions have the same way of using spices responsible of the odour, while Koung-Khi and Mifi have a common way of using the three spices for the scent of *nkwi*. This may be due to interactions of people, taking into consideration their geographical positions on figure1. Generally, in Nde, Menoua, Bamboutos, Mezam and Upper-Nkam, *S. zenkeri* fruit is mostly used; it is for this reason that these divisions are found bellow the F2 axis. In Upper-plateau, Koung-Khi Mifi and Lebialem, *H. gabonii* bark is preferred over *S. zenkeri* fruit. It is for this reason that these divisions are found above the F2 axis. Others prefer to mix the three spices and said when used as such, the flavour of food is well raised than when each of them is utilised individually.

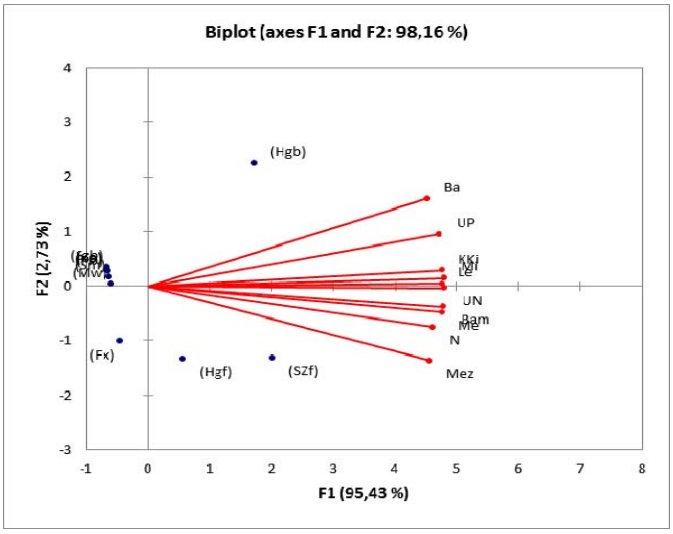

Fig 6: PCA representation of spices responsible of the odour of *nkwi* with respect to the divisions

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa

Hgb: *H. gabonii* bark; Hgf: *H. gabonii* fruit; Szf: *S. zenkeri* fruit

Lopes *et al.* [12] showed that the use of spice in combination improves the sensorial properties of food than when they are employed individually and could help to reduce the use of sodium chloride consumption in food products, without compromising the sensorial properties. The odour that characterises *nkwi* might be a garlic-like odour. Analyses of the fruits of *H. gabonii* and *S. zenkeri* showed that the odour that characterises these fruits is a garlic-like odour, provided by sulphur bonds found in the chemical structures of most molecules of these plant materials [13, 14]. Though *X. parviflora* seems to be less important to provide the odour of *nkwi*, several women underlined the fact that it was the spice that is employed to provide the bright red colour that is required by most consumers for a good *nkwi*.

3.6 Quantities of essential spices used for the preparation of *nkwi*

The preparation of *nkwi* requires appropriate quantities of some local spices that must be there to provide the expected sensorial qualities. Table 5 presents the mean weights of each essential spice in grams (g), for the preparation of one litre of *nkwi* in the various divisions.

Table 5: Mean weights of essential spices for the preparation of *nkwi*

Quantities of spices for 1L of *nkwi* (g)				
Divisions of residence	**Fx**	**Mw**	**Szf**	**Sm**
UN	2.92 ±1.79	13.36±7.68	2.62±1.33	1.92±1.14
Mi	2.16±1.52	14.27±7.98	2.04±0.98	1.78±1.26
UP	3.07 ±2.19	16.11±8.79	1.64±0.99	2.84±1.51
Mez	0.95±0.49	3.16±2.73	1.06±0.57	0.79 ±0.48
KKi	3.56±2.66	16.01±6.78	1.67±1.28	2.17±1.38
N	1.93±1.23	18.27±9.29	1.34±0.89	1.54±1.11
Ban	1.08±0.87	13.95±9.39	1.52±0.76	2.46±1.17
Me	2.06±1.68	11.57±10.21	2.06±1.48	1.19±0.92
Le	0.58±0.33	7.61±1.51	2.71±1.90	1.77±0.87
Bam	1.36±1.33	13.36±9.75	2.32±1.23	1.12±1.06

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa

Fx: *F. xanthozyloides*; Mw: *M. whitei*; Szf: *S. zenkeri* fruit; Sm: *S. melongena*. The values are means of the following number of measurements: Fx (310); Mw (327); Szf (394); Sm (299)

Table 5 shows that the standard deviations of most mean weights of the local spices were very high and this illustrates the fact that the variability is not only at the level of the type of spice utilised, but also at the level of the quantity of each of these spices, when it comes to prepare *nkwi* in the different localities of the Western Regions of Cameroon. It is the case with *M. whitei*, *F. xanthozyloïdes*, and *S. melongena*. The weights of essential spices used for the preparation of *nkwi* varied between 0.79g for *S. melongena* in Mezam division to 18.27g for *M. whitei* in Nde division for one litre of *nkwi*. The variability of the quantities of these spices is due to the preference of a particular taste that the consumer is looking for, and which depends on each consumer. This variability was also due to the fact that some people were not familiar with some spices, but knowing that they are used for this soup, they prefer to put a little bit of the said spices with the conviction that a good soup depends on the mixture of high number of spices. Some of these spices are used to ease digestion and for other health purposes when added in this soup. They include *S. melongena*, *P. guineense*, *E. giganteus* among others. For this reason some people employ much than the required quantity to prevent or heal digestion or other health problems.

3.7 Illustrative variations of the standard deviations of the mean weights of local spices for a litre of *nkwi*

There were differences at the level of the standard deviations of the mean weights of spices. These differences were

represented in the form of histograms on figure 7 in order to better visualize the spices that are responsible of inconsistencies in the ways of making the compositions of *nkwi* within and with respect to the different divisions of Western Cameroon.

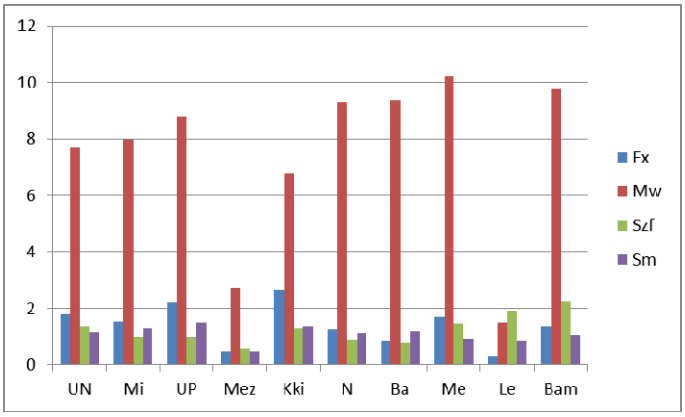

Fig 7: Variability in the standard deviations of the mean weights of essential spices used for the preparation of a litre of *nkwi* within and with respect to the divisions

UN: Upper Nkam; Mi: Mifi; UP: Upper Plateau; Mez: Mezam; KKi: Koung-Khi; N: Nde; Me: Menoua; Le: Lebialem; Bam: Bamboutos; Ba: Bansoa
Fx: *F. xanthozyloides*; Mw: *M. whitei*; Szf: *S. zenkeri* fruit; Sm: *S. melongena*. The values are means of the following number of measurements: Fx (310); Mw (327); Szf (394); Sm (299)
Figure 7 indicates that there is inconsistencies in the way essential spices are employed for the preparation of *nkwi*. Differences in terms of quantity in the way of utilising essential spices are higher with *M. whitei* within and with respect to the different divisions. In Mezam and Lebialem divisions the quantity utilised for a litre of *nkwi* is almost the same from one person to the other, and is totally different for those of the rest of the divisions. In the different divisions of the West region of Cameroon, the differences in terms of quantities of spices used for the same quantity of soup were very high from one person to the other, thus the height of long of histograms. This means that there are people who employ small quantities while others utilise very large quantities of the same spice and for the same quantity of soup.

4. Conclusion

The type and quantities of spices utilized for the preparation of *nkwi* varied greatly from a person to the other and from a division to the other in the Western Regions of Cameroon. Essential spices employed for the taste and those required for the odour of *nkwi* could be organised in two groups. In the West region, there was a similarity in the way local spices are used for the preparation of *nkwi* in all aspects, except that of the odour. Beside the variability in terms of number of spices used form a division to the other, the main difference in making the spice composition of this soup is at the level of the spices responsible of its odour. Three spices are mainly responsible of this variability: *S. zenkeri* fruit (49.1%); *H. gabonii* fruit (21.5%) and *H. gabonii* bark (44.3%). Acquiring knowledge concerning these variations appears as a step forward for the development of a ready-to-use spice formulation for the consumers of *nkwi*.

5. References

1. Oniang'o KR, Mutuku Serah JM, Malaba J. Contemporary African food habits and their nutritional and health implications Asia Pacific Asia Pacific J Clin Nutr. 2003; 12(3):231-236.
2. Zimmet PG. Coca-colonization and the chronic disease epidemic: can the Doomsday scenario be averted J Intern Med. 2000; 247:301-310.
3. Raschke V, Oltersdorf U, Elmadfa I, Wahlqvist ML, Cheema BSB, Kouris-Blazos A. Content of a novel online collection of traditional east African food habits (1930s – 1960s): data collected by the Max-Planck-Nutrition Research Unit, Bumbuli, Tanzania Asia Pacific Asia Pac J Clin Nutr. 2007; 16(1):140-15.
4. Tchiégang C, Mbougueng PD. Composition chimique des épices utilisées dans la préparation du nah poh et du nkui de l'Ouest Cameroun. Tropicultura 2005; 23(4):193-200.
5. Abdou Bouba A. Contribution à l'étude du développement d'un aliment fonctionnel à base d'épices du Cameroun: Caractérisation physico-chimique et fonctionnelle. Thèse présentée devant l'Institut National Polytechnique de Lorraine et l'Université de Ngaoundéré en vue d'obtention du titre de Docteur de L'INPL et Docteur Ph D de l'Université de Ngaoundéré, 2009, 223.
6. Abdou Bouba A, Njintang YN, Foyet HS, Scher J, Montet D, Mbofung CMF. Proximate composition, mineral and vitamin content of some wild plants used as spices in Cameroon Food and Nutrition Sciences 2012; 3:423-432.
7. Nana Ngassam T. Contribution à la connaissance de la composition en épices entrant dans les préparations du nah poh et du nkui. Mémoire présenté en vue de l'obtention du Diplôme de Professeur d'Enseignement Secondaire II ^{e} Grade (DI. P. E. S II), Ecole Normale Supérieure, Université de Yaoundé I (Cameroun) 1997, 49.
8. Badau MH, Igene JO, Collison EK, Nkama I. Studies on production, Physico-chemical and sensory properties of a standard kilishi ingredient mix powder International Journal of Food Sciences and Nutrition. 1997; 48:165-168.
9. WWF (World Wild Fund for Nature) and IUCN (World Nature Conservation), Centres of plant diversity, A guide and strategy for their conservation IUCN publication units, Cambridge, U.K, 1994; 1:335.
10. Cheek M. Xylopia Africana The IUCN Red List of Threatened Species: 2014; e.T45423A3001846,2014,http://dx.doi.org/10.2305/IUCN.UK.20143.RLTS.T45423A3001846.en.
11. Modi VK, Sidde Gowda GS, Sakhare PZ, Mahendrakar NS, Narasimha Rao D. Pre-processed spice mix formulation and changes in its quantity during storage Food sciences and technology 2006; 39:613-620.
12. Lopes ODC, Barcelos MDFP, Dias NAA, Carneiro JDDS, Abreu WCD. Effect of the addition of spices on reducing the sodium content and increasing the antioxidant activity of margarine Food Science and Technology 2014; 58:63-70.
13. Jirovetz L, Buchbouer G, Ngassoum MB, Geissler M. Analysis of headspace aroma compound of the seeds of the Cameroonian 'garlic plant' H. gabonii using SPME/ GC/FID SPME/ GC/ MS and alfactometry European

European Food Research and Technology 2002; 214:212-215.
14. Songue JL, Azebaze AGB, Vardamides JC, Ndom JC, Meyer AM, Dongo E *et al*. A novel alkylsulfone from the seeds of Scorodophloeus zenkeri. Harms. Bulltin of Chemical Society of Ethiopia 2006; 20 (1): 173-176.