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# Ethnobotanical study of pumpkin (*Cucurbita moschata* Duchesne) landraces in Benin

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## Abstract

**Background:** Pumpkin, *Cucurbita moschata* Duchesne, is important food resource due to their nutritional composition. Despite their food advantages, they still remain underutilized crops in Africa and particularly in Benin. No documented information is available on the knowledge of producers on the use, conservation and commercialization of *Cucurbita moschata*. The objectives of this study are to (i) collect various accessions of pumpkin on the basis of local taxonomic criteria in Benin; (ii) collect information on uses of pumpkin in Benin. To this end, an investigation was carried out in the departments of Couffo (Dogbo, Djakotomey, Klouékanme and Aplahoué) and Borgou (Parakou and N'dali).

**Methods:** One hundred twenty (120) farmers grouped into 06 different ethnic groups (*Adja, Bariba, Bialy, Fon, Gourmantché* and *Zarma*) were interviewed. Six pumpkin landraces were identified in 19 villages surveyed through systematic census of farmers supported by the snowball technique.

**Results:** Varietal diversity on a municipal level varied from two to four. Pumpkin was mainly cultivated by men and about 15% were cultivated in cultural association with maize, cassava, cowpea and groundnut. The harvested fruits were used for consumption, commercial, therapeutic and occult purposes. However, about 48% of producers have abandoned its production mainly due to production and marketing constraints. This abandonment could induce a risk of genetic erosion of this species. Thus, the conservation and an enhancement of the genetic resources of this species is essential.

**Conclusions:** This study made it possible to establish farmers' knowledge on the utilization and production of pumpkin landraces, and identify the varietal diversity of Benin landraces of pumpkin.

**Keywords:** Pumpkin, Underutilized crop, Benin, Varietal diversity

## Background

The genus *Cucurbita* consists of five different species. They are: *Cucurbita argyrosperma*, *Cucurbita moschata*, *Cucurbita maxima*, *Cucurbita pepo* and *Cucurbita ficifolia*. *C. maxima*, *C. moschata* and *C. pepo* are the most important species in terms of world agricultural production (OECD 2016). Their annual production is estimated about 20 million tons (Kim et al. 2012). The world production of all *Cucurbita* species in tons for 2000, 2004,

2005, 2016 were 16,000,000, 19,310,604, 19,527,949 and 26,486,618 respectively (FAOSTAT 2016). Mbogne et al. (2015), revealed that African production is estimated at 1.8 million tons from 140,000 ha, with an average yield of 12.8 t/ha. In Africa, exceptional production is recorded in Malawi (480,233 t), Egypt (477,283 t) and Algeria (388,875 t) (FAOSTAT 2018). However, there are no statistics related to the production of *Cucurbita* in Benin, as it is still a marginalized crop in terms of research, production, industrialization and marketing.

*Cucurbita moschata* is generally grown for their leaves, flowers, fruits and sometimes for their oil seeds (Fu et al. 2006). According to Mbogne et al. (2015) the leaves

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of *C. maxima* contains iron, vitamin A and C that are important in countries where anemia due to malaria and immune deficiency is common. They are low-calorie vegetables that are suitable for any diet. Vines and fruits are used as fodder for domestic animals (Mariano and Dirzo 2002). González et al. (2001) reported that pumpkin is an important source of vitamin A ( $4 \pm 20$  mg / g). They can thus play an important role in the fight against Avitaminosis A, which affects more than 250 million children under five years of age worldwide (Mbogne et al. 2015). They are a good source of ascorbic acid (22.9 mg/100 g) and inhibit the development of degenerative diseases such as cancer, diabetes, cardiovascular and neurological diseases (Roura et al. 2007). The seeds of *Cucurbita* species are sources of oils and proteins (Robinson and Decker-Walters, 1997). Despite their nutritional benefits, pumpkin is among the neglected crop in Benin.

Farmers play a crucial role in plant domestication and conservation (Missihoun et al. 2012). They ensure the preservation and management of local species. The international scientific community has officially recognized the importance of the contributions of local populations and especially farmers to the conservation of genetic resources for the well-being of present and future populations (OAU 2002). This institutional recognition is mainly based on the evidence that farmers, on the one hand, over centuries of domestication, management and selection, have shaped the diversity of crop plants and, on the other hand, this action continues over time in some parts of the world (Missihoun et al. 2012). Therefore, a better strategy for the conservation, valorization and improvement of *C. moschata* genetic resources in Benin must take into account the perception of farmers who are the first actors. Despite the nutritional, medicinal and biodiversity benefits of pumpkin to agriculture, humans and livestock, to the best of our knowledge, no work has been done on the level of varietal diversity at national level, the drivers for its production and utilization, the farm management methods, the local taxonomy, the probable origin and seed management practices of these Beninese landraces. Hence, the specific objectives were to: (i) conduct a survey for the collection of the various accessions of pumpkin on the basis of local taxonomic criteria in Benin; (ii) collect information on the uses of pumpkin in Benin.

## Materials and methods

### Study areas

The survey for the collection of the various accessions, uses and knowledge of producers on were carried out in the departments of Borgou (townships of Parakou, N'dali) and Couffo (townships of Aplahoué, Djakotomey, Dogbo, Klouékanmey) in the Republic of Benin. The township of

N'dali located in the agro-ecological zone 3 is known as the food-producing zone of South-Borgou and covers an area of 23 444 Km<sup>2</sup>. The climate is of Sudano and has a Sahelian trend towards the north of the country. The climate is also marked with rainy and dry seasons. The rainy season lasts from May to September, with 145 rainy days ranging from 900 to 1300 mm per year. However, rainfall is inadequate in some places.

The townships of Parakou and Aplahoué located in the agro-ecological zone 5 are known as the cotton-producing zone. According to RNDH (2015) it covers a vast area of 31,722 Km<sup>2</sup>. The climate is both Sudano and Sudano-Guinean with long rain season and short dry season.

The township of Djakotomey, Dogbo and Klouékanmey situated at the agro-ecological zone called the zone of ferric oxide soils made of sandy clay in a wet state. It covers an area of 10 500 km<sup>2</sup>. The climate is of Sudano-Guinean type with two rainy seasons alternating with two dry seasons. The rainfall generally recorded in the area varies between 800 and 1 400 mm per year. On average, the temperature varies between 25.3 °C and 29.7 °C.

These townships are favorable to agricultural production and are characterized by a diversity of crop production which constitutes an in-situ conservation of different local landraces of crops including *Cucurbita moschata*. Pumpkin was predominantly grown in Borgou and Couffo departments. Thus, the six townships were randomly selected so as to collect, identify and document the use of different accessions of pumpkin in study area.

### Sampling techniques and data collected

The systematic censuses of producers supported by the snowball technique were used for the identification of respondents. To achieve this, data on the number of pumpkin producers in each township were collected from each local governmental center for agricultural development. Having collected the data the following formula was used to determine the number of pumpkin producers per township.

$$n = t^2 \frac{p(1-p)(N-n)}{(e^2)(N-1)}$$

$n$  is the sample size,  $t$  student test,  $p$  the proportion of household pumpkin producer in the total number of agricultural households,  $N$  the number of pumpkin producers, and  $e$  margin of error fixed at 5%.

Thus, a total of one hundred and twenty (120) respondents were surveyed in the six townships.

A questionnaire was administered to farmers for data collection on pumpkin landraces. The main ethnic groups were *Adja*, *Fon*, and *Bariba*. The local authorities were of great help in meeting the producers of pumpkin.

The sampling unit was represented by the six municipalities, the producers were considered as the respondents in the sampling unit. The producers were selected for interview based on their experience in pumpkin production. Data collection and accessions were carried out through direct and individual interviews with the help of local translators.

The below parameters were used to estimate the existing relationships between pumpkin, and different ethnic groups: number of varieties identified, local names given to the pumpkin, meaning of the names and origin of the varieties, proportion of women and men involved in their production, variety preference, crop production system, seed selection methods for sowing, distribution of species and their use, description of the processing of pumpkin products, their medicinal uses, grouping of the pumpkin producers, problems related to their production, uses of different organs of the plant in diet, and marketing.

**Statistical analysis**

The data obtained was analyzed using descriptive statistics (mean and frequency) with R 3.6.2 software to plot graphs and present some data with tables. The level of fidelity of food and medicinal uses of *C. moschata* was determined according to the formula:  $FL = I_p / I_u * 100\%$  according to Friedman et al. (1986) where:

$I_p$  = the number of informants who mentioned a species for a certain purpose  $p$ .

$I_u$  = the number of informants who mentioned the species for any use. The use value (UV) served to assess the importance of *C. moschata* specie for a given community Phillips (1996), according to the formula:

$$UV = \sum_{i=1}^{I_n} U_i / n$$

$U_i$  = the number of uses mentioned by an informant  $i$ .

$n$  = the total number of informants interviewed.

**Results**

Nineteen villages were visited during the survey. The number of villages at the communal level was 03 in Dogbo, 06 in Djakotomey, 03 in Klouékanme, 02 in Aplahoué, 03 in Parakou, and 02 in N’dali (Table 1). The dominant ethnic groups in the department of Couffo were "Adja" and "Fon". In Borgou, "Zarma", "Bariba", "Bialy" and "Gourmantché" were the most represented ethnic groups. The number of local landraces interviewed per township varies from 2 to 4 with an average of 1.85 over the entire survey area. In N’dali, the ethnic groups were "Bariba", "Bialy", and "Gourmantché" with the highest number of local varieties (4). A small number of local variety (1) was obtained in Dogbo township.

Eight (08) names in local languages including synonyms were identified and used to designate the diversity of 06 local varieties of pumpkin grown by producers. These local varieties names in local languages were given to the varieties based on two criteria of varietal nomenclature: fruit morphology (62.5%) and human food (37.5%). The vernacular names vary according to the ethnic group (Table 2). The "Adja" ethnic group describes a variety with a round shape and protruding ribs (Fig. 1) as "Yovogbo or Agonli yovogbo", which means the big fruit of the white people. Seeds of these varieties came from Klouékanme (27%), Nigeria (18.9%), Dogbo (13.5%), Azovè (10.8%), Cotonou (8.1%), Parakou (5.4%), the remaining percentage i.e. 16.3% were from unknown sources, Abomey, Djakotomey, Lokossa, Pobè, Togo respectively (2.7%). "Ekipin or Yovoté" means the egg-shaped fruit or the fruit of the whites in "Adja", represents a variety of which fruit color is green with white spots (Fig. 2). The seeds of this variety came from Azovè (42.9%), Djakotomey (21.4%), Cotonou, Klouékanme, Nigeria, Porto-Novo and Toffo (7.1%, respectively).

**Table 1** Township and villages surveyed and number of varieties identified (n = 120)

Townships	Villages	Ethnics	Local names
Dogbo	Ayomi-Centre, Avedjin, Zohoudji	Adja	Yovogbo
Djakotomey	Lokou-Bedjamey, Tohouehoue Houngbézanmey, Houégamey, Loko-Atoui Houngba	Adja	Yovogbo, ékpin
Klouékanme	Zounzonkanmé, Akouegbadja, Gnantchimé	Adja, Fon	Yovogbo, ékpin
Aplahoué	Zohoudji, Djikpamé	Adja	Yovogbo, ékpin
Parakou	Zongo II, Swinrou, Wore	Zarma	Wianru, Laboutanga
N’dali	Boko, Gomez-Kparou	Bariba Bialy Gourmantché	Wianru, Labou- tanga, Lifèly, Nousam

**Table 2** Vernacular names of pumpkin, and meaning of the names and origin of the varieties (n = 120)

Number	Ethnic group	Vernacular names	Another vernacular names	Meaning of names
1	<i>Adja</i>	<i>Yovogbo</i>	<i>Agonli yovogbo</i>	The big fruit of the Whites
2	<i>Adja</i>	<i>Ekpin</i>	<i>Yovoté</i>	Yam of the White The fruit is shaped like a pawpaw (ovoid)
3	<i>Bariba</i>	<i>Wianru</i>	–	Squash sauce or soup
4	<i>Zarma</i>	<i>Laboutanga</i>	–	Squash sauce or soup
5	<i>Gourmantché</i>	<i>Lifèly</i>	–	Squash soup
6	<i>Bialy</i>	<i>Nousam</i>	–	Squash soup or stew

**Fig. 1** *Yovogbo***Fig. 2** *Ekpin* or *Wianru*

"*Ekpin*" or "*Wianru*" were found both in the south and north. Base on the two production zones and different ethnic groups, "*Ekpin*" and "*Wianru*" were classified

into two different local varieties. Each ethnic group in the North (*Bariba*, *Zarma*, *Gourmantché*, and *Bialy*) used a local name to call several varieties. All these varieties (Fig. 3) were given the same name in each ethnic group in the North. Among the "*Bariba*", it is "*Wianru*" in Bariba local name and among the "*Zarma*", it was given "*Laboutanga*" meaning a sauce or stew made from squash. "*Wianru*" seeds came from N'dali (82.9%), Malanville (8.6%), Natitingou (5.7%), and Parakou (2.9%). "*Laboutanga*" seeds came from Parakou (85%), N'dali (10%) and Malanville (5%). "*Lifèly*" and "*Nousam*" in "*Gourmantché*" and "*Bialy*", respectively mean a sauce or soup made from squash. The seeds of "*Lifèly*" came only from Malanville while those of "*Nousam*" came only from N'dali.

The means of acquisition of these different seeds by the producers were buy (9.9%), donation (89.2%) and loan (0.8%).

The results also showed that men (53%) were the main producers of pumpkin while 47% of the women are interested in its production.

70% of the producers had no preference for the different varieties grown. Good post-harvest conservation, good organoleptic quality and high yield were the main criteria for the choice of the different varieties grown by producers as varietal preference.

Monoculture was practiced by most of farmers because they consider the species as creeping species with good soil coverage capacity. According to them, monoculture allows full coverage of pumpkin on the soil which inhibits weed development. 14.20% of the producers practice cultural association with maize, cassava, cowpea and groundnut. Farmers adopted mixed cropping in order to maximize the use of agricultural land, avoid crop failure and mulch the soil with other crop residues so as to prevent pumpkin fruits being in direct contact with the soil.

The yields of the fruits of pumpkin depend on the quality of the seeds i.e. vigor, purity, health and viability used for sowing. The organoleptic quality of the fruits



**Fig. 3** *Wianru* or *Laboutanga* or *Lifèly* or *Nousam*

**Table 3** Distribution and use of *C. moschata* (n = 120)

Departments	Townships	Utilization (%)
Borgou (60)	Parakou (20) N'dali (40)	Human food (100) Sale (100) Medicinal use (0)
Couffo (60)	Dogbo (12) Djakotomey (14) Klouékanme (18) Aplahoué (16)	Human food (97) Sale (93) Medicinal use (3,33)

depends on the types and genetics constitution of varieties. It is therefore necessary to pay great attention to the type of seeds for crop production. The results show that 56% of producers adopt the manual seed sorting method to eliminate seeds that are infested by insects or of poor quality while 44% used floating method before sowing. Farmers reported that manual sorting and floating of seeds in water results in a high germination rate. However, no producer in the surveyed areas practices the combination of the two methods.

In Borgou Department where 20 and 40 producers were respectively interviewed in Parakou and N'Dali, the

different local varieties were used for consumption or sale (Table 3). In the townships of Dogbo, Djakotomey, Klouékanme, and Aplahoué the number of farmers interviewed were 12, 14, 18, and 16, respectively. The different uses of the varieties in the Couffo are for human consumption, sale, and medicinal use. The average use value (1.95) was the quantified value of the importance of *C. moschata* recorded in "Adja" ethnic group. The average of this use value was (2) recorded in "Bariba, Bialy, Fon, Gourmantché, and Zarma" communities.

Table 4 shows the average monthly consumption of pumpkin. Several recipes were obtained from the fruits and seeds of the different varieties identified during the survey. "Cooked *Ekpin* and fried *Ekpin*" were recipes very loved by the "Adja", the average monthly consumption of each of them was 10 and 9 times, respectively. Fruits of "Yovogbo", "Wianru" and "Laboutanga" varieties were used to prepare simple sauce, vegetable sauce and snacks. These recipes were consumed 9.61, 10.67 and 10.95 respectively on average in a month. The almonds from the seeds of «*Ekpin*" variety was used by the "Adja" to prepare egusi sauce with an average monthly consumption of 12. The fruits of the varieties of "Wianru, Laboutanga,

**Table 4** The different recipes of the pumpkin for consumption (n = 120)

Recipes	Side dishes	Mean number of times pumpkins are consumed per month
Cooked <i>Ekpin</i>	Groundnut oil, pepper juice, fried food	9.45
Fried <i>Ekpin</i>	Pepper juice	9
Frying	Cowpea, rice	10.95
Stew	–	10.12
Simple sauce	Solidified corn pap, rice	9.61
Egussi sauce	Solidified corn pap, rice	12
Okra sauce	Solidified corn pap, pounded yam	4
Vegetable Sauce	Solidified corn pap, cooked gari	10.67
Groundnut sauce	Solidified corn pap, rice, crushed yam	6

*Lifely*, and *Nousam*" were used to prepare different recipes: okra sauce, groundnut sauce and stew. The average monthly consumption of each of these recipes was 4; 6 and 10.12, respectively. The organoleptic quality of all these recipes varies from sweet to very sweet throughout the survey area. Indeed, after the calculation of the Fidelity Level, *C. moschata* was used by the rural population for the preparation of a simple sauce (75%) with a high degree of consensus. However, these species are not widely used for the preparation of a vegetable sauce (5%) and egusi sauce (0.83%) based on the same indices.

The majority of the producers identified during the survey (98.33%) do not know the medicinal properties of the different varieties but they did recognize the importance of the species in their daily diet. The medicinal uses were therefore revealed by a minority of producers in the township of Djakotomey. The leaves of "Ekpin" were used to fight against fever and external hemorrhoid. They triturated the leaves and massage the children's bodies with the resulting liquid for the cure of fever while they put the leaves on the fire and then the ashes obtained are used to massage around the anus. According to the Loyalty Level indices, *C. moschata* is not popular for the treatment of fever and external hemorrhoid (0.83%).

Pumpkin production is at risk of extinction over time as many producers are giving up due to certain constraints affecting different links in the value chain (Table 5). 47.50% of producers had abandoned the production of vegetables of the genus *Cucurbita*. The main difficulties encountered by producers are related to the production and marketing.

During the survey only 1% of farmers use pumpkin seeds for food purposes. The fruit (99%) is mostly used in the preparation of various recipes, while the flowers and leaves are not consumed at all.

The analysis of Fig. 4 shows the price of different local landraces of pumpkin in times of abundance and scarcity. The cost of fruit depends on the size. "Yovogbo" is

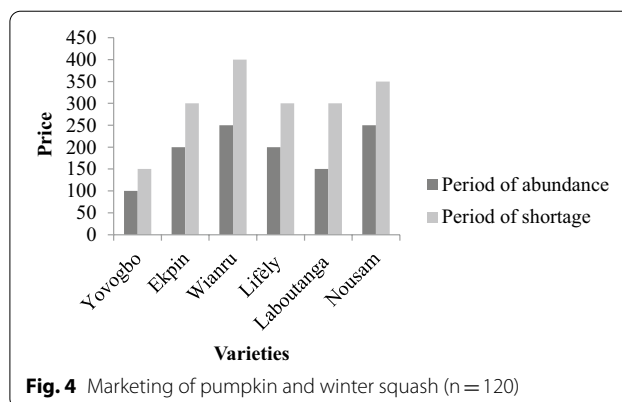


Fig. 4 Marketing of pumpkin and winter squash (n = 120)

the local variety with the lowest cost per fruit in time of abundance (100 francs per fruit). During the lean season, "Wianru" and "Nousam" cost 400 and 350 francs per fruit respectively. The exchange rate is 1 USD = 552.46 francs.

### Discussion

According to Missohoun et al. (2012) in traditional agriculture, local landraces constitute the bulk of the plant material used. They are old and well adapted to the difficult pedoclimatic conditions in which they are grown. These local landraces are found in rural areas and are preserved by farmers over the years. The existence of these local names is linked to the diversity of languages and the geographical distribution of production areas. Thus, this study showed that a single name can designate different varieties of pumpkin. This observation is made among producers in the North. A similar situation exists for other species: for example, the same local name can designate different ecotypes of sorghum in Ethiopia (Mekbib 2007). A similar study on the endogenous knowledge of local landraces of *Cucurbita moschata* and *Cucurbita maxima* in Zimbabwe identified seven different local landraces "Nzunzu", "Ditimanga", "Ndodo", "Hokore", "Musatani", "Dasanana" and "Muzwere" in four communes (Ndoro et al., 2007). The recognition of the names given to the varieties and a perfect knowledge of the traditional classification system are important because the local landraces name is the basic unit that producers use in the management and selection of these genetic resources (Missihoun et al. 2012). Local names provide important information on plant morphology. The local taxonomy (shape and color of fruits) was used to differentiate between local landraces collected in the South and those collected in the North. Consequently, local taxonomy criteria play a crucial role in the management and conservation of crop genetic resources (Adoukonou-Sagbadja et al. 2006; Barnaud et al. 2007; Kudadjie 2006; McGuire 2002; Sambatti et al. 2001).

Table 5 Problems related to the production of pumpkin (n = 120)

Different stages	Problems	% of respondents
Production	Seed pests	3.1
	Lack of agricultural land	31.3
	Infertility of agricultural land	15.6
	Drought	3.1
	Insect infestation of fruits	46.9
Harvest	No problem	100
Storage	No problem	100
Processing	No problem	100
Sale	Low consumption rate	100

The seeds of the different varieties are acquired either nationally or regionally. This phenomenon favors the genetic flow and genetic variability in the species and reduces the risk of extinction of these species in case of natural disasters. The more a species has genetic variability, the more likely it will be able to withstand abiotic and biotic stresses. The results of this study could serve as a basis to initiate research on the agro-morphological and genetics characterization of pumpkin landraces in Benin.

In Kenya, men are the main producers of pumpkin (Isaboke et al. 2012). This observation is contrary to those obtained by (Mbogne et al. 2015). According to them *Cucurbita moschata* and *Cucurbita maxima* were mainly grown by women (90%) in Cameroon. In Kenya, this gender variation in production can be explained by several determinants. Household size, land tenure, access to credit, group membership, market information and access to extension services significantly influence the likelihood of adopting pumpkin (Isaboke et al. 2012).

According to Mbogne et al. (2015) the choice of *Cucurbita moschata* and *Cucurbita maxima* morphotypes grown by farmers in Cameroon is based, among others, on the organoleptic characteristics of the fruits, fruit texture, leaf size and fruit yield. Producers take these factors into account so that the fruits of the pumpkin meet consumer demands. Priori et al. (2018) reported that the commercialization of *Cucurbita maxima* fruit for consumption is related to the fresh matter (size and weight of the fruit), a characteristic of a quality that is essential for the consumer market.

Mbogne et al. (2015) indicated that in Cameroon, monoculture represents 80% while mixed cropping (20%) was generally with groundnut, maize, cassava, soybean and yam. This intercropping allows producers to protect themselves against the lack of market for *C. moschata*. The observations of Ndoro et al. (2007) are contrary to the above observations. According to these authors, most farmers (85%) grow *C. moschata* in mixed cropping with maize and other crops. The main reason is due to lack of land and labor in most rural areas of Zimbabwe. Mixed cropping will help to reduce the pest build up and thus decrease the rate of fruit infestation in the field. According to the research carried out by OECD (2016) in America, *Cucurbita* have traditionally been one of the three sisters of indigenous agriculture along with beans (*Phaseolus vulgaris*) and corn (*Zea mays*). All these three crops were grown together, with maize providing support for the climbing beans and shade for the *Cucurbita*. *Cucurbita* covers the soil to limit weed development and keep the soil moist. The beans fix nitrogen for all three crops. Pumpkin is house crops. They are mainly produced on garbage heaps.

These rudimentary methods i.e. the manual seed sorting system and the water floating methods used by the growers enabled to eliminate seeds of poor quality and thus increase the germination rate during sowing. This finding corroborates that of Mbogne et al. (2015) in Cameroon. The farmers' seed management practices (selection and exchange) observed and described in this study is widely known practices already reported on various crops in the West African sub-region (Adoukonou-Sagbadja et al. 2006). The survey shows that pumpkin can be used for food and medicinal. Different recipes are obtained from the fruits and seeds in order to meet the food and nutritional needs of rural populations. According to Robinson and Decker-Walters (1997) *Cucurbita* seeds can be consumed directly, ground into paste, semolina, and fine flour. They are also sources of oils and proteins. Once the hull is removed, the seeds contain about 50% oil and up to 35% protein. Most of the oil is composed of unsaturated fatty acids and therefore has a high nutritional value. In Latin America, flowers are also consumed as vegetables (Merrick 1992; Nee 1990).

The leaves of the varieties "Ekpin" have therapeutic virtues. It can treat fever and external hemorrhoids. Several species of *Cucurbita* are used in traditional medicine; as anthelmintic (Argueta 1994; Chou and Huangfu 1960; Schabert 1978). Fu et al. (2006) reviewed the pharmacological properties of several squashes (*C. moschata*, *C. pepo*, *C. maxima*, *C. mixta*, and *C. ficifolia* and *Telfairia occidentalis*) and reported that these squashes are anti-diabetic, antimicrobial and anticancer. In general, the use of pumpkin is significantly correlated with ethnicity.

The different varieties of pumpkin are sold in local markets. They are produced in a rain-fed agricultural system. They are accessible because their prices reflect the importance of the fruit in the food security of rural populations. The price depends on the size and weight of the fruit. These fruits are mostly bought by the food vendors. However, despite their food and nutritional importance, it is clear that producers are experiencing enormous difficulties in selling the fruit in the market. This is due to the lack of consumer awareness of their nutritional and therapeutic virtues.

During the different phases of production of pumpkin, growers are faced with several problems. These problems are particularly encountered during production and when the fruit is being sold. These are related to poor sales and infestation of the fruits in the field. These reasons explain the abandonment of production by about 48% of farmers. This abandonment can cause genetic erosion of local landraces and consequently the loss of biodiversity. The agro-morphological and molecular characterization of these local landraces in Benin is necessary in order to organize an efficient documentation of

the data relating to these local landraces and make them available to the national and international scientific community for a judicious use in the crop improvement and crop production. In line with these observations, Ndoro et al. (2007) indicated that insect pests and diseases would be the biggest problems (60.7%) in production and poor sales during period of abundance in the market (52.5%). Hence, there is need to undertake scientific studies on the pests of pumpkin plants and the physico-chemical, nutritional and technological characteristics of these fruits. Which can help minimize the infestation rate and also put in place technological packages for its popularization among consumers.

## Conclusion

The results of this study revealed that the phenotypic diversity of local landraces of pumpkin is maintained and managed by farmers in the Borgou and Couffo departments of Benin. These farmers are knowledgeable about the pumpkin varieties they produce. This study also enables us to establish farmers' knowledge on the diverse utilization and production of pumpkin landraces, and identify the varietal diversity of Benin landraces of pumpkin. But in managing this diversity, farmers encounter constraints that need to be addressed. The results show that the criteria most used by pumpkin growers to categorize varieties are the color and shape of the fruit. However, these criteria do not allow for effective differentiation of these varieties. Research on agro-morphological and molecular characterization based on UPOV and IPGRI descriptors of these local landraces will facilitate efficient conservation management and sustainable use of these genetic resources in varietal improvement.

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## Authors' contributions

VE designed the study, data analysis and revised the manuscript. UHG collected and analyzed data and drafted the manuscript. GBTAS and AA supervised data collection. All authors read and approved the final manuscript.

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## Availability of data and materials

The datasets supporting the conclusions of this article are included within the article.

## Declarations

### Ethics approval and consent to participate

No ethical approval was needed for this study. Prior to data collection, participants gave oral consent to participate in the study.

### Consent for publication

The respondents were informed that their opinions were to be published in a scientific paper and gave their approval.

## Competing interests

The authors declare that they have no competing interests.

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