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Farmers' Knowledge and Interest Traits of Black Nightshade (*Solanum nigrum* L.) Grown in Burkina Faso

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A B S T R A C T

The present study aimed at contributing to a better sociocultural knowledge of *S. nigrum* through an inventory of local knowledges and the identification of characters of interest for farmers. Fifty-two (52) accessions were collected from thirty-six (36) villages across eleven (11) provinces. The survey was carried out using a semi-structured interviews method with 209 producers, traders and consumers. The majority of the respondents was female (85%), aged between 30 and 45 years (84%). Around 88% of respondents reported they never ate this leafy vegetable. Thirteen (13) vernacular names were registered from the respondents. Phenotypic characteristics such as the color and size of the leaves and organoleptic characteristics such as the taste of these leaves are criteria used by farmers for naming the local accessions of *S. nigrum*. Meanwhile, the study revealed that farmers obtain their seeds through purchases, donations, self-production or by direct collection of ecotypes in spontaneous environments and in cultivated environments. This survey also revealed a lack of knowledge on this vegetable by some consumers and producers, especially in urban areas. In Burkina Faso, the crop is mainly produced by the Mossi, Bissa, Gurunsi and Dioula ethnic groups. In fact, these ethnic entities use the leaves of this plant as leafy vegetables for sale and for cooking traditional dishes. The leaves constitute organs of interest to local populations who use them as food. The results of this study could make it possible to undertake varietal improvement of this species according to the needs of consumers and producers.

Introduction

Many wild, protocultured and cultivated plants are used as food supplements and contribute to solving the poverty of African populations (Schreckenberg *et al.,* 2006; Iranbakhsh *et al.,* 2009). The black nightshade (*Solanum nigrum* [L]) is one of these species. This species belongs to the Solanaceae family and to the genus Solanum.

It is of Africa and Indonesia origin and is widely used as vegetable and fruit. This species is of great importance in food, medicine and industry. Its leaves eaten as leafy vegetables are rich in mineral salts (Ca, Mg, K, P, Na) (Kientega, 2014).

In Burkina Faso, black nightshade is a plant of socio-economic importance for the populations. However, national reports on the state of plant genetic resources for food and agriculture provide very little information on the state of its cultivation and diversity (MECV, 2006; MAHRH, 2008). Its is usually produced in monoculture or in association with other crops such as koreta, sorrel, pepper and amaranth on small areas. Rare studies have shown that the species is little known, neglected and highlighted the endogenous knowledge on this crop.

Many of the studies reported this species is affected by a genetic erosion, meaning that the crop is prone to disappearance. Therefore, it is imperative that strategies for the valorization and conservation of this leafy vegetable be developed. This requires prior knowledge of peasant practices for managing diversity and describing local naming processes.

Thus, the present study aims to contribute to a better knowledge of the cultivation of black nightshade in Burkina Faso. This will specifically involve identifying peasant knowledge of management of the species and identifying the organs and characteristics of interest for the population.

Materials and Methods

Prospection-collection zones

The prospection and the collection were carried out from February 2022 to June 2023 in the three phytogeographic zones of Burkina Faso. It consisted of identifying the growing areas of black nightshade. The identification of the main growing areas and the collection of accessions' seeds were carried out with the assistance of the technical team of the Ministry of Agriculture. Thirty-six (36) villages across eleven (11) provinces were covered by the study.

Ethnobotanical surveys

A survey involving 209 respondents was conducted through direct, semi-structured interviews methods. Respondents comprised of traders and consumers of black nightshade. The ethnobotanical data collected were essentially related to local names and their meanings, the uses, the general information local on the species, the cultural practices, the modes of seed acquisition and conservation methods of black nightshade seeds.

The exhaustive collection technique was used by collecting from all producers in each village visited. The plant material collected from farmers was the whole fruit or the seed.

Data analysis

The collected data were subjected to an statistical analysis using Excel 2013 software. Calculations of frequencies, averages of the different parameters, grouping of data into classes and construction of histograms were carried out using XLSTAT Pro 7.5.2. ArcGIS 10.8 software was used to develop a map of the survey areas.

Results and Discussion

Distribution of collected accessions

Table 1 shows the distribution of collected accessions according to the phytogeographic zone, the province and the gender of respondent. Eleven (11) provinces were identified as black nightshade cultivation zones. The greatest number of accessions was recorded from the Oubritenga and Kadiogo provinces, with respectively 19 and 11 accessions, while the lowest number of accessions was registered from the provinces of Boulkiemdé, Zoundwéogo, Sissili, Boulgou, Kouritenga and Gnagna recorded, with two accessions for each province. Women were the main producers of black nightshade (85.96%). The results showed that the highest number of accessions was recorded from the Sudano-Sahelian zone, while the lowest was registered from the Sahelian zone.

Table 2 shows the vernacular names of black nightshade vary depending on the ethnic group. In naming morphotypes, producers refer to the visible morphological and organoleptic characteristics of the fruit and the leaf, particularly size and color. Based on the leaves size, especially the leaf blade dimensions, two morphotypes were distinguish by producers. A morphotype called in Moore “loud-van bonesse”, which means “black nightshade with small leaves” and a morphotype called in Moore “loud-van bèda”, which means “black nightshade with large leaves". Based on the organoleptic characteristics of the leaves and fruit, the respondents distinguished two morphotypes as well. A morphotype with light green leaves called in Bissa “Gnoucou” (36% of Bissa respondents) and a morphotype with dark green leaves also called in Bissa “Gô-koussi”, which means “the bitter tree” and in Dioula “naa fi », meaning “dark sauce”, highlighting the dark color of the leaves in sauces. Among the Dioula, the different names reported refer to geographical origins: "Fébourou" (74.6%) for the Dioula of Burkina Faso, "Yongobrou" for the Dioula of Burkina Faso originating from Ivory Coast.

Variation of *S. nigrum* production depending on the ethnic group and the gender of the producer

The survey revealed that four ethnic groups cultivate black nightshade for various reasons. The main producers of black nightshade are mainly the Mossé (37.77%) and the Bissa (29.94%) groups. The smaller number of producers was recorded in the Dioula ethnical group (12.53%).

Depending on the producer gender, the cultivation of black nightshade is mainly practiced by women (68.62% of the farmers surveyed). This situation is however reversed among the Bissa where most of the producers are men (54.22%).

Farmer management of black nightshade in Burkina Faso

Cropping systems

In Burkina Faso, black nightshade is cultivated on small areas of less than 0.25 ha. From the information collected, three cultivation systems are used: the monoculture by the Mossé, Bissa and Dioula, intercropping with other crops by the Gourunsi and the two other cropping systems reported by the Mossé. Most of the producers practice monoculture in black nightshade production (57%). The cultural association of *S. nigrum* is made with other vegetable species such as corets, amaranths, peppers, etc. The combination of the two types of cultivation practice (monoculture and cultural association) is practiced by a minority of the respondents (14%), especially by gardeners. Cultivation is done on the edges of water reservoirs and in open fields. Black nightshade is grown under rainfed conditions and in the off-season (Figure 4). 64% of respondents produce black nightshade during both rainy and dry seasons, 21% in dry season using irrigation, while only 15% grow black nightshade in strict rainy conditions. In the rainy season, crops are only watered during drought pocket periods.

Growing seasons

Black nightshade production during dry seasons is done on the edges of dams. Watering is done in the morning or evening using watering cans or using water supply systems connecting the water source to the garden. In the dry season, cultivation is more developed in urban areas whose production is mainly intended for marketing, compared to rural area.

Methods of seed acquisition

The acquisition of seeds by producers is done either by purchase, self-production or donation. The majority of seeds used are obtained from self-production (59.65%). In 8.77% of cases, producers buy their seeds on the market or directly from other producers. This method of seed acquisition, the least common in rural areas, is carried out by gardeners in urban centers that produce black nightshade for marketing purpose.

Methods of seed conservation

Methods of seeds conservation vary from a socio-cultural group to another. Two methods of seed conservation have been identified: the conservation of spare plants as seed and the conservation of bare seed using various containers such as boxes, cans, bottles and plastic bags.

Seed extraction is carried out by drying and grinding ripe fruits in the sun (74% of respondents) or by ripping fruits in water and filtering to extract the seeds (26% of the respondents).

Organs and characters of interest of *S. nigrum*

The results showed that the main organs of interest for producers and consumers are leaves (90%). The vast majority of producers and traders (71%) prefer the broad leaf morphotype and justify their preference by the availability of seeds, the large size of the plants, the high leaf biomass and the organoleptic quality of this morphotype which are the features most appreciated by consumers. Producers who prefer this morphotype are mainly in urban centers, particularly in Ouagadougou, and produce the plant mainly for marketing. On the other hand, only 23% of producers and consumers, particularly from the Bissa ethnic group, prefer the small leaves morphotype and justify their choice by social, cultural reasons and the fact that this morphotype remains in protoculture on their soils. Producers and consumers who have no preferences between the two morphotypes represented 6% of respondents. They explained their attitude by the fact that the seeds available are always heterogeneous, containing seeds of both morphotypes. Furthermore, it should be noted that approximately 87.22% of respondents from urban centers claim to have never consumed this leafy vegetable.

The results of the ethnobotanical survey revealed that black nightshade is known and exploited in many areas in Burkina Faso, as evidenced by the size of the collected samples and the diversity of the black nightshade local names registered. The greatest number of accessions were collected from provinces which are all located in the Sudano-Sahelian zone. The large extent of this climatic zone and the fact that black nightshade is one of the leafy vegetables grown for the preparation of sauces could explain this situation. The scarcity of the black nightshade in the Sahelian climatic zone could be due to climatic aridity unfavorable to its development. However, a clear lack of knowledge of its cultivation is noted in the prospected area. The area of production of black nightshade is reduced and the number of black nightshade producers per province is small (2 to 19 of the respondents). This lack of knowledge could be linked to the introduction and promotion of improved varieties of exotic vegetables (*Solanum macrocarpum, Cleome gynandra, Amaranthus* ssp, etc.) to the detriment of *S. nigrum*.

On one hand, the high number of female producers among the Mossé, Gurunsi and Dioulas, compared to that of men, is due to the fact that black nightshade is mainly produced in peasant environments by women for the preparation of sauce intended for family consumption. Indeed, in a peasant environment, there is a distribution of tasks according to gender. The condiments and the preparation of the sauce are entirely the role of the woman while the contribution of the main dish (cereals and tubers) is to men.

The wives therefore systematically devote themselves to the cultivation of black nightshade for the preparation of sauces. On the other hand, the men who produce black nightshade do it mainly for marketing. This observation has been noted for other leafy vegetables (Kpangba *et al.,* 2020). The work of Ngo Bogmis *et al.,* (2018) also reported that black nightshade has been considered as women's crop in the traditional environment. However, these results vary depending on ethnic groups. Indeed. Among the Bissa, the cultivation of black nightshade is a little more reserved for men. This could be explained by socio-cultural reasons, especially the tradition and the level of valorization of black nightshade. Similar results were reported by Nandkangre (2016) on ginger.

The results also revealed a diversity of local names according to ethnic groups. Indeed, a variation of generic names drawn from morphological characteristics depending on ethnic groups has been observed. The color and size of the leaves are used by people to characterize the plant. In Burkina Faso, the identification of vegetable cultivars by morphological markers has already been reported by Bationo-Kando *et al.,* (2015); Kiébré (2016) and Ouédraogo (2016). This could be explained by the mode of peasant selection based essentially on phenotypic characteristics that are generally visible and easy to observe. According to Missihoun *et al.,* (2012), the local name is the basic element used by producers in the management and selection of genetic resources.

The influence of sociocultural attributes on the level and structuring of cultural diversity has already been reported by VomBrocke *et al.,* (2003). Thus, knowledge of peasant nomenclature and the traditional system of classification of varieties allows a better understanding of the dynamics of their diversity.

The monoculture, the most practiced compared to other production systems, is attributable to the high demand of black nightshade which is stronger especially in urban centers than in the countryside as also reported Ngo Bogmis *et al.,* (2018) in Cameroon. Thus, producers to meet this strong consumer demand produce *S. nigrum* several times a year.

Table.1 Distribution of collected accessions and producers according to climatic zone, province and gender

Climatic zones	Provinces	Number of accessions	Gender	
			Women	Men
Sahelian	Gnagna	02	02	00
Soudano-sahelian	Kadiogo	11	09	02
	Oubritenga	19	17	02
	Boulgou	02	01	01
	Kouritenga	02	04	00
	Bazèga	04	04	00
	Boulkiemdé	01	03	01
	Zoundwéogo	02	02	00
Soudanian	Sissili	02	02	00
	Houet	04	03	01
	Comoé	03	02	01
Total	11	52	49	08

Figure.1 Location map of collection sites of black nightshade accessions

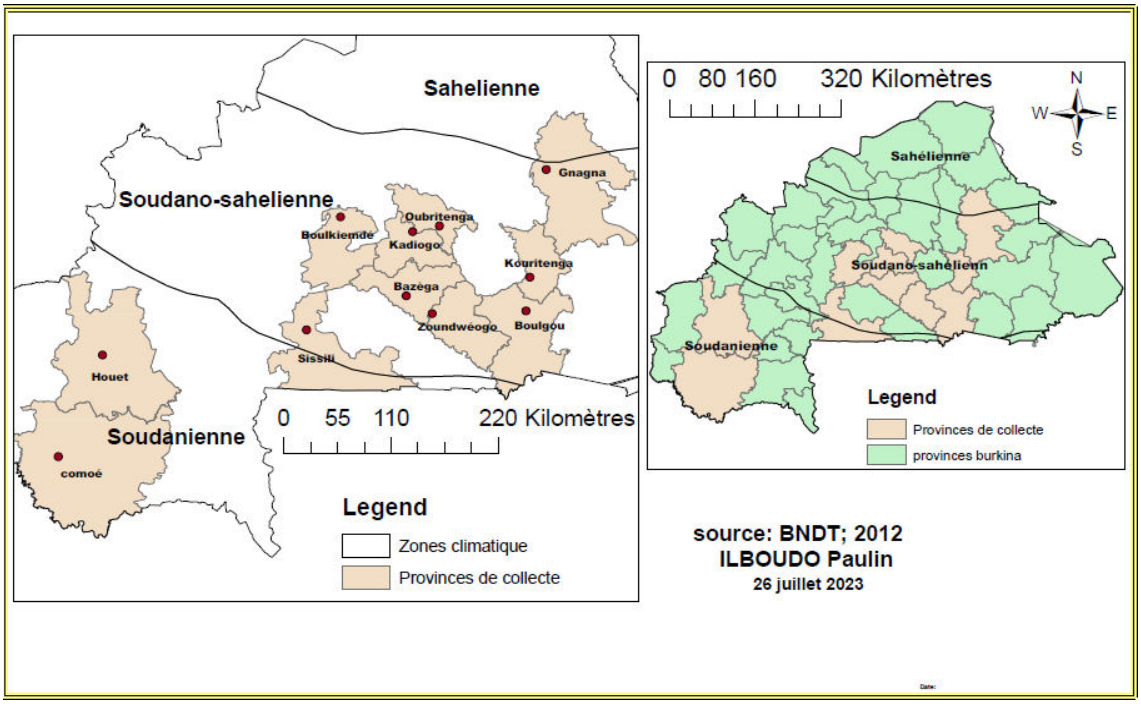


Table.2 Total Distribution of vernacular names of black nightshade by ethnic group

Ethnic group	Local names	Frequences (%)
Moosé	Loudo	100
Bissa	Gnoucou	36
	Gô-koussi	61
	Yongbaare	01
	Ganko	02
Gurunsi	Barkimia	64
	Kinkikamié	21
	Esipiou	11
	Loko	04
Dioula	Fébourou	74,6
	Yongobrou	16,4
	Naa-fi	09
Peuhl	Yanwidgari	100

Figure.2 Percentage of accessions collected according to ethnic groups

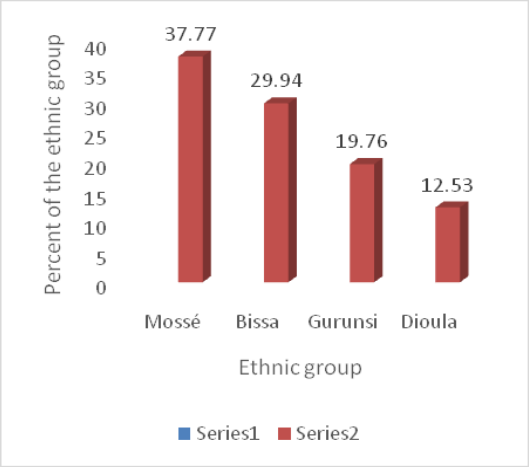


Figure.3 Distribution of *S. nigrum* producers according to gender

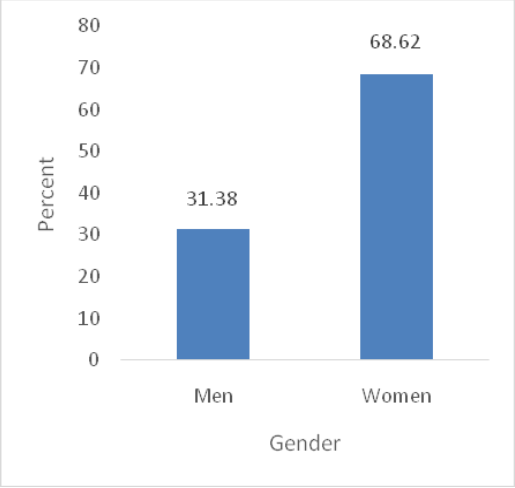


Figure.4 Proportion of different black nightshade cultivation systems

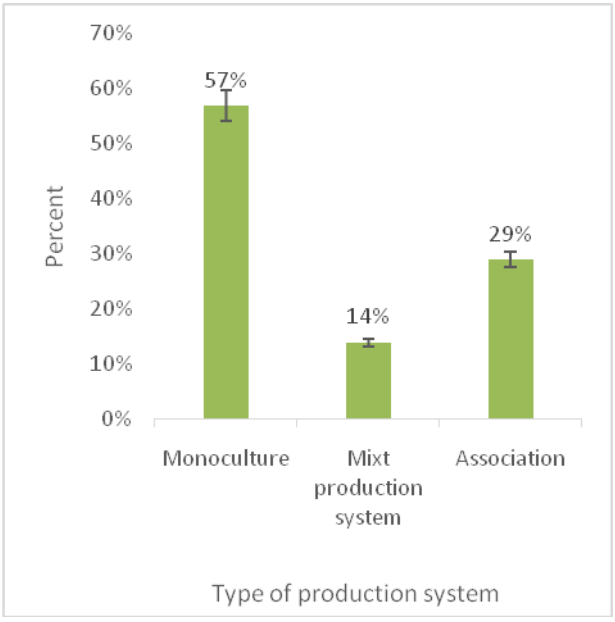


Figure.5 Proportion of different black nightshade production seasons

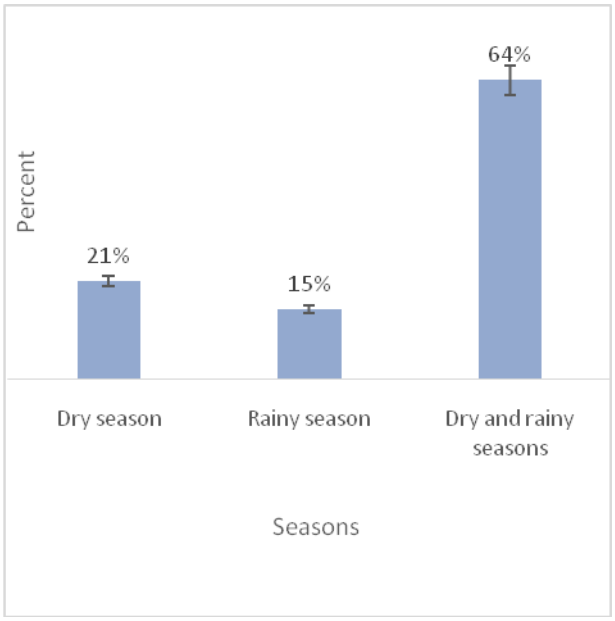


Figure.6 Proportion of acquisition methods of black nightshade seeds in a farming environment

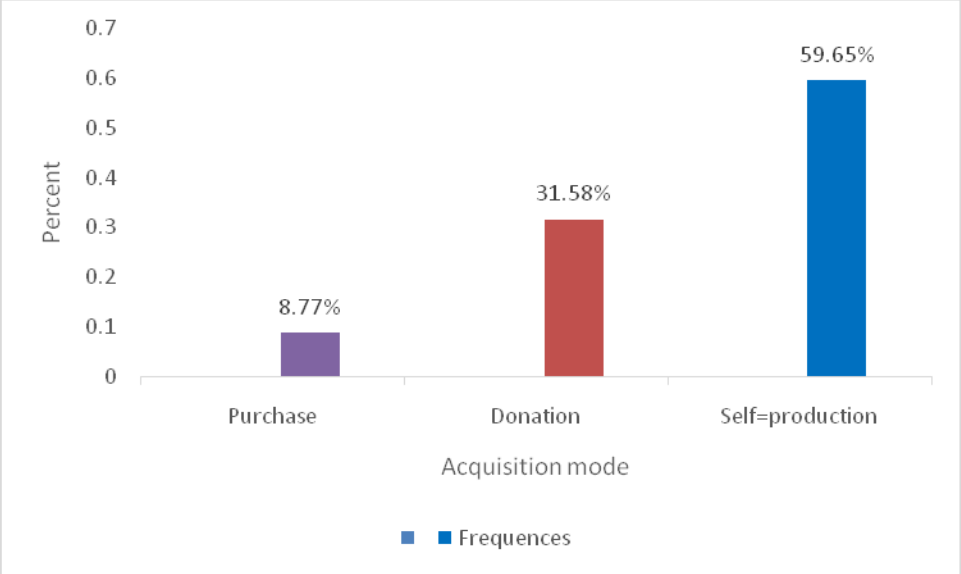


Figure.7 Methods of preserving S. nigrum seeds: A = dried and pounded ripe fruit seeds; B = seeds of ripe fruits pressed and washed in water; C = seeds stored in bags

Figure.8 Proportions of interest depending on organs

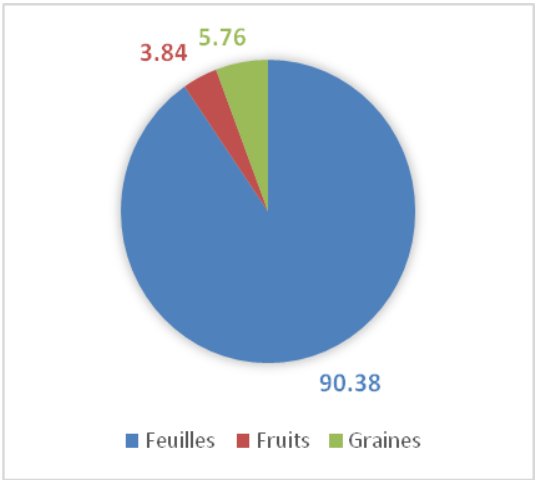
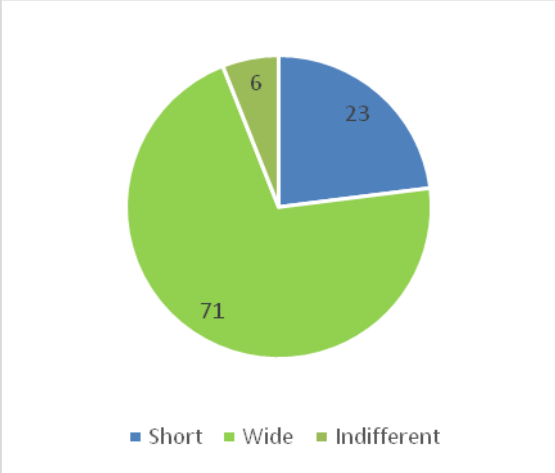


Figure.9 Proportion of preferred morphotypes of producers and consumers



The cultivation of black nightshade in the dry season by gardeners could be explained by the desire to make the vegetable available at any time of the year and to meet growing consumer demand. Indeed, it is used as a replacement for some exotic vegetables, especially eggplant and amaranth leaves, during the periods of their unavailability or inaccessibility.

The higher number of producers in the dry season than in the rainy season is due to the fact that at this time of year, the scarcity of vegetables on the markets leads to high selling prices, which can even double (Konkobo – Yaméogo *et al.,* 2002). While in the rainy season, their very high availability leads to a drop in prices.

The small cultivation areas (< 0.25 ha / producer) and the cultivation system adopted by the majority of producers could be due to the fact that black nightshade is still in protoculture. So far, small quantities are produced and sold in local markets. According to Kahane *et al.,* (2005), the leafy vegetable sector in tropical countries suffers from a lack of organization and competition from exotic vegetables.

The methods of seed acquisition identified in this study show that the seeds used by producers are maintained and managed traditionally. In fact, no seed supply network for improved varieties of black nightshade exists in Burkina Faso.

The unavailability of African vegetable seeds and the absence of an adequate seed distribution system were reported by Masuka *et al.,* (2012). However, this situation is improving with the start of mass selection carried out by gardeners who exert selection pressure oriented towards the preferential characteristics of consumers.

The conservation of seeds in cans, boxes, bottles and plastic bags has already been reported on various speculations (Barro-Kondombo, 2010; Missihoun *et al.,* 2012; Sawadogo, 2015) and aims at better protecting of seeds against pests.

A varietal selection project must take into account the needs and requirements of producers and consumers. Thus, a selection of high-performance varieties of black nightshade in Burkina Faso could be made on the basis of the size of the leaf blade and the large size of the plant. The large leaf morphotype, highly appreciated by producers and consumers, would have better yields (leaf biomass) compared to the small leaf morphotype. The work of Missihoun *et al.,* (2012) demonstrated that the adoption of local varieties is generally done on the basis of yield or organoleptic qualities. Just like most African leafy vegetables, black nightshade is very "perishable" due to lack of adequate preservation methods. Thus, adopting a variety whose organoleptic quality is in line with consumer preferences constitutes a factor facilitating its sale, which makes it possible to avoid losses.

In conclusion, this study revealed that the *S. nigrum* species is still cultivated in Burkina Faso, but its cultivation has clearly declined in favor of other exotic leafy vegetables. In the surveyed areas, the leaves are

most consumed by the Mossé, the Bissa, the Gurunsi and the Dioula. The fruits are used to extract seeds for marketing and the rest of the plant is used as fodder. This study also revealed a diversity of seed acquisition methods based on self-production, donations and purchases on the market and mass selection. Farmer nomenclature shows that farmers use morphological descriptors in the naming of their local varieties. All this information can be taken into account in a varietal improvement program.

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Author Contribution

Nongbzanga Paulin Ilboudo: Investigation, formal analysis, writing—original draft. Mahamadi Hamed Ouedraogo: Validation, methodology, writing—reviewing. Hervé Nandkangre:—Formal analysis, writing—review and editing. Kouka Fidèle Tiendrebeogo: Investigation, writing—reviewing. Célestin Thiombiano: Resources, investigation writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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