frontiers | Frontiers in Horticulture

TYPE Original Research
PUBLISHED 03 February 2026
DOI 10.3389/fhort.2025.1740404

Check for updates

OPEN ACCESS

EDITED BY
Andrea Mazzucato,
University of Tuscia, Italy

REVIEWED BY
Alio Moussa Abdourazak,
Abdou Moumouni University of Niamey, Niger
Joan Casals,
Fundació Miquel Agustí, Spain

*CORRESPONDENCE
Clémence Zerbo
clemencezerbo16@gmail.com

RECEIVED 05 November 2025
REVISED 28 December 2025
ACCEPTED 29 December 2025
PUBLISHED 03 February 2026

CITATION
Zerbo C, Nanema KR, Kiebre Z, Kiebre M, Tietiambou FRS, El Bilali H, Acasto F, Nanema J and Sawadogo M (2026) Participatory selection of *Hibiscus sabdariffa* L. landraces in Burkina Faso: characteristics of interest and selection criteria for leaves. *Front. Hortic.* 4:1740404. doi: 10.3389/fhort.2025.1740404

COPYRIGHT
© 2026 Zerbo, Nanema, Kiebre, Kiebre, Tietiambou, El Bilali, Acasto, Nanema and Sawadogo. This is an open-access article distributed under the terms of the Creative Commons Attribution License (CC BY). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Participatory selection of *Hibiscus sabdariffa* L. landraces in Burkina Faso: characteristics of interest and selection criteria for leaves

Clémence Zerbo[1*], Kiswendsida Romaric Nanema[1], Zakaria Kiebre[1], Mariam Kiebre[1], Fanta Reine Sheirita Tietiambou[2], Hamid El Bilali[3], Filippo Acasto[4], Jacques Nanema[5] and Mahamadou Sawadogo[1]

[1]Department of Plant Biology and Physiology, University Joseph KI-ZERBO, Ouagadougou, Burkina Faso, [2]University Centre of Gaoua, Nazi BONI University, Bobo-Dioulasso, Burkina Faso, [3]International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM-Bari), Valenzano (Bari), Italy, [4]Italian Agency for Development Cooperation (AICS), Ouagadougou, Burkina Faso, [5]Programme Agrinovia, University Joseph KI-ZERBO, Ouagadougou, Burkina Faso

Introduction: *Hibiscus sabdariffa* L. is an economically important and widely adopted crop in Burkina Faso. Yet its production is constrained by the lack of improved, locally adapted varieties. This study used a participatory variety selection approach to identify preferred landraces and selection criteria across two agroecological zones: Sudanian and Sudano-Sahelian.

Methods: The evaluation of landraces/accessions was carried out using an ordinal rating system, assigning scores ranging from 9 (most preferred accession), through 7 (very interesting), 5 (moderately interesting), 3 (less interesting), to 1 (least interesting). Landraces considered undesirable were specifically evaluated using negative scores of −5, −3, and −1, reflecting the degree of rejection expressed by the participants.

Results: Participatory selection involved 126 stakeholders (75.4% women), including producers (37.3%), consumers (30.9%), processors (16.7%), and traders (15.1%). The findings showed that 130 accessions (81.25%) were positively selected across zones, with traits such as leaf size, tenderness, absence of pubescence, market value, and drought tolerance being prioritized. Preferences differed significantly by agroecological zone, ethnicity ($p < 0.001$), age group, and actor role ($\chi^2 = 360.21$, $p< 0.001$). Two accessions (CKK1 and CKN5) were consistently ranked at the top, with index scores of 0.0441 and 0.0428, respectively. In contrast, accessions like CKO2 and HBB3 were most rejected due to poor agronomic and culinary traits. The analysis showed that only 30% of the selected accessions were shared between the two zones.

Conclusion: These results highlight the potential value of participatory selection in identifying varieties that are well-adapted, socially acceptable, and potentially more resilient for underutilized species in West Africa.

KEYWORDS

roselle, sorrel, participatory variety selection, neglected and underutilized species, Burkina Faso

1 Introduction

Hibiscus sabdariffa L., also known as roselle, sorrel, *bissap*, or *karkade*, is an annual plant of the Malvaceae family widely cultivated in tropical and subtropical regions, particularly in Africa, Asia, and Central America (Bule et al., 2020; Izquierdo-Vega et al., 2020). It is valued for its culinary, medicinal, and industrial uses (Aziato et al., 2020; Salami and Afolayan, 2021; Onyeukwu et al., 2023). In West Africa, notably in Burkina Faso, it holds a prominent position within traditional agricultural systems, serving as both a significant source of household income and a staple in local diets (Ouangraoua et al., 2021). *Hibiscus sabdariffa* L. is recognized not only for its nutritional value, but also for its pharmacological properties, including antioxidant, hypotensive, diuretic, and anti-inflammatory properties (Da-Costa-Rocha et al., 2014; Sanou et al., 2022; Akpo et al., 2023; Bevan et al., 2023). This makes it a species of growing interest in the fields of agriculture and health (Richardson and Arlotta, 2021; Amylee and Bashar, 2022).

In Burkina Faso, two major agroecological zones are considered with conducive conditions for the cultivation of roselle: the Sudano-Sahelian zone, which receives between 600 and 900 mm of rainfall per year, and the Sudanian zone, which receives between 900 and 1200 mm (MEEVCC monographie nationale sur la diversité Biologique du Burkina Faso, 2020). These agroecological zones differ not only in terms of precipitation but also in terms of soil composition, average temperatures, length of the rainy season, and exposure to abiotic stresses such as drought and soil degradation. These environmental variations have a significant influence on the agronomic performance of local landraces, particularly in terms of yield potential and calyx quality (Juhari et al., 2018; Geja and Mengesha, 2020).

Despite the socio-economic and agroecological significance of *Hibiscus sabdariffa* L., breeding efforts for improving roselle in Burkina Faso are limited. Producers rely mainly on informal, loosely structured seed systems. However, the genetic diversity observed in the field, particularly through morphological variability (viz., shape and color of calyxes, plant habit, type of foliage), is an important background for local varietal improvement (Ouangraoua et al., 2022; Caballero et al., 2024; Wouokoue et al., 2025). The current levels of genetic diversity could be realized through selection approaches adapted to the local context. Participatory variety selection, which directly involves the various stakeholders in the selection process, from choosing selection criteria to validating varieties, appears to be a relevant alternative to conventional methods, which are often too centralized and ill-suited to the realities of rural farms (Ceccarelli, 2015; Etten et al., 2019; Ceccarelli, 2020). In the Sudano-Sahelian and Sudanian zones of Burkina Faso, adopting such an approach represents an opportunity to develop varieties that are better suited to local climatic conditions, while meeting the needs of all actors in the value chain in terms of yield, drought tolerance, earliness, and calyx quality. It also helps to strengthen the resilience of family farms to the effects of climate change, characterized by uncertain rainfall and prolonged periods of drought.

This study aims to contribute to the improvement of local landraces of *Hibiscus sabdariffa* L. in Burkina Faso, using a participatory selection approach adapted to local climatic and socioeconomic conditions. The specific objectives were to:

i. identify the selection criteria favored by actors in the value chain based on their agroecological contexts;
ii. determine the characteristics of interest to these different stakeholders; and
iii. identify the most promising accessions/landraces according to their preferences.

2 Materials and methods

2.1 Plant material and experimental sites

One hundred and sixty local landraces, collected from fourteen provinces in Burkina Faso (Figure 1), were used for the participatory selection. These provinces were selected based on the production gradient of *Hibiscus sabdariffa* L., and the average farm size of farmers. The trials were conducted at the SUSTLIVES project experimental site in Gampèla, in the Sudano-Sahelian zone, and experimental plot of the Institute for Environment and Agricultural Research (INERA) in Farakô-Ba, in the Sudanian zone, from July to December 2023 (Figure 1). The SUSTLIVES project site is located on the Ouagadougou-Fada N'Gourma axis, between 1° 35' west longitude and 12° 41' north latitude. It has a Sudano-Sahelian climate, with vegetation consisting mainly of wooded savannahs, shrubby savannahs, and rice-growing areas. Average maximum temperatures range from 33.3°C to 34.6°C, while minimum temperatures fluctuate between 12.5°C and 23.3°C. The average rainfall recorded during the rainy season (July to October) was approximately 583.5 mm. Its soil is characterized by a predominantly silty-sandy texture and a slightly acidic pH of 5.70 (Kiebre et al., 2025). The Farakô-Ba site is located southwest of Bobo-Dioulasso on the road connecting Bobo-Dioulasso to Banfora, between 4°20′ west longitude and 11°6′ north latitude (Kone et al., 2025). Its vegetation belongs to the South Sudanic phytogeographic sector, characterized mainly by wooded, grassy savannah, sometimes quite dense. Weather records taken at the Farakô-Ba station indicate rainfall of 811.5 mm, spread over 35 rainy days between July and October. Its soil is characterized by a predominantly silty-sandy texture and a slightly acidic pH of 5.92.

2.2 Experimental design

For each site, Gampèla in the Sudano-Sahelian zone (SSZ) and Farakô-Ba in the Sudanian zone (SZ), the experimental design used is a randomized complete block design with three replications. Each accession was sown in a single row measuring 3.6 meters in length, consisting of seven hills. The distance between the rows was 0.8 m

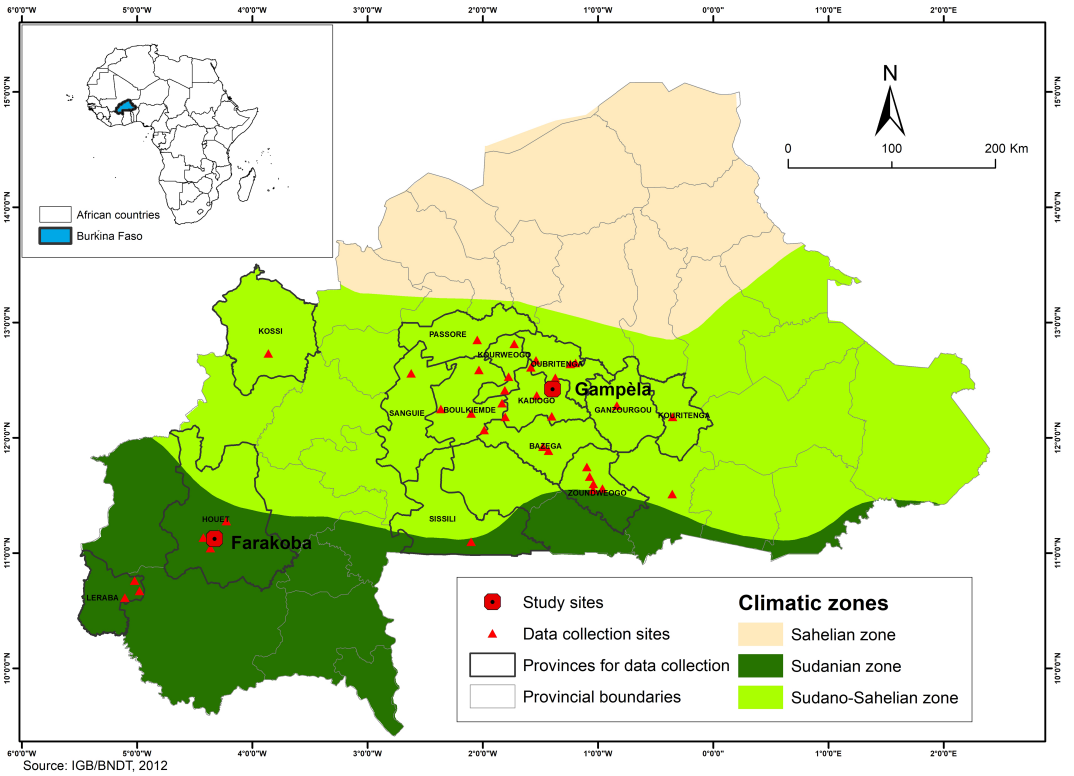


FIGURE 1
Map showing accession collection locations and the geographical location of the experimental sites.

and between plants was 0.6 m. The distance between successive replications was 1.5 m.

2.3 Conduct of the trial

The trial was conducted following agroecological practices aimed at enhancing soil fertility and reducing the use of chemical inputs. Soil preparation consisted of the application of manure at a rate of 5 t/ha, followed by shallow plowing to loosen the soil and create a good seedbed. Maintenance operations consisted of weeding and insecticide application. A natural biopesticide, SUPERFASO N, based on neem, developed by the Institute for Research in Applied Sciences and Technology (IRSAT) of the Department of Natural Substances (DSN) in Ouagadougou, was applied at a rate of 6 L/ha to control insect pests.

2.4 Data collection

A total of 126 participants were involved in the study, including 86 at the Gampèla experimental site and 40 at the Farakô-Ba site. All individuals present during the participatory selection activities and having a defined role within the roselle value chain participated in the evaluation process. These participants were members of the local communities surrounding each experimental site and included producers, consumers, traders, and processors.

Before the selection of accessions, separate focus group discussions were conducted with men and women to identify the full list of selection criteria used by the different actors along the value chain. These gender-differentiated discussions made it possible to capture specific preferences and priorities and to establish a comprehensive list of criteria for evaluating roselle accessions. The following variables represent the selection criteria used by actors to select accessions: ACF: Leaf acidity; APC: Suitable for storage; COF: Leaf color; CYC: Short cycle; CYL: Long cycle; DIF: Leaf dimensions; DSM: More demanded on the market; FMP: Less perforated leaves; FNP: Non-pubescent leaves; FNPR: Non-perforated leaves; FOF: Leaf shape; FPR: Perforated leaves; NRP: Number of primary branches; PAC: Most appreciated by customers; PRE: More profitable; QUO: Organoleptic qualities; REF: Leaf yield; RES: Drought resistance; TEF: Leaf tenderness; TOB: Tolerant to biotic stress; VAM: Market value. These selection criteria were not measured instrumentally but evaluated by participants during the participatory selection process.

A questionnaire was then administered to each participant to collect socio-demographic data such as agroecological zone, ethnic group, education level, marital status, age, and gender, and to invite each participant to indicate, from the list generated during the focus groups, the criteria they personally used during the selection process. Participatory selection was then carried out at the experimental sites during the vegetative stage of the plants, two months after sowing. Each actor was invited to conduct an individual evaluation of the accessions according to their own

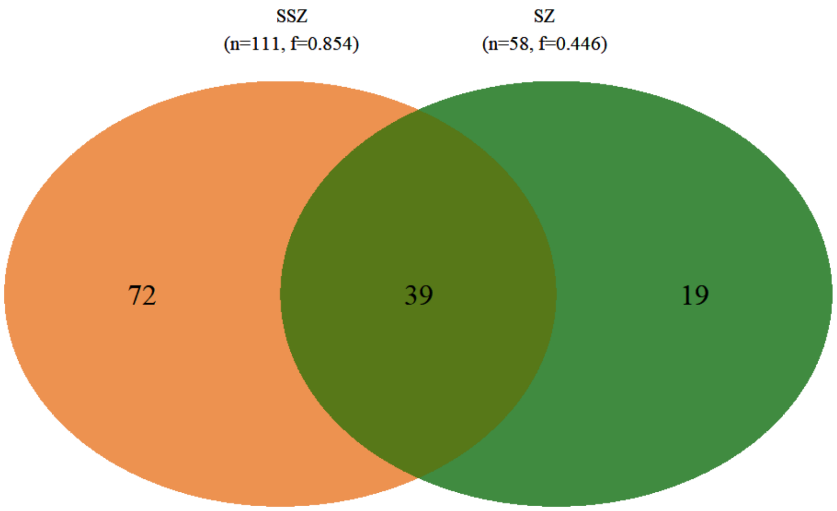


FIGURE 2
Distribution of the 130 selected accessions across the Sudanian zone (SZ) and the Sudano-Sahelian zone (SSZ). n, number of accessions selected at least once at each site; f: relative frequency.

preference criteria. This assessment consisted of ranking the accessions according to an ordinal scoring system: 9: accession considered most interesting; 7: very interesting; 5: moderately interesting; 3: not very interesting; 1: least interesting. Participants were then asked to specify the criteria they used to justify their selections, ranking them in order of importance. At the same time, each actor was asked to identify and justify the rejection of three accessions, specifying the reasons for this choice. Rejected accessions were scored using a negative scoring system: −5, −3, and −1. This scoring method made it possible to quantify preferences and rejections, thus facilitating the comparative analysis of the selection criteria and priorities of the various actors in the value chain.

2.5 Data analysis

The collected data were systematically recorded and processed using Microsoft Excel to ensure accuracy, consistency, and reliability in data management. Regarding age, the informants were grouped into three categories, following Assogba et al (Assogba et al., 2017): young (age< 30 years), adult (30 ≤ age< 60 years), and old (age ≥ 60 years). Before analysis, errors during data collection and entering were double-checked. The survey data were described and analyzed using the R software (R Core Team R, 2024). The chi-square test (χ^2) was used to compare categorical variables between the two zones (Sudano-Sahelian zone and Sudanian zone). The level of statistical significance of differences for the variables was tested at the 5% threshold between the two agroecological zones. An index for ranking of accessions was calculated for the first three ranks following Getachew et al. (Getachew et al., 2010), Bayou et al. (Bayou et al., 2018), Zewdu et al. (Zewdu et al., 2018), Ouédraogo et al. (Ouédraogo et al., 2020), and Badjibassa (Akounda et al., 2024).

$$\text{Index} = \sum_{n=1}^{3} a_m X_{nm} \Big/ \left(\sum_m \sum_{n=1}^{3} a_n X_{nm}\right)$$

where a_m is the rank weight associated with accessions m ($a_1 = 3$, $a_2 = 2$, $a_3 = 1$), X_{nm} is the proportion of participants who ranked the m^{th} accessions in the n^{th} rank (n = 1 to 3 ranks), and m represents accession. This index reflects the level of preference or rejection expressed by participants. Accessions were then ranked according to the calculated index. For selection, a higher index indicates that the accession is more preferred by the participants. For rejection, a higher index indicates that the accession is more rejected by the community.

Correspondence analyses were conducted to elucidate the relationships between selection criteria and participant profiles, taking into consideration their ethnic affiliation, roles within the value chain, and age categories, using the packages FactoMineR (Husson et al., 2008) and factoextra (Kassambara and Mundt, 2020). The results were visualized through three plots: selection criteria projected according to ethnic groups, value chain actors, and age categories, respectively. Accessions that were selected at least once at each site were filtered, and a Venn diagram was created to visualize the specificity of selected accessions of *Hibiscus sabdariffa* L. for each study zone.

3 Results

3.1 Sociodemographic characteristics of participants

The participatory selection was carried out with 126 people, including 40 in the Sudanian zone (SZ) and 86 in the Sudano-Sahelian zone (SSZ) (Table 1). A strong disparity was noted in ethnic distribution ($p< 0.001$). The Mossi ethnic group predominated in SSZ (94.19%), whereas the Bobo and other

ethnic groups were more common in SZ (45% and 40%, respectively). The mean age was slightly higher in SSZ (36.73 ± 13.88) than in SZ (33.92 ± 10.51), with a statistically significant difference ($p< 0.001$). Age group distribution also varied significantly between zones ($\chi^2 = 49.333$, $p< 0.001$), though the majority of participants in both zones were adults. The roles within the value chain also differed significantly between zones ($\chi^2 = 17.873$, $p = 0.0005$); producers were more common in SZ (57.5%), while end consumers and processors were more prevalent in SSZ.

3.2 Main accessions selected through participatory evaluation in the Sudano-Sahelian and Sudanian zones of Burkina Faso

Table 2 presents the top 10 *Hibiscus sabdariffa* L., accessions identified through the participatory selection in the Sudanian zone, Sudano-Sahelian zone, and across both zones (Overall). The ranking is based on a scoring and index system reflecting participants' preferences. Out of the 160 *Hibiscus sabdariffa* L., accessions initially presented to participants for participatory selection, a total of 130 accessions, representing 81.25%, were selected across both climatic zones. In the Sudanian zone, 58 accessions (36.25%) were chosen, whereas in the Soudano-Sahelian zone, 111 accessions (69.38%) were selected.

In the SZ, the best-performing accession was CKN5 (index = 0.0708), followed by CKK1 (index = 0.0667) and PCL12 (index = 0.0625). In the SSZ, the top accession was CKN2 (index = 0.0394), followed by CEK3 and CKO8, both with an index of 0.0354 (Table 2). Some accessions, such as CKK1 and CKN5, were highly ranked in both zones, demonstrating a cross-regional preference. CKK1 ranked 2nd in SZ (index = 0.0667) and 4th in SSZ (index = 0.0335), making it the top-ranked accession overall, with a combined index of 0.0441. Similarly, CKN5 ranked 1st in SZ and 9th in SSZ (index = 0.0295), placing it 2nd overall with an index of 0.0428.

3.3 Distribution of *Hibiscus sabdariffa* L. accessions in two agroecological zones

The Venn diagram (Figure 2) illustrates the distribution of the 130 selected *Hibiscus sabdariffa* L., accessions across two agroecological zones: the Sudanian zone and the Sudano-Sahelian zone. Among the total accessions, 14.6% (n = 19) are found exclusively in SZ, 55.4% (n = 72) are exclusive to SSZ, and 30.00% (n = 39) are shared between the two zones.

TABLE 1 Sociodemographic characteristics of participants in the Sudano-Sahelian and Sudanian zones of Burkina Faso.

Characteristics	Overall	SZ	SSZ		
Number of participants	126	40	86	χ^2	P-value
Sex (%)					
Male	24.6	55.00	10.47	32.508	<0.001
Female	75.4	45.00	89.53		
Ethnic group (%)					
Mossi	69.05	15.00	94.19	81.078	<0.001
Bobo	15.08	45.00	1.16		
Others	15.87	40.00	4.65		
Age (Mean ±SD)	35.84±12.93	33.92±10.51	36.73±13.88		< 0.001
Age group (%)					
Young	36.51	40.00	34.88	49.333	<0.001
Adult	57.14	55.00	58.14		
Old	6.35	5.00	6.98		
Value chain (%)					
Trader	15.08	12.50	16.28	17.873	0.0005
End consumer	30.95	20.00	36.05		
Producer	37.30	57.50	27.91		
Processor	16.67	10.00	19.77		

SD, Standard deviation; SSZ, Sudano-Sahelian zone; SZ, Sudanian zone.

10.3389/fhort.2025.1740404

TABLE 2 Top 10 *Hibiscus Sabdariffa* L. accessions selected through the participatory evaluation in the Sudano-Sahelian and Sudanian zones of Burkina Faso.

Zone	Accessions	Score	Index	Rank
SZ	CKN5	17	0.0708	1st
	CKK1	16	0.0667	2nd
	PCL12	15	0.0625	3rd
	CKO10	14	0.0583	4th
	COL5	12	0.0500	5th
	CODr5	11	0.0458	6th
	PZK1	9	0.0375	7th
	COM3	8	0.0333	8th
	CSMD1	8	0.0333	9th
	CKI1	7	0.0292	10th
SSZ	CKN2	20	0.0394	1st
	CEK3	18	0.0354	2nd
	CKO8	18	0.0354	3rd
	CKK1	17	0.0335	4th
	CLW2	17	0.0335	5th
	CODr4	17	0.0335	6th
	BKN1	15	0.0295	7th
	CKG1	15	0.0295	8th
	CKN5	15	0.0295	9th
	CKO9	12	0.0236	10th
Overall	CKK1	33	0.0441	1st
	CKN5	32	0.0428	2nd
	CEK3	23	0.0307	3rd
	CKN2	20	0.0267	4th
	CODr4	20	0.0267	5th
	CKO8	18	0.0241	6th
	CKO9	17	0.0227	7th
	CLW2	17	0.0227	8th
	PCL12	16	0.0214	9th
	BKN1	15	0.0201	10th

SSZ, Sudano-Sahelian zone; SZ, Sudanian zone.

3.4 Structure of ethnic preferences in leaf trait selection

The correspondence analysis reveals a significant relationship between ethnic groups and the criteria used for leaf selection (Chi^2 = 371.16; $p< 0.001$). The two dimensions account for all the observed variability (Figure 3). The first (80.4%) is mainly associated with the Mossi, who prioritize leaf perforation (FPR, FMP), absence of pubescence (FNPR), and related traits. The second (19.6%) reflects the preferences of the Bobo and other ethnic groups, emphasizing leaf shape (FOF), acidity (ACF), branching (NRP), and absence of pubescence (FNP).

This is consistent with the classification based on the principal components, which shows that the Mossi are mainly associated with PRE, FPR, FNPR, FMP, DSM, and PAC (Supplementary Figure S1); the Bobo with DIF, QUO, NRP, Uses, ACF, and VAM; and the other ethnic groups with CYL, FNP, RES, REF, APC, CYC, TOB, FOF, COF, and TEF. Together, these findings highlight distinct and well-structured patterns in selection preferences across ethnic groups.

3.5 Structure of value chain actor preferences in leaf trait selection

The results show a highly significant association between value chain actors (consumers, producers, traders, processors) and leaf selection criteria (Chi^2 = 360.21; $p< 0.001$). The first two dimensions explain 84.8% of the total variance, with 51.4% explained by the first and 33.4% by the second (Figure 4). The first dimension clearly separates traders, who strongly associate with the criterion of less perforated leaves (FMP), from producers and consumers, who favor criteria such as non-pubescent leaves (FNP, NRP) and leaf tenderness (TEF). The second dimension contrasts consumers and producers, on the one side, with traders and processors, on the other side, mainly based on traits like acidity (ACF) and leaf pubescence (FNPR).

These findings are consistent with the classification based on the principal components, which shows that consumers are mainly associated with PRE, FPR, FNPR, FMP, DSM, and PAC; processors with DIF and QUO; producers with CYL, FNP, RES, REF, APC, CYC, TOB, FOF, COF, and TEF; and traders with NRP, Uses, ACF, and VAM (Supplementary Figure S2). Overall, these analyses highlight well-differentiated selection preferences according to the actors' roles in the value chain, reflecting the specific needs of each group.

3.6 Leaf trait selection preferences across age groups

The results show a highly significant association between age groups and leaf selection criteria (Chi^2 = 168.11; $p< 0.001$). The two dimensions account for 100% of the total variance, with 80.7% explained by dimension 1 and 19.3% by dimension 2 (Figure 5). Dimension 1 strongly separates adults from the other age groups. Adults are associated with positive coordinates and strongly related to criteria such as leaf tenderness (TEF), non-pubescent leaves (FNPR), leaf size (DIF), and number of primary branches (NRP). In contrast, young and old individuals are positioned negatively on this axis and show stronger associations with visual and structural traits such as less perforated (FMP) and perforated leaves (FPR), leaf shape (FOF), and leaf pubescence (FNP). Dimension 2, which contributes less (19.3%), mainly distinguishes older individuals,

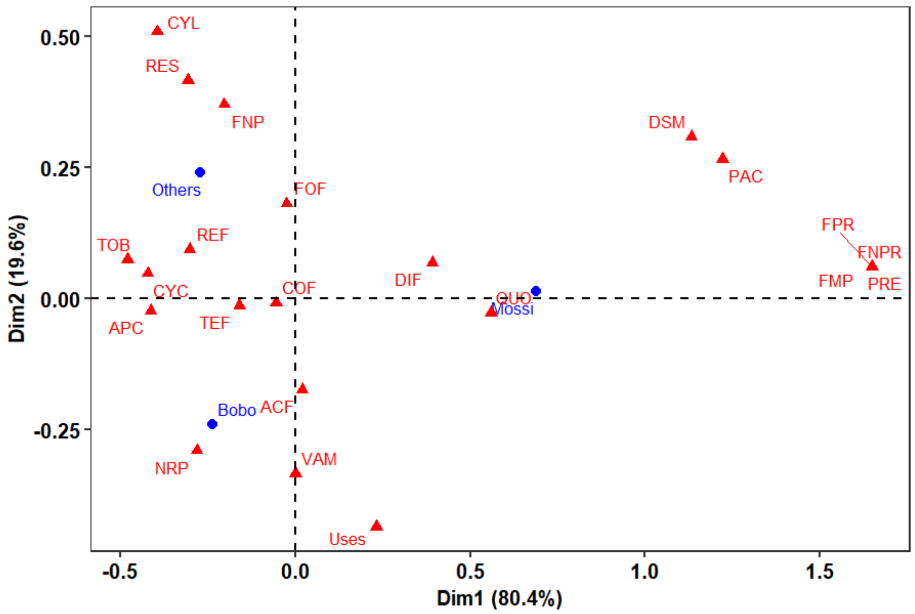


FIGURE 3
Selection criteria based on ethnic groups. ACF, Leaf acidity; APC, Suitable for storage; COF, Leaf color; CYC, Short cycle; CYL, Long cycle; DIF, Leaf dimensions; DSM, More demanded on the market; FMP, Less perforated leaves; FNP, Non-pubescent leaves; FNPR, Non-perforated leaves; FOF, Leaf shape; FPR, Perforated leaves; NRP, Number of primary branches; PAC, Most appreciated by customers; PRE, More profitable; QUO, Organoleptic qualities; REF, Leaf yield; RES, Drought resistance; TEF, Leaf tenderness; TOB, Tolerant to biotic stress; VAM, Market value.

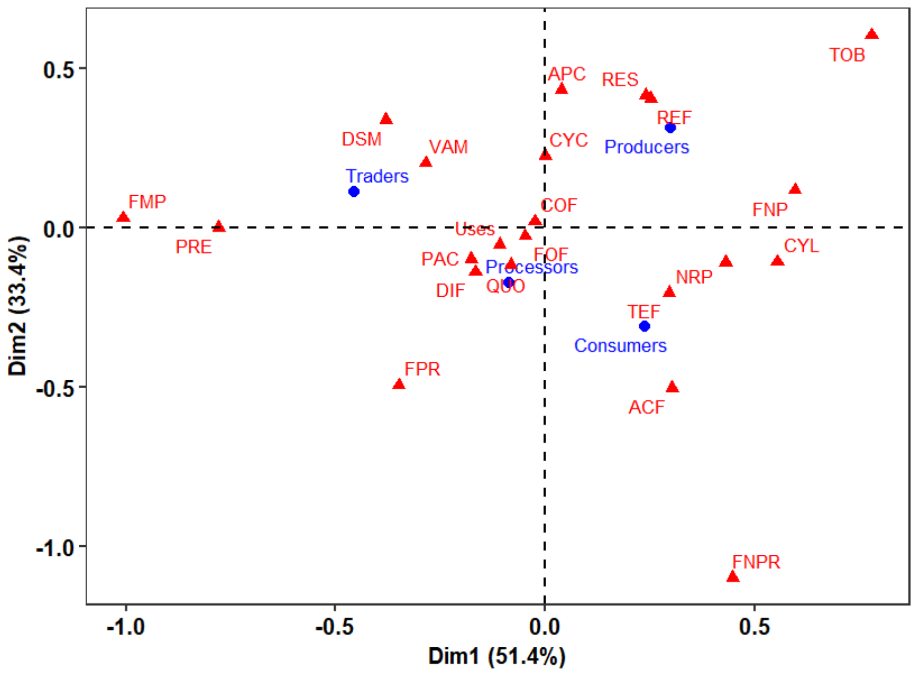


FIGURE 4
Selection criteria aligned with the different stages of the value chain of *Hibiscus sabdariffa* L. ACF, Leaf acidity; APC, Suitable for storage; COF, Leaf color; CYC, Short cycle; CYL, Long cycle, Leaf dimensions; DSM, More demanded on the market; FMP, Less perforated leaves; FNP, Non-pubescent leaves; FNPR, Non-perforated leaves; FOF, Leaf shape; FPR, Perforated leaves; NRP, Number of primary branches; PAC, Most appreciated by customers; PRE, More profitable; QUO, Organoleptic qualities; REF, Leaf yield; RES, Drought resistance; TEF, Leaf tenderness; TOB, Tolerant to biotic stress; VAM, Market value.

10.3389/fhort.2025.1740404

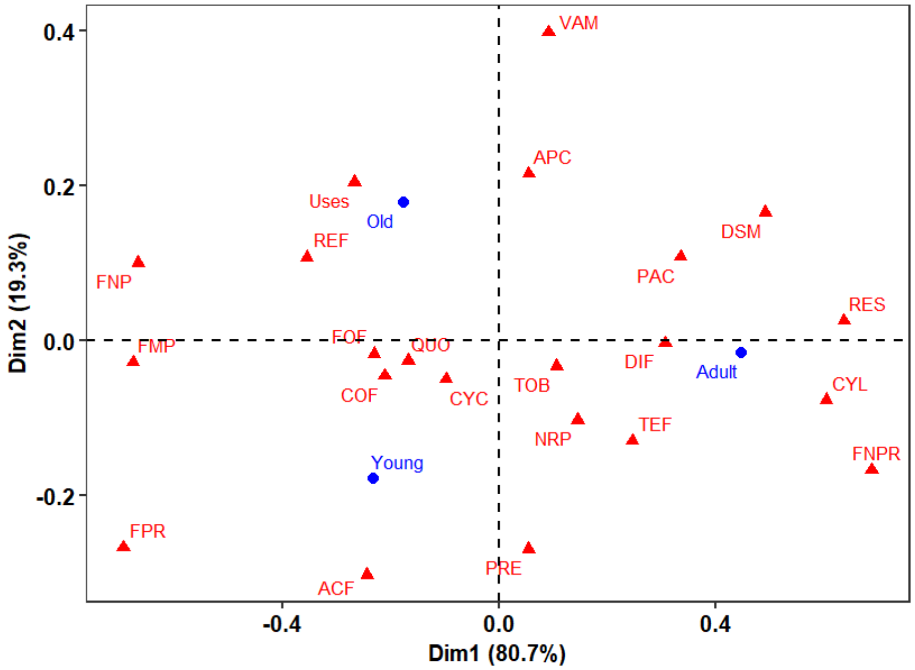


FIGURE 5
Selection criteria based on age cohorts. ACF, Leaf acidity; APC, Suitable for storage; COF, Leaf color; CYC, Short cycle; CYL, Long cycle; DIF, Leaf dimensions; DSM, More demanded on the market; FMP, Less perforated leaves; FNP, Non-pubescent leaves; FNPR, Non-perforated leaves; FOF, Leaf shape; FPR, Perforated leaves; NRP, Number of primary branches; PAC, Most appreciated by customers; PRE, More profitable; QUO, Organoleptic qualities; REF, Leaf yield; RES, Drought resistance; TEF, Leaf tenderness; TOB, Tolerant to biotic stress; VAM, Market value.

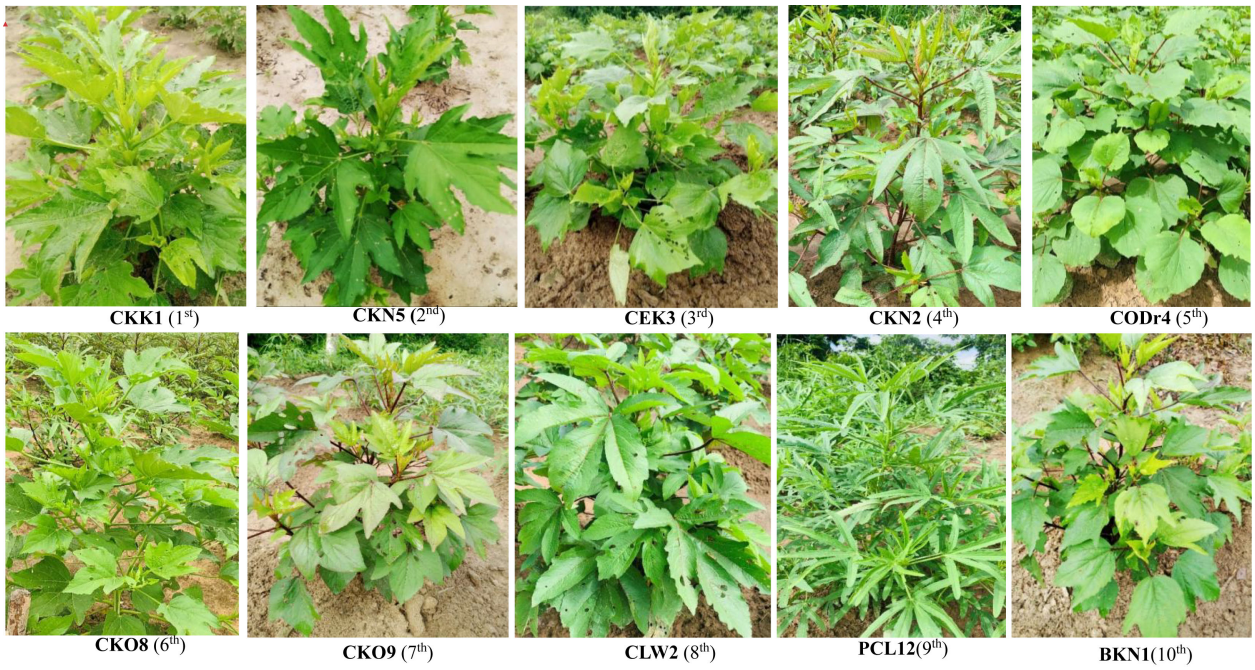


FIGURE 6
Illustration of the top ten *Hibiscus sabdariffa* L. accessions selected by value chain actors.

who are positively associated with this axis and linked to leaf acidity (ACF); the younger and adult groups, by contrast, show lower contributions to this dimension.

These findings are consistent with the classification based on the principal components, which shows that adults are mainly associated with FNPR, CYL, DSM, RES, DIF, and PAC; young individuals with FPR, FMP, and FNP; and older individuals with REF, ACF, CYC, Uses, TOB, NRP, FOF, QUO, COF, APC, TEF, and VAM (Supplementary Figure S3). Together, these analyses highlight distinct and structured patterns of leaf selection across age groups, reflecting differences in perception and preference that vary with age.

3.7 Variations in phenotypic preferences of *Hibiscus sabdariffa* L. across agroecological zones, ethnic groups, value chain actors, and age groups

Table 3 reveals significant variation in preferences for phenotypic traits of *Hibiscus sabdariffa* L., which depend on agroecological zone (SZ and SSZ), ethnic background, value chain role, and age group. In the Sudanian zone, phenotypic traits such as leaf color (COF), leaf shape (FOF), and leaf yield (REF) are particularly valued, especially by consumers, producers, and younger individuals. Conversely, in the Sudano-Sahelian zone, preferences shift toward organoleptic quality (QUO), drought resistance (RES), and market value (VAM). Processors and traders prioritize storage-related attributes (APC) and consumer preferences (PAC). Young respondents demonstrate a strong interest in a combined set of traits, including leaf shape and color (FOF, COF), tolerance to biotic stress (TOB), organoleptic quality (QUO), and market value (VAM).

3.8 Reasons for selecting the five best accessions of *Hibiscus sabdariffa* L. in the Sudanian and Sudano-Sahelian agroecological zones

Table 4 presents a ranking of the top five (05) accessions of *Hibiscus sabdariffa* L., selected from two climatic zones, based on several phenotypic criteria. In the Sudanian zone, the accession CKN5 stands out as the most promising, primarily due to its large leaf size, high number of primary branches, and good storability. Other accessions, such as CKK1 and PCL12, are valued for a variety of traits, including dark green leaf color, tenderness, resistance to biotic stress, and high leaf yield. In the Sudano-Sahelian zone, the accession CKN2 is preferred for its combination of large leaf size, desirable organoleptic qualities, and short growth cycle. The other selected accessions also display a diversity of characteristics, including leaf shape and color, drought tolerance, and high market value. Figure 6 illustrates the photographs of the ten accessions selected by all stakeholders along the value chain.

3.9 Rejection criteria of the top five least-preferred *Hibiscus sabdariffa* L. accessions in the Sudanian and Sudano-Sahelian agroecological zones

The analysis of community preferences across agroecological zones revealed the most rejected accessions based on a weighted score index, where a higher index indicates stronger rejection by the community (Table 5). In the Sudano-Sahelian zone, CKO2 recorded the highest rejection index (0.0833), followed by HBDf3 (0.0562) and COB3 (0.0543), reflecting a strong negative perception. Similarly, in the Sudanian zone, HBB3 ranked first in rejection (0.0583), with CKO2 again appearing among the top rejected accessions (0.0458), suggesting a consistent pattern of disapproval across zones. These findings highlight the need for further investigation into the traits driving community rejection and underline the importance of incorporating local preferences into participatory selection and dissemination strategies.

4 Discussion

The participatory selection of local landraces of *Hibiscus sabdariffa* has provided a better knowledge of the selection criteria used by all actors in the value chain. This also made it possible to identify the most promising accessions and determine undesirable criteria for better valorization of this species. Indeed, these selection criteria varied according to climate zones, stages in the value chain, ethnic groups, and age groups. These results confirm the relevance of participatory approaches in variety selection, particularly in agricultural systems with a strong endogenous component and low mechanization (Ceccarelli, 2020). Actors in the Sudano-Sahelian zone prioritize characteristics such as drought resistance and organoleptic quality, whereas those in the Sudanian zone focus on productivity traits, including leaf size and yield. A similar observation was made in Benin, where agroecological zones strongly shape user priorities in cowpea variety selection (Houenou et al., 2022).

The analysis of sociocultural factors reveals a significant difference in selection criteria, as also shown by Sakande et al. (Sakande et al., 2022). Thus, the Mossi favor criteria related to leaf texture (non-pubescent leaves, less perforated leaves), which reflects a selection process guided by culinary expectations. The Bobos and other ethnic groups prefer the color and acidity of the leaves, which suggests dietary and therapeutic uses. These results reinforce the arguments put forward by Autfray et al (Autfray et al., 2022), who emphasized the importance of integrating cultural and ethnic preferences into participatory selection frameworks to improve the adoption and impact of varieties brought to market.

The CKK1 and CKN5 accessions, which recorded the highest indices in both agroecological zones, demonstrate their potential. The CKK1 accession combines characteristics sought after by consumers (tenderness and leaf color) and producers (drought resistance, yield), illustrating a rare convergence between

TABLE 3 Distribution of phenotypic selection criteria in roselle (*Hibiscus sabdariffa* L.) among agroecological zones, ethnic groups, value-chain stakeholders, and age groups.

Zone	Parameters	Criteria	COF	DIF	FOF	TEF	FNPR	FPR	FMP	ACF	FNP	NRP	REF	CYC	CYL	RES	TOB	QUO	APC	DSM	VAM	PAC	Uses	PRE
SSZ	Ethnic group	Mossi	54.32	46.91	37.04	23.46	6.17	4.94	6.17	19.75	9.88	12.35	17.28	3.7	2.47	4.94	1.23	72.84	6.17	18.52	25.93	23.46	32.1	17.28
		Others	50	25	50	25	–	–	–	25	–	–	–	25	25	–	–	50	25	25	25	25	25	–
		Bobo	–	–	100	–	–	–	–	–	–	100	–	–	–	–	–	100	0	0	100	0	0	–
	Value chain	Consumers	45.16	48.39	32.26	35.48	12.9	6.45	3.23	35.48	16.13	22.58	3.23	3.23	6.45	3.23	–	70.97	9.68	9.68	12.9	9.68	29.03	3.23
		Producers	54.17	33.33	33.33	20.83	–	–	–	–	8.33	8.33	54.17	12.5	4.17	8.33	4.17	70.83	–	29.17	29.17	29.17	29.17	8.33
		Traders	57.14	57.14	35.71	14.29	–	7.14	21.43	–	–	7.14	–	–	–	7.14	–	78.57	21.43	35.71	50	21.43	35.71	42.86
		Processors	64.71	47.06	58.82	11.76	5.88	5.88	5.88	35.29	5.88	5.88	–	–	–	–	–	70.59	–	5.88	29.41	41.18	35.29	29.41
	Age	Old	16.67	66.67	33.33	33.33	16.67	–	–	–	–	33.33	–	–	16.67	33.33	–	50	–	33.33	33.33	33.33	16.67	16.67
		Adult	56	48	38	22	4	4	6	12	12	10	24	6	2	4	2	74	8	22	34	26	32	12
		Young	56.67	36.67	40	23.33	6.67	6.67	6.67	36.67	6.67	13.33	6.67	3.33	3.33	–	–	73.33	6.67	10	13.33	16.67	33.33	23.33
SZ	Ethnic group	Mossi	83.33	16.67	100	50	–	–	–	16.67	33.33	100	83.33	50	–	16.67	33.33	50	–	–	–	–	–	–
		Others	93.75	31.25	75	56.25	–	–	–	18.75	43.75	50	93.75	43.75	12.5	31.25	37.5	25	31.25	–	18.75	–	6.25	–
		Bobo	94.44	27.78	44.44	55.56	–	–	–	33.33	16.67	72.22	66.67	38.89	5.56	11.11	27.78	33.33	33.33	–	44.44	–	44.44	–
	Value chain	Consumers	100	25	62.5	75	–	–	–	25	–	100	87.5	62.5	–	–	25	37.5	–	–	–	–	–	–
		Producers	91.3	26.09	65.22	47.83	–	–	–	30.43	43.48	65.22	69.57	30.43	8.7	26.09	43.48	30.43	43.48	–	34.78	–	26.09	–
		Traders	100	40	80	20	–	–	–	20	–	20	100	80	–	–	–	40	–	–	20	–	20	–
		Processors	75	25	50	100	–	–	–	–	50	75	100	25	25	50	25	25	25	–	50	–	50	–
	Age	Old	100	50	0	100	–	–	–	50	0	50	50	50	0	0	50	0	50	–	0	–	0	–
		Adult	90.91	22.73	72.73	45.45	–	–	–	27.27	31.82	68.18	81.82	40.91	9.09	22.73	31.82	31.82	36.36	–	45.45	–	40.91	–
		Young	93.75	31.25	62.5	62.5	–	–	–	18.75	31.25	68.75	81.25	43.75	6.25	18.75	31.25	37.5	12.5	–	6.25	–	–	–

ACF, Leaf acidity; APC, Suitable for storage; COF, Leaf color; CYC, Short cycle; CYL, Long cycle; DIF, Leaf dimensions; DSM, More demanded on the market; FMP, Less perforated leaves; FNP, Non-pubescent leaves; FNPR, Non-perforated leaves; FOF, Leaf shape; FPR, Perforated leaves; NRP, Number of primary branches; PAC, Most appreciated by customers; PRE, More profitable; QUO, Organoleptic qualities; REF, Leaf yield; RES, Drought resistance; TEF, Leaf tenderness; TOB, Tolerant to biotic stress; VAM, Market value; SSZ, Sudano-Sahelian zone; SZ, Sudanian zone.

10.3389/fhort.2025.1740404

10.3389/fhort.2025.1740404

TABLE 4 Reasons for the selection of the top five *Hibiscus sabdariffa* L. accessions in the Sudano-Sahelian and Sudanian zones of Burkina Faso.

Zone	Accession	Rank	Selection criteria
SZ	CKN5	1st	Large leaf size, high number of primary branches, and suitable for storage
	CKK1	2nd	Green leaf color, leaf tenderness, and high market value
	PCL12	3rd	High leaf yield, non-pubescent leaves, and tolerant to biotic stress
	CKO10	4th	Leaf shape, organoleptic quality, and long growth cycle
	COL5	5th	Multiple uses, drought tolerance, and short growth cycle
SSZ	CKN2	1st	Large leaf size, good organoleptic quality, and short growth cycle
	CEK3	2nd	Leaf shape, green leaf color, and high leaf yield
	CKO8	3rd	High market value, non-pubescent leaves, and less leaf perforation
	CKK1	4th	Drought resistance, tolerance to biotic stresses, and leaf tenderness
	CLW2	5th	Leaf acidity, long growth cycle, and suitable for storage

SSZ, Sudano-Sahelian zone; SZ, Sudanian zone.

organoleptic quality and agroecological performance. The analysis of value chain roles revealed a clear functional differentiation in varietal preferences. Producers prioritize vegetative vigor and stress resistance, while processors and traders value characteristics such as ease of storage and commercial appearance. These findings align with observations by Sakande et al. (Sakande et al., 2024) in Burkina Faso, where intra-chain specialization significantly shaped varietal evaluation criteria.

CKN2 and CKO10 accessions have attributes related to nutritional quality, suggesting high potential for community nutrition interventions. Recent studies (Saha et al., 2022; Raphael et al., 2023) have shown that *Hibiscus sabdariffa* L., rich in antioxidants and micronutrients, can significantly improve the nutritional status of women and children in sub-Saharan Africa.

The rejection criteria observed (tough, hairy leaves, long cycle) reveal a negative sensory evaluation rather than a strictly agronomic one. These attributes, although potentially conducive to physiological resistance, are rejected by stakeholders due to the difficulty of processing or low organoleptic appeal. This underscores that varietal acceptability depends not only on agronomic performance but also on sociocultural and sensory factors. These observations support the work of Weltzien et al (Weltzien et al., 2019), who have emphasized the need to integrate cultural perceptions into variety evaluation to avoid adoption failures despite good agronomic performance.

Overall, this study provides compelling evidence in favor of user-centered selection approaches that take into account agroecological variability, functional specialization, and sociocultural diversity. These strategies are essential for increasing the adoption of improved varieties, particularly for neglected and underutilized species (NUS) in West African agricultural systems. The distribution of accessions shown in the Venn diagram can be explained by the marked agroecological differences between the two climatic zones. More specifically, the Sudano-Sahelian zone is characterized by a more arid climate and soils that are often poor in nutrients compared to the Sudanian zone. These conditions probably favor natural and anthropogenic selection of varieties that are better adapted to drought and soil constraints. Previous studies

TABLE 5 Top 5 most rejected accessions by the community in the Soudano-Sahelian and Sudanian zones of Burkina Faso.

Zone	Accessions	Rank	Reasons
SSZ	CKO2	1st	Leathery leaves, few primary branches, and susceptible to pests
	HBDf3	2nd	Leaf pubescence, palmately-lobed leaf shape, and stem pubescence
	COB3	3rd	Low yield, low market value, and laborious harvesting
	CLW3	4th	Poor organoleptic quality, not drought-resistant, and long growth cycle
	COL3	5th	Low yield, small leaf size, and not suitable for storage
SZ	HBB3	1st	Low market value, green-red leaf color, and overly acidic leaves
	CKO2	2nd	Low yield, short growth cycle, and susceptible to pests
	CKO3	3rd	Few primary branches, leathery leaves, and laborious harvesting
	HBB6	4th	Long growth cycle, poor organoleptic quality, and green-red leaf color
	PCT3	5th	Small leaf size, not drought-resistant, and palmately-lobed leaf shape

SSZ, Sudano-Sahelian zone; SZ, Sudanian zone.

have shown that the genetic diversity of cultivated plants is often closely linked to their ability to adapt to specific environmental conditions (Khoury et al., 2014). The presence of accessions common to both areas suggests that *Hibiscus sabdariffa* L., has considerable ecological plasticity, enabling it to adapt to diverse environments. These accessions, which are widely adopted, constitute valuable genetic resources that could facilitate breeding efforts aimed at improving resilience and productivity in different agroecological zones.

Despite the relevance of the results obtained, certain limitations should be acknowledged. The evaluations were conducted at two experimental sites during a single growing season, which may limit the generalization of the findings to other environments. Participatory variety selection inherently involves a degree of subjectivity, linked to individual perceptions, sociocultural contexts, and the roles of actors within the value chain. Although collective scoring and consensus methods were employed, these factors may have influenced the prioritization of criteria and the final ranking of accessions. The study primarily relied on agronomic, sensory, and user-defined criteria, without systematic biochemical or nutritional analyses. Consequently, the nutritional potential attributed to certain accessions should be confirmed through additional laboratory analyses.

5 Conclusion

This study highlights the effectiveness of participatory approaches in identifying the varieties of *Hibiscus sabdariffa* L., preferred by value chain actors (producers, processors, traders, consumers), which are well-suited to the agroecological and sociocultural conditions of Burkina Faso. The results reveal significant variations in variety preferences according to agroecological zones, sociocultural groups, age, and value chain actors. It should be noted that the active involvement of women, who represent the majority of participants, is essential to promoting an inclusive and equitable seed system. In the longer term, these participatory frameworks could serve as scalable models for the promotion of underutilized crops, thereby strengthening seed sovereignty and agroecological resilience throughout West Africa.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The study was conducted in accordance with the code of ethics for scientific research of Joseph KI-ZERBO University (ARRETE N 2023-001/MESRI/SG/UJKZ/P, on January 10, 2023). Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article. Concepts and the objectives of the study were explained to them. They were informed that their anonymity would be assured and that there was no risk involved in participating.

Author contributions

CZ: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Software, Visualization, Writing – original draft, Writing – review & editing. RN: Conceptualization, Supervision, Validation, Writing – review & editing. ZK: Conceptualization, Supervision, Validation, Writing – review & editing. MK: Data curation, Writing – review & editing. FT: Writing – review & editing. HE: Funding acquisition, Project administration, Validation, Writing – review & editing. FA: Funding acquisition, Project administration, Writing – review & editing. JN: Funding acquisition, Project administration, Writing – review & editing. MS: Conceptualization, Supervision, Validation, Writing – review & editing.

Funding

The author(s) declared that financial support was received for this work and/or its publication. This research was funded by the DeSIRA initiative (Development Smart Innovation through Research in Agriculture) of the European Union (contribution agreement FOOD/2021/422-681).

Acknowledgments

The authors would like to thank the SUSTLIVES project (SUSTaining and improving local crop patrimony in Burkina Faso and Niger for better LIVes and EcoSystems – https://www.sustlives.eu) for its scientific, technical, and financial support. They extend their thanks to Badjibassa AKOUNDA (ORCID: 0000-0001-7150-6226) for statistical assistance. Their gratitude is also expressed to all participants from the villages of Gampèla and Farakô-Ba.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was not used in the creation of this manuscript.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial

intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fhort.2025.1740404/full#supplementary-material

SUPPLEMENTARY FIGURE 1
Dendrogram of relationships between ethnic groups and selection criteria.

SUPPLEMENTARY FIGURE 2
Dendrogram of relationships between chain value actors and selection criteria.

SUPPLEMENTARY FIGURE 3
Dendrogram of relationships between age groups and selection criteria.

SUPPLEMENTARY TABLE 1
Ranking of accessions based on participants preferences in Sudanian Zone.

SUPPLEMENTARY TABLE 2
Ranking of accessions based on participant preferences in Sudano-Sahelian Zone.

SUPPLEMENTARY TABLE 3
Overall ranking of accessions based on participant preferences in Soudanian Zone and Soudano-Sahelian Zone.

SUPPLEMENTARY TABLE 4
Ranking of accessions rejected by participants in Sudano-Sahelian Zone

SUPPLEMENTARY TABLE 5
Ranking of accessions rejected by participants in Sudanian Zone.

References

Akpo, J.-M. K., Sangare-Oumar, M. M., Sacramento, I. T., Issotina, A. Z., Guinnin, F. F., and Houngbeme, A. (2023). Analyse Phytochimique Des Extraits Éthanoliques de la Variété Blanche d'*Hibiscus Sabdariffa* Linn (Malvaceae) et Évaluation de Toxicité Aiguë Par Voie Orale Chez Des Rats Wistar. *Int. J. Biol. Chem. Sci.* 17, 2909–2924. doi: 10.4314/ijbcs.v17i7.24

Amylee, A., and Bashar, K. (2022). Mechanisms of action of nutritionally rich *Hibiscus sabdariffa*'s therapeutic uses in major common chronic diseases: A literature review. *J. Am. Nutr. Assoc.* 41, 116–124. doi: 10.1080/07315724.2020.1848662

Assogba, G. A., Fandohan, A. B., Salako, V. K., and Assogbadjo, A. E. (2017). Usages de *Bombax Costatum* (Malvaceae) Dans Les Terroirs Riverains de la Réserve de Biosphère de la Pendjari, République Du Bénin. *Bois For. Trop.* 333, 17. doi: 10.19182/bft2017.333.a31465

Autfray, P., Rakotofiringa, H. Z. N., Letourmy, P., and Vom Brocke, K. (2022). Évaluation multicritère et participative de variétés de riz pluvial dans une gamme contrastée d'environnements à Madagascar. *Biotechnologie Agronomie Société Environnement*. 26 (1), 43-545. doi: 10.25518/1780-4507.19481

(2020). *MEEVCC monographie nationale sur la diversité Biologique du Burkina Faso* (Ouagadougou: Ministry of Environment, Green Economy and Climate Change (MEEVCC)).

Aziato, K., Bouka, E. C., Lawson-Evi, P., Savadogo, A., and Kwashie, E.-G. (2020). Sparkling ''wine'' Production tests from extract of *Hibiscus sabdariffa* L. Flowers. *Int. J. Biol. Chem. Sci.* 14, 3231–3240. doi: 10.4314/ijbcs.v14i9.20

Akounda, B., Ouédraogo, D., Burger, P. A., Rosen, B. D., Van Tassell, C. P., Sölkner, J., et al. (2024). Participatory investigation of goat farmers' Breeding practices, trait preference, and selection criteria in Burkina Faso. *Trop. Anim. Health Prod* 56, 35. doi: 10.1007/s11250-023-03869-w

Bayou, E., Aynalem, H., Solomon, G., and Yoseph, M. (2018). Definition of smallholder sheko cattle keepers breeding objectives through phenotypic ranking and choice experiments in Ethiopia. *Afr. J. Agric. Res.* 13, 389–402. doi: 10.5897/AJAR2014.9119

Bevan, P., Pastor, M. V., Almajano, M. P., and Codina-Torrella, I. (2023). Antioxidant and antiradical activities of *Hibiscus sabdariffa* L. Extracts encapsulated in calcium alginate spheres. *Polymers* 15, 1740. doi: 10.3390/polym15071740

Bule, M., Albelbeisi, A. H., Nikfar, S., Amini, M., and Abdollahi, M. (2020). The antidiabetic and antilipidemic effects of *Hibiscus sabdariffa*: A systematic review and meta-analysis of randomized clinical trials. *Food Res. Int.* 130, 108980. doi: 10.1016/j.foodres.2020.108980

Caballero, P. C., Enciso Garay, C. R., Macchi, L. G., Nakayama, H. D., González, C., Ma, C., et al. (2024). Dataset on the qualitative characteristics of roselle varieties (*Hibiscus sabdariffa* L.). *Data Brief* 54, 110480. doi: 10.1016/j.dib.2024.110480

Ceccarelli, S. (2015). Efficiency of plant breeding. *Crop Sci.* 55, 87–97. doi: 10.2135/cropsci2014.02.0158

Ceccarelli, S. (2020). Grando, S. Participatory plant breeding: who did it, who does it and where? *Exp. Agric.* 56, 1–11. doi: 10.1017/S0014479719000127

Da-Costa-Rocha, I., Bonnlaender, B., Sievers, H., Pischel, I., and Heinrich, M. (2014). *Hibiscus sabdariffa* L. – A phytochemical and pharmacological review. *Food Chem.* 165, 424–443. doi: 10.1016/j.foodchem.2014.05.002

Etten, J. V., Beza, E., Calderer, L., Duijvendijk, K. V., Fadda, C., Fantahun, B., et al. (2019). First experiences with a novel farmer citizen science approach : crowdsourcing participatory variety selection through on-farm triadic comparisons of technologies (Tricot). *Exp. Agric.* 55, 275–296. doi: 10.1017/S0014479716000739

Geja, W. W., and Mengesha, K. B. (2020). Performance of roselle (*Hibiscus sabdariffa* L.) in different agro-ecologies of Ethiopia. *Medicinal Aromatic Plants* 9, 1–7. doi: 10.35248/2167-0412.20.9.352

Getachew, T., Haile, A., Tibbo, M., Sharma, A. K., Sölkner, J., and Wurzinger, M. (2010). Herd management and breeding practices of sheep owners in a mixed crop-livestock and a pastoral system of Ethiopia. *Afr. J. Agric. Res.* 5, 685–691.

Houenou, A., Hinnou, C. L., Maliki, R., and Tede, S. (2022). Analyse Genre de la Sélection Participative Des Cultivars Locaux de Niébé Cultivés Au Centre Du Bénin. *Ann. UP Série Sci. Nat. Agron.* 12, 43–60. doi: 10.56109/aup-sna.v12i1.12

Husson, F., Josse, J., Le sébastien,, and Marzet, J. (2008). Multivariate exploratory data analysis and data mining. *J. Stat. Software* 25, 1–18. doi: 10.18637/jss.v025.i01

Izquierdo-Vega, J. A., Arteaga-Badillo, D. A., Sánchez-Gutiérrez, M., Morales-González, J. A., Vargas-Mendoza, N., Gómez-Aldapa, C. A., et al. (2020). Organic acids from roselle (*Hibiscus sabdariffa* L.)—A brief review of its pharmacological effects. *Biomedicines* 8, 100. doi: 10.3390/biomedicines8050100

Juhari, N. H., Bredie, W. L. P., Toldam-Andersen, T. B., and Petersen, M. A. (2018). Characterization of roselle calyx from different geographical origins. *Food Res. Int.* 112, 378–389. doi: 10.1016/j.foodres.2018.06.049

Kassambara, A., and Mundt, F. (2020). *Factoextra: extract and visualize the results of multivariate data analyses*. Available online at: https://CRAN.R-project.org/package=factoextra

Khoury, C. K., Bjorkman, A. D., Dempewolf, H., Ramirez-Villegas, J., Guarino, L., Jarvis, A., et al. (2014). Increasing homogeneity in global food supplies and the implications for food security. *Proc. Natl. Acad. Sci. U.S.A.* 111, 4001–4006. doi: 10.1073/pnas.1313490111

Kiebre, Z., Kiebre, M., Nanema, R. K., Tietiambou, F. R. S., Zerbo, C., Tonde, I., et al. (2025). Participatory selection of bambara groundnut landraces in Burkina Faso: effects of gender and participant diversity. *Agriculture* 15, 1769. doi: 10.3390/agriculture15161769

Kone, S., Konate, K., and Amn, O. (2025). New rice lines resistant to xanthomonas oryzae pv. Oryzae: A promising pathway to food security in Burkina Faso. *Adv. Agric. Technol. Plant Sci.* 8 (2), 1–14. doi: 10.63235/AATPS.180176

Onyeukwu, O. B. B., Njideaka, O. T., and Dibie, D. C. (2023). *Hibiscus sabdariffa* - uses, nutritional and therapeutic benefits - A review. *JBBD* 8, 18–23. doi: 10.31248/JBBD2023.178

Ouangraoua, J. W., Kiebre, M., Kiebre, Z., Ouedraogo, H., and Mahamadou, S. (2021). Caractérisation Ethnobotanique de l'Oseille de Guinée (*Hibiscus Sabdariffa* L.) de l'ouest Du Burkina Faso. *Int. J. Innovation Appl. Stud.* 32, 437–448. Available at: http://www.ijias.issr-journals.org/.

Ouangraoua, W. J., Traore, R. E., Kabore, B., Sawadogo, P., and Sawadogo, M. (2022). Agromorphological characterization of *Hibiscus sabdariffa* L. Collection from Burkina Faso. *Eur. Sci. Journal ESJ* 18, 184–184. doi: 10.19044/esj.2022.v18n27p184

Ouédraogo, D., Soudré, A., Ouédraogo-Koné, S., Zoma, B. L., Yougbaré, B., Khayatzadeh, N., et al. (2020). Breeding objectives and practices in three local cattle breed production systems in Burkina Faso with implication for the design of breeding programs. *Livestock Sci.* 232, 103910. doi: 10.1016/j.livsci.2019.103910

Raphael, D. O., Ademoyegun, O. T., and Ahmed, R. S. (2023). Nutritional quality and health benefits of roselle calyces. *Acta Universitatis Sapientiae Alimentaria* 16, 63–74. doi: 10.2478/ausal-2023-0005

R Core Team R (2024). *A language and environment for statistical computing* (Vienna, Austria: R Foundation for Statistical Computing). doi: https://www.R-project.org/

Richardson, M. L., and Arlotta, C. G. (2021). Differential yield and nutrients of *Hibiscus sabdariffa* L. Genotypes when grown in urban production systems. *Scientia Hortic.* 288, 110349. doi: 10.1016/j.scienta.2021.110349

Saha, B. U. F., Choumessi, A. T., Ayomo, A. M., Kuagny, R. B. M., Teta, I., Nantia, E. A., et al. (2022). Nutritional quality of three iron-rich porridges blended with moringa oleifera, *Hibiscus sabdariffa*, and solanum aethiopicum to combat iron deficiency anemia among children. *J. Food Qual.* 2022, 1–10. doi: 10.1155/2022/4309892

Sakande, B., Sawadogo, A., Kiebre, Z., and Kiebre, M. (2022). Bationo/Kando, P. Sélection Participative de Génotypes d'intérêt de Cleome Gynandra L. Dans Les Deux Principales Villes Du Burkina Faso. *JABs J. Appl. Biosci.* 171, 17838–17848. doi: 10.35759/JABs.171.6

Sakande, B., Zida, W. F. M. S., Sory, S., and Kiebre, Z. (2024). Bationo/kando, P. Perception of the preferences of the links in the spider plant (*Cleome gynandra* L.) value chain in Burkina Faso. *J. Plant Breed. Crop Sci.* 16, 1–7. doi: 10.5897/jpbcs2023.1027

Salami, S. O., and Afolayan, A. J. (2021). Evaluation of nutritional and elemental compositions of green and red cultivars of roselle: *Hibiscus sabdariffa* L. *Sci. Rep.* 11, 1030. doi: 10.1038/s41598-020-80433-8

Sanou, A., Konate, K., Dakuyo, R., Kabore, K., Sama, H., and Dicko, M. H. (2022). *Hibiscus sabdariffa*: genetic variability, seasonality and their impact on nutritional and antioxidant properties. *PloS One* 17, e0261924. doi: 10.1371/journal.pone.0261924

Weltzien, E., Rattunde, F., Christinck, A., Isaacs, K., and Ashby, J. (2019). "Gender and farmer preferences for varietal traits: evidence and issues for crop improvement," in *Plant breeding reviews* (Wiley), 243–278.

Wouokoue, T. J. B., Fouelefack, F. R., Leticia Liejip, N. C., Biakdjolbo, W. E., and Mafouo, T. E. (2025). Morphoagronomic and phenological characteristics of roselle (*Hibiscus sabdariffa* L.) grown in Sudano-sahelian zone of Cameroon. *Int. J. Agron.* 2025, 5568972. doi: 10.1155/ioa/5568972

Zewdu, A., Alemayehu, K., and Wondifraw, Z. (2018). Breeding practices and farmers trait preferences on indigenous dairy cattle production in east gojjam zone, Ethiopia. *Asian J. Agric. Food Sci.* 06, 685–691.