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‘Sikitita 2’: A New Olive Cultivar for High-density Orchards

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Traditional olive orchards host many traditional cultivars that are well adapted to specific edaphoclimatic conditions and sparse planting densities (Barranco et al. 2025; Rallo et al. 2018). Currently, olive cultivation is undergoing major transformations, driven mainly by the intensification of cultivation systems, with a particular emphasis on the implementation of superhigh-density (SHD) hedgerow systems, which can reach planting densities of up to 2000 trees/ha (Connor et al. 2014; Rallo et al. 2018). In these plantations, two traditional cultivars, Arbequina and Arbosana, are cultivated extensively worldwide because of their low vigor and because their tree architecture is well suited for mechanical harvesting, and for their high productivity and early bearing (Díez et al. 2016; Rosati et al. 2013). The global dominance of these two cultivars entails reduced genetic diversity and significant risks, particularly because of increased vulnerability to both biotic and abiotic stresses. In addition, the market demands olive oils with diverse organoleptic attributes and a long shelf life. To address these limitations, the olive breeding program at the University of Cordoba and the Andalusian Institute of Agricultural and Fisheries Research and Training in Spain have focused on developing new olive cultivars well adapted to high-density conditions. To do so, alternative cultivars were incorporated as genitors to increase the genetic diversity of the new cultivars adapted to intensive, SHD systems.

The cultivar Sikitita, which is known commercially known as Sikitita 1, was the first cultivar released from this breeding program. It was registered in 2009 as the first cultivar adapted specifically for hedgerow systems (Rallo et al. 2008). Almost 20 years later, in 2025, the cultivar Sikitita 2 was registered as a new option for high-density orchards and is characterized by its high yield, low vigor, and early ripening.

Origin

‘Sikitita 2’, recorded as UC-I 2-35 in the breeding program, originated in 1991 from a directed cross between two traditional olive cultivars: Arbequina (female genitor) and Picual (male genitor). ‘Sikitita 2’ underwent rigorous, multiphase evaluation and selection processes comprising three consecutive stages (Rallo et al. 2018).

The first stage involved the germination of the seedlings and their forced growth under controlled conditions (Santos-Antunes et al. 2005). ‘Sikitita 2’ was subsequently planted in the field in 1995 at the Andalusian Institute of Agricultural and Fisheries Research and Training experimental farm (Centro Alameda del Obispo, Cordoba, Spain), alongside other seedlings from the same and different crosses. ‘Sikitita 2’ produced its first crop in 1997, and after three consecutive harvests, it was selected for its early bearing and high oil content (León et al. 2004).

The second stage involved intermediate trials, in which ‘Sikitita 2’ and other selected genotypes were evaluated with replicates in randomized blocks. In these trials, ‘Sikitita 2’

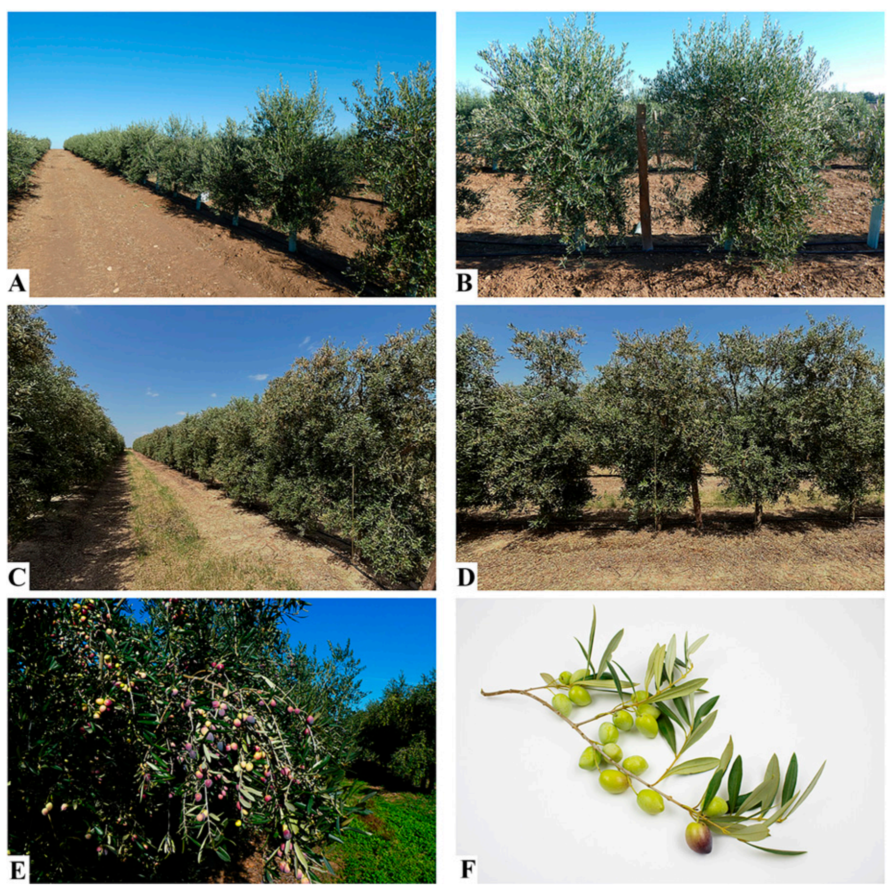

Fig. 1. ‘Sikitita 2’ complete lines of trees, 3 years after planting (**A and B**), 8 years after planting (**C and D**), and branches with fruit (**E and F**) in the evaluated trials.

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Fig. 2. 'Sikitita 2' fruit (**top row**) and endocarps (**bottom row**).

Table 1. Allelic profiles for the 12 microsatellite simple sequence repeat (SSR) markers of the new cultivar Sikitita 2 and its genitors, 'Arbequina' and 'Picual'.

SSR marker	Sikitita 2	Arbequina	Picual
ssrOe-DCA-3	229/237	229/241	237/247
ssrOe-DCA-9	190/204	182/204	182/190
ssrOe-DCA-11	140/178	140/178	140/176
ssrOe-DCA-16	122/124	122/144	124/152
ssrOe-DCA-18	166/174	164/174	166/172
UDO-43	175/208	175/175	208/212
GAPU-59	206/210	206/220	210/220
DCA-15	243/243	243/243	243/254
UDO-11	119/129	116/129	116/119
UDO-19	129/153	129/153	129/129
GAPU-71B	121/127	121/141	118/127
GAPU-101	183/191	183/205	191/217

Table 2. Olive fruit yield of 'Sikitita 2', 'Arbequina', and 'Arbosana' in two superhigh-density orchards (1667 trees/ha) located in Acedera (Extremadura, Spain) and Carmona (Andalusia, Spain).

		Fruit yield ($t \cdot ha^{-1}$)				
Trial	Cultivar	2021–22	2022–23	2023–24	2024–25	Avg
Acedera	Sikitita 2	3.2	2.9	9.5	7.1	5.6
Acedera	Arbequina	3.0	4.2	6.8	8.6	5.4
Acedera	Arbosana	5.0	2.7	7.3	7.5	5.5
Carmona	Sikitita 2	10.0	8.4	19.0 a[i]	23.4	15.2 a
Carmona	Arbequina	9.7	4.9	9.1 b	17.0	10.2 b
Carmona	Arbosana	10.5	7.5	11.9 ab	17.4	11.8 b

[i] Values with the same or no letter are not significantly different according to analysis of variance followed by Tukey's test at $P = 0.05$.

confirmed the promising traits observed earlier, including high fruit and oil yields. In addition, its oil has a high oleic acid content (~75%) and a total phenolic content of > 400 $mg \cdot kg^{-1}$, indicating high oxidative stability (Janfi 2021; Velasco and Dobarganes 2002).

The third and final evaluation stage involved comparative precommercial field trials, during which advanced selections were evaluated across multiple environments alongside the leading cultivars in the SHD orchards, 'Arbequina' and 'Arbosana', as controls. In our study, the performance of 'Sikitita 2' was assessed in two of these field trials characterized by contrasting edaphoclimatic conditions, located in Carmona (Andalusia, Spain) and Acedera (Extremadura, Spain). Both trials were established in 2019 at a tree density of 1667 trees/ha and were managed under similar agronomic practices.

Table 3. Oil yield for 'Sikitita 2', 'Arbequina', and 'Arbosana' in two superhigh-density orchards (1667 trees/ha) located in Acedera (Extremadura, Spain) and Carmona (Andalusia, Spain).

		Oil yield ($t \cdot ha^{-1}$)				
Trial	Cultivar	2021–22	2022–23	2023–24	2024–25	Avg
Acedera	Sikitita 2	0.7	0.6	1.7 a[i]	1.5 ab	1.1
Acedera	Arbequina	0.7	0.9	1.2 b	1.7 a	1.1
Acedera	Arbosana	1.0	0.5	1.2 b	1.4 b	1.0
Carmona	Sikitita 2	1.6	1.3	2.5 a	3.6 a	2.3 a
Carmona	Arbequina	1.5	0.9	1.4 b	2.4 ab	1.6 b
Carmona	Arbosana	1.6	1.2	1.5 b	2.2 b	1.6 b

[i] Means with the same or no letter are not significantly different according to analysis of variance followed by Tukey's test at $P = 0.05$.

Morphological description and molecular marker identification. 'Sikitita 2' was characterized morphologically according to the methodology proposed by Barranco et al. (2000), which is based on 24 traits that describe the tree, leaf, fruit, and endocarp. We used 12 simple sequence repeats (SSRs) (Trujillo et al. 2014) to characterize the unique genetic profile of 'Sikitita 2'.

Trial location and vegetal material. Two equally designed trials were evaluated over 6 years (2019–24), which included four yield seasons at two different locations: Carmona (Andalusia, Spain; lat. 37°24′41″N, long. 5°28′52″W), with a clay loam soil classification, and Acedera (Extremadura, Spain; lat. (39°02′20″N, long. 5°34′30″W), with a Calcixerept soil classification. The experimental trees were cultivated in a standard SHD frame configuration (4.0 × 1.5 m), with a density of 1667 trees/ha, an annual irrigation dose of 1500 $m^3 \cdot ha^{-1}$, and similar agronomic management. In these trials, 'Sikitita 2' and a set of olive genotypes were classified as advanced selections and underwent rigorous evaluation, using 'Arbequina' and 'Arbosana' as reference cultivars. The experimental design comprised four randomized blocks, with each block consisting of three complete rows for cultivar selection and advanced selection. The central row was used for the measurement process.

Yield, tree, and fruit characteristics. Fruit yield was determined through a comprehensive evaluation of four trees per cultivar and block across four consecutive seasons from 2021 to 2024. The oil yield was determined as the percentage of oil content for each fruit sample as established by the official laboratory.

In addition to the 24 traits delineated in the next section, other morphological and key agronomic traits, including the weight of the fruit and stone, pulp-to-stone ratio, oil content, fruit moisture, canopy volume, and bearing index, were assessed in accordance with the protocols described by Díez et al. (2016) and Rallo et al. (2018).

Oil characteristics. The oil of the cultivars was extracted in the 2021–22 season by using an Abencor™ mill (Mc2 Ingenieria y Sistemas, Sevilla, Spain) system according to the methodology established by Ben-David et al. (2010). Subsequently, an officially accredited laboratory determined the stability by the Rancimat method (100 °C). The fatty acid profile of the samples was determined by the Department of Analytical Chemistry at the University of Cordoba by using the gas chromatography–flame ionization detector methodology (Tomé-Rodríguez et al. 2021). In addition, phenolic analysis was carried out by following the protocol described by Castillo-Luna et al. (2021). For this purpose, a Thermo Scientific UltiMate 3000 series LC system coupled to a Thermo Scientific triple quadrupole TSQ Quantum™ Access MAX detector with heated electrospray ionization was used.

Table 4. Mean values (2019–24) of fruit characteristics and tree vigor for ‘Sikitita 2’, ‘Arbequina’, and ‘Arbosana’ in two superhigh-density orchards (1667 trees/ha) located in Acedera (Extremadura, Spain) and Carmona (Andalusia, Spain).

Fruit characteristics	Acedera			Carmona		
	Sikitita 2	Arbequina	Arbosana	Sikitita 2	Arbequina	Arbosana
Fruit weight (g)	2.4 a[i]	2.1 ab	1.7 b	2.4 a	1.6 b	1.2 b
Oil (dry matter) (%)	51.4 a	46.3 b	45.1 b	45.0 a	40.0 b	36.0 b
Fruit moisture (%)	58.1 a	53.8 b	54.3 b	65.2 a	59.6 b	60.9 b
Oil content (%)[ii]	21.5	21.4	20.8	15.2	15.7	13.7
Tree height (m)	1.93 b	2.51 a	1.90 b	2.63 b	3.03 a	2.59 b
Tree width (m)	1.17 b	1.46 a	1.20 ab	1.55 b	1.72 a	1.64 ab
Hedgerow volume ($m^3 \cdot ha^{-1} \times 10^3$)	4.4 b	7.2 a	4.1 b	8.4 b	10.9 a	8.7 b

[i] Values with the same or no letter are not significantly different according to analysis of variance followed by Tukey’s test at $P = 0.05$.
[ii] Fresh weight.

Description

Morphological description and molecular marker identification. The morphology of ‘Sikitita 2’ was examined and documented according to 24 traits that delineate the tree, leaf, and endocarp, as proposed by Barranco et al. (2000). In terms of its 24 morphological traits (Figs. 1 and 2), trees have weak vigor, a spreading to drooping growth habit, and a medium canopy density. Leaves demonstrate a medium length and width, a ratio of length to width that is slightly to moderately elongated, and a curvature of the longitudinal axis that is straight.

Fruit have a low weight, a ratio of length to width at position A (Left, position A is the position in which the organ shows its largest asymmetry) that is moderately elongated, an overall color at full maturity that is dark, a symmetry at position A that is strongly asymmetric, a shape of the apex at position A that is acute, a moderate nipple, and a shape of the base at position A that is truncated. The stone has a moderately elongated length-to-width ratio, a low weight, is weakly asymmetric at position A, is symmetric at position B (Medium, position B is reached from position A by turning 90° along the longitudinal axis in a way to present the most developed part of the organ to the observer), and has less than seven grooves on the basal end, a distribution of grooves on the basal end that is grouped weakly around the suture, an acute apex shape at position A, a mucron, a rounded shape at the base of position A, and medium surface rugosity.

The genetic profile of ‘Sikitita 2’ was determined to be unique after the application of 12 SSRs (Trujillo et al. 2014), and the identity of its progenitors (the traditional cultivars Arbequina and Picual) was confirmed (Table 1). Furthermore, the probability of finding another genotype with the same SSR profile as ‘Sikitita 2’ is extremely low (7.94e-07).

Tree yield and fruit characteristics. ‘Sikitita 2’ was initially selected for its early bearing, which was consistently confirmed in subsequent field trials. The first crop of ‘Sikitita 2’ occurred 2 years after planting at all the locations where it was evaluated (Tables 2 and 3). With respect to productivity, ‘Sikitita 2’ exhibited high performance, with average fruit and oil yields comparable to or significantly greater than those of ‘Arbequina’ and ‘Arbosana’. For instance, the average fruit and oil yields of the three cultivars were similar in Acedera, whereas ‘Sikitita 2’ performed markedly better in Carmona, producing 44% more oil than the control cultivars (Table 3).

In both trials, compared with ‘Arbosana’, ‘Sikitita 2’ showed similar tree vigor in terms of tree height and canopy width, whereas ‘Arbequina’ was consistently the most vigorous cultivar (Table 4). Similarly, compared with ‘Arbosana’, ‘Sikitita 2’ presented a similar hedgerow volume in the two locations considered (Table 4).

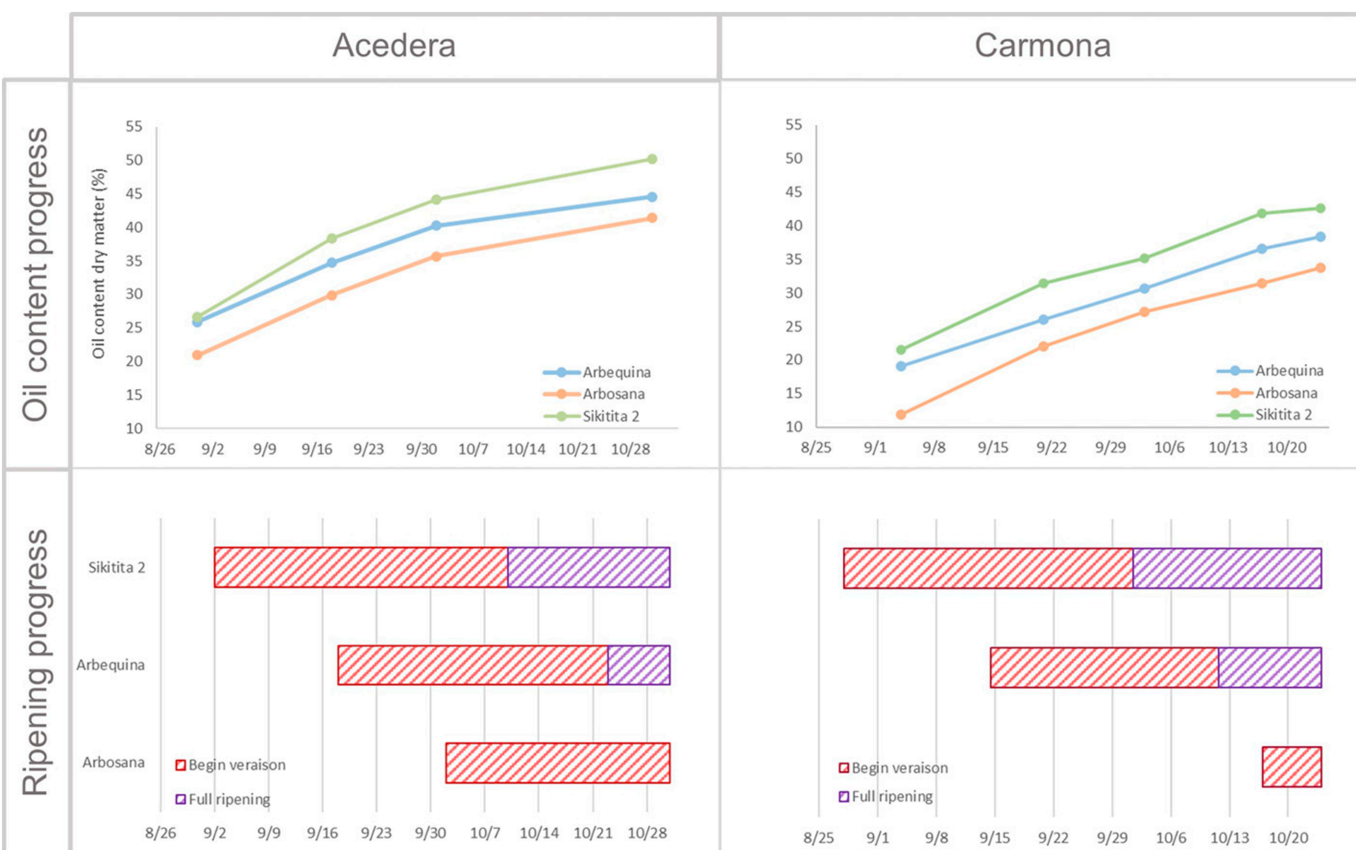

Fig. 3. Oil fruit content (dry matter) (**top row**) and ripening progress (**bottom row**) of ‘Sikitita 2’, ‘Arbequina’, and ‘Arbosana’ (2023–24 season) in two superhigh-density orchards (1667 trees/ha) located in Acedera (Extremadura, Spain) and Carmona (Andalusia, Spain).

Table 5. Oil fatty acid profiles, measured as a percentage, of ‘Sikitita 2’, ‘Arbequina’, and ‘Arbosana’ (2021–22 season) in two superhigh-density orchards (1667 trees/ha) located in Acedera (Extremadura, Spain) and Carmona (Andalusia, Spain).

	Acedera			Carmona		
Acid	Sikitita 2	Arbequina	Arbosana	Sikitita 2	Arbequina	Arbosana
Oleic	73.9 a[i]	65.3 b	69.4 ab	72.6 a	63.4 c	69.6 b
Palmitic	15.0 c	16.8 a	16.2 b	15.2 b	17.3 a	16.1 ab
Palmitoleic	2.02	1.82	1.86	2.10 a	1.70 b	1.54 b
Stearic	2.11	1.91	1.93	2.03 b	1.87 b	2.41 a
Linoleic	5.1 c	12.2 a	8.5 b	6.0 c	13.8 a	7.9 b
Linolenic	0.68 b	0.62 c	0.77 a	0.78 a	0.67 b	0.80 a

[i] Values with the same or no letter are not significantly different according to analysis of variance followed by Tukey’s test at $P = 0.05$, with the exception of oleic acid according to Kruskal-Wallis analysis followed by Dunn’s test at $P = 0.05$.

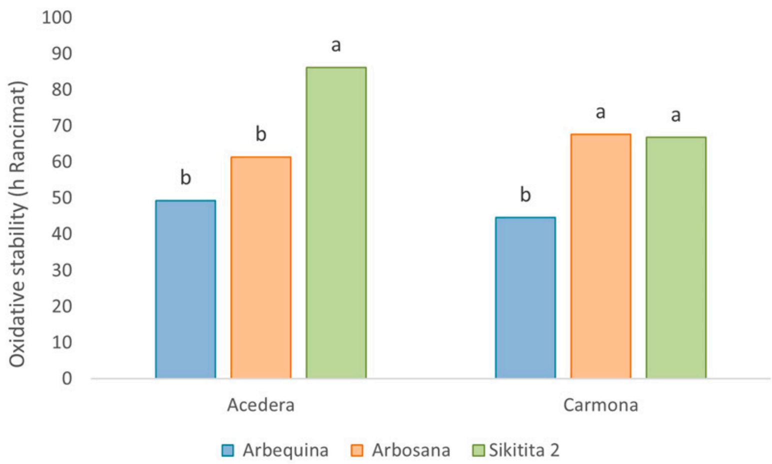

Fig. 4. Oxidative stability measured by a Rancimat for ‘Sikitita 2’, ‘Arbequina’, and ‘Arbosana’ (2021–22 season) in two superhigh-density orchards (1667 trees/ha) located in Acedera (Extremadura, Spain) and Carmona (Andalusia, Spain). Bars with the same letter are not significantly different according to analysis of variance followed by Tukey’s test at $P = 0.05$.

‘Sikitita 2’ fruit weight was significantly greater than the fruit weight of ‘Arbequina’ and ‘Arbosana’ (Table 4). The dry matter oil content of ‘Sikitita 2’ ranged from 40% to 50% at harvest at the two evaluated locations. These values exceeded those of ‘Arbequina’ and ‘Arbosana’, which were 5% to 9% less, depending on the location (Table 4 and Fig. 3). ‘Sikitita 2’ oil content was greater than that of the two other cultivars throughout the ripening period (Fig. 3).

The onset of ripening (veraison) of ‘Sikitita 2’ occurred between late September and early November (Fig. 3). ‘Sikitita 2’ was the earliest cultivar to ripen, reaching veraison ∼12 to 14 d earlier than ‘Arbequina’ and significantly earlier than ‘Arbosana’ (Fig. 3), which typically exhibits minimal changes in fruit color during ripening. The earlier ripening and greater oil content of ‘Sikitita 2’ relative to those of ‘Arbequina’ and ‘Arbosana’ offer potential advantages for commercial marketing. Although fruit ripening indices may not fully reflect oil accumulation (Navas-Lopez et al. 2019), they offer producers tentative guidance for harvesting.

Oil characteristics. Compared with the ‘Arbosana’ and, especially, the ‘Arbequina’ fatty acid profiles, the ‘Sikitita 2’ fatty acid profile was characterized by a greater oleic acid content and a lower linoleic acid content in both trials (Table 5). Although the oleic acid content of ‘Sikitita 2’ exceeded 70%, that of ‘Arbequina’ and ‘Arbosana’ remained consistently less than this threshold. ‘Sikitita 2’ also showed a stable fatty acid composition in both locations, more Rancimat stability than ‘Arbosana’ and ‘Arbequina’ did in Acedera (86% vs. 61% and 49%, respectively), and more stability than ‘Arbequina’ in Carmona (67% vs. 45%, respectively) (Fig. 4).

The oil phenolic content and composition of the three cultivars were strongly influenced by the environment (Table 6). The total phenolic content (sum of individual phenol concentrations) of ‘Sikitita 2’ was not significantly different from that of ‘Arbequina’ and ‘Arbosana’ in the Acedera trial (Table 6). However, in Carmona, ‘Sikitita 2’ and ‘Arbequina’ presented lower total phenolic contents than ‘Arbosana’ (Table 6). Similar variability was also observed for the secoiridoid derivatives constituting the major phenolic constituents of extra virgin olive oil, including oleacein 3,4-DHPEA-EDA (dialdehydic form of decarboxymethyl oleuropein aglycone, commonly known as oleacein), oleocanthal p-HPEA-EDA (dialdehydic form of decarboxymethyl ligstroside aglycone), and the aldehydic derivatives of oleuropein and ligstroside aglycones [3,4-DHPEA-EA (aldehydic form of oleuropein aglycone) and p-HPEA-EA (aldehydic form of ligstroside aglycone), respectively].

Last, ‘Sikitita 2’ oil was evaluated by an official tasting panel, which noted a balanced organoleptic profile (Fig. 5). Compared with ‘Arbequina’ and ‘Arbosana’, ‘Sikitita 2’ exhibited notable green leaves and bitter characteristics, along with marked sweet and nut notes.

Conclusion

‘Sikitita 2’ was compared with ‘Arbequina’ and ‘Arbosana’, the standard cultivars used in hedgerow olive orchards worldwide. In accordance with this comparison, ‘Sikitita 2’ has the following characteristics: 1) it is an early-bearing cultivar, with yields comparable to those of ‘Arbosana’ and superior to those of ‘Arbequina’; 2) it has a tree vigor similar to that of ‘Arbosana’, with both cultivars showing less vigor than ‘Arbequina’; 3) compared with ‘Arbequina’ and ‘Arbosana’, ‘Sikitita 2’ consistently presented a significantly greater oil

Table 6. Oil phenolic profiles of ‘Sikitita 2’, ‘Arbequina’, and ‘Arbosana’ (2021–22 season) in two superhigh-density orchards (1667 trees/ha) located in Acedera (Extremadura, Spain) and Carmona (Andalusia, Spain).

Location	Cultivar	Ligustroside ($mg \cdot kg^{-1}$)	Oleacein ($mg \cdot kg^{-1}$)	Oleocanthal ($mg \cdot kg^{-1}$)	Oleuropein ($mg \cdot kg^{-1}$)	Sum of phenols ($mg \cdot kg^{-1}$)
Acedera	Sikitita 2	93.8 a[i]	143.5	68.0	106.5	436.8
Acedera	Arbequina	22.1 b	188.3	111.6	43.1	381.5
Acedera	Arbosana	180.5 a	146.5	103.6	147.0	595.5
Carmona	Sikitita 2	28.4 b	80.8 b	41.8 b	67.1 ab	240.0 b
Carmona	Arbequina	13.0 b	124.8 b	83.0 a	34.1 b	268.5 b
Carmona	Arbosana	58.3 a	210.0 a	123.5 a	97.5 a	530.8 a

[i] Values with the same or no letter are not significantly different according to analysis of variance followed by Tukey’s test at $P = 0.05$.

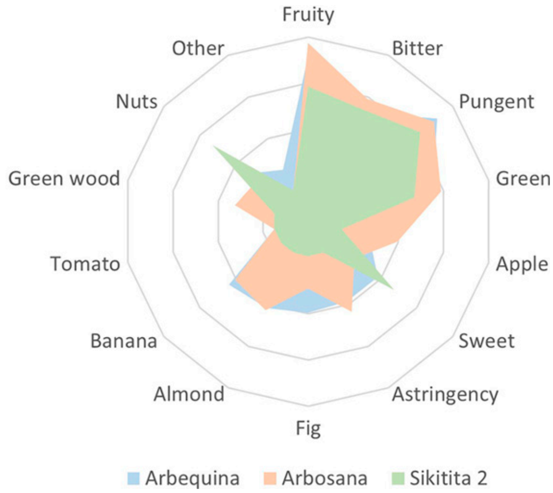

Fig. 5. Sensory characterization of the AOVEs of ‘Sikitita 2’, ‘Arbequina’, and ‘Arbosana’ (2021–22 season) from a superhigh-density orchard (1667 trees/ha) located in Carmona (Andalusia, Spain).

content (dry matter) in both trials and during the harvesting season. In addition, it is an early-ripening cultivar, enabling earlier harvests, reducing weather and pest risks, allowing earlier market entry, and improving commercial competitiveness. It produces extra virgin olive oils with a high oleic acid content, elevated total phenols, and strong oxidative stability, which are the attributes that extend shelf life and improve marketability. Last, its oil composition results in bitter green oils and commercial potential.

Availability

‘Sikitita 2’ is registered under European Union regulations under decision N. EU 69233. Information regarding nursery availability or acquisition can be obtained from www.sikitita.com or by contacting pomologia@uco.es.

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