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Original article

The potential of the Sorb (*Sorbus domestica* L.) as a minor fruit species in the Mediterranean areas: description and quality traits of underutilized accessions

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Summary. Biodiversity linked to fruit cultivation plays a key role in terms of the availability of quality products and nutraceutical compounds for the food industry. Thus underutilized species such as *Sorbus domestica* L. can be an important resource. The aim of this study was to evaluate 31 local accessions from different growing areas on the Island of Sicily and characterize the fruits according to the biometric-carpological features that constitute their quality in order to understand the potential that this species may have not only regarding the recovery and preservation of genetic resources in the Mediterranean area but also the nutraceutical compounds it offers. The results from this preliminary study showed significant differences in quality between the considered accessions and suggested that these local varieties are a good source of total polyphenol compounds.

Key words: biodiversity, *Sorbus domestica* L., minor fruits, quality, polyphenols

Introduction

Among the distribution ranges that fall within the Mediterranean basin, Italy has always been an important secondary differentiation center for many fruit species. The natural variability that distinguishes our agricultural landscape is based on a large biologic diversity both at the level of genes and species, as well as of population and ecosystem. Through man's actions, this diversity has been passed down over time in the cultivated landscape, the environmental mosaic and the ecologic web. However, as a result of globalization phenomena, today we are before a progressive diminution of this genetic variability partly due to the intensification of fruit plantations and partly to the fact that 95% of our overall food requirements is based on 30 plant species and three fourths of our diet is based on just 10 crops. The progressive abandonment of old cultivars in favor of new ones is in part a consequence of marketing and large-scale retail's need to standardize production. The demand for a product that comes from one or a few varieties per species with homogenous characteristics both regarding size and qualitative parameters has inevitably caused a flattening of consumer tastes and indirectly the progressive loss of the plant patrimony that was once the foundation of Italian fruit cultivation (1). However, consumer taste is changing, going back to seeking out both traditional flavors that satisfy the palate as well as quality products, and consequentially greater scientific interest is being given to the study of products with an elevated nutraceutical value (functional food). In any case, we are witnessing a progressive rediscovery of "forgotten flavors" that, in national fruit cultivation, is leading to a renewed interest and appraisal of "local varieties" particularly characterized by those elevated organoleptic and nutritional standards that were widespread in the past. The terms "local variety" or "accession" are derived from the English translation of the German "landrasse" (landrace) and is a technical term used for each distinct taxonomical and genetic unity introduced into a germplasm collection (2). In addition, accessions can also be defined as "historic populations made up and established in specific zones, as a result of the availability offered the natural environment and by the agricultural techniques used by man and furnished with a notable capacity to adapt to biotic and abiotic stress. They represent an important source of genes for the characteristics constituting quality and productivity in marginal environments." As stated in 2008 by the Minister of Agricultural, Food and Forest Policy, in the document "National Plan on Biodiversity of Agricultural Interest", native biodiversity (the term biodiversity was coined by W.D. Rosen in 1985 as BioDiversity, combining the expression Biological Diversity into a single word) can, in many cases, provide a useful response to new market needs. In fact, the possibility of taking advantage of native fruit resources is a great opportunity to increment a productive sector that is highly tied to seasonality and represents an important opportunity for implementing biodiversity as a resource, and also from the point of view of the supply and demand of nutritional components (3) as well as the food safety. In the field of underutilized or forgotten fruit species, the minor fruits (defined as such due to common attributes regarding biologic, socio-economic-cultural, productive and commercial aspects) (4) such as: the azerole (*Crataegus azarolus* L.), the carob tree (*Ceratonia siliqua* L.), the strawberry tree (*Arbutus unedo* L.), the cornelian cherry (*Cornus mas* L.), the quince (*Cydonia oblonga* Mill.), the kaki persimmon (*Diospyros kaki* Thunb.), the mulberry (*Morus alba* L., *Morus nigra* L., *Morus multicaulis* Loud., *Morus rubra* L.), the jujube (*Zizyphus vulgaris* Lam.), the pomegranate (*Punica granatum* L.), the common medlar (*Mespilus germanica* L.), the loquat [*Eriobotrya japonica* (Thunb.) Lindl.], the stone pine for pine nuts (*Pinus pinea* L.), the pistacchio (*Pistachia vera* L.), the elderberry (*Sambucus nigra* L.) and the service or sorb tree (*Sorbus domestica* L.) definitely constitute an important resource to study, preserve and promote since they amply contribute to the recovery and to the safeguarding of the arboreal genetic resources of the region. For example, in the past service trees were used as medicinal plants and their fruits were stored as precious sources of vitamins and sugars to be used during the winter (5). Considering the limited information relative to the characterization of service tree ecotypes in the Mediterranean distribution ranges (6) for the Italian region, after identifying and finding the accessions belonging to the *Sorbus domestica* L. germplasm present in the Sicilian region, the objective of this study was that of characterizing the fruits both from a biometric-carpological point of view as well as from a nutraceutical one with the aim of expressing this potentiality in conservation programs.

Materials and Methods

Fruits and sampling

The collection of sorb (*Sorbus domestica* L.) accessions to be studied was carried out in the Sicilian region in the autumn of 2014 within the survey of minor fruits effectuated by the Local Sections of the Sicilian Department of Agriculture and Forestry. Among the 89 minor fruit accessions identified (also including azerole, carob, strawberry tree, quince, jujube, and the common medlar), 31 were sorbs (Tab.1). For the morphologic and qualitative analysis, 30 fruits were harvested (between 6th-15th of october) and sampled for each accession from plants cultivated *in situ* or rather in their native habitat.

Carpological and qualitative sampling

Each accession included the carpological analysis of 30 fruits, using a descriptor list written specifically for minor fruits (ECPGR Minor Fruit trees Database). For each accession, the 30 fruits were weighed and the accessions average value with the standard deviation (± SD) was recorded. A digital scale (SE622, WVR, USA) was used with a precision of 0.01 g. The consistence of the flesh was measured through a manual penetrometer (Effegi, Turoni, Italy) with a diameter of 5mm. For each accession (30 fruits), two readings were taken on each of the opposite sides as well as the equatorial zone of the fruit and the average value was recorded (Kgf) cm^{-2}. The same fruits (10 g of flesh) were blended for 20 minutes at 8,000 rev/min (Sigma 3-18 K, Osterode and Harz, Germany) to extract the juices so as to determine respectively the total sugar content in °Brix as a dry refractive residual content via an Atago PAL-1 (Atago Co. Ltd., Japan) refractometer and the titratable acidity expressed as g of malic acid was evaluated through an automatic titrator (484 Titrino plus, Metrohm, Switzerland). The value reported is the average of three measurements. The determination of the total polyphenol content was carried out after extracting 10 g of flesh/ fruit plus 25 nL of buffer (500 mL of methanol. 23.8 mL of deionized water and 1.4 mL of hydrochloric acid at 37%).

After 1 hour in the absence of light each extract was homogenized (3 minutes with Ultra Turraz, IKA, Staufen, Germany), centrifuged (14 minutes x 3,000 rev/minute) and conserved at -20°C before the analyses. The total soluble polyphenols in acetonitrile extract were determined with the Folin-Ciocalteu reagent and expressed as equivelent to gallic acid (mg/100g of gallic acid) (7). The absorbance values were converted to mg/100g of gallic acid with the formula:

(0.8961502 x A765 + 6.025374 x 10-3) x (20+P)/10xP
Where:
0.8961502= molar extinction coefficient of gallic acid
A765= absorbance at 765 nm of polyphenols
6.025374 10^{-3}= mg of gallic acid contained in 1 g of methanol/acid solution
20 = weight in g of 25 ml of solution

Quality control and conservation

The morphological characterization and the qualitative analyses, with the exception of the polyphenol content, were determined using fresh fruits from all of the accessions at harvest. The content in total polyphenols however, was measured for the most productive accessions of all 5 provinces for a total of 12 different germplasm) at harvest and again after being stored at room temperature (+20°C) for 4 to 8 days.

Statistical analysis of the data

The data obtained was elaborated when possible with the ANOVA analysis of simple variation using the IBM-SPSS.22 (2015) software and the averages separated with the Tukey test for values equal or greater than 0.05.

Results and Discussion

Table 1 shows the list of native sorb (*Sorbus domestica* L.) cultivar accessions identified in the Sicilian region. At a morphological level (Table 2), the fruits can be distinguished, as written in the bibliography, into maliform and piriform (8). The size of the same in relation to the fruits' weight (Table 3) varies from small to quite large. Considering the size of the fruits (Table 4), it is possible to collocate the different accessions considered into three dif-

Table 1. List of sorb (*Sorbus domestica* L.) native cultivars and accessions of local germplasm in Sicily.

Native cv and Accession denomination		Source	Data of harvest
1	69SRB011S	ME	6 th October
2	69SRB004P	ME	6 th October
3	69SRB005S	ME	6 th October
4	69SRB012S	ME	6 th October
5	69SRB003S (SN2)	ME	6 th October
6	69SRB002S Sorbo Natalino	ME	6 th October
7	69SRB006P (SN5)	ME	6 th October
8	69SRB001S	ME	6 th October
9	69SRB008P (SN7)	ME	6 th October
10	69SRB004P (SN3)	ME	6 th October
11	67SRB008A	PA	8th October
12	67SRB009A	PA	8th October
13	67SRB010A	PA	8th October
14	67SRB005A	PA	8th October
15	67SRB004A	PA	8th October
16	67SRB003A	PA	8th October
17	67SRB002A	PA	9th October
18	67SRB001A	PA	9th October
19	66SRB023S	ME	6 th October
20	66SRB002S	ME	6 th October
21	66SRB017S	ME	6 th October
22	66SRB022S	ME	6 th October
23	71SRB003CD	AG	13 rd October
24	71SRB006CD	AG	13 rd October
25	71SRB009A Sorbo Tardivo	CT	15th October
26	71SRB005A Austarica	CT	15th October
27	104SRB003A	TP	10th October
28	61SRB001P	PA	9th October
29	DCASRB001	PA	9th October
30	Zorba d'inverno Kolymbetra	AG	13 rd October
31	90SRB050G	PA	9th October

ME= Messina; PA= Palermo; AG= Agrigento; CT = Catania; TP= Trapani

Table 2 Carpological characteristics of the Sorb accessions (*Sorbus domestica* L.) of local germoplasm in Sicily.

	Native Cv and accession denomination	Size	Form	Epicarpal surface	Epicarpal color	N° Lenticels	Flesh color
1	69Srb011s	Medium-Large	Piriform	Smooth	Yellow-Red	Few	Yellow
2	69Srb004p	Small	Piriform	Smooth	Yellow-Red	Few	Yellow
3	69Srb005s	Medium	Piriform	Smooth	Yellow-Red	Many	Yellow
4	69Srb012s	Large	Piriform	Smooth	Yellow-Red	Many	Yellow
5	69Srb003s (Sn2)	Medium	Piriform	Smooth	Yellow-Red	Medium	Yellow
6	69Srb002s Sorbo Natalino	Medium	Piriform	Smooth	Yellow-Red -Brown	Medium	Brown-Yellow
7	69Srb006p (Sn5)	Medium	Sperical Apple	Smooth	Wellow	Many	Yellow
8	69Srb001s	Medium	Spherical-Piriform Apple	Smooth	Yellow-Red	Many	Yellow
9	69Srb008p (Sn7)	Medium-Large	Spherical-Piriform Apple	Rough	Yellow-Red	Medium	Yellow
10	69Srb004p (Sn3)	Medium	Conic Piriform	Smooth	Yellow-Red	Few	Yellow
11	67Srb008a	Medium-Large	Flatened Apple	Smooth	Green Red	Few	Green-Yellow
12	67Srb009a	Medium	Piriform	Smooth	Red-Bordeaux	Few	Yellow
13	67Srb010a	Small	Spherical Apple	Smooth	Yellow-Red	Medium	Yellow
14	67Srb005a	Large	Spherical Apple	Smooth	Yellow-Red	Medium	Yellow
15	67Srb004a	Medium	Piriform	Rough	Red Green Yellow	Medium	Green-Yellow
16	67Srb003a	Medium	Flatened Apple	Smooth	Dark Red	Medium	Brown
17	67Srb002a	Large	Spherical Appl	Smooth	Green-Red	Many	Orange-Brown
18	67Srb001a	Large	Piriform	Smooth	Yellow-Red	Medium	Yellow
19	66Srb023s	Medium	Spherical Apple	Smooth	Yellow	Few	Yellow
20	66Srb002s	Medium-Large	Piriform	Smooth	Yellow	Medium	Yellow
21	66Srb017s	Medium	Spherical Apple	Smooth	Brown	Few	Yellow-Brown
22	66Srb022s	Extra Large	Very Piriform	Smooth	Intense Yellow-Red	Many	Yellow
23	71Srb003cd	Small	Spherical Apple	Smooth	Green Red	Medium	Green-Yellow
24	71Srb006cd	Extra Small	Piriform	Rough	Red-Violet	Few	Brown
25	71Srb009a Sorbo Tardivo	Medium-Large	Spherical Apple	Smooth	Yellow-Red	Medium	Yellow
26	71Srb005a Austarica	Medium-Large	Spherical-Piriforme Apple	Smooth	Yellow Brown	Many	Yellow-Brown
27	104Srb003a	Medium-Large	Piriform	Smooth	Yellow-Red	Many	Yellow
28	61Srb001p	Medium-Large	Spherical Apple	Smooth	Yellow Brown	Medium	Yellow
29	Dcasrb001	Medium	Spherical Apple	Smooth	Dark Red	Medium	Brown
30	Zorba D'inverno Kolymbetra	Medium	Piriform	Smooth	Green	Many	Yellow
31	90Srb050g	Small	Piriform	Rough	Yellow Red	Many	Yellow

ferent classes (< 10 g; 10-20 g; > 20 g) (8). The majority of the fruits (77%) present a size with a range of variability included between 10.74 and 18.79 g. The 90SRB050G accession (average value 5.43 g) is the smallest, while accession 66SRB022S (22.7 g) has the heaviest fruits. It is worth noting that the polychromia that characterizes the

Table 3. Morphologic characterization of the seeds of the sorb (*Sorbus domestica* L.) accessions from germoplasm located in Sicily.

Denomination and source	n° tot seeds		tot weight seeds		seed height		average seed thickness	
69SRB011S	3.20 ± 0.17	c-f	0.14 ± 0.01	n.s.	6.55 ± 0.00	c-g	3.92 ± 0.07	a-e
69SRB004P	1.40 ± 0.20	i- o	0.12 ± 0.01	n.s.	7.41 ± 0.02	a-d	3.91 ± 0.05	a-e
69SRB005S	3.40 ± 0.21	c-e	0.27 ± 0.02	n.s.	7.90 ± 0.16	a-c	3.93 ± 0.10	a-e
69SRB012S	3.30 ± 0.16	c-f	0.17 ± 0.01	n.s.	6.72 ± 0.09	b-g	3.91 ± 0.02	a-e
69SRB003S (SN2)	1.67 ± 0.19	h- o	0.06 ± 0.01	n.s.	7.37 ± 0.20	a-d	3.39 ± 0.09	b-g
69SRB002S Sorbo Natalino	4.00 ± 0.00	bc	0.21 ± 0.00	n.s.	7.16 ± 0.05	a-f	3.54 ± 0.02	a-f
69SRB006P (SN5)	3.50 ± 0.17	cd	0.14 ± 0.01	n.s.	6.54 ± 0.04	c-g	3.77 ± 0.04	a-f
69SRB001S	1.83 ± 0.14	g-o	0.07 ± 0.01	n.s.	7.03 ± 0.05	a-e	4.34 ± 0.05	ab
69SRB008P (SN7)	3.41 ± 0.25	c-e	0.14 ± 0.01	n.s.	6.91 ± 0.05	a-g	3.54 ± 0.06	a-f
69SRB004P (SN3)	2.27 ± 0.19	d- m	0.09 ± 0.01	n.s.	7.06 ± 0.05	a-f	3.43 ± 0.11	b-g
67SRB008A	3.83 ± 0.14	bc	0.15 ± 0.01	n.s.	6.59 ± 0.23	c-g	3.87 ± 0.08	a-e
67SRB009A	2.20 ± 0.31	e-n	0.14 ± 0.02	n.s.	6.05 ± 1.01	d-g	3.42 ± 0.58	b-g
67SRB010A	2.13 ± 0.27	f-n	0.13 ± 0.02	n.s.	7.42 ± 0.11	a-d	4.09 ± 0.14	a-d
67SRB005A	1.30 ± 0.11	i-o	0.04 ± 0.00	n.s.	6.74 ± 0.12	b-g	3.70 ± 0.02	a-f
67SRB004A	2.57 ± 0.16	d- i	0.17 ± 0.01	n.s.	7.03 ± 0.22	a-g	3.48 ± 0.07	b-g
67SRB003A	0.65 ± 0.13	o	0.02 ± 0.00	n.s.	3.76 ± 1.02	h	2.50 ± 0.68	g
67SRB002A	1.00 ± 0.00	no	0.10 ± 0.00	n.s.	7.07 ± 0.03	a-f	3.71 ± 0.03	a-e
67SRB001A	3.00 ± 0.00	c-g	0.09 ± 0.00	n.s.	6.57 ± 0.02	c-g	3.10 ± 0.01	d-g
66SRB023S	4.00 ± 0.22	bc	0.19 ± 0.01	n.s.	6.03 ± 0.22	d-g	3.75 ± 0.12	a-f
66SRB002S	2.47 ± 0.18	d- l	0.13 ± 0.01	n.s.	6.34 ± 0.14	c-g	3.71 ± 0.11	a-f
66SRB017S	1.45 ± 0.17	i-o	0.05 ± 0.01	n.s.	5.54 ± 0.62	f-g	3.31 ± 0.37	c-g
66SRB022S	3.10 ± 0.29	c-f	0.16 ± 0.01	n.s.	7.50 ± 0.12	a-d	3.70 ± 0.05	a-f
71SRB003CD	6.00 ± 0.63	a	0.15 ± 0.02	n.s.	5.82 ± 0.15	e-g	2.98 ± 0.10	e-g
71SRB006CD	5.40 ± 0.77	a	0.14 ± 0.01	n.s.	5.40 ± 0.09	g	2.79 ± 0.10	fg
71SRB009A Sorbo Tardivo	5.80 ± 0.13	a	0.18 ± 0.01	n.s.	7.83 ± 0.09	a-c	3.06 ± 0.04	e-g
71SRB005A Austarica	5.04 ± 0.44	ab	0.15 ± 0.01	n.s.	8.47 ± 0.12	a	3.93 ± 0.05	a-e
104SRB003A	1.10 ± 0.10	m-o	0.07 ± 0.01	n.s.	6.46 ± 0.15	c-g	4.54 ± 0.07	a
61SRB001P	1.47 ± 0.09	i-o	0.09 ± 0.01	n.s.	6.45 ± 0.05	c-g	3.88 ± 0.05	a-e
DCASRB001	2.80 ± 0.27	c- h	0.14 ± 0.01	n.s.	7.31 ± 0.07	a-d	4.29 ± 0.05	a-c
Zorba D'inverno Kolymbetra	1.00 ± 0.00	n-o	0.09 ± 0.00	n.s.	8.26 ± 0.07	ab	3.61 ± 0.10	a-f
90SRB050G	3.43 ± 0.13	c-e	0.14 ± 0.01	n.s.	6.74 ± 0.10	b-g	3.31 ± 0.04	c-g

The values of the Medium Values indicated by the same letters don't show statistically significant differences p≤0.05 (Tukey's test).

epicarp of the fruits oscillates between yellow without an over-coloring to dark red passing to yellow-red and bordeaux. The color is a very important aspect for the consumer, who is usually attracted to fruits with stronger and more accentuated tonalities and, in the case of fruits destined for processing industries, these latter ones are used as natural colorant additives. 77% percent of the accessions had a smooth epicarp. The sample group included both sorb fruits with an elevated number of lenicels and others with lenticels that are almost completely absent. Even if the considered fruits present an elevated variability in relation to the presence of seeds and to their biometric char-

Table 4. Qualitative characteristic of the sorb (*Sorbus domestica* L.) accessions from local germoplasm in Sicily

Native Cv and accession denomination	Fruit weight (g)	Fruit lenght (mm)	Consistancy (kg/cm^{-2})	Total soluble solids (°Brix)	Titolable acidity (meq/L)
69SRB011S	13.16 ± 0.45 d-i	27.49 ± 0.38 d-i	2.58 ± 0.13 b-i	21.10 ± 0.10 o-q	7.94 ± 0.01 n-p
69SRB004P	8.17 ± 0.29 op	27.43 ± 0.41 e-l	0.82 ± 0.25 pq	22.00 ± 0.23 nm	7.10 ± 0.02 s
69SRB005S	12.30 ± 0.46 e-l	25.47 ± 0.38 i-m	1.22 ± 0.21 n-p	26.20 ± 0.21 b	9.60 ± 0.04 i
69SRB012S	14.04 ± 0.35 c-h	29.39 ± 0.35 e-l	3.08 ± 0.06 b-d	24.52 ± 0.05 d-f	9.80 ± 0.02 i
69SRB003S (SN2)	13.88 ± 0.56 c-h	33.14 ± 0.49 b	2.98 ± 0.06 b-e	27.20 ± 0.04 a	17.70 ± 0.01 ab
69SRB002S Sorbo Natalino	14.82 ± 0.46 c-g	29.93 ± 0.29 e-l	1.53 ± 0.04 m-p	19.40 ± 0.04 r	8.10 ± 0.01 no
69SRB006P (SN5)	10.74 ± 0.43 h-o	25.01 ± 0.43 l-o	3.37 ± 0.51 b	22.47 ± 0.51 lm	11.40 ± 0.01 g
69SRB001S	14.23 ± 0.61 c-h	28.72 ± 0.40 d-g	2.32 ± 0.10 d-l	25.10 ± 0.10 cd	17.70 ± 0.01 ab
69SRB008P (SN7)	13.15 ± 0.71 d-i	25.10 ± 0.69 i-n	2.66 ± 0.05 b-h	23.20 ± 0.05 g-i	12.10 ± 0.01 f
69SRB004P (SN3)	8.11 ± 0.34 op	28.19 ± 0.36 d-h	3.19 ± 0.12 bc	24.70 ± 0.12 de	9.80 ± 0.03 i
67SRB008A	18.79 ± 0.44 b	26.28 ± 0.24 g-l	2.77 ± 0.12 b-g	17.50 ± 0.12 s	7.20 ± 0.01 rs
67SRB009A	12.83 ± 0.80 e-i	25.38 ± 0.46 i-n	2.09 ± 0.06 f-m	20.20 ± 0.06 qr	7.60 ± 0.01 qr
67SRB010A	9.52 ± 0.88 l-o	22.95 ± 0.49 n-p	1.77 ± 0.20 l-o	21.67 ± 0.28 m-p	7.75 ± 0.02 p-r
67SRB005A	14.30 ± 0.63 c-h	26.68 ± 0.36 f-l	1.97 ± 0.04 g-n	25.80 ± 0.04 bc	12.40 ± 0.03 f
67SRB004A	12.44 ± 0.30 e-l	25.92 ± 0.22 i-m	1.69 ± 0.23 m-o	21.40 ± 0.04 n-p	10.50 ± 0.04 h
67SRB003A	8.35 ± 0.33 n-p	18.67 ± 0.24 r	1.08 ± 0.04 o-q	21.60 ± 0.04 m-p	8.23 ± 0.01 mn
67SRB002A	16.10 ± 1.25 b-d	29.83 ± 0.73 de	2.00 ± 0.03 g-n	24.00 ± 0.04 e-h	8.63 ± 0.01 lm
67SRB001A	15.62 ± 0.67 c-e	32.33 ± 0.54 bc	2.25 ± 0.07 d-l	23.80 ± 0.04 e-i	14.69 ± 0.01 d
66SRB023S	11.30 ± 0.68 h-n	22.03 ± 0.47 p	1.76 ± 0.20 l-o	23.80 ± 0.20 e-i	17.20 ± 0.03 c
66SRB002S	13.38 ± 0.47 d-i	25.84 ± 0.38 i-m	1.86 ± 0.22 i-o	23.60 ± 0.20 f-i	17.50 ± 0.01 bc
66SRB017S	14.56 ± 0.75 c-g	26.06 ± 0.91 h-l	1.61 ± 0.13 m-p	17.30 ± 0.20 st	5.20 ± 0.01 t
66SRB022S	22.70 ± 0.84 a	36.48 ± 0.62 a	3.42 ± 0.10 b	23.80 ± 0.20 e-i	14.00 ± 0.02 e
71SRB003CD	7.95 ± 0.31 op	22.79 ± 0.22 op	2.07 ± 0.04 f-n	24.10 ± 0.13 e-g	13.10 ± 0.01 f
71SRB006CD	5.74 ± 0.27 p	18.94 ± 0.25 qr	0.28 ± 0.10 q	24.10 ± 0.13 e-g	13.54 ± 0.02 ef
71SRB009A Sorbo Tardivo	16.58 ± 0.87 bc	28.67 ± 0.40 d-g	2.88 ± 0.10 b-f	19.80 ± 0.10 r	12.40 ± 0.01 f
71SRB005A Austarica	15.33 ± 0.31 c-f	29.07 ± 0.58 d-f	1.26 ± 0.07 m-p	16.60 ± 0.17 t	8.83 ± 0.02 l
104SRB003A	14.30 ± 0.80 c-h	28.71 ± 0.82 d-g	2.24 ± 0.04 d-l	20.80 ± 0.04 pq	13.90 ± 0.01 e
61SRB001P	9.21 ± 0.35 m-o	22.21 ± 0.27 p	2.12 ± 0.07 e-m	23.00 ± 0.07 hi	13.80 ± 0.03 e
DCASRB001	12.37 ± 0.50 e-l	23.43 ± 0.38 m-o	2.37 ± 0.11 c-l	19.90 ± 0.13 r	10.10 ± 0.01 hi
Zorba d'inverno Kolymbetra	12.47 ± 0.24 e-l	25.27 ± 0.16 i-m	5.69 ± 0.15 a	10.00 ± 0.11 u	23.40 ± 0.03 a
90SRB050G	5.43 ± 0.16 p	21.15 ± 0.24 pq	5.20 ± 0.26 a	21.83 ± 0.26 m-o	14.00 ± 0.01 e

The values of the medium Values indicated by the same letters don't show statistically significant differences $p \leq 0.05$ (Tukey's test).

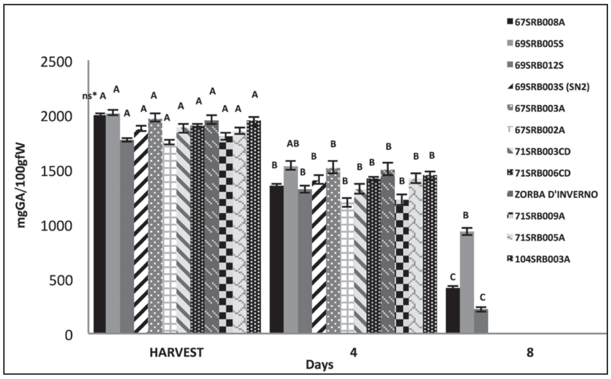

Figure 1. Polyphenol content for some local accessions at harvest and after storage at room temperature (+20°C) from 4 to 8 days. ns*= no significant differences among samples for each storage time. Uppercase letters show significant differences (p <0.05) during storage.

acteristics (Table 3), no statistically significant differences were observed regarding their weight and no correlation exists between fruit dimension and number of seeds; in fact, both accessions 90SRB050G as well as 66SRB022S present a similar number of seeds (3.4 e 3.1 respectively). The presence of seeds, however, is an important characteristic for the propagation of these minor fruits. Even if the total soluble solid content, which was highly variable for the 31 considered accessions, included a range that passed from a minimum value of 10° Brix for the Winter Kolymbetra Zorba accession to a maximum value of 27.20° Brix for the 69SRB003S (SN2) accession. The titolable acid value is not correlated to the sugar content for these two accessions. In fact, no statistically significant difference was found (23.40 and 17.70 meq/L) for these two accessions. The key to meeting the organoleptic and qualitative requirements of the fruits for consumption is generally defined by the relationship between soluble solids and acids more than their single value. In fact, based on this parameter (data not shown) (maturation index), we can assert that the 69SRB004P and 66SRB017S (respectively 3.1 and 3.3 against 0.4 for Kolymbetra Winter Zorba) accessions are those with the most defined perception of a sweet taste. The higher availability of total simple sugars is further confirmed, as would be expected, by low values of flesh consistency (texture) (0.82 and 1.61 kg/cm^2 respectively), significantly different from the values measured for the less sugary accessions (5.69 kg/cm^2). The antioxidant properties of the fruits are directly ascribable to the total polyphenol content and in particular to the specific content of composts including phenolic acids and flavonoids (9, 10). Recent studies have indicated that neochlorogenic acid (NCGA) and the chlorogenic acid (CGA) contribute most to the total accumulation of polyphenols, especially in the species *Sorbus commixta* with respectively 2583 and 5905 µg/g (11). Furthermore, extracts of polyphenols derived from sorb fruits show an inhibitory effect regarding the aldose reductase (ALR2) enzyme responsible for the etiology of long term complications for diabetes (12) suggesting a different protective potential in relation to the various stages of maturation of the fruits (13). In this study, the total polyphenol content in the harvested fruits (Fig. 1) seems to be very high for all of the considered accessions, and it falls between a minimum value of 1772.9 and a maximum value of 2017.6 mgGA/100gFW. It was possible to storage up to the end of 8 days only three of the most productive accessions of the five provinces considered (67SRB008A, 69SRB005S and 69SRB012S). After 4 days of storage at +20°C other fruits were affected by molds and it was not possible to evaluate the polyphenol content of their tissues. This was probably due to the rains that hit the areas of picking some days before the harvest time and that have caused increased susceptibility of fruits to fungi attacks. No statistically significant differences are visible between the accessions in the area of each one of the quality controls or of the conservation time of each of the accessions. As the level of maturation increases, there is a decrease in the total polyphenol content and all samples showed statistically significant differences already after 4 days of storage if compared with the harvest time. At this time point the highest levels was observed for the 69SRB005S while the lowest value were observed for the 67RB002A (respectively 1536.6 and 1220.3 mgGA/100gFW). After conserving the sorb accessions for 8 days at room temperature (+20°C), an important decrease in polyphenols can be observed for the most preservable samples in respect to the value at harvest equal to 87.5%. 79.9% and 53.8% for 69SRB012S, 67SRB008A and 69SRB005S the only ones to be maintained at the end of the storage. The more mature fruits contain a higher amount of tannins that are more resistant to hydrolysis in comparison to "greener" fruits that instead contain a higher amount of soluble phenols (13). The greatest decrease in the total content of polyphenols is observed in 69SRB012S, where the value goes from 1772.9 to 221.1 mg gallic acid/100 g after 8 days from harvest. While, out of all of the samples, accession 69SRB005S shows the best predisposition for conservation since it tends to preserve the neutraceutical composts in conservation maintaining values equal to 931.5 mg gallic acid/100 g of product until the end of conservation.

Conclusions

The work presented here represents a first approach to the study of biodiversity regarding the "minor" fruit species. The possibility offered by the application of the principal morphological descriptors in the study of this material constitutes a real contribution to the comparative knowledge of the genetic resources belonging to our native patrimony. The obtained results showed a high level of genetic variability present in the sorb apples examined, regarding the biometric characteristics of the fruit. The fact that all of the plants are indigenous in origin and furthermore devoid of any form of agricultural management since they are wild confirmed how much the genetic variability of the germplasm considered can be the result of both environmental pressure as well as exchanges of plant material for propagation between local cultivators (1). It is noteworthy that this variability is present not just throughout the regional area, but even within specific districts of a modest area. The sorb-apple is in fact equally present throughout all of Sicily, as it makes up (together with other plants) the Mediterranean shrub land, or *macchia*. However, it is particularly widespread on the north-eastern side of the island. In fact, it is clear that where agriculture has been affected by less intensification and by plantation renewal, for whatever social, agricultural or climatic reason, biodiversity has been better preserved. The conservation, recovery and reintroduction of minor fruits such as the sorb-apple is of great interest not only for the purposes of requalifying the region, but also in reference to the nutraceutical properties possessed by its fruits as demonstrated by the total content of polyphenols, as well as the rustic nature of the species, which is not very susceptible to pathogen and parasite attack. This latter aspect allows the fruits to be handled and processed while maintaining a high biological value.

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