Production of ready to drink red and rosé wines from new seedless grapevine crossbreeds

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Abstract. Monomeric and polymeric flavan-3-ols (proanthocyanidins) content in grapes is higher in seeds compared to berry skins. Monomeric flavan-3-ols are more astringent, however, they can combine with other monomer, with anthocyanins and with mannoproteins released by yeast and therefore lose their harsh features in wines. Proanthocyanidins extracted during fermentation and maceration processes in red wines, are important for the organoleptic characteristics of the product and for its aging. There is a difference between skins and seeds proanthocyanidins, with the latter being perceived as more harsh and astringent. One of the most important purposes of refinement and aging of red wines very rich in polyphenols is the slow loss of bitterness. Instead, for wines ready to drink seeds tannins can give bitter overtones, therefore reducing their quality since consumers generally prefer a reduced astringency and attenuated bitterness. This paper investigates the possibility of employ some new seedless grapes crossings of Vitis vinifera L., obtained in recent breeding programs carried out at the CREA-VE of Turi, for the production of improved red and rosé wines made with traditionally red winemaking.

1. Introduction

Among the most important polyphenols found in grape anthocyanins are coloured pigments that characterize red grapes varieties which are mainly present in berry skin [1] and, just in traces, in the subepidermical region of the most coloured varieties. Another class of polyphenols, oligomers of flavan-3-ols called proanthocyanidins, are located part in the skin, others in seeds and in high quantity in grapes stems. [2] There is a difference among the structure of different proanthocyanidins based on their localization in different parts of the berry. Proanthocyanidins stored in seeds are mainly composed of: (+)-epicatechin, (−)-epicatechin and (−)-epicatechin-3-gallate (ECG) [3] whereas in the skin four monomers are usually found: (+)-catechin, (–)-epicatechin, (–)-epicatechin-3-gallate (ECG) and (–)-epigallocatechin (EGC) [4]. Moreover, the mean degree of polymerization (mDP) is usually different between seeds and skin: it is lower in seeds and higher in skin. [5] The lower polymerization of proanthocyanidins in seeds is responsible of important modifications of the perceived astringency of red wines. [6] Indeed, proanthocyanidins influence the bitter perception of wines which increases with the decrease of mDP and the galloylation degree, [7] the hydroxylation of B ring and the stereochemistry of single subunits. [8] The presence of anthocyanins reduces the perception of astringency, [8] indeed during aging the reaction of anthocyanins and proanthocyanidins might explain the change from "hard" to "soft" tannins [7] During fermentation and aging of wine the interaction of proanthocyanidins and anthocyans reduces the astringency, the influence of this interaction depends on the amount of these two classes of polyphenols in wine. Proanthocyanidins also play a role in the stabilization of wine colour due to reactions with anthocyanins. [9] In red winemaking during fermentation and maceration these important compounds pass from grape to wine. The specific winemaking conditions (temperature, SO2, ration grape skin to berry volume and presence of seeds) influence the wine final composition. [10] During fermentation, the mechanical action, punch downs, pumpovers and run-off of replacements, together with the effect of temperature and alcohol, dissolve the protective cuticle present in grape seeds, resulting in the passage in the must/wine of the substances contained in them. Depending of the desired final wine composition different operations are followed during winemaking. Ready to drink wines, which are commercialized after few months from harvesting, are required to be less astringent and with an intense and recognizable aromatic composition, therefore it is necessary to reduce the harsh astringency conferred by proanthocyanidins of the seeds. Wines such as "Beaujolais Nouveau" in France or "Novello" in Italy are produced with carbonic maceration, which differs from classical red winemaking and gives rise to ready to drink wines. In previous works seeds have been manually removed [7] in order to decrease the bitter and astringent compounds present in seeds. This paper investigates the possibility of enhancing some new seedless grapes crossings of Vitis vinifera L., obtained in recent breeding programs carried out at the CREA-VE of Turi, through the production of wines made with traditionally red winemaking. From the crossings available, were selected those who had a black-blue staining of the epidermis, an average berry weight preferably less than 4 g and a titratable acidity greater than 5 g/L. In addition, in the 2016 harvest, characterized

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by strong development of rot, the grapes of the vines that in mid-late October were completely healthy were picked, with a good chance to possess resistance / tolerance to the above adversity. The crossings used in the trial were 6 in 2015 (early maturation genotypes) and 6 in 2016 (late maturation genotypes). The genetic diversity of the varieties was tested with ampelographic analysis and analysis of molecular markers SSR. The grapes were fermented immediately after collection comprising the steps of disarticulation of the grapes, crushing, activation with selected yeast, maceration (fermentation at controlled temperature), separation of the wine from the pomace. After subsequent stabilization, the wines were analyzed for the most important oenological parameters. The wines are described as fruity and quite balanced, with separate colour intensity as a function of the grapes used in the experimentation and, indeed, they show different winemaking potential.

2. Experimental section

2.1. Harvest and wine production

During ripening the main parameters of grape maturation were checked (pH, total acidity and sugar content), together with the presence and number of seeds. Berries without any trace of seeds belong to the 1 apirenic class (seedless), while berries with small hint of seeds which remain soft and herbaceous even late in ripening belong to the 2/3 apirenic class. Finally to 4 apirenic class belong varieties that have the fully formed, woody and taught seeds. For both vintages grapes have been harvested the same day in order to perform the winemakings at the same time. It was employed the same winemaking technique inoculating the same commercial yeast (Awri350 – Maurivin company). Three manually fullings every 7–8 hours were performed during the first 3/4 of the consumption of sugars during the fermentation process, and then two fullings every 10–12 hours until the total consumption of the sugars (Babo°) were performed. Finally musts were manually pressed in a wine press and stored at 10 °C after two-three days until bottling.

2.2. Chemicals

Formic acid, hydrochloric acid and water (HPLC grade) were purchased from J.T. Baker (Deventer–Holland). Ethanol RPE was purchased from Carlo Erba (Milano, Italy). The anthocyanins delphinidin-3-O-glucoside chloride, cyanidin-3-O-glucoside chloride, peonidin-3-O-glucoside chloride, and malvidin-3-O-glucoside chloride, the flavonols, quercetin-3-O-glucoside and kaempferol-3-O-glucoside, and the flavan-3-ols, procyanidin B2, (+)-catechin and (−)-epicatechin were purchased from Extrasynthese (Genay, France) and used as HPLC reference standards.

2.3. Grape must and wine composition

Total acidity, pH and alcohol were all determined on wine according to EEC regulation 2676/90. °Brix was measured from fresh berries by refractometer (Atago Pocket Refractometer). The spectrophotometric analyses were performed on an Agilent 8453 single-beam UV/VIS spectrophotometer. The Folin-Ciocalteu index for total polyphenols, the total flavonoids and the total anthocyanins amounts were measured following the Di Stefano et al. methods. [11] Due to the limited amount of grape available from the plants of the collection, two wine samples were analyzed for each variety.

2.4. HPLC–DAD analysis

An HPLC 1100 equipped with a DAD detector (Agilent Technologies, Palo Alto, Calif., USA) was used. The samples were injected into a Phenomenex Synergi Hydro-RP 80A C18 column (250 × 4.6 mm, 4 μm) with a pre-column. Separation was carried out at 22 °C, the flow rate was 1.0 mL/min and the injection volume 20 μL. The following gradient system was used with water / formic acid (90:10, v/v) (solvent A) and methanol / water / formic acid (50:40:10, v/v) (solvent B): linear gradients from 85 to 55% A in 15 min; from 55 to 30% A in 30 min; from 30 to 10% A in 10 min; from 10 to 0.1% A in 5 min; from 0.1 to 85% A in 10 min; equilibration time 5 min. The DAD detection was set at 520, 360, and 280 nm. [12] Each wine was filtered through a 0.45 μm syringe cellulose filter prior HPLC analysis. For 2015 vintage wines an anthocyanins extraction was moreover performed, adapted from the method of De Rosso et al. 2012. [12] Compounds were identified according to the retention time and the UV–Vis spectral features described in the literature. The results were expressed in terms of mg/L of malvidin-3-O-glucoside (for anthocyanins), (+)-catechin (for flavan-3-ols) and quercetin-3-O-glucoside (for flavonols).

3. Results and discussion

In 2015 all grapes were harvested that the beginning of October in order to perform a simultaneous winemaking. The analysis on grapes showed that all already accumulated a quantity of sugar over 18° Brix and a titratable acidity higher than 5 g/L. At the end of fermentation the pH was between 3.18 and 3.60 and total acidity was between 5.4 and 6.4 (Table 1), suggesting that grapes reached a perfect timing of maturation, with the only exception of S17/039 that probably was still not completely ripen. In 2016 the harvest was performed at the end of October from new genotypes obtained from late ripening varieties in order to compare both early and late ripening grapevine crossbreads. Wines obtained from these grapes shown a pH between 3.32 and 3.71 and a total acidity not below 4.8 g/l of tartaric acid (S04/132). Just for the N07/110 grapevine crossbread, which was characterized by a high production of grapes (15–20 bunches per vine), the pH was lower (3.19) and at the end the fermentation it showed the lowest amount of alcohol (7.8 %vol). The diversity between the different crossbreedings determine a different accumulation of sugar and other compounds and even a difference in the apirenic class, resulting in different wines, even if it was employed the same winemaking technique. Indeed, N11/030 and N11/008 are obtained from the same parents but have a different number of seeds: totally missing in N11/030 but present, still herbaceous and not well formed in N11/030 (Table 1).

Table 2 shows how alcohol (%vol) remained below 11.5 %vol in all the analyzed wines; it is possible that due to pedoclimatic conditions and type of cultivation of the vines (*tendone*), the plants were able just to produce

Table 1. Grape.

Vintage	Sample	AC	Berry weight (g)	Grape weight (g)	Brix °[a]	pH[a]	TA[a]
2015	S18/ 009	2/3	4	–	20.6	3.34	6.1
	S17/ 039	2/3	3.1	–	18.3	3.18	4.9
	S20/ 071	2/3	2.5	–	21.8	3.44	7.3
	N06/ 124	1	2	–	20.1	3.67	5.1
	N20/ 137	1	3.2	–	18.8	3.36	6.5
	N22/ 115	1	3	–	20.4	3.51	5.5
2016	S04/ 142	1	2.2	272.3	19.9	3.83	6.2
	S23/ 115	1	4.4	483.8	18.6	3.46	6.2
	N11/ 030	1	3	110.7	20.5	3.80	6.4
	N07/ 110	1	3.6	593.3	15.9	3.45	5.1
	N11/ 008	2/3	4.1	274.7	18.9	3.82	5.2
	S04/ 132	4	3.7	350.5	17.4	3.67	6.3

[a] Calculated on must. AC: apirenic class; TA: total acidity.

Table 2. Chemical composition of wine.

Sample	Apirenic class	pH	Total acidity	%Vol
S18/009	2/3	3.41±0.03	6.4±0.1	9.3
S17/039	2/3	2.94±0.01	7.5±0.1	9.0
S20/071	2/3	3.18±0.00	6.2±0.1	10.9
N06/124	1	3.39±0.01	5.5±0.1	11.1
N20/137	1	3.39±0.01	5.6±0.1	10.4
N22/115	1	3.60±0.03	5.4±0.1	10.5
S04/142	1	3.52±0.01	5.5±0.1	10.5
S23/115	1	3.32±0.01	6.6±0.4	10.1
N11/030	1	3.71±0.01	5.9±0.1	11.2
N07/110	1	3.19±0.00	6.1±0.1	7.8
N11/008	2/3	3.70±0.00	5.1±0.1	9.9
S04/132	4	3.55±0.02	4.8±0.2	9.4
ANOVA		***	***	

Total acidity is expressed as g/l of tartaric acid. ***: Values are significantly different ($p<0.001$).

Table 3. Colour.

Sample	C.I.	T	%420	%520	%620
S18/009	0.62±0.00	0.75±0.01	36.9	49.4	13.8
S17/039	0.51±0.01	0.65±0.00	34.8	53.1	12.2
S20/071	0.76±0.01	0.70±0.00	35.6	51.3	13.1
N06/124	0.80±0.02	0.65±0.01	34.3	52.9	12.8
N20/137	0.30±0.01	1.01±0.02	44.6	44.0	11.4
N22/115	0.50±0.01	1.07±0.01	44.1	41.3	14.6
S04/142	0.20±0.02	1.46±0.07	52.8	36.4	10.7
S23/115	0.25±0.00	0.93±0.00	44.0	47.3	8.7
N11/030	0.60±0.05	1.45±0.05	50.6	34.8	14.6
N07/110	0.20±0.02	1.09±0.04	44.9	41.3	13.8
N11/008	0.31±0.01	1.05±0.01	45.9	43.8	10.3
S04/132	0.25±0.01	1.00±0.01	45.3	45.5	9.2
ANOVA	***	***			

C.I. (Colour intensity); T (Tint). ***: Values are significantly different ($p<0.001$).

an amount of sugar that did not exceeded 21° Brix. This was confirmed by the "Saturno 150" analyzer (Crony Instruments) analysis of the residual sugar in the wines at the end of the fermentation, which were all completely dry (<1 g/L of residual sugar).

The colour intensity (C.I.) is different among 2015 and 2016 wines (Table 3). In 2016 the C.I. is 0.3 on average and only N11/030 wine shows the highest value (0.60), instead in 2015 the C.I. is 0.58 on average, with N20/137 as the less coloured wine (0.30). For all wines there was no influence of the "blue" component i.e. 620 nm absorbance, as it was expected since they are not young wines. In 2015 the 520 nm component is especially important if compared with the other two (420 and 620 nm), instead in 2016 the 420 nm is the most important component, with the exception of S23/115 for whom 520 nm component is greater. However, 420 and 520 nm are the two most important components in rosé wines, indeed, even after a traditional red winemaking the wines obtained did not showed a great red colour with a few exception.

Table 4 shows that N06/124 and N22/115 (both wines of 2015) have the highest content of total polyphenols and total flavonoids but only N06/124 has a high content of total anthocyanins. For N22/115 wine a large contribution to the polyphenolic compounds pool comes from the hydroxycinnamic and benzoic acids (data not shown). Generally, for some wines with a high total polyphenolic content we found that a considerable part of this parameter is linked to the presence of benzoic and hydroxycinnamic acids instead of flavonoids (HPLC analysis data not shown), especially for S20/071, N22/115, N11/030 and S04/132 wines. Concerning 2016 vintage wines N11/008 shows the highest content of both total polyphenols and total anthocyanins.

Two 2015 (S20/071 and N06/124) and one 2016 (N11/008) wines show the highest total anthocyanins amount. Anyway, the HPLC analysis of anthocyanins showed different results for wines from the two vintages. Four wines of 2015, namely S18/009, S17/039, S20/071, N20/137 and N22/115 are poor of the main anthocyanins usually found in wines and showed peaks at the end of the chromatogram which are characteristic of polymerized anthocyanins. Indeed, the colour of these wines was orange-red, suggesting the presence of oxidized forms.

Wine N06/124 was an exception showing an anthocyanin profile similar to 2016 vintage wines. The HPLC analysis performed on wines of the 2016 vintage shows how the principal anthocyanin is malvidin-3-O-glucosyde and its coumaroylated product (Table 5). All mono glucosylated forms, even if in small amount in certain varieties, are present with the exception of cyanidin in wines N11/030, N07/110, N11 /008 and N06/124 (2015). Malvidin has two methoxy groups, for that reason it is more resistant to oxidation, it looks like that in our winemaking conditions it was the main anthocyanin present in wine and also after few months after bottling, as it was detected by HPLC in good quantity in 2016 wines and is still the highest anthocyanins in even after one year

Table 4. Polyphenolic indexes.

Sample	Total polyphenols	Total flavonoids	Total anthocyanins
S18/009	567.28±15.09	475.4±50.4	84.0±7.3
S17/039	776.51±18.52	780.4±5.6	64.1±4.4
S20/071	797.23±28.83	605.1±26.6	104.5±2.6
N06/124	1394.53±18.98	1287.5±28.0	134.2±4.6
N20/137	641.39±9.13	530.7±4.7	35.7±5.8
N22/115	1173.18±13.93	800.2±11.2	56.1±7.8
S04/142	332.21±7.02	228.8±4.2	32.8±1.5
S23/115	528.22±6.24	416.0±0.0	52.3±3.0
N11/030	397.67±0.05	186.2±39.2	35.8±3.9
N07/110	329.24±9.01	264.4±54.6	19.2±2.8
N11/008	666.48±13.13	556.6±2.8	149.7±3.2
S04/132	608.07±23.05	454.6±12.6	80.9±1.9
ANOVA	***	***	***

***: Values are significantly different ($p<0.001$). Total polyphenols and total flavonoids are expressed as mg/l of (+) catechin; total anthocyanins are expressed as mg/l of malvidin-3-O-glucoside.

(2015 wines). There are some varieties that present higher amount of other anthocyanins: S23/115 has the highest amount of peonidin-3-O-glucoside; N11/008 of petunidin-3-O-glucoside and S20/071 of cyanidin-3-O-glucoside. Therefore would be interest to further investigate this aspect in order to understand if this is due to a specific and characteristic production of these anthocyanins in the hybrid grapes. Acetylated and coumaroylated forms are also present, unfortunately it was not possible to identify all the detected compound due to a lack of available standards.

In wines from 2015 vintage the HPLC analysis generally showed few anthocyanins in small amounts and polymeric forms of anthocyanins, eluted together at the end of the chromatogram. It is possible that a part of the anthocyanins did polymerized with other organic compounds or polyphenols or have been oxidized, resulting in a decrease of their content by time. Since the number and amount of compounds found did not justify the total anthocyanin parameter and the colour observed (both measured using the 520 nm absorbance) we also hypnotize the presence of cofactors which link with anthocyanins resulted in an increase of perceived colour (hypercromic effect) as reported by other authors. [13] Copigmentation is a phenomenon in which pigments and other non-coloured organic components form molecular associations or complexes, resulting in an enhancement in the absorbance. Copigmentation has not previously been taken into account in traditional wine colour measures, in the relationship between colour and pigment analysis, or in spectrophotometric assays for anthocyanin content. A confirm to this hypothesis might come from wine N06/124 (2015 vintage).

As reported in previous works alcohol content inhibits the formation of cofactor-anthocyanis pigment [13] indeed for N06/124 sample, which is the 2015 wine with the highest alcohol content (11.1%) the HPLC analysis shows an anthocyanins profile compatible with the total anthocyanins value.

In 2015 is the opposite: flavan3ols content is higher in “2/3 seeds” than “1 seeds”. Unfortunately it was not possible to identify all the detected compound due to a lack of available standards. Therefore we plan to evaluate both the proanthocyanidin and flavan reactive to vanillin content in order to measure the index of condensation (V/L) and perform more detailed analyses using HPLC-MS instruments.

Among the detected flavan-3-ols, all wines showed the presence of both (+)− catechin and (−)-epicatechin. Procyanidin B2 was only found in wines from 2015 vintage and in wines and the only two wines of 2016 vintage produced from not completely seedless grapes. There is not a clear link between the presence of galloylated forms and the apirenic classes of the grape employed. In 2015 and 2016 wines (+)-catechin is higher in all wines produced from grapes belonging to 2/3 and 4 apirenic classes for both the vintages (Table 6), and moreover it was high in a wine produced from a seedless variety, namely N06/124.

Instead for (–)-epicatechin there was a higher amount in the seedless 2016 vintage wines, a smaller quantity in the 2/3 class (N11/008) and almost nothing in the 4 apirenic class (S04/132). In 2015 vintage the wines from seedless varieties have a content of epicatechin in average 62.3% lower if compared to the 2/3 varieties. It is possible that the climate influenced the proportion of accumulation of catechin and epicatechin in seedless, 2/3 and 4 grape varieties, therefore would be interesting to investigate how the metabolic pathway might have changed depending on the presence or absence of seeds. For procyanidin B2 is interesting to notice how in 2016 this compound is only present in wines produced by 2/3 and 4 apirenic classes grapes. Differently in 2015 procyanidin B2 is present in good quantity in the seedless wines, even if it is higher in 2/3 varieties, involving the possibility that ageing of wine increases the presence of oligomeric and polymeric forms. The astringency and bitterness of red wines cannot be predicted from their component composition. There is considerable confusion as to the relative roles of monomeric and polymeric phenols in both astringency and bitterness, and there is growing evidence that the role of monomeric forms is much greater than has previously been considered. An informal sensory analysis has been already performed, and a future planned sensorial trial of these wines will be conducted with a panel of trained testers in order to understand the perception of some important characteristics of these wines especially concerning taste, body, bitterness and astringency.

We were also able to identify the main flavonols which were quercetin glucoside and glucuronide, followed by

Table 5. HPLC anthocyanin profile.

Sample	DG	CG	PeG	PG	MG	PC	MC
S18/009	1.36±0.07	0.12±0.01	0.18±0.01	0.23±0.013	7.02±0.34	0.24±0.0	0.80±0.04
S17/039	0.16±0.01	0.14±0.01	0.35±0.02	0.203±0.01	4.01±0.19	n.f.	0.404±0.02
S20/071	0.62±0.030	0.35±0.01	0.47±0.02	0.74±0.04	6.33±0.31	0.37±0.02	0.50±0.02
N06/124	0.60±0.03	n.f.	2.83±0.14	1.89±0.09	37.11±1.80	0.43±0.02	2.93±0.14
N20/137	n.f.	0.09±0.00	n.f.	0.14±0.01	0.25±0.01	n.f.	n.f.
N22/115	0.22±0.01	n.f.	n.f.	0.14±0.01	0.17±0.01	n.f.	0.11±0.01
S04/142	0.38±0.02	0.07±0.00	0.89±0.043	1.26±0.06	21.55±1.04	0.37±0.02	1.95±0.09
S23/115	0.282±0.01	0.12±0.01	0.97±0.05	5.78±0.28	23.58±1.14	1.83±0.09	3.10±0.15
N11/030	0.35±0.02	n.f.	0.45±0.02	0.17±0.01	18.50±0.90	0.18±0.01	1.09±0.05
N07/110	0.06±0.00	n.f.	0.30±0.01	0.57±0.03	10.78±0.52	0.35±0.02	1.34±0.06
N11/008	1.46±0.07	n.f.	5.10±0.25	3.18±0.16	144.64±7.01	2.89±0.14	9.29±0.45
S04/132	0.87±0.04	0.20±0.01	2.7±0.13	5.407±0.27	69.73±3.38	1.02±0.05	4.02±0.19
ANOVA	***	***	***	***	***	***	***

***: Values are significantly different ($p<0.001$).Compounds are expressed as mg/l of malvidin -3-O-glucoside; DG: delphinidin -3-O- glucoside; CG: cyanidin -3-O- glucoside; PeG: petunidin -3-O- glucoside; PG: peonidin -3-O- glucoside; MG: malvidin -3-O-glucoside; PC: peonidin -3-O- (6-p-coumaroyl) glucoside; MC: malvidin -3-O- (6-p-coumaroyl) glucoside.

Table 6. HPLC flavan-3-ols profile.

Sample	Catechin	B2	Epicatechin	ECG
S18/009	9.106±0.513	5.074±0.286	6.290±0.354	n.f.
S17/039	4.807±0.271	6.057±0.341	5.521±0.311	1.489±0.084
S20/071	2.468±0.139	4.262±0.240	3.908±0.220	2.147±0.121
N06/124	3.928±0.221	1.148±0.065	2.118±0.119	n.f.
N20/137	1.238±0.070	1.245±0.070	2.423±0.136	0.486±0.027
N22/115	1.324±0.075	2.344±0.132	1.629±0.092	2.631±0.148
S04/142	0.916±0.052	n.f.	25.197±1.419	2.416±0.136
S23/115	1.785±0.101	n.f.	3.263±0.184	1.559±0.088
N11/030	1.657±0.093	n.f.	14.579±0.821	2.418±0.136
N07/110	0.859±0.048	n.f.	5.288±0.298	9.128±0.514
N11/008	2.260±0.127	0.318±0.134	1.171±0.492	n.f.
S04/132	2.023±0.114	0.380±0.021	0.635±0.036	0.972±0.055
ANOVA	***	***	***	***

***: Values are significantly different ($p<0.001$). Compounds are expressed as mg/l of (+)-catechin; B1: procyanidin B1; ECG: epicatechin gallate.

kaempherol glucoside and glucuronide. In all samples Quercetin glucuronide is the main flavonol found, withthe exception of wine S18/009 in which the main compound was kaempherol glucuronide (Table 7). This class of flavonoids anyway was present in small amounts in all wines.

4. Conclusions

The exploratory analyses performed on wines obtained with red winemaking of new seedless grapevine crossbreeds showed how a long aging is not suited for these wines since there is a loss of a large part of the anthocyanins mainly due to polymerization phenomena. These grapes seems optimal for the production of wines to be consumed during the same year of production, exactly as young red wines have to be without the problem of an excess of polyphenolic compounds responsible for the astringent perception which are mainly present in seeds.

An informal sensorial evaluation of these wines has already been performed and a very interesting bouquet of aromas has been found in some wines. In N22/115 wine of the 2015 vintage (hot and dry summer) it was possible to clearly recognize a smell resembling marmalade of red fruits. In another one, namely N06/124 (from seedless grape), the sensorial perception of the wine reminded another particular variety of Central Italy, the Lacrima di Morro d'Alba which is a fruity red wine, which has a strong structure due to its peculiar content of astringent polyphenols. The N06/124 wine possesses the pleasant sensory quality of this famous wine without its astringency. Instead, other wines from 2015 vintage did not show any particular characteristic even if all winemakings, both in 2015 and 2016, were performed using the same commercial yeasts and the same treatments (SO2 addition, etc.). In 2016 wines (colder and rainy summer), instead, the perfumes are less intense but some varieties show light and pleasant bouquets: N07/110 (cherries), N11/008 (fruity and pleasant) and S23/115 (red fruit in alcohol).

Due to the high variability of the new grapevine crossbreeds each grape could be used in order to produce different types of wines e.g. rosé wine, sparkling wine and so on. The present results combined with the analysis of grape and wines produced from the same grapes in the next vintage will clarify the possible final destination of the winemaking product of each variety. Concerning the wines already produced and analyzed, it is possible to understand what would be the most suitable final product. N07/110 wine at a first sight seems to be not interesting (low alcohol, low anthocyanins content and a pale rosé colour), nevertheless it is one of the most interesting wines, because from these grapes it is possible to produce less alcoholic

Table 7. HPLC flavonols profile.

Sample	Qglucur	QGlu	Kglucur	KGlu
S18/009	2.133±0.120	0.961±0.054	3.697±0.208	0.023±0.001
S17/039	7.218±0.407	0.371±0.021	0.357±0.020	n.f.
S20/071	4.027±0.227	1.996±0.112	3.627±0.204	n.f.
N06/124	5.338±0.301	0.569±0.032	1.064±0.060	n.f.
N20/137	4.016±0.226	1.989±0.112	3.616±0.204	n.f.
N22/115	3.189±0.180	0.637±0.036	0.244±0.014	n.f.
S04/142	0.823±0.046	0.450±0.025	1.017±0.057	n.f.
S23/115	2.999±0.169	0.368±0.021	6.330±0.357	n.f.
N11/030	1.318±0.074	0.118±0.007	2.310±0.130	n.f.
N07/110	1.116±0.063	0.612±0.034	1.620±0.091	0.122±0.007
N11/008	5.083±0.286	1.546±0.087	0.133±0.008	0.341±0.019
S04/132	6.893±0.388	0.685±0.039	0.143±0.008	0.290±0.016
ANOVA	***	***	***	***

***: Values are significantly different ($p<0.001$). Compounds are expressed as mg/l of quercetin-3-O-glucoside. Qglucur: quercetin-3-O-glucuronide; QGlu: quercetin-3-O-glucoside; Kglucur: kaempferol-3-O-glucuronide; KGlu: kaempferol-3-O-glucoside.

sparkling wines with a higher residual sugar at the end of the second fermentation (like Moscato d'Asti). In other cases, from some new grapevine crossbreeds it is possible to obtain good quality light rosé wines characterized by few of total polyphenols, flavonoids and anthocyanins but with a pleasant sensorial bouquet. letting the skin-must contact during the maceration process continue until the end of the fermentation, without worries of an excessive extraction of astringent polyphenols compounds or too much anthocyanins (see S23/115 or N20/137). For other wines, such as N06/124 and N11/008, which already showed interesting sensorial features, a good content of polyphenols and a more intense red colour would be possible to obtain red traditional wine (more intense colour) but with characteristics similar to Beaujolais Nouveau or Novello wines with an adequate management of the vineyard (decreasing the number of bunches for each vine) and type of training system (e.g. trellis).

Interestingly even new grapevine crossbreads obtained from the same varieties are different, e.g. N06/124 and N07/110 wines (same grape parents and same wine-making) show a very different content of polyphenolic compounds, and in other cases the same parents produced very different apirenic classes (S04/132 and S04/142). Therefore, due to these strong differences even for grapes coming from same crossbreading, we will investigate other novel grapevine crossbreads varieties created by our research group and present in the experimental field of CREA-VE in Turi (Bari).

This exploratory analysis allowed the identification of interesting seedless grapes to be employed in order to obtain novel red or rosé wines with improved features. The research will go on to further characterize these and other new grapevine crossbreads in the CREA-VE Turi (Bari) experimental field and the resulting wines, especially concerning the aromatic composition and acidic profile.

5. Future perspectives

–Evaluate both the proanthocyanidin and flavan reactive to vanillin content (Index of condensation (V/L)).

–Study of the actual acidic profile of the wines (benzoic and hydroxycinnamic acids) with HPLC.

–Investigate the presence and/or contribution of anthocyanins-cofactor pigments (% copigmentation) and the degree of anthocyanins polymerization (% polymerization) to total wine.

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