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GRAPE POMANCE GENERATION FROM GRAPE CULTIVARS CULTIVATED IN TÂRNAVE VINEYARDS IN THE FRAMEWORK OF THE CLIMATE CHANGE

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ABSTRACT

Grape pomace is a by-product obtained from the technological processing of grapes and represents on average 20% of the total amount of grapes taken for winemaking. Due to the medical, food and cosmetic interest in the valorisation of grape pomace, the present study presents the percentage of pomace resulting, the yield of must and the sugar content of must obtained for 25 grapevine cultivars, hybrids and clones for white and red wines, cultivated in the SCDVV Blaj vineyards from Blaj, Crăciunelu de Jos and Ciumbrud. In the climatic conditions of the year 2020 with heavy rains in June and cold nights in September, the highest amounts of GP are obtained from the white cultivar Hibernal (GP yield33.43% and sugar concentration in must 205 g/L) and from the white cultivar Pinot gris 18-5 (GP yield34.09% and sugar concentration in must 210 g/L). The lowest percentage of GP was obtained in the case of Pinot gris 34 Bl clone, (GP yield18.09% and sugar concentration in must 236 g/L). Our data show that the harvesting time and the terroir influence the GP yield.

Keywords: grape pomace, yield, climat changes, must, Transylvanian grapes

INTRODUCTION

Grape pomace (GP) is a byproduct generated during the winemaking process and it accounts for approximately 10–30% of the mass of grapes crushed (Tomaz et al., 2016; Voşloban et al., 2020). GP is constituted of skins, pulp, stalks and seeds, which account to 25–35 kg per 100 L of produced wine (Mendes et al., 2013). The yield of pomace production varies due to the variability in freshness and moisture contents among the various sources (Muhlack et al., 2017), to the cultivar and terroir, respectively (Voşloban et al., 2020).
GP's generation during the the winemaking process is different for white and red grapes. Thus, seeds and skins are removed before fermentation in white grape winemaking, but not removed only after a maceration period in contact with fermenting must in red grape winemaking (Antoniolli et al., 2015; Tomaz et al., 2016).
Red grapes are entirely involved in fermentation and processed skins contain much less pulp and residual sugars than the skins from white grapes that are mechanically pressed to produce juice and are not subjected to ethanolic fermentation (Silva, 2003; Ruberto et al., 2007; Mendes et al., 2013). Yield is indicator that shows the percentage ratio between the total mass used and the amount of resulting must (Balteş, 2016; Visan et al., 2018), and GP, respectively.The meteorological conditions in which specific grape cultivars are cultivated influence the maturity stage of the grapes and, obviously, the quality of the wine and GP.

Climate change has left its mark on viticulture in recent years through sudden changes in temperature and heavy rainfall or drought.
Growing grapes is a long-term commitment that requires at least five years before the newly planted vines give high-quality grapes. Changes in weather conditions (an average of 30 years), such as variations in temperature and humidity, late spring frosts, and early autumn frosts, floods, and drought, lead to certain diseases that affect grapes (Iliescu et al., 2019, Irimia et al., 2018).The health benefits of GP polyphenols have been the great interest of researchers, food industry(Beres et al., 2017), cosmetics (Beres et al., 2017; Maluf et al., 2018) and animal nutrition (Beres et al., 2017; Chedea et al., 2019; Chedea et al., 2018). In addition to phenolic antioxidants (Cotea et al., 2018), GPs also contain significant amount of lipids, proteins, nondigestiblefibre and minerals (Yu and Ahmedna, 2012). Due to these interests in GP valorisation this work presents the GP yields for some winegrapescultivars and clones cultivated in Târnave vineyards in the changing climatic conditions of the year 2020.

MATERIALS AND METHODS

Twenty-five winegrape cultivars: 11 cultivars including 8 white cultivars and 3 red cultivars; 13 clones for white wine, homologated at SCDVV Blaj as well as 1 red hybrid were analysed in this study.
Table 1 presents all the cultivars as well as their harvesting time, vineyard and pressing method.After harvesting the wine grapes were transported to the winemaking unit, were weighted and the berries were taken from the clusters by destemming. In function of the grapes mass's taken for vinification (Table 2) the destemming was done as following: for the mass less than 100 kg (e.g. Muscat-Ottonel 12 Bl from Crăciunelu de Jos, Syrah, Amurg) the manual crusher/destemmer Marchisio Baby Mano Tram (Italy) was used, for the mass between 101kg-1000 kg (e.g. Fetească Neagră, Traminer roz-60 Bl, Roze Blaj), the electrical crusher/destemmerGrifo DMC (Italy) was used, and for masses higher than 1001 kg (Feteasca Regală-21 Bl, Pinot-gris-34 Bl, Riesling Italian-3 Bl), the mechanical-horizontal destemmer /crusher was used. After destemming the resulted clusters were weighted and their percentage from the total grape mass was calculated. The grapes' pressing was done either by small pneumatic (for 90 kg), either by big pneumatic presser (for 1100 kg) as indicates Table 1.
For the resulting must different parameters were measured: the volume and weight of free run must, the free run must's content in sugar and its density, the volume and weight of the press must, the press must content in sugar, and its density. Sugar content in the must was measured using a refractometerKubler TA 25 no 656/91 (Germany).
In this measurement the unit vol. alc. was used. The density of the must was measured using a densitometer M.D.-A. (Romania) (Voşloban et al., 2020).The mass of total sugar free-run or pressed must (Kg) resulted from multiplication the free-run or pressed must volume with its sugar concentration (free run or pressed must sugar concentration in g/L) (Voşloban et al., 2020).Total sugar (of free-run or pressed must in kg) = Volume of the must x Sugar concentration.
The resulted GP was weighted and its yield was calculated. The percentage of losses was also calculated (Voşloban et al., 2020). Finally the yields for POD wine and table wine was calculated as following: Yield=(Amount of wine or GP/ Amount of grapes)x100.

Table 1. Studied wine grapecultivars, their harvesting time, vineyard location and pressing method

Cultivar/Clone/Hybrid	Harvesting data	Location	Pressing method
Cultivars			
White cultivars			
Blasius	01.10.2020	Crăciunelu de Jos	small pneumatic presser
Ezerfurt	29.10.2020	Crăciunelu de Jos	small pneumatic presser
Furmint	29.10.2020	Crăciunelu de Jos	small pneumatic presser
Hibernal	07.10.2020	Crăciunelu de Jos	small pneumatic presser
Radames	30.09.2020	Crăciunelu de Jos	small pneumatic presser
RozeBlaj	01.10.2020	Crăciunelu de Jos	small pneumatic presser
Rubin	25.09.2020	Crăciunelu de Jos	small pneumatic presser
Selena	25.09.2020	Crăciunelu de Jos	small pneumatic presser
Red cultivars			
Amurg	09.10.2020	Crăciunelu de Jos	small pneumatic presser
Fetească Neagră	24.09.2020	Crăciunelu de Jos	small pneumatic presser
Syrah	09.10.2020	Crăciunelu de Jos	small pneumatic presser
Clones (white cultivars)			
Fetească Albă-29 Bl	17-19.10.2020	Crăciunelu de Jos	big pneumatic presser
Fetească Regală-21 Bl	30.09-02.10.2020	Crăciunelu de Jos	big pneumatic presser
Ioardană 9-1 Bl	01.10.2020	Crăciunelu de Jos	small pneumatic presser
Muscat Ottonel-12 Bl	15-16.09.2020	Ciumbrud	big pneumatic presser
Muscat Ottonel-12 Bl	05.10.2020	Crăciunelu de Jos	small pneumatic presser
Neuburger-10 Bl	01.10.2020	Crăciunelu de Jos	small pneumatic presser
Pinot gris 11 Bl	05.10.2020	Blaj	small pneumatic presser
Pinot gris 18-5	05.10.2020	Blaj	small pneumatic presser
Pinot gris -34Bl	16.10.2020	Crăciunelu de Jos	big pneumatic presser
Riesling italian-3 Bl	21-22.09.2020	Ciumbrud	big pneumatic presser
Riesling italian-3 Bl	14-19.10.2020	Crăciunelu de Jos	big pneumatic presser
Riesling italian 18-15	29.10.2020	Blaj	small pneumatic presser
Riesling de Rhin 7-2 Bl	30.09.2020	Crăciunelu de Jos	small pneumatic presser
Sauvignon blanc-9 Bl	07-15.10.2020	Crăciunelu de Jos	big pneumatic presser
Traminer roz-60 Bl	16-17.10.2020	Craciunelu de Jos	big pneumatic presser
Hybrids			
Red cultivar			
Regent	10.09.2020	Blaj	small pneumatic presser

The experimental data was analyzed with the program Statview 5.0 performing one-way analysis of variance (ANOVA), followed by a Fisher protected least significant difference (PSLD) test. P values lower than 0.05 were considered significant while p values between 0.05 and 0.1 were considered as tendencies.

RESULTS AND DISCUSSIONS

Twenty-five winegrape cultivars: 11cultivars including 8 white cultivars and 3 red cultivars; 13 clones for white wine, homologated at SCDVV Blaj as well as 1 red hybrid were analysed in this study. Most cultivars cultivated in Transylvania, are white cultivars, because these vineyards belong to the B area, according to the UE zoning (Soare et al., 2010.). Following the technological line of grapes vinification, Table 2 shows the yield of clusters, wich is calculated after crushing-desteamming the grapes.

The desteamming is done by the removal of clusters in order to have a good quality wine and also GP. In our case the percentage of clusters is between 6.1 and 6.7 as Table 2 indicates. The results are in accordance to those presented in the work of Voşloban et al. (2020) also. Ţârdea et al. (2010), indicate that the clusters represent 3-8% of the grape mass and that their chemical composition is close to the one of leaves and tendrils (Ţârdea et al. 2010).

The winemakers choose to make the desteamming because during the vinification process in the clusters take place some osmotic processes as it would be the passage of the clusters' water in mustwhich is hipertonic rich in sugar, and also because during the alcoholic fermentation a part of the formed alcohol is absorbed by the clusters (Ţârdea et al. 2010, Voşloban et al. 2020).

During the crushing-desteamming process the free-run must is collected from which after fermentation the high quality POD wine is obtained. The crushed and desteammed matrix after collecting the free-run must is further pressed- in our case either with a small pneumatic presser, either with a big pneumatic presser in function of the pressed quantity (Table 1)- and the pressing must results. The pressing must is further the base of a lower quality wine like table wine.

For the resulting free-run and pressing must different parameters were measured and calculated (Table 2): volume, mass, sugar concentration, total sugar content and density. In terms of sugar concentration of the free run and pressing must, the limits were between 201.27 g/L for Fetească Regală- 21 Bl, 202.5 g/L for Riesling italian-3Bl, 204.85 g/L for Sauvignon blanc-9Bl and 236 g/L for Pinot gris-34 Bl.The results show a wine yield between 54% and 68 %, with the highest value for the cultivars Selena and Furmint, the clones Pinot gris-34 Bl and Fetească Regală-21 Bl (Table 2). The lowest yield (54%) was determined for the cultivar Hibernal and the clone Pinot gris 18-5 had also a low yield of 56%. After pressing the matrix resulted after crushing-destemming process, the grape pomace was collected and it was registered a GP yield between 34.09% for Pinot gris 18-5, 33.43% for Hibernal cultivar and 18.09% for Pinot gris 34 Bl, 18.56% for Furmint cultivar.

GP's chemical composition and its generation yield, can vary depending on factors such as environmental conditions, place of origin, grape cultivar, harvest period and various vinification techniques (Bettio, 2008). In this context the climatic conditions influence the production of GP, as they influence the growth and development of the grapes. For instance from our results we can see that the two cultivars of Pinot gris, Pinot gris 18-5 and Pinot gris 34 Bl are situated at extremes concerning the amount of GP generation. The differences might be explained by the fact that they were cultivated in different plantations, Pinot gris 18-5 at Blaj and Pinot gris 34 Bl at Crăciunelu de Jos (Table 1) so we can have a terroir influence and that the grapes havesting dates are at a difference of ten days, 05.10.2020 for Pinot gris 18-5 and 16.10.2020 for Pinot gris 34 Bl respectively.

Târnave vineyard classically produces white dry POD wines. In order to check if there is any significant difference between the white cultivars and white clones homologated at SCDVV Blaj and cultivated in Târnave vineyard, in terms of GP production, we performed a statistical analysis.Figure 1 shows that there is no significant difference between these two groups (p=0.5474).

Table 2. Technological caracteristics of the studied grape cultivars, clones and hybrids at vinification

Cultivar/ Clone/ Hybrid	Vinified grapes	Clusters		Resulting grape must										Wine yield %			Grape pomace yield		Losses	
				Free run must					Pressing must											
				Volume	Sugar					Sugar										
	(Kg)	(Kg)	(%)	(L)	Concentration (g/L)	Density	Mass (Kg)	Total sugar (Kg)	Volume (L)	Concentration (g/L)	Density	Mass (Kg)	Total sugar (Kg)	POD	Table wine	POD+ Table wine	(Kg)	(%)	(Kg)	(%)
Cultivars																				
White																				
Blasius	158	10	6,2	79	210	1,089	86	17	20	210	1,089	22	4	50	13	63	38	24,05	2	1,4
Ezerfurt	780	49	6,3	390	210	1,089	425	82	117	210	1,089	127	25	50	15	65	170	21,79	9	1
Furmint	1390	89	6,4	737	209	1,088	802	154	209	207	1,0881	227	43	53	15	68	258	18,56	14	1
Hibernal	332	21	6,4	136	205	1,087	148	28	43	205	1,0872	47	9	47	13	54	111	33,43	5	1,5
Radames	307	19	6,3	153	208	1,088	166	32	49	208	1,0881	53	10	50	16	66	65	21,17	4	1,3
Roze Blaj	239	15	6,3	120	207	1,088	131	25	33	207	1,0881	36	7	50	14	64	54	22,59	3	1,2
Rubin	212	13	6,3	108	209	1,089	118	23	34	209	1,0885	37	7	51	16	67	41	19,33	3	1,3
Selena	213	13	6,3	117	210	1,089	127	25	28	210	1,089	30	6	55	13	68	40	18,77	3	1,2
Red																				
Amurg	95	6	6,5	47	207	1,088	51	10	12	207	1,0881	13	2	50	13	63	24	25,26	1	1,2
Fetească Neagră	231	14	6,2	120	208	1,088	131	25	35	208	1,0881	38	7	52	15	67	45	19,48	3	1,4
Syrah	95	6	6,4	48	208	1,088	52	10	15	208	1,0881	16	3	51	16	67	20	21,05	1	1,1
Clones (white)																				
Fetească alba 29 Bl	6390	407	6,33	3211	206,7	1,088	3489	653	1069	206,7	1,0877	1138	215	51	15	66	1266	20,58	79	1,3
Fetească regală-21 Bl	22870	1409	6,1	12752	201,3	1,086	13852	2591	2885	201,3	1,0856	3133	585	56	12	68	4248	18,98	228	1,1
Iordană 9-1 Bl	110	7	6,4	55	205	1,087	60	11	16	205	1,0872	17	3	50	15	65	25	22,72	1	1,3
Muscat Ottonel-12 Bl *Ciumbrud*	7800	523	6,7	4290	209	1,089	4670	896	780	209	1,0885	849	163	55	10	65	1683	21	75	1
Muscat Ottonel-12 Bl *Crăciunelu*	80	5	6,5	40	210	1,089	43	8	10	210	1,089	11	2	50	12	62	20	25	1	1,4
Neuburger- 10 Bl	81	5	6,1	40	209	1,089	44	8	12	209	1,0885	13	2	50	15	65	18	22,22	1	1,2
Pinot Gris 34 Bl	2150	133	6,7	1183	236	1,1	1300	279	279	236	1,0996	307	279	55	13	68	389	18,09	21	1
Pinot gris 11 Bl	69	4	6,2	35	210	1,089	38	7	7	210	1,089	8	1	50	10	60	18	26,08	1	1,4
Pinot gris 18-5	88	5	6,1	38	210	1,089	41	8	10	210	1,089	11	2	43	13	56	30	34,09	1	1,5
Riesling Italian 18-15	150	9	6,3	75	210	1,089	82	16	19	210	1,089	21	4	50	13	63	36	24	2	1,1
Riesling Italian-3 Bl	34140	2151	6,3	9708	202,5	1,086	19220	3685	3982	202,5	1,0859	4297	785	55	13	67	7069	20,31	351	1,1
Riesling de Rhin 7-2 Bl	180	12	6,4	90	210	1,089	98	19	29	210	1,089	32	6	50	16	66	36	20	2	1,1
Sauvignon blanc-9 Bl	44880	2785	6,22	23287	204,9	1,087	25311	4760	6749	204,9	1,0871	7335	1380	51	16	67	9000	19,83	449	1
Traminer Roz-60 Bl	7700	485	6,3	4235	218	1,092	4265	923	847	218	1,0922	925	185	55	11	66	1565	20,32	100	1,3
Hybrids																				
Red																				
Regent	70	5	6,5	35	210	1,089	38	7	10	210	1,089	11	2	50	15	65	15	21,42	1	1,2

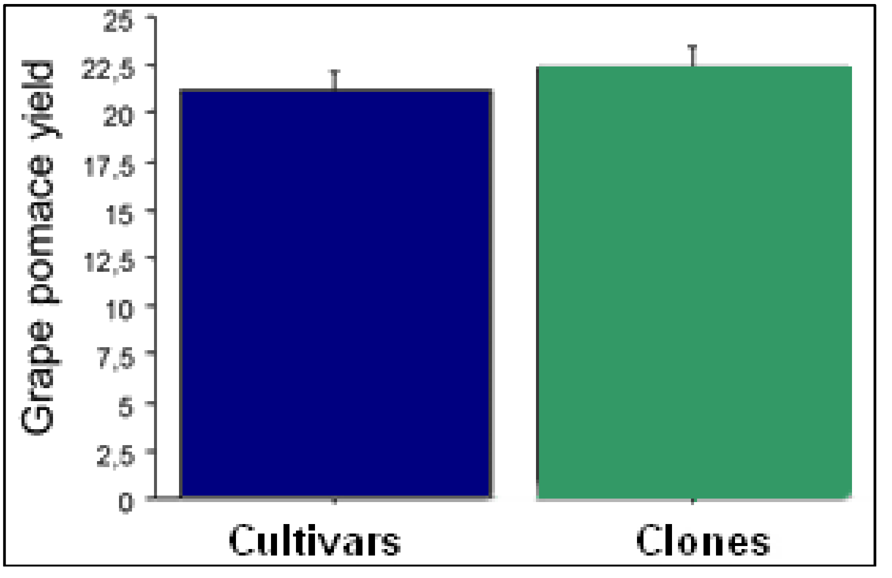

Figure 1. Grape pomace yields for the white cultivars and clones homologated a SCDVV Blaj and cultivated in Târnave vineyard

In the year 2020, the most critical period, climatically, with a negative effect on the plant, was the period of heavy rains in June that delayed the onset of flowering on the vine, and where the plant bloomed there were losses in fruit set.Also, the delay of the flowering period, by about 10 days, created a disturbance of the grapes' veraison. The veraison of grapes was particularly atypical and uneven.The cooling of the nights, in September, had a negative influence on the process of technological maturation of the grapes, with an influence on the sugar/ acidity balance in the must.The values for the active and useful thermal balance, during the vegetation period 2020 are slightly higher than the multiannual value, due to the higher temperatures in March and April. The global thermal balance has lower values until June and exceeds the multiannual average starting with July.

CONCLUSIONS

In the climatic conditions of the year 2020 with heavy rains in June and cold nights in September, the highest amounts of GP are obtained from the white cultivarHibernal (GP yield33.43% and sugar concentration in must 205 g/L) and from the white cultivar Pinot gris 18-5(GP yield34.09% and sugar concentration in must 210 g/L). Our data show that the harvesting time and the terroir influence the GP yield.

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