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Wine made from Saperavi grape variety harvested in Kindzmarauli micro zone; chemical transformations going on during the aging process of the wine and determining the aging potential.

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There are about 450 local grape varieties in Georgia. The distinguished high quality Georgian wine grape variety is Saperavi. The given variety, including Kindzmarauli, reveals its distinctive properties in a certain micro zone. Our aim was to make dry wine of different fractions from Saperavi grape variety harvested in Kindzmarauli micro zone. We planned to ferment them in different vessels and then compare them to one another organoleptically and find out what physical – chemical and biochemical transformations we would witness during its aging. Conduction of research has become more interesting for us once it turned out that there is no research found on the aging of dry wine harvested in the Kindzmarauli zone in Georgian academic papers. We believe that Saperavi, the really unique variety, should have special aging potential, especially in Kindzmarauli micro zone.

Out of 25 wines registered in the protected designations of origin in Georgia, 19 of them are produced in Kakheti. Among the red grape vine varieties, Saperavi is the most widespread in this region. It is the best material for almost all types of wine though it reveals the best properties in soil and climate conditions of macro and micro region that is typical of it. One of such micro zones is the Kindzmarauli zone.

Saperavi grape variety is used “to make both Qvevri (earthenware vessel) and European wines. Excellent rose and sparkling wines can also be produced from Saperavi.” (www.wine.gov.ge)

Saperavi that is grown on the left side of Alazani valley, in the foothills of the Caucasus, mainly on medium alluvial – carbonate, alluvial – non carbonate soils produces comparatively softer, Bordeaux – type, full bodied, harmonious, velvety wines. They are: Kvareli (Kindzmarauli), Napareuli, Sabue, Artana (training) and other high quality red wines of other places of origin. (Ampelography of Georgia)

“Professor K. Modebadze (2) describes Saperavi wine as intensely colored, full bodied, velvety when aged, which do not fall behind the best French wines when made with European methods.” (Ampelography of Georgia)

Many famous winemakers have mentioned high properties of Saperavi wine. “Indeed, Saperavi, with its high organoleptic properties, intense coloring, body, harmonious combination of the components and the strong bouquet in aging, takes first place among the best red wines in the world.” (Ampelography of Georgia)

Based on the 2019 data of the National Wine Agency, “Kindzmarauli” is the most exported wine from the wines of protected designations of origin – 17418683 bottles.” (National Wine Agency). It should be noted that the given figure exceeds the number of wines exported last year, and it increases every year.

These data also show that the interest in Kindzmarauli as a naturally semi – sweet wine is particularly high in the world wine market. However, it is no less interesting for us in what special properties the dry wine can be distinguished that is produced from Saperavi grape variety harvested from the same micro zone. It should be noted that there is no research conducted on the aging potential of dry wine made from Saperavi grape variety particularly from this micro zone. We believe that the issue is extremely significant and noteworthy.

The aim of our research was to study what physical – chemical, biochemical transformation were being carried out in the wine made from Saperavi grape variety harvested in Kindzmarauli micro zone, as well as find out what aging potential it has.

The content of tannins and phenolic compounds is very low in relation to other components of wine, about 0.1%. However, their importance is special from the grape skin of the red wine.

Anthocyanins are derived from grape skin. It is known to be one of the most important components of the red wine as they go into reaction with other compounds in the wine and polymeric pigments are produced as a result. Together with aging of wine, anthocyanin molecule goes into different reactions as a result of which their concentration in the wine bottle falls. Despite this fact, the wine still retains the red color.

Although anthocyanins are colored, their color depends on pH and thus they have different color at different acidity levels. Transformation of the given components is exactly the subject of interest for us during the course of the research in the aging process of wine.

One more very important compound in wine is tannins. Condensed tannins are Flavan – 3 polymers which give acidity, slight bitterness and dryness to the wine. It is known that the changes in the structure of tannins play a crucial role in the aging process of wine.

It's worth noting that there is no experimentally grounded research found in Georgian scientific literature, thus we aimed to start the examination by determining the chemical composition of Saperavi grape variety which was obviously harvested from Kindzmarauli micro zone. It turned out that the research conducted on a spectrophotometer showed different data both in the whole grain and pomace as well as in juice and wine.

Table 1.

	Total phenols mg/ml (calculated based on Chlorogenic acid)	Phenolic acid mg/ml (calculated based on Caffeic acid)
Saperavi		
Whole grain	6.304	1.233
pomace	60.111	6.530
juice	1.626	0.258
wine	1.716	0.671

As a result of the study we found that the number of total phenols mg/ml (calculated based on Chlorogenic acid) turned out to be the highest in the pomace 60.111, and the lowest in juice 1.621. Phenolic acids mg/ml (calculated based on Caffeic acid) turned out to be the highest in the pressed fraction 6.530, and the lowest in juice 0.258.

Table 2.

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	Total flavonoids mg/ml (calculated based on Quercetin)	Catechins mg/ml (Calculated based on D catechin)
Saperavi		
Whole grain	5.039	2.482
Pomace	50.042	23.940
Juice	1.313	0.471
wine	1.031	0.297

The highest content of total number of Flavonoids mg/ml (calculated based on Quercetin) turned out to be in pomace 50.042, and the lowest in wine 1.031 mg/ml. Catechins mg/ml (calculated based on D catechin) turned out to be highest in pomace 23.940 and the lowest in wine 0.297.

Table 3.

	Total Anthocyanins mg/ml (Calculated based on Cyanidin 3 -O glucoside chloride)	Monomeric anthocyanin mg/ml (calculated based on Malvidin 3-O glucoside)	Leucoanthocyanins per leucoanthocyanidin mg/ml	Antioxidant activity - 50% inhibition of DPPH radical by mg sample
Saperavi				
Whole grain	0.316	0.257	0.747	6.676
Pomace	4.821	3.903	4.416	0.780
Juice	0.048	0.038	0.124	94.064
wine	0.047	0.038	0.401	10.400

Total anthocyanins mg/ml (calculated based on cyanide 3-O glucoside chloride) revealed the highest index in pomace 4.821, and the lowest in wine 0.047. Monomeric anthocyanins mg/ml (calculated based on Malvidin 3 – O glucoside) turned out to be the highest in pomace 3.903, and the lowest and equal index was revealed in wine and juice 0.038. Leucoanthocyanins per leucoanthocyanidin mg/ml was found to be the highest in pomace 4.416, and the lowest in juice 0.124. Antioxidant activity – 50% inhibition of DPPH radical by mg sample – turned out to be the highest in pomace 0.780, and the lowest in juice 94.064.

For the examination we made dry wine from Saperavi grape variety of the Kindzmarauli micro zone 2024 for which we used different methods. For analyzing, we had the wine made both in polyethylene and glass containers. In both cases we had self – flowing as well as pumped fraction fermented separately. In order to analyze the harvest of the last year, as an experiment we added the wine produced from the 2022 harvest in the same micro zone which was made both in cisterns and qvevri.

Table 4.

Wine	Total phenols mg/ml (calculated based on chlorogenic acid)	Phenolic acids mg/ml (calculated based on caffeic acid)	Total flavonoids mg/ml (calculated based on quercetin)
Saperavi Control 2022	4.963	0.889	3.510
Saperavi Kindzmarauli zone 2022	6.941	1.440	4.273
Saperavi Kindzmarauli zone cistern 2022	4.737	0.881	3.660
Qvevri Saperavi 2022	4.225	1.240	2.220
Self – flowing Saperavi Plastic 2024	3.869	1.071	2.222
Saperavi, pumped plastic, Kakheti 2024	3.995	1.110	2.601
Self – flowing Saperavi glass 2024	3.801	1.076	2.544
Saperavi, pumped Glass, Kakheti 2024	3.769	1.021	2.115

The examinations conducted on spectrophotometer showed that total phenols mg/ml (calculated based on chlorogenic acid) turned out to be the highest in the wines of 2022. Phenolic acids mg/ml (calculated based on caffeic acid) turned out to be the highest in the wine of Saperavi Kindzmarauli zone 2022 – 1.440, and the lowest in the wine of Saperavi made in a cistern 2022 – 0.881. Flavonoids mg/ml (calculated based on quercetin) turned out to be the highest in the wine of Kindzmarauli zone 2022 – 4.273, and the lowest in pumped Saperavi of 2024 harvest made in a glass container – 2.115.

Table 5.

Wine	Catechins mg/ml (Calculated based on D catechin)	Total anthocyanins mg/ml (calculated based on Cyanidin 3-O glucoside chloride)
Saperavi, Control 2022	0.750	0.044
Saperavi Kindzmarauli zone 2022	1.244	0.064
Saperavi Kindzmarauli zone cistern 2022	0.999	0.035
Saperavi in Qvevri 2022	0.796	0.085
Self-flowing Saperavi Plastic 2024	0.779	0.077
Pumped Saperavi Plastic, Kakheti 2024	0.758	0.065
Self – flowing Saperavi Glass 2024	0.776	0.066

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Pumped Saperavi glass, Kakheti 2024	0.691	0.046

The highest index of Catechins mg/ml (calculated based on D catechin) is in the wines of 2022, in particular, Saperavi Kindzmarauli zone 1.244, and the lowest index in pumped Saperavi made in a glass container in 2024 0.691. Total anthocyanins mg/ml (calculated based on cyaniding 3-O glucoside chloride) turned out to be the highest in Saperavi made in Qvevri in 2022 0.085, and the lowest in Saperavi from the Kindzmarauli zone made in a cistern in 2022 – with 0.023 index.

Table 6.

Wine	Monomeric anthocyanins mg/ml (Calculated based on Cyanidin 3-O glucoside)	Leucoanthocyanins per leucoanthocyanidin mg/ml	Antioxidant activity - 50% inhibition of DPPH radical by mg sample
Saperavi, Control 2022	0.020	1.468	4.309
Saperavi, Kindzmarauli zone 2022	0.048	1.759	4.280
Saperavi Kindzmarauli zone cistern 2022	0.021	1.264	4.363
Saperavi Qvevri 2022	0.076	0.882	4.500
Self – flowing Saperavi Plastic 2024	0.064	0.851	5.909
Saperavi, pumped Plastic, Kakheti 2024	0.052	0.765	6.125
Self – flowing Saperavi Glass 2024	0.052	0.617	5.915
Saperavi, pumped glass, Kakheti 2024	0.038	0.899	6.077

As for monomeric anthocyanins mg/ml (calculated based on 3 –O glucoside), the highest index 0.076 was observed in Saperavi qvevri in 2022, and the lowest index 0.020 was observed in the harvest of 2022 in control Saperavi. Leucoanthocyanins per leucoanthocyanidin mg/ml turned out to be the highest in Saperavi Kindzmarauli zone in 20222 – 1.759, and the lowest was found in Saperavi harvest 2024, which was fermented in a glass container – 0.617. Antioxidant activity - 50% inhibition of DPPH radical by mg sample - was found to be the highest among the research samples in Saperavi Kindzmarauli zone in 2022 – 4.280, and the lowest was found in Saperavi pumped in the harvest of 2024, which was fermented in polyethylene containers at 6.125.

It should be noted that the year of 2022 was much more droughty, and the year of 2024 was rainier, therefore the chemical composition of wine also differs.

When summing up the results of our spectrophotometric examination, we conclude that the year of the harvest is of great importance in determining the aging potential of wine, in particular, meteorological factors play a significant role in it. As a result, we found that excessive precipitation in 2024 reduced the content of phenolic compounds in wine that determine the viability of wine.

Based on our research we concluded that the wines of 2022 harvest made from Saperavi grape variety collected in Kindzmarauli micro zone have a good potential of aging. The study will also show a comparison of aromatic components that we believe is no less interesting issue.

References:

1) Ampelography of Georgia
2) https://wine.gov.ge/-/News/33808

SUMMARY

Wine made from Saperavi grapes harvested in Kindzmarauli microzone, chemical transformations occurring during aging of all wines and determination of aging potential.
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