IMPACT OF PECTOLYTIC ENZYMES ON THE QUALITY OF GRAPE MUST AND QVEVRI WINE

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Annotation. The issue of wine stabilization – giving sustainability to wine and its subsequent maintenance - is an actual topic for both Georgian and world oenologists. The existence of excess polysaccharides – pectin substances in wine creates the problem of instability.
The stability of Qvevri wine needs special examination because it is made based on the fermentation of Chacha – stems rich in pectin substances and long term maceration.
To avoid this process and to give stability to wine, synthesized enzymes – pectinases have been used in processing the grapes recently. Different pectolytic enzymes out of which the most active enzymes were chosen for the experiment were tested on Qvevri wine produced by various grape varieties: for red grape varieties - LAFAZYM® XL EXTRACTION and for white grape varieties - LAFAZYM® 600 XL ICE. The concentration of pectin substances produced during the activity of these enzymes in grape must and wine has been studied.
The concentration of residual pectin substances in the wines produced is so little (up to 0,0023%) that it can only give a positive effect to the organoleptic properties of wine – it makes wine soft and smooth. In addition, there is no danger that residual pectin substances will appear in the form of protective colloids in bottled wines ready for sale.

Introduction. The history of wine production likely dates back to before the Neolithic period, which can be confirmed by the oldest archeological materials such as more than 8000 years old clay jugs with the remains of cultural grape pip and wine stone, discovered in Georgia, in Shulaveri area. Since that time, a special Georgian image of winemaking, that is, the production of Qvevri wine, has been established in Georgia, which is recognized as the homeland of wine.
During this time many problems have been solved related to winemaking, however, the issue of the stabilization of wine, that is, giving sustainability to wine and its subsequent maintenance, is an actual topic which both Georgian and world oenologists face.
One class of chemical compounds which creates the problem of instability when in excess amounts in wine, is high molecular polysaccharides – pectin substances (on the contrary, pectins in small amount give the wine velvety taste and softness).
With the ripening of grapes, as a result of the disruption of the process of the wall of the skin of the seed cell, the components of the cell, including pectin compounds, get into the grape must. Thus, due to these natural biochemical processes, the grape must, along with other substances, is enriched with pectin compounds of various forms.
They, as very negative protective colloids, surround the micelles (proteins, nucleic acids, polysaccharides), do not allow them to form and precipitate a large complex compound, which prevents the wine from being purified, causes the purified wine to become turbid and makes the filtration of the wine difficult. [Baghaturia 2015, Durmishidze, Khachidze 1985, Navari 2004].
This is the action which is characteristic to the pectin substances contained in Botrytis grapes. When grapes ripen, they first get into the grape must from the solid parts of the bunch and then into the wine and causes the problems described above. [http://www.svvr.ru/; http://dirty.ru/comments/]

To avoid this process and to give stability to the wine, synthesized enzymes – pectinases have been used recently in processing the grapes, which also increases the yield of wine.

Qvevri wine has become highly demanding in recent years the stability issue of which needs to be specially examined because it is made based on the fermentation of Chacha – stems rich with pectin substances and aged on it. The present article discusses the results of the experiments conducted to study the effectiveness of some pectolytic enzymes in making Qvevri wines.

Research objects and methods. For an examination were used Saperavi from Tsinandali micro zone for red grape variety and Mtsvane from Tsinandali micro zone for white grape variety.

Pectolytic enzymes: COLOR PLUS, VIAZYM ROUGE, Endozym ICS 10 Rouge, LAFAZYM ® XL EXTRACTION present on the market of the auxiliary materials for wine were tested on Qvevri wine made from Saperavi grape. Enzymes, such as ENARTIS ZYM AROM MP, TRENOLIN®BUKETT DF, LAFAZYM ®600 XLICE, were tested on Qvevri wine made from Mtsvane grape variety.

For determining the technical terms of the activity of pectolytic ferments (enzymes) for Qvevri wine, the grape pulp was heated at different temperature levels for each option and pH was measured.

The research object was the pulp of Saperavi, Mtsvane and Rkatsiteli heated at different temperature and proper Qvevri wines produced with and without different commercial enzymes.

The percentage content of pectin substances (soluble and insoluble pectin) in grape must and ready wines has been studied with spectrophotometric [Сборник, 1985] and gravimetric methods [Метлицкий ,1970].

Determination of pectin substances with a spectrophotometric method is based on the interaction of acid hydrolysis products of pectins with carbazole, during which the resulting colored (from crimson to red) products are measured based on the spectrophotometric and colorimetric method [Филиппов, 1999, O.I.V – (2010)].

The gravimetric (weight) method determining the pectin substances is based first on the precipitation of soluble pectin substances with calcium soluble salt in the form of calcium pectate and then on the assessment with Metlitski method.

Experimental part and results.

The grape must of Mtsvane (white grape variety) and Saperavi (red grape variety) from Tsinandali micro zone was taken to determine the activity of pectolytic enzymes. These two varieties were selected because of high content of pectin substances – protopectin and hydropectin – in their bunch [Шиукашвили, и др.2019, Shiukashvili 2019 and others. 2021].

Temperature ranges 20, 30, 40, 50 and 70^0C were selected to measure the activity of the enzymes introduced by different manufacturers. For each option was determined the yield (free –run) of the grape must and an analysis of the total pectin content in the must was performed. The results are given in Table N 1.

Table 1
Establishing technical terms of the activity of various enzymes for the grape must

Enzyme, dose	Content of pectin substances and yield of the grape must									
	20 ^{0}C		30^{0}C		40^{0}C		50^{0}C		70^{0}C	
	Pectin substance ,%	Yield, DKL	Pectin substance ,%	Yield, DKL	Pectin substance ,%	Yield, DKL	Pectin substance ,%	Yield, DKL	Pectin substance ,%	Yield, DKL
COLOR PLUS, 3g/100kg (Saperavi)	0,3321	31,3	0,3642	34,2	0,3842	37,5	0,4612	43,4	0,5565	46,6
VIAZYM ROUGE, 3g/100 kg (Saperavi)	0,3143	33,3	0,3503	35,3	0,4077	40,7	0,4562	43,8	0,5247	47,6
Endozym ICS 10 Rouge, 2ml/1t (Saperavi)	0,3426	37,8	0,3716	38,5	0,4118	39,8	0,5762	45,6	0,5960	52,3
LAFAZYM ® XL EXTRACTION, 2 ml/1t (Saperavi)	0,3236	36,2	0,3451	37,3	0,3909	42,5	0,4476	44,8	0,5162	49,7
Enartis Zym AROM MP, 40g/1t (Mtsvane)	0,2345	39,6	0,4638	39,4	0,5127	39,7	0,6253	45,1	0,7329	49,3
Trenolin® Bukett DF,10ml/100kg (Mtsvane)	0,3345	39,4	0,3953	39,3	0,6029	40,2	0,6551	44,4	0,6968	47,6
LAFAZYM ®600 XL^{ICE}, 1ml/100kg (Mtsvane)	0,3120	39,3	0,4532	40,1	0,5823	43,2	0,6547	44,7	0,7187	48,5

With the increase of the temperature, the activity of enzymes increased, which resulted in the growth of yield of grape must and the concentration of pectin substances.

The organoleptic data of the must showed that the temperature above 400^0C reduced the quality of taste indices of the must, which means that the must got taste of bitterness and boiled notes that later leads to the formation of unpleasant organoleptic properties of wine – non – specific color, smell and aroma.

In order to observe the subsequent activities of pectolytic enzymes, experiments were decided to be set at 40^0C and the duration of the fermentation process was determined as 1 hour.

According to the test results, from pectolytic enzymes were selected the most active enzymes: LAFAZYM® XL EXTRACTION was found to be the best for red grape varieties and LAFAZYM® 600 XL ^{ICE} – for white grape varieties.

As known, pectolytic enzymes make an influence on the skin and pulp of grape seed cells, disintegrate the cells and convert the insoluble pectin substances into the soluble condition. The amount of hydropectin increases in the must and creates a danger of colloid turbidity in the wine.

The impact of natural and commercial pectolytic enzymes on the amount of hydropectin converted into the must has been studied. In addition, the content of pectin substances in Qvevri wine produced with and without enzymes (naturally) was also determined. Table N2

Table N 2

Impact of enzyme on the content of pectin substances in Qvevri wine

Grape variety, place of origin	Enzyme applied, dose	Concentration of total pectins in the pulp prior to enzyme administration %	Concentration of pectin substances in wine %	
			With enzyme	Without enzyme
Rkatsiteli - Tsinandali	LAFAZYM® 600 XL ^{ICE} , 2,5 ml/t	1,6453	0,0084	0,0234
Mtsvane - Tsinandali	LAFAZYM® 600 XL ^{ICE} , 2,5 ml/t	1,7818	0,0103	0,0653
Saperavi - Tsinandali	LAFAZYM ® XL EXTRACTION, 2 ml/1t	1.1539	0,0023	0,0245

The Table shows that compared to the initial must the content of pectin substances in the wine reduced much more. This is especially evident in the wine produced with the must processed by commercial enzyme.

For example: For Saperavi, while the initial amount of pectin in the grape must was 1.1539 %, its amount was reduced 47 times (up to 0,0245%) in the wine obtained without the addition of pectolytic enzyme (with natural enzyme) and in the wine obtained with enzyme it reduced about 500 times (up to 0,0023%). A similar approach applies to the wines made from other varieties.

Thus, based on the conducted experiment it is evident that the use of enzyme LAFAZYM ®600 XL ICE from white grapes (Mtsvane, Rkatsiteli) and enzyme LAFAZYM ® XL EXTRACTION from red grapes (Saperavi), give significant results during their processing as Qvevri wine with a Kakhetian method. The optimal conditions for them are 40^0C, delay of pulp for 1 hour.

Under these conditions the yield of grape must is high. The concentration of residual pectin substances in the produced wines is so small that it can only have positive effect on the organoleptic properties of the wine – it softens and makes it smooth. In addition, there is no danger that the residual pectin substances will appear in bottled wines, ready for sale.

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