ABSTRACT

The *Doctoral Thesis* entitled "**Improving Technology of the Quality Dry White Wines Production in the Jidvei Winegrowing Centre – Târnave Vineyard"**, has been accomplished in the Jidvei Company, the Viticulture Complex. Data as reported represent five years' investigation, between 2003 and 2008. The *Fetească regala, Sauvignon Blanc,* and *Italian Riesling* grapevine varieties were used as raw material; these varieties are cultivated in the main viticultural areas of the Jidvei winegrowing centre. The research were conducted in the Jidvei winemaking laboratory where I work.

S**tructure**. The *Doctoral Thesis* has two parts, with seven chapters: **Part I – *Knowledge Stage***, the main part, contain the first two chapters; **Part II – *Personal Contributions***, the experimental part, contain five chapters.

In the main part, the Jidvei winegrowing centre is presented within the Târnave vineyards (chapter one); an incursion into the research on the Târnave wines assortment (chapter two); description of the technological draft for producing quality white wines (chapter three).

In the experimental part, the research objectives are formulated (chapter four); the quality of the grapes/raw material is established (chapter five); presentation of the research on the technological factors for improving the technology of wine manufacturing (chapter six); physico-chemical and organoleptic characterization of the wines obtained (chapter seven).

Chapter I - *Presentation of the Jidvei winegrowing centre.* The largest and the most important within the Târnave vineyard, the Jidvei winegrowing centre occupies an area of 1583 hectares (in 2006). As the winegrowing centre is set in the Târnava Mică hydrographic area, the vine plantations are located around Jidvei, Cetatea de Baltă, Bălcaciu, Tătârlaua and Sânmiclăuş. The climatic conditions here are favourable for the vine culture.

***Ecological characterisation*.** The area is hilly and rough, the average altitude is 400-600 meter high while most of the vine plantations are set on southern-western exposure slopes, with

an inclination of 5-20%. The wine plantations cover the South, South-East and South-West slopes, as well as the valleys between the hills, which shelter the vines and provide solar radiation and insolation. Brown eumezobazic soils and antrophic soils are used for viticulture while being previously modified through land working carbonate regosols are rarely encountered.

Ecological factors. The *average annual temperature* for Jidvei wine growing centre is 9.7°C, with 0.7°C higher than the mean temperature of the Târnave vineyard; the i*nsolation* during wine vegetation is 1426 hours; the *annual precipitations* sum up to 617 mm, with 459 mm in the vegetation period. Synthetical ecological indicators: the *Heliothermal Index* (Branas, 1946), IHr = 1,75; the *Hydrothermal coefficient* (Seleaninov, 1936) CH=1,5; the *Bioclimatic index* (Constantinescu, 1964), Ibcv = 6,32; the *Oenoclimatic aptitude index* (Teodorescu, 1978), IAOe = 4359. Good natural conditions are provided for growing wine varieties, with an average *vegetation period* of 170-175 days.

Chapter II - *Research on the Târnave wines assortments.* The Târnave wines have been well-known ever since the Medieval Ages (early Medieval Ages, the 10^{th}-13^{th} centuries), when this area from Transylvania was named *The Wine Land* (Weinland). The colonization of the Saxons in Transylvania in the 12^{th} century under Arpadian kings contributed to the development of viticulture and vinification.

Professional schools of viticulture and vinification in Transylvania were organized earlier than in the Romanian Kingdom; for instance, schools for wine cellar guardians were set up in Târnăveni and Aiud, and one School of Viticulture in Miniş (1881). Due to these schools and their thorough activity the research on wines started.

However, systematic research started with the opening of the **Viticulture Experimental Station** in Crăciunel (1946), the Blaj **Viticulture Experimental Station** at present. These stations have focused on the study of grapevine varieties grown in different wine regions and on defining the technological procedures for obtaining the Târnave wines.

Chapter III - *Technological draft for high quality white wines manufacturing.* The scheme was conceived and implemented along with the setting up of the Viticulture Complex in I.A.S. Jidvei in 1972. At that time the technology was mainly oriented towards manufacturing industrial *"sulphitic"* white wines, based on the rapid separation of the must from the pomace and severe clarification before fermentation, and also alcoholic fermentation with reduced possibilities of temperature control. The technology was producing low efficiency rates for

grape viticulture. They would obtain wines with no specific profiles and weak individual bouquets for different varieties.

Meanwhile the wine manufacturing technology has developed into quality wines, whose aroma are not obtained only by fermentation, but they also display a natural grape aroma. These are obtained through pre-fermentative pellicular maceration of must, with the help of enzymes.

After the privatization of the I.A.S. Jidvei in 1999, in the new Jidvei Trading Company the Vinification Complex was re-technologized. The technology line of primary grape vinification was modernized with new facilities for grape desteming and crushing, pre-fermentative pelicular maceration of must (self-vinification maceration), direct pomace processing with pneumatic horizontal presses etc.

The technology of must fermentation has been modernized and automated. The fermentation room has a capacity of 20160 hl, equipped with stainless steel tanks and is fully automated. The operator can monitor the information displayed on the screen attached to the control panel where the circuits are connected, thus there is the possibility of operating on several circuits.

Chapter IV - *Research objectives.* Establishing the quality of the grapes / raw material collected in the main vineyards; perfecting the technological procedures in the primary vinification stage; using selected yeasts and enzymatic preparations in the technology of quality white wine manufacturing.

Chapter V - *Establishing the quality of grapes / raw material.* The grape maturation process was monitored for four years (between 2003 and 2006) in the main areas of the winegrowing centre. The data obtained for the wine varieties in the main areas:

- *Fetească regală*, the Jidvei winegrowing centre (Farm-23), Bălcaciu (Farm-14), Cetatea de Baltă (Farm-23/1);
- *Sauvignon blanc*, the Jidvei winegrowing centre (Farm-7), Bălcaciu (Farm-14), Cetatea de Baltă (Farm-23/1);
- *Riesling italian*, the Jidvei winegrowing centre (Farm-23), Bălcaciu (Farm-14), Cetatea de Baltă (Farm-6).

Fetească regală. Wine variety originating from the Târnave vineyards, with a high quality potential, grown in all areas of the Jidvei winegrowing centre.

Grape maturation stage starts between 15-22 September and lasts until 25-28 November, with a total of 38-40 days. Large quantities of sugars are accumulated in the grapes (190 grams/

L), high acidity > 6 grams/L in sulphuric acid content. The values of the glucoacidimetric index at full grape maturation (Z/A) vary between 29-34.

Sauvignon Blanc. It is a cosmopolitan wine variety, with a biologic quality potential higher than the one of Fetească regală. It has high ecological plasticity and provides quality productions in all vineyards.

Grape maturation stage starts between 15-22 August and lasts for 35-38 days. Large quantities of sugars are accumulated in the grapes (200-215 grams/L), the total acidity remains stable, between 5.5-6 grams/L in sulphuric acid content The values of the gluco-acidimetric index at full grape maturation (Z/A) vary between 32-36.

Riesling italian. It is a wine variety with a high quality potential, which is yet less powerful than the one of Sauvignon Blanc wine variety. It produces quality grapes in all vineyards, especially in Bălcaciu and the Jidvei vineyards.

Grape maturation stage starts between 15-23 August and lasts for a long period, an average of 40 days. Large quantities of sugars are accumulated in the grapes (190-200 grams/L must), the total acidity is stable, between 5.5-6.5 grams/L in sulphuric acid content. The values of the gluco-acidimetric index at full grape maturation reaches peak values of 35-41.

Chapter VI - *Experimented technological factors*. The reference is made to the main technological processes in the primary stage of vinification:

** Grape / pomace antioxidant protection;*

** Grape processing and must efficiency standards;*

** Pre-fermentative pellicular maceration of must;*

** Use of pectolytic and β-glucoside enzymes;*

** Must separation/extraction through direct pomace pressing;*

** Must fermentation at low temperature with selected cryophilic yeasts.*

Grape/pomace antioxidant protection. It is produced through sulfitation with watery solutions of SO_2, concentration of 5-6%, administered on the grapes in the alimentation cave or in the pomace through injection with the dosing pump attached to the transport pipeline with the pomace.

The administrated doses of SO_2: 5-8 grams SO_2/ 100 Kg grapes/ pomace for Fetească regală wine variety, 8-12 grams SO_2 for Riesling italian, and 10-15 grams SO_2 for Sauvignon Blanc. These small doses of SO_2 do not affect the varietal aromas in grapes.

Grape processing/technological efficiency. Declustering the grapes before crushing the berries with the help of proper equipment: the declustering-crusher type VELO (made in Italy) and the breaking of the clusters through aspiration.

Technological efficiency after marc / pomace pressing (average values): Fetească regală 78%, Sauvignon Blanc, and Riesling Italian 72-75 %. These efficiency rates in press musts and free run musts assure quality in white wines.

Pre-fermentative pellicular maceration of must. It was performed directly in the basket press for Fetească regală and in self-vinification for the semi-aromatic Sauvignon Blanc and Riesling Italian wine species. Enzymatic preparations are needed for the pectin hydrolyze and for the extraction of primary varietal aromas from grapes.

In the case of Fetească regală the maceration in the basket press is short, around three to four hours, and it is made with the help of pectolytic enzymes. For semi-aromatic varieties the maceration is long, around six to ten hours, and it takes place in stainless steel tanks, with the help of enzymes at low temperatures of 10-15°C for preserving the aromas.

The experimental variants: V_1 without enzymatic preparations, at the temperature in nature; V_2-V_{10} with enzymatic preparations, at low temperatures of 10-15°C, the maceration time of six to ten hours.

Conducting the process: recording the temperature and the cooling of the must as many times as needed; homogenization of the marc at time intervals of three hours, for ten minutes; recycling the must for one hour.

The result is the efficiency of pectolytic enzymatic preparations, type Ultrazym, temperature stability at 15°C and the length of the enzymatic process of eight to ten hours.

Must extraction/separation. It was performed through direct pressing of the pomace with horizontal pneumatic presses, with a membrane (VELO and WILMES). A slow gradual pressing takes place, with the separation of the must according to its quality: press musts and free run musts. This resulted in perfecting the technology through direct pressing of must, which assures high efficiency in the musts obtained without pressing the grapes (60-65%).

The use of enzymatic preparations. Pectolytic and β-glucosidasic enzymes were experimented and with their help the pectines and the pre-aromatic formations from the grapes undergo hydrolyze. Experimented enzymatic preparations: Ultrazym, Lallzym, and Zymoclaire.

It was concluded that there is the possibility of perfecting the technological processes of pre-fermentative pellicular maceration and of pomace pressing with pectolytic enzymatic preparations.

Must clarification through partial debourbage. This occurs by keeping the deposits in must that are rich in nitric substances necessary for the yeasts during alcoholic fermentation. The clearing rate for must is 50-100 NTU.

Sulfitated musts are given a pause for 24 hours in order for the must deposits to settle through gravitation. The result is that Fetească regală musts clarify the fastest; the clarification

period takes nine hours, time during which 80% of the must deposits settle. Sauvignon Blanc musts clarify in between eleven and thirteen hours, and in the case of Riesling Italian musts the clarification time is shorter, between nine and eleven hours.

It has been pointed out that musts resulting from the grape varieties for which the pomace has been enzymated are quicker to clarify. For accelerating the technological line, with large quantities of must, the clarification is achieved with the help of Alfa-Laval centrifuge.

Must fermentation. The experiments focused on reaching advanced uniform fermentation of the sugars with the help of selected cryophilic yeasts so that wine aromas be preserved; obtaining high efficiency in alcohol rates; avoiding the interruption of the fermentation; easy settling of the yeast.

The fermentation was performed in stainless steel tanks, fully automated, equipped with cooling cloaks, temperature control sensors, a two-way pressure valve and an exit bath.

Experimental variants: V_1- with yeasts from spontaneous flora; V_2- Lallemand R2 selected yeasts; V_3-v IOC R-9001 selected yeasts; V_4- ICV-D47 selected yeasts; V_5- Fermol Cryoarome selected yeasts. Fermentation activators (nutrients) were not used/ administrated.

The observations and the determinations conducted focused on the length of fermentation, its speed and temperature.

Fetească regală. In this case the must is poorer in sugar, so the length of fermentation is shorter, nine to ten days. Its peak was reached at must fermentation with cryophilic yeasts, Fermol cryoarome (V_5).

Sauvignon Blanc. The must is rich in sugar, so the length of fermentation is long, up to twelve-fourteen days. The fermentation peak is for selected yeasts, which are difficult to adapt to high concentrations of sugar in must (variants V_2-V_5).

Riesling italian. The length of fermentation varied between nine to fifteen days, the minimum length was reached in the case of yeasts with spontaneous flora (variants V_1), and the peak was reached between thirteen and fifteen days with selected cryophilic yeasts (V_5).

Wine quality. The wines were analyzed at the end of alcoholic fermentation so that their quality potential could be analyzed. The following data was concluded:

* *Fetească regală* wines have high quality potential; the alcoholic concentration is of 11,4-12,0% alcohol by volume. Among the best ones, the wines obtained with selected yeasts ICV-D47 *(Sacch. cerevisiae)* and IOC-R 9001 *(Sacch. cerevisiae)*.

* *Sauvignon Blanc* wines have the highest quality potential; the alcoholic concentration is of 11.7-12.3% alcohol by volume. Among the best ones, the wines obtained through must fermentation with selected cryophilic yeasts, Fermol cryoarome *(Sacch. cerevisiae ph. uvarum).*

* *Riesling Italian* wines have high quality potential, similar to the one of Sauvignon Blanc wines; the alcoholic concentration is of 11,6-12,2% vol. Among the best ones, the wines obtained with selected cryophilic yeasts, Fermol cryoarome and ICV-D47.

Malolactic fermentation. Quality white wines from the Jidvei winegrowing centre contain high quantities of malic acid which reached over 2-3 grams/ L in colder years (2003 and 2005). High malic acidity shows quality and gives the wine a strong fruity taste.

Through the process of malolactic fermentation, the malic acid content in the wine is consumed by malolactic/ lactic bacteria, which results in the formation of lactic acid and carbon dioxide. By this transformation of one strong dicarboxylic acid into a weaker monocarboxylic acid, the total acidity of the wine is reduced by 1-2 grams/ L and the free/ ionic acidity (the pH of wine) increases.

The factors which influence the start of the malolactic fermentation: the pH of wine that must be > 3,2 and the free SO_2 in wine that must be < 20-30 mg/L.

Malolactic fermentation opportunity. Malolactic fermentation is a secondary microbiological process which starts spontaneously in wine at the end of alcoholic fermentation or later during wine keeping. The effects: the reduction of wine total acidity, biological stabilization in relation to lactic bacteria, and the alteration of wine organoleptic character.

For the Jidvei wines malolactic fermentation does not take place, due to the pH that has low values of 2,9-3,2 and the free SO_2 in wine.

It is necessary to seed wines with selected lactic *Oenococcus oeni* bacteria. No research has been conducted in this sense yet.

By corroborating the experimental results on the technological factors, the present technology of manufacturing quality white wines could not be improved in the Jidvei wine centre.

Chapter VII - *Characteristics of composition and senzory profile of the wine produced.*

The wines obtained in the experimental period were analyzed and tested organoleptically.

Fetească regală wines. They are produced in the highest quantity in all vineyards. They are dry and semidry, characterized by the following chemical parameters of composition and organoleptic character:

- *Fetească regală of Bălcaciu*. It has 11,3-12,3% alcohol by volume, total acidity 6,71-8,36 grams /L in tartaric acid content, dry unreduced extract 20,3-21,2 grams/ L, unfermented reduced sugars 1,3-3 grams/ L.

- *Fetească regală of Jidvei*. It has 10,9-12,0% alcohol by volume, total acidity 6,97-8,32 grams /L in tartaric acid content, dry unreduced extract 20,1-21 grams/ L, sugars 1,7-2,6 grams/ L.

- *Fetească regală of Cetatea de Baltă*. It has 10,8-11,6% alcohol by volume, total acidity 6,95-8,56 grams/L in tartaric acid content, dry unreduced extract 19,8-20,6 grams/ L, reduced sugars 0,9-2,7 grams/ L.

Organoleptic character: strong fermentation aroma, due to the high quantities of fermentation esters; fruitiness, due to the high quantities of malic acid; weak velvet-like bouquet, due to the low quantity of glycerol.

Fetească regală wines are valued and commercialized mainly as young wines when their specific organoleptic character is fully preserved. They are used for producing sparkling wines (sparkling wine of Jidvei).

***Sauvignon Blanc wines*.** They are produced in large quantities in all vineyards. They are dry, semi-dry, and semi-sweet wines, but they are best known as dry and semi-dry wines with the following chemical composition parameters and organoleptic character:

- *Sauvignon Blanc of Bălcaciu*. It has 11,5-12,6% alcohol by volume, total acidity 6,30-7,38 grams/L in tartaric acid content, dry unreduced extract 21,4-22,1 grams/ L, unfermented sugars 1,4-2,4 grams/ L.

- *Sauvignon blanc of Jidvei*. It has 11,5-12,5% alcohol by volume, total acidity 6,33-7,81 grams/L in tartaric acid content, dry unreduced extract 21,1-21,8 grams/ L, unfermented sugars 1,4-2,6 grams/ L.

- *Sauvignon blanc of Cetatea de Baltă*. It has 11,2-12,0% alcohol by volume, total acidity 6,71-8,02 grams/L in tartaric acid content, dry unreduced extract 21,0-21,5 grams/ L, unfermented sugars 1,3-2,3 grams/ L.

Organoleptic character: strong individual bouquet, due to methoxypyrazinic compounds; the taste is harmonized by the right balance between acidity and alcoholic concentration, gentle velvet-like bouquet, due to its richness in glycerol.

Sauvignon dry and semi-dry wines are valued and commercialized mainly as young wines. They are suited for aging (for two or three years), as they increase in quality, due to the formation of chemical esters of aging.

Rieling italian wines. They have a significant share in the Jidvei winegrowing centre. They are quality dry and semi-dry wines, rarely semi-sweet. Dry and semi-dry wines are characterized by the following composition parameters and organoleptic character:

- *Riesling italian of Bălcaciu*: It has 11,7-12,6% alcohol by volume, total acidity 5,97-6,73 grams/L in tartaric acid content, dry unreduced extract 21,0-21,7 grams/ L, unfermented sugars 1,6-2,8 grams/ L.

- *Riesling Italian of Jidvei*. It has 11,5-12,6% alcohol by volume, total acidity 6,14-6,82 grams/L in tartaric acid content, dry unreduced extract 20,8-21,5 grams/ L, unfermented sugars 1,5-2,5 grams/ L.

- *Riesling italian of Cetatea de Baltă*. It has 11,2-12,1% alcohol by volume, total acidity 6,45-7,34 grams/L in tartaric acid content, unfermented sugars 1,3-2,2 grams/ L.

Organoleptic character: white-greenish colour, similar to the colour of the must it emerges from; typical Riesling aroma; pleasant taste, due to the succinic acid; velvet-like, firmly structured wine.

Riesling italian wines are kept for aging for two or three years and are valued and commercialized mainly as aged wines.

My Doctoral Thesis ends with *general conclusions* (chapter eight) and the bibliography used.