Winery Professional Internship

In

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“The more grateful I am, the more beauty I see”

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Resumo

A presente dissertação de mestrado centra-se na realização de um estágio profissional, que se baseia no estudo de diferentes técnicas, protocolos e procedimentos de produção de vinho por vários métodos convencionais, realizados profissionalmente pela reconhecida empresa José Maria da Fonseca, sediada na Península de Setúbal, Portugal.

Este relatório pretende apresentar, de forma resumida, os protocolos de trabalho de um estagiário sobre os vários métodos de prática de produção de vinho na vinha e na adega para se tornar um produtor profissional . No entanto, este relatório tem como objetivo o foco no trabalho baseado na produção em adega. O presente relatório composto por quatro partes. O trabalho prático tem início com a utilização da poda mecânica em fevereiro, tendo-se seguido, em abril, a realização do trabalho laboratorial com a determinação dos parâmetros químicos. No fim, realizou-se a colheita durantes os meses de agosto e setembro.

A poda que é realizada durante fevereiro e marçoe, conhecida como a poda de inverno. A poda é um procedimento de rentabilização económica na produção de vinho. É necessário realizar poda adequada para se obter um vinho de qualidade. Trata-se de procedimento demorado. Para tal, introduziu-se uma nova técnica designada de poda mecânica que permite economizar muito tempo.

É necessário seguir um conjunto de diretrizes elaboradas pela OIV e IVV para verificar os parâmetros necessários para terminar o envelhecimento e antes das etapas de engarrafamento para comercializar o vinho produzido. A principal tarefa é manter o vinho estável na adega protegê-lo e preservá-lo de qualquer deterioração microbiológica. Os parâmetros são medidos: pH, acidez total, acidez volátil, teor alcoólico, açúcar residual (frutose, glicose), SO2 total e livre. A principal tarefa é manter o vinho estável na adega e protegê-lo e preservá-lo de qualquer deterioração microbiológica obrigatória para os vinhos engarrafados. Periodicamente, de acordo com as estações do ano (meses), na época de agosto, foram realizadas na adega para a época da colheita no processo de vinificação.

Keywords: **Região De Vinhos Da Peninsula Setúbal, José Maria da Fonseca, Poda mecánica, Parámetros tecnicos enológicas, Processo de vinificação.**

Abstract

The present Master Thesis is about Professional Internship which is based on the study of different techniques, protocols and procedures of Wine Production by several conventional and developed method professionally performed in a respected and well recognized company **José Maria da Fonseca** based in Setubal Peninsula, Portugal .The winery was founded in 1834, making his mark as the biggest wine company of Portugal. With the great old history of wine production, the company has always shown its concern to develop and adopt new effective scientific ways to produce wine of better quality and to superior extent. The company is currently operating on 7th generation wine production which is totally dedicated to produce great brands of Portuguese wine. The company is lashed with highly potent and efficient wine makers along with new tools, equipment, technology and structured export model. The company is currently exporting nearly 70 percent of its overall production providing the blend of wine to the tables of different countries like USA and many others.

This report comprises the basic idea and working protocols for a professional intern on how to perform several practices of wine production in the **vineyard** as well as in the **cellar** to be a professional wine maker. Although, this report readily focuses on cellar based work in wine production.

While we know great wine comes from the great grapes (quality-wise) for that proper harvesting is a major and quality-decisive process in a vineyard for the vines. Pruning is performed during January and February, known as **winter pruning**, Pruning is a very cost-effective procedure in wine production. A proper pruning is required to be done for good quality wine. Pruning is a time consuming procedure. Introduced a new technique called mechanical pruning by using pneumatic system of switcher attached with the tractor for pruning vines to save lot of time and cost.

To make the wine commercialize have a set of guidelines asserted by International Organisation of Vine and Wine (OIV) and Instituto da Vinha e do Vinho (IVV) is needed to be followed to check the essential chemical parameters to know the wines' status and also the quality control. Which performed all along the year, at the time April. I joined laboratory and have performed the chemical parameters checking which to finish the aging and prior to bottling steps to commercialize the wines. The parameters are measured, those are pH, Total

Acidity, Volatile Acidity, Alcoholic Strength, Residual sugar (Fructose, Glucose), Total and Free SO_2, The main task is to keep the wine stable in the cellar and protect and preserve it from any microbiological spoilage which is mandatory for bottled wines. Periodically in order by the seasons (months) at the time of August have performed in the cellar for the harvest time in vinification process.

Also, application of some new technologies for the enhanced production of wine to a larger scale have been discussed to make the production more profitable and less time consuming.

This professional internship is very beneficiary for the master student to have all knowledge to run a winery as an Enologist.

Keyword: Wine region Península de Setúbal. Jose Maria de Fonseca, Winter Mechanical Pruning, Oenological chemical Parameters, Vinification Process.

Resumo Alargado:

A presente dissertação de mestrado centra-se na realização de um estágio profissional, que se baseia no estudo de diferentes técnicas, protocolos e procedimentos de produção de vinho por vários métodos convencionais, realizados profissionalmente pela reconhecida empresa José Maria da Fonseca, sediada na Península de Setúbal, Portugal. A empresa vinícola foi fundada em 1834, deixando sua marca ao surgir como a primeira empresa de vinhos de Portugal. Com base na sua antiga história da produção de vinho, a empresa sempre demonstrou preocupação em desenvolver e adotar novas formas científicas e eficazes de produzir vinho de qualidade superior. Atualmente, a empresa conta com a participação da 7ª geração, totalmente dedicada à produção de grandes marcas de vinho português. A empresa está envolvida com produtores de vinho altamente eficazes e eficientes, além de novas ferramentas, equipamentos, tecnologia e modelos de exportação estruturados. Presentemente, a empresa exporta quase 70% de sua produção total, fornecendo a mistura de vinho para mesas de diferentes países como EUA e muitos outros.

Este relatório pretende apresentar, de forma resumida, os protocolos de trabalho de um estagiário sobre os vários métodos de prática de produção de vinho na vinha e na adega para se tornar um produtor profissional . No entanto, este relatório tem como objetivo o foco no trabalho baseado na produção em adega. O presente relatório composto por quatro partes. O trabalho prático tem início com a utilização da poda mecânica em fevereiro, tendo-se seguido, em abril, a realização do trabalho laboratorial com a determinação dos parâmetros químicos. No fim, realizou-se a colheita durantes os meses de agosto e setembro.

Uma colheita adequada é um processo importante que deve ser dotado de uma qualidade decisiva. A poda que é realizada durante fevereiro e marçoe, conhecida como a poda de inverno. A poda é um procedimento de rentabilização económica na produção de vinho. É necessário realizar poda adequada para se obter um vinho de qualidade. Trata-se de procedimento demorado. Para tal, introduziu-se uma nova técnica designada de poda mecânica que permite economizar muito tempo.

É necessário seguir um conjunto de diretrizes elaboradas pela OIV e IVV para verificar os parâmetros necessários para terminar o envelhecimento e antes das etapas de engarrafamento para comercializar o vinho produzido. A principal tarefa é manter o vinho estável na adega protegê-lo e preservá-lo de qualquer deterioração microbiológica.

De acordo com as estações do ano, durante o mês de agosto, teve início o processo de vinificação na adega.

O trabalho realizado teve igualmente como foco a discussão de aplicações de novas tecnologias para um aumento da produção de vinho, de modo a tornar a produção mais rentável.

Contents

1. Introduction

This thesis based on the Professional Internship in the **José Maria Da Fonseca**, which is situated in Setubal Peninsula, in the village is called "Azeitão". I have done my Internship 6 months for my master thesis in one of the biggest wine producer in Portugal. There are five areas discussed in wine industry. At the introduction have shown with short view of **Portuguese wine regions** and Characteristic of the **Setúbal Peninsula** with **profile of the José Maria de Fonseca** and his **prestigious wines brand**. After that overview of the advanced tools for pruning done by machine, is known as **mechanical pruning**. Then in **laboratory, checking enological chemical** parameters of wines for Quality Control and racked wine, and also performing **Chemical stabilization prior to bottle**. At the end finished with my **Vinification Process** In the cellar. This professional based internship have done by periodically during February to August.

2. Wine production in Portugal

Portuguese wine regions are classified in mainly three groups. These are DOP (Denominação de Origem Protegida), IGP (Protected Geographical Indication) and Wine. Portugal comprises a total of 14 wine regions (mainland Portugal, Azores and Madeira archipelagos), which Include 31 protected Denomination of Origin.

Wine production is considered as one of the most relevant socio—economic activities. The recent scenario have shown a slight decreasing vineyard (-2%/year), and reason cited behind this is gradually decreasing vineyard area. Recent area of vineyard is 192 thousands ha. However, Portugal is currently the 11th largest wine producer and 10th largest exporter in the world, which is remarkable considering the size of the country. More than half of the total annually produced wine is currently being exported. In absolute terms, it contributes to the national exports with over 700 million Euro/ Year. A major factor for this success is the wide recognition of Portuguese wine in foreign markets (Fraga et all, 2017).

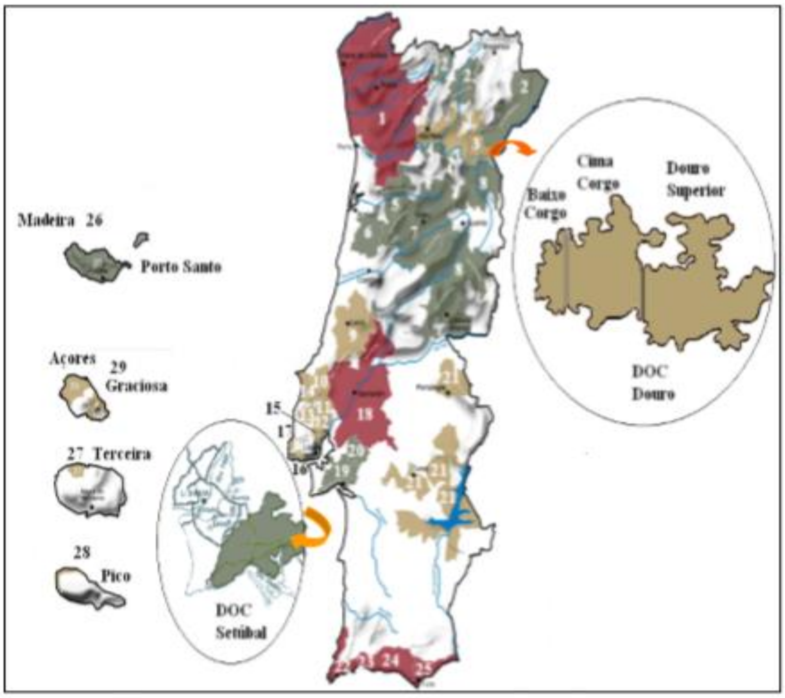


Figure 1: General Overview of the Portuguese Wine regions (Frago et al, 2017)

Setubal Peninsula is situated in south of Lisbon and one of the well-recognized port in Portugal since long time and popular as wine region since 1907.

3. History of Setubal Wine Region

Setubal Peninsula has a strong viticulture tradition. The region welcomed the first vineyard of the Iberian Peninsula, around 2000 B.C. at the hand of the Tartessians. But it was certainly with the arrival of the Phoenicians and the Greeks, after the 8th century B.C, that the art of winemaking and of drinking wine gained new form. Favorable characteristics and conditions had a pivotal role in this sector, being in the case of the Arrabida hills. The Romanization of the Iberian Peninsula contributed to the modernization of the vineyard culture with the introduction of new grape varieties and perfecting the cultivation technique.

In early middle age, from 12th to 15th Century, wine was one of the main products being exported in 1381 as a commercial treaty regarding the export of Portuguese wine to England starts, England starts to be one of the main markets of Portuguese wine. In 1675 that wine exporting from Setubal to England. Many well-known people contributed to the identity of the Setubal peninsula and to the advancement of the regional agriculture economy among them Jose Maria da Fonseca was one of the well-known. They made the “Vila Nogueira de Azeitao” as a main viticulture area and also protected the fame and prestige of the Moscatel de Setubal.

4. Localization of Setubal Wine region

Setubal this wine region has a typical “terroir” well situated to the production of its famous and much appreciated liquor wine. This region can be divided into two completely distinct geographic zones. The one in the south and south east, is mountainous, formed by the Arrabida, Roca and St. Luis mountain range and the Palmela, and Azeitão mountains, all of which are interwoven with valleys and hills, at altitudes from 100 and 500 meters; The other , by contrast, is flat, extending over a large plain along the river Sado. It has a mixed subtropical, Mediterranean climate influenced by the proximity of the sea. The river basins of the Tagus (Tejo) and Sado and by the mountain ranges and uploads of the region.

Overall, the natural heritage of the Setubal Peninsula in terms of geology, flora and fauna present in 15 areas classified according to the regional, national and international conservation criteria. The soil texture in Setubal is “podsols”, Loam is the predominant soil texture in Portugal.

The soil in the Setúbal Peninsula is essentially characterized into two types, namely, lands dominated by sediments of sandy character and acid soils in the flat zones, which justify the domination of Sobreirais and which are favorable to winemaking, intensive and irrigated horticulture and argilocalcary type in the areas of greater relief, rich in nutrients, favorable to grazing, viticulture and for diverse tree vegetation.

4.1 Setubal Climate

Overall, the wine regions in mainland Portugal are present in Mediterranean- like climate conditions, with warm dry summer and mild wet autumns-winters. In general the temperature is higher in southern part as compared to northern part. South of Portugal is warmer than other regions. (Fraga et al., 2017)

Figure 2: Setubal Wine Region

4.2 Setubal Wine Region

Setubal based on two Denominação de Origem Controlada (DOC). DO Pamela and DO Setubal. And one Geographical Protected Indication (IGP) which is called (Peninsula de Setubal) The designated area covers a total of 9,210 hectares of vineyards, although roughly 2075 hectars (ha) of this total is committed for the wine production of DO quality. Most of the produced wine is exported globally.

DOC Palmela is an important DOC on Setubal Peninsula region, immediately across the Tejo estuary main production is 67 % Castelão, and also Cabernet Sauvignon, Shyrah and

Trincadeira. Outside the DOC Castelão is very hard to get ripe in the summer time. Castelão is very found by the peninsula's warm, sandy soils which is favorable for ripen the grapes properly. Every vine varieties are exceptional by their distinct characteristics and Castelão is good aromatic red varieties to make great wine like Periquita. The aroma characteristics are fresh, fruity (red fruit). With barrel aging give complex structure of tannins soft and smooth touch like soft tannins touch sensation on the plate.

5. History of Jose Maria da Fonseca Vinhos, SA

Jose Maria da Fonseca was a Mathematician from Dão (North Portugal). He was a merchant in Lisbon. He had a land in Azeitão, that had been given as security for a debt by his father. The land where the Jose Maria began his own company in a region was already known for Muscatel. He was a visionary who introduced innovation in wine production. Jose, for the first time, planted a grape variety called Castelão that he brought from Ribatejo and from this grape variety he made **Periquita** which is recognized as Portuguese oldest table red wine. His contribution in Setubal is remarkable. He was a visionary who introduced innovation in vineyard to winemaking and also in wine business for exporting. The culture and trend of bottling of wine is brought up by JMF. Before this, wine was used to be stored and transported in large vessels. JMF emphasized on the attractiveness and personalization of wine bottles. Thus labels' were applied and the wine bottles are started to be named as brand. For instance Moscatel De Setubal dates from 1849 and Periquita from 1850. Jose Maria had a strong ambition of exporting and started selling his bottles to foreign lands. Export of winery was not common in those days but it kept progressing rapidly helped Jose Maria Da Fonseca gaining popularity and recognition nationally as well as internationally. His company was honored by King Pedro V with the Order of the Tower and Sword of Valor, Loyalty and Merit. The company started exporting in 1881 in Brazil as its 1st foreign destination and since then it has continued to export. The company exports nearly 1.2 million bottles of wine every year globally.(Carvalho, 2013)

5.1 Present Generations

Jose Maria de Fonseca was founded in 1834, crossed almost 184 years and it is still remained under the control of the same family for seven generations. And its path was, since the earliest times, carved & marked by a strong entrepreneurial spirit and international character.

JMF is the oldest Portuguese table wine producer. Currently, it owns one of the most advanced wineries in Europe and also largest in Portugal. They have a producing capacity of 6.5 million liters of wine. The company acquires 700 hectare of vineyard of its own apart from 3rd party vineyard in Setubal. Besides 100 hectare in Alentejo and 25 hector(ha) in the Douro region and they are expanding their business in every single step using new technology and enriching the business with exporting different countries.(Carvalho, 2013)

JMF grabbed no.1 position in the ranking based on the exporting value across the world, at present, António Maria Soares Franco is the marketing director and Vice president of the company. His brother, Domingos Soares Franco who is a head winemaker and responsible for the productions.

Figure 3: Present (7th &6th) Generations of Jose Maria De Fonseca Vinhos, SA

5.2 Present situation of JMF in International markets

JMF exports more than 75% of its production and is present in more than 40 markets. Sweden is the main export market in Europe and Brazil is right after it. The most important non-European market for the Group. 5 percent of the total export of JMF is engaged in the USA market giving the company great opportunity to serve its production to the most developed country and enabled the company to export the wine as per the requirement and preferred taste of elite consumers based in USA. Wine was not very much popular in USA before the entrance of JMF in USA market. Italy, Canada and other developed countries have been proven as the potent and stable market for the JMF. Steadily, JMF marked his presence as one of the most liked European wine company in the global market giving a tough competition to the other companies.

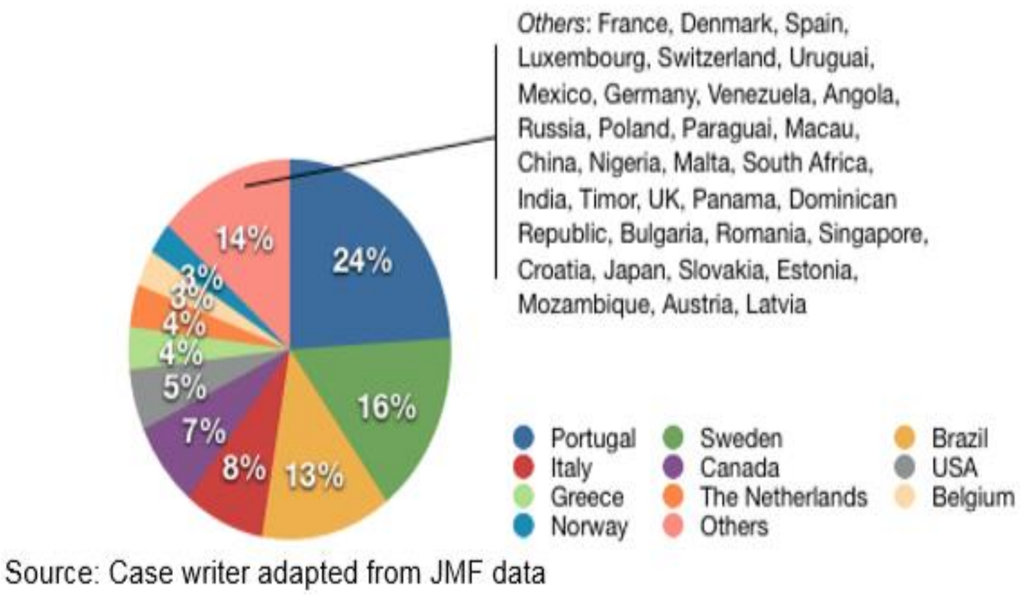


Figure 4: Selling Countries of JMF, Carvalho, 2013

5.3 Jose Maria De Fonseca major reference of wine brands

There were forty nine brands in total in the portfolio of JMF production house in 2011. The wine is broadly classified into two types, **Table wine and Fortified wine**. The wines are further classified into three markedly famous criteria viz. Covering key, Premium and super Premium Brands.

Among the forty nine wines of JMF production portfolio, **Periquita, Lancers and Moscatel** are the most recognized and appreciated wines. These three wines are completely different from each other considering different process of producing wines and divided by two aforementioned category- Table wine and Fortified/ liquors wine. Periquita and Lancers is known as Table wine whereas Moscatel de Setubal is a Fortified wine, DOC by the EU.

5.3.1 Periquita

Periquita is almost 160 years old table wine from JMF. It is the oldest wine in the portfolio of company which is blended by the greatest varieties eg Castelao,Trincaderia and Aragones. It was prepared for the first time in 1850 "*Cova da Periquita estate*".. Process of preparing Periquita is based on traditional red wine making and aging and vat for 8 months. These grapes varieties are very typical for the blending of red wines. It is one of the best-selling table wines in Portugal. Periquita is considered as the privilege of JMF wines. The 'Periquita brotherhood' was created in 1993 to promote the prestige and tradition of the wine of that name.

Figure 5: Evolution of Periquita labels and bottles (JMF book)

5.3.2 Lancers

Lancers is the new trend wine for the millennial. It is the reform of oldest rose called “Faisca” and the 1st rose was made by the JMF. American wanted a new and easy drinkable wine which is elegant but without bold European wines. Antonio Porto Soares Franco created a light rose called “Faisca”. Then Henry Behar exported Faisca to the USA. Later on the name baptized Faisca to Lancer which was coined from the favorite painting of Behar called “Las Lanzas” and became Lancers (“Lancers and Mateus – Representing a Nation of Wine,” 2007)

Figure 6: Faisca and Lancers wines (Roy)

Lancers is accounted as the most distinguished wine in the USA market after over 60 years from its inception. Production of Lancers wine helped JMF Company to spread its wings of success in the vast USA market. There are different brands of Lancers wine but mainly the most famous one is Rose.

The process of production of Lancers wine is totally different from the other table wine. The Lancers wine is prepared by vinification process which provides fresh taste to the wine making it smooth to drink. The must/ collected in a vat accompanied with sulfur di-oxide for several months to held the fermentation process. Later on with Spinning Cone apparatus is used to treat the must for di-sulfiting of the must and followed by fermentation process, This wine process which makes the wine fresh, aromatic and generating small little bubbles making the consumer palate more generous.

5.3.3 Moscatel Setubal

In JMF's 49 wines brand, the one most exceptional and authentical is Moscatel Setubal. It is a fortified dessert type wine. This region is mark Designation of Origin (DO) recognized by European Union. This region produces one third of the total fortified wines of Portugal. Since 1797, the region was registered for the production of these wines under the name "Moscatel de Setubal".

The name' Moscatel de Setubal is used when this following varieties contributes at least 85%, The wine must comply with the requirements defined by the rules of Setubal Peninsula Regional Wine Commission (CVRPS) regarding color, clarity, aroma and flavor.

5.3.3.1 Grapevine Variety

The main variety is Moscatel de Setubal which is also known as Muscatel Alexandria. 85 percent of grapes variety should be Muscatel Alexandria to authorize by the wine commission.

5.3.3.2 Characteristics of Moscatel Setubal

The actual alcoholic strength must be between 16.5 % & 22% by volume. Volatile acidity should have a maximum value of 1.2 g/l for wines over 10 years and 1.5 g/l for younger wines (under 10 years), both expressed in terms of acetic acid, with a tolerance of 15 % (for stock wines). Reducing sugars expressed as invert sugar must have a maximum value of 200 g/l for wines under 20 years of age and 280 g/l for wines over 20 years (Bravo, 2008)

5.3.3.3 Vinification Process of Moscatel

The vinification process of the Moscatel is characterized by a short-fermentation period, halted by fortification with the wine spirit or brandy (52%-86% ABV). Or wine alcohol (96%) followed by an extended maceration of 5-7 months contact with must and alcohol. Sulfur Di-oxide is only added before crushing, and the concentration of SO_2 is 30 mg/l (depend on the sanitary condition). The fermentation that occurs in contact with grape skins and alcohol in strength interrupted and the amount of unfermented sugars gives the wine the desired sweetness (90-160 g/l residual sugar). The addition of brandy gives the wine peculiar organoleptic characteristics, improves the chemical oenological stability.

Process of making Moscatel de Setubal

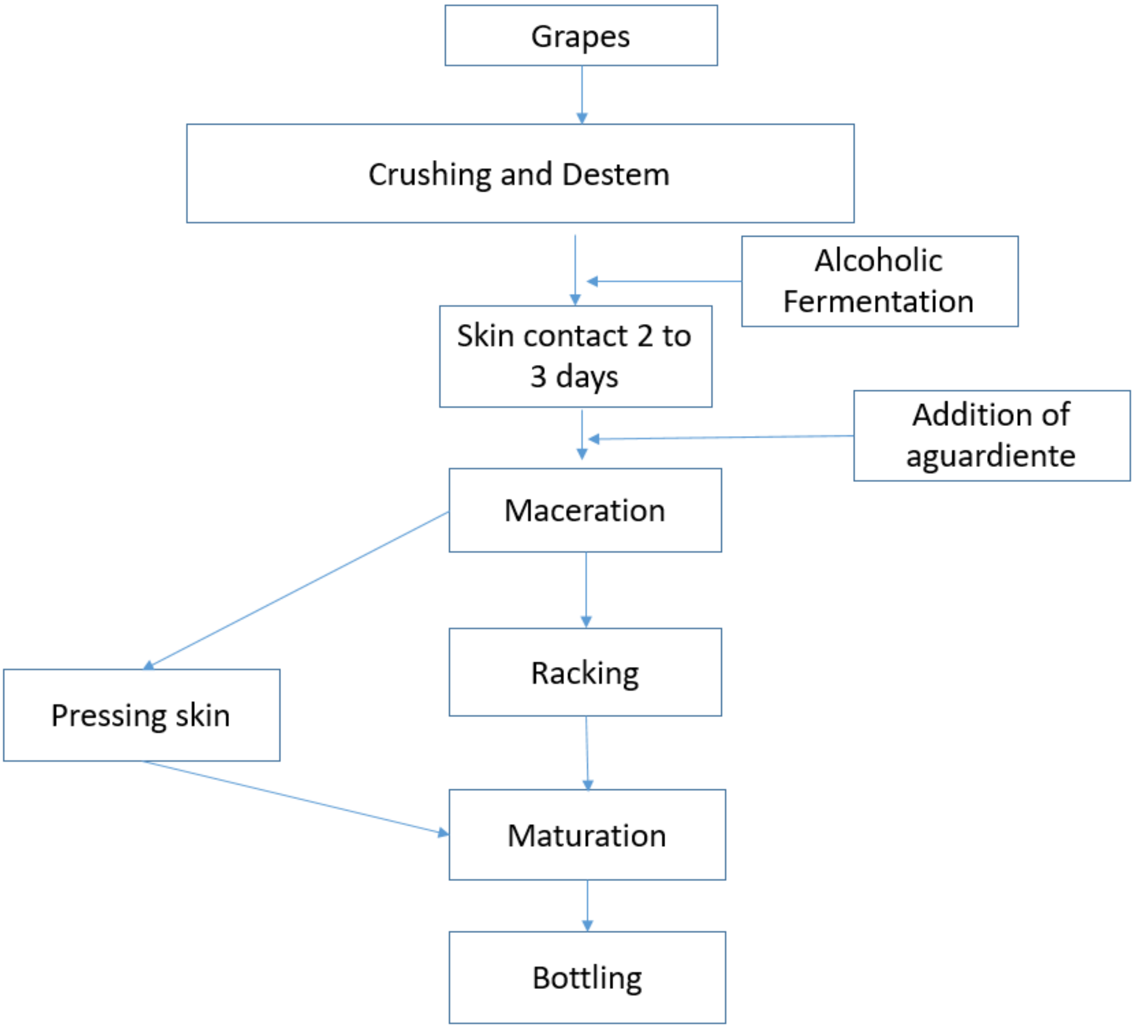


Figure 7: Flow diagram of Moscatel Vinification Process (Bravo, 2008)

After a period of maceration with skin contact, the wine is separated from the masses and the masses are pressed to obtain the tear wine which will be added to the wine resulting from the racking process. The products thus obtained and then stored in resin-lined cement vats for a few months and this process is called maturation or it can age in old oak casks, where it is ages for a minimum of 24 months, when it is time for bottling, the wine previously stabilized by cold and filtered and blends with wines from the same harvest to harmonize their organoleptic characteristics. And before bottle to put the name approval by the "Comissao Vitivinicola Regional de Penisula de Setubal" is required.

5.3.3.4 Fortified wine's composition

Wine phenolic compound

In Wine the component "Phenols" make the wine distingue from the other and, gives perfect gesture to drink. Phenolic compound extract from grape pulp, skins and seeds during winemaking, but they can also extract from wood during aging periods, The most important compound in Fortified wine is phenolic compound. The concentration of phenolic contents range from 400-1700 mg/l (galic acid in Moscatel) because of the old barrels and also long time maceration (Feliciano et al., 2009). Also muscat is now to be great varities which has lot of phenols.

Polyphenol content of fortified wine

Polyphenols are affected by several reason including grape variety, sun exposure, vinification techniques and aging, singnificant changes in phenolic compound can suffer diverse reactions, Oxidation and plomerization and extraction from wood, that are usually associated to the changes in color and colloidal stability, flavor, bitterness and astringency.

In the phenolic compund there is another subgroup which is called Non-Flavonoid. Non flavonoid and antioxidant. There were several research about the fortified wine and phenol. In 1984 Franco et all where he showed some valuable results about the Moscatel Setubal. He found that the total phenol of the wine and aging process has a liner relation on total phenol increasing during the long aging process in the wooden vat And also that total extract and Residual sugar increased with age two times and result shows the reason behind the increasing of this compound is because of evaporation and other soluble solids from the wood. Because of long aging process there is a huge relation with Volatile Acidity but the result is quite favorable for higher alcohol and Volatile Acid (VA) is reduces by Evaporation, for higher alcohol strength and other factors in such wine. And most soughtest one is Non-flavonoid increase with aging periods and Non flavonoid is one of the valuable compound in wine which is beneficial for health (Franco & Singleton, 1984).

Polyphenols are the main compound which are related to benefits of wine consumption due to antioxidant and free radical scavenging properties. These effects are related mainly to flavonoids and stilbens, namely quercetin, catechin, galic acid ad trans-reverstrol,

In Phenol composition of wine Falvonol and non-flavonoid are most benifical as an antioxidant. In non-flavanoid group of the wine Stilbens is the most positive compound for benifite of human health and the compounds called Resveratrol is the which is the major stilbens component found in the wine (red and white). Resveratrol are in two group (TRAS and CIS). The trans-resveratrol is natural phenol which is most abundant form and mainly located in grape skin. Trans-resveratrol has an important role in human health as it present also antibacterial, antifungal and anti-oxidant properties (M. N. Bravo et al., 2008)

Antioxidant Activity of wine Polyphenol, Components with antioxidant activity is an important factor of health protection. Grape polyphenols are known to belong to this category of substances. The consuming properties of grape wine and brandies depend to a considerable extent of polyphenols entering their composition. Polyphenol, due to their high antioxidant activity, account for the health benefit of the vintage products, which is confirmed by the considerable research over the recent 10-15 years.

6. Tasks developed during my Professional Internship

In February have done **mechanical pruning** and in April I joined in laboratory of JMF as an intern have performed **chemical analysis** on following parameters and also performing **chemical stabilization for racking wines**, prior to bottles and also for quality control. The following **vinification** part mentioned about the process for the wine making at harvest time taking grapes, following destem, crush and pressing, **Inoculation** and other steps of **vinification processes** of wine making.

7. Vines and Vineyard

Grapevine is a perennial plant, which grows or blooms over the spring and summer, dies back during the autumn and winters months and then repeats the cycle from itself from the vines on the following spring. Grapevines will naturally grow into a bushy-tree like mess of leaves and branches. In the case of wine making the phrase is "great wines come from great grapes" considering this and human invention, meticulous pruning and training help vines stay nice. Vine phenology is mandatory for efficiency of vine canopy management. Canopy management is notable impacted by the grapevine phenology. After pruning, when vines are in growth period, there are lot of practice need to do for yield quality. Those work are shoot thinning and positioning which is tightly linked to a specific growth, remove unwanted sucker. Vineyard pest and disease control also consider on this time, Irrigation management. To prevent the fungal disease spraying in the vineyard on specific time periods which are related to the phonological stage of vine.

To produce wine the main product is grape. To make good wine needs good quality grapes". It is always necessary to take care of the vines and doing regular tasks (periodically) during all seasons to get the best quality of the grapes. For that performing pruning to vines is one of the main tasks. Aim for pruning is getting good quality yields. Consider this task is mandatory for the vines for the next year production. Pruning mainly done by manually in Portugal and other EU countries which cost maximum cost of the production wine. To reduce cost of pruning wine industry make mechanical pruning with less cost and time saving,

On this part mainly focus on the **mechanical pruning and routine base tasks need to perform for proper vines.**

On vineyard the most cost effective task consider manual pruning while last few years vine growers trying to reduce the cost of pruning. To reduce the cost and time is the reason to introduce mechanical pruning.

8. Pruning Method

The basic concepts vines could prune in various way, according to local and traditional practices. In order to make a trellis need to take in account the region climate index and soil quality (Downton and Grant,1992). Pruning is considered as a mandatory intervention in vine growing to obtain grapes quality and keep the vine alive for the long time. This practice considered as one of the most important and time consuming operation in vineyard management. In conventional viticulture, vine pruning of grape vines is done manually. This manual pruning is labour intensive operation which is contribution to the annual costs of producing wine grapes (Archer & Van Schalkwyk, 2007).

The most effective pruning method in wine industry are mechanical pruning (minimal pruning and hedge pruning). Minimal pruning was introduced in the period from 1930 to 1950 (Winkler et al 1974). Removing vegetative tissue reduces the capacity of the plant to produce and accumulate dry matter, Conventional winter pruning. There is a reduction of the amount of 1years old wood of about 85 percent (Winkler et al. 1974.Pruning Consist the removal of the living parts of the plant such as cane, leaves or shoots and maintaining the shape of the canopy, yield regulation and grape quality (Winkler et al 1974).

Pruning is the practices have been established regarding some component among them canopy management is the one of the vital issue for that optimizing the sunlight interception, photosynthetic capacity and fruit microclimate to improve yield and also wine quality particularly in vigorous and shaded vineyards. (winkler et al 1974)

8.1 Manual pruning

Manual pruning is a traditional cultural intervention. The idea of manual pruning the suppression/cut of the canes partially to obtain certain level of buds, in this pruning method usually removes up to 95% of the preceding year wood (Pardal, 2015). Manual pruning allows retaining a specific number of nodes, the ones with the most potential to produce, in an optimal distribution (Zabadal et al.2002). Generally, only a few buds are selected to get a balance between vigor and yield. Removing most of the vegetative growth of the last preceding year. This technique is designed to maintain vine shape and size. Maintaining bud and shoot number and hence, bunch number and size. If the number of buds is too low so the cane vigor increases and yield decreases because the vegetative growth and the reproductive growth compete for available resources (Keller et al 2004). In other case when buds number is high the fertility is lower and the canes and brunches are lighter and viability of the plants can be affected. Therefore, it is important to achieve a balance between shoots and fruit growth in order to obtain a sufficient photosynthetic structure of the vine (Keller et al.2004). Pruning influences the quality of the harvest- since excessive yield can be the cause of maturation problems and if the canopy is dense, to get affected by the fungal diseases.

There are many types of manual pruning. In Portugal, the most common system are Royat cordon and Guyot.

8.2 Mechanical pruning in Vine

During the last few decades different mechanical pruning techniques have been introduced according to the country, region and grape varieties. These alternative pruning methods are mainly hedge pruning (May and Clingeleffer, 1977) and minimal pruning of cordon-trained vines (MPCT) all those alternative pruning methods have shown the ability to reduce labor cost significantly.

Mechanical pruning methods, a positive impact on cost, yield without major effect on grape quality. The principle result of mechanical pruning is that the vegetative organs of the plants (shoots, leaves and cluster) get smaller but more numerous it also shows in bunches. There is a change in the expression of vigor and tendentially, an increase in yield in these pruning systems. In mechanical pruning system vines have shorter shoots, smaller leaves and smaller bunches. Production cost reduces due to reduced hand labor. For this pruning and canopy management is one important aspect should observed that is this technique or low input training system on mechanical pruning vine are mainly used to produce low to medium quality grapes on a larger scale. Consider the production of Portugal and wine selling price it is the best practice to reduce the cost of the production where manual technical skilled based labor is shortage.

Figure 8: Mechanical Pruning (Roy)

8.2.1 Hedge Pruning

In mechanical pruning to prune vines using a pneumatic system which consists in a set of shears with a compressor mounted on a tractor. In alternative this system can be adapted through the use of a static compressor at the top of the row. Also can use electric shear can be used. On mechanical pruning by the pneumatic system need a skilled driver and the advantage is that prune the vine in less time (few minutes).

In alternative way of this system could be replaced by the use of a static compressor at the top of the rows using electric shears can be used. Using mechanical pre pruning can be done in order to reduce the size of the canes, which is the easier to remove the part of the top of the vines .the main idea of this pruning consists in hedging the vines on top and on the sides, giving the grapevine like box shape canopy. The one negative effective could be occur , that is increasing its density which can lead to less sunlight exposure and poor canopy microclimate which could be occur fungal development and effect on the vine longevity (Pixner, 2011)

Vine growers have misconceptions that over cropping for the high node numbers retained on the mechanical pruned vines might lead to reduction of grape quality and eventually vine decline (Keller et al. 2004). Research shows that mechanical hedging can have different levels of severiity but according to (Intrieri et al 2011). Australian and Italian grape growers were among the first to adopt this technology to Vitis vinifera cultivers (Clingeleffer, 1984).All over the countries on mechanical hedge pruning has the positive effect to increase in yield (Morris et all 1975; May & Clingeleffer, 1977)

8.2.2 Minimal pruning

Minimal pruning of cordon trained vines (MPCT) is the concept not pruning the vines (the vine are skirted to prevent shoots and fruits to contact with the soil) (Morris 2008). This technique was first introduced in irrigated vineyard in warm climate region in Australia (Poni et al. 2000). The main concept is that no shoots are removed and the number of remaining buds is much higher when compared to normally pruned vines and mechanical spur pruning (Archer and van Schalkwyk, 2007). Minimal pruned vines achieve higher yields, because higher number of shoots and bunches per vine are obtained compared to normal pruned vines. In this method shoots grow shorter and shoot growth stops earlier in this season compared to other pruning methods. Minimal pruning seems to be well adapted to vigorous and dry situations where irrigation is possible (Jackson, 2008). To sustain and ripen such a high crop, it is important that the vines have enough vigor.

Another important effect that needs to be considered is the canopy microclimate which is need to maintain fruitfulness. Shoot growth should stop early enough to enhance berry ripening and maintain microclimate. In some cases it is shown that cool climate and wet climate region were not promising to introduce minimal pruning. Late ripen varieties may not reach complete maturity (Jackson, 2008).

8.3 Sustainability, Increasing yield and Savings cost

Vine sustainability issue is the most critical concern to get the optimum yield and also for the wine quality. For this reason, researchers developed the technique to get the higher and quality while not effecting yield, which is the main target to practice mechanical pruning. The winter pruning is mainly done by manual experienced labor. Although lot of benefit to do manual pruning but manual winter pruning is the most expensive work in vineyard (Clingeleffer, 2013). In viticulture the winter pruning is a time consuming operation which take approximate time 60- 120 hours of manual labor per hectare which depends on the vine vigor and trails types and design and equipment availability also.

Increasing yields is one of the main objectives of this practice getting numerous number of buds in the cordon when compared to manual pruning that selects the buds retained in the cordon. In the list Australia from new world wine country and Italy, France, Germany have promising indications about the mechanical pruning. In all these countries mechanized pruning in a sustainability increase in yield (Reynolds, 1988).

In early 1970's in New York before adaptation mechanical pruning and after adopting mechanical harvesting shows that the cost of production cost was the highest reason why mechanical pruning interest increased also. And after the mechanical pruning or pre pruning introduce in mid1970 and it has shown a sharp declined the price of production cost. (Bates, 2008)

The winter pruning is a costly operation as it requires 70 to 100 hour/ha of human labor depending on the training system.

To successfully compete with the produced all over the world. In Portugal growers are trying to find ways to reduce costs. Switching to mechanical pruning is less cost and also quantity as yield is similar .it could be 70% higher, Manual pruning requires about 30 % of cost goes to pruning techniques and because of several climatic changes effects losing vines in the vineyard in hot regions which also effects in the soil and fruitfulness. To introduces this mechanical pruning practice improving the cost and improving techniques.(Kurtural et al, 2012)

9. Post- harvest vineyard practices

Post-harvest vineyard practices involve several works which will be foundation for the next harvest is being largely laid now. Sufficient soil water is very important at this time for grapevine roots need for growing in the second growth phase which is after bud burst. Along with the root growth need sufficient nutrient. To give an indication of its importance, it has been calculated that during the post-harvest periods. Grapevine uptake represents 38% of its nitrogen requirements, 23 % of phosphorous and 16% of potassium. Therefore it is very important to use fertilizer application of the season at the time period of post-harvest. There is one thumb rules to effective fertilization program can only be drawn up based on accurate soil analysis and should be done every three years. There is recommendation that fertilizer need to put as early as possible after pruning when vine is growing and also depend on the soil. As compare the Setubal soil which is soil need to use fertilizer in instalments for the sandy soils where water retention capacity is high. The wine objective should be borne in mind; high quality and noble cultivar require moderate growth to produce top quality, while mass required more vigor.

To ensure optimal nutrient uptake and production and retention of reserves, there should be sufficient soil water, thus necessitating post-harvest irrigation. And it is always needed to monitoring soil moisture and grapevines should not get too much stress in the sand soil and high temperature region like Setubal, there is less rainfall in the season is recommended to use cover crop for optimal growth and material production. By cover crops for optimal growth and material production. By so doing there is an accumulation of organic matter which will release nitrogen when water becomes available again.

Weeds control is always necessary for the yield quality of the vines and berry; and also to prevent the loss of irrigation and fertilization. There could be different option for different type of weeds. It is always good option to uproot the roots instead of using chemical which could be hamper the grapevine quality.

In the case of fungal disease of the vine which is very common in the Setubal region for Downy mildrew and powdery mildrew which is very occur is vines so need to practice chemical herbicides in instalment also and checking the perfect weather condition for this (there should not be rain 2/3 days before and after putting products) (Schalkwyk, 2017).

9.1 Chemical parameter analysis in the laboratory

In laboratory chemical analysis of the various parameters of the wines for checking the condition of the wine and to make the stable index of the wine and correct the finishing product on the microbial and chemical stability before and also after bottling for the food safety and quality purposes.

Analytical technique have become increasingly important with the development of technology and increased government regulation. Analysis of grape and wines are performed for a number of reasons, Quality control reason is the base for the analytical measurement which are depend on , processing and aging, Spoilage reduction and process improvement, Blending needs more precise analyses leading to more precise blends for the aromatic compound and perception of Acidity and tannins, In wine and must components there are some parameter which is mandatory to analysis to understand the quality of the grape juice and wine which are Soluble solids (Sugar, extract, Glucose and fructose) Acidity Total, Volatile Acidity, pH, Alcohol (Ethanol), Phenolic compound (Total phenol fraction including anthocyanin), Chemical additions (SO_2, Sorbic Acid, DMDC), Common and trace metals (Fe, Cu,), Dissolve Oxygen, CO_2 (Some of wines)) (Zoecklein et al, 1995)

The chemical parameter recognized by the OIV and IVV on European winery to commercialize the product and food quality verification. The main parameter which are authorized by the IVV those are on the following. These are based on Oenological point of view, which are consider to understand well to know the wine better in quality aspect.

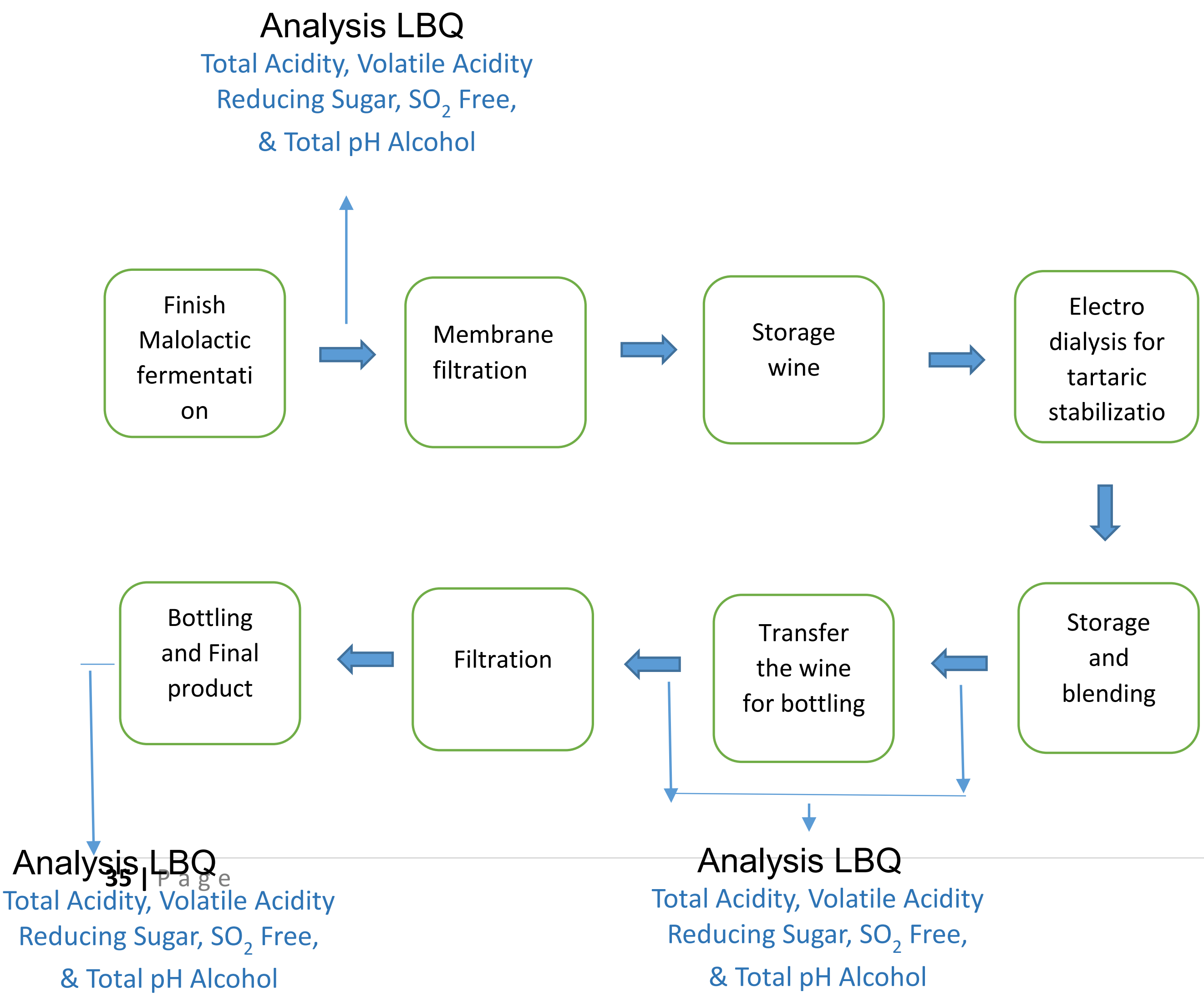
The analysis is for better understanding of the wine is achieved, but a compromise between time and information requirements must be established in order to guarantee a given quality with minimum cost. Therefore, only a few parameters are periodically checked. Between them, the most common are: soluble solids, reducing sugar, alcoholic strength, pH, total and volatile acidity, sulfur di-oxide, color, polyphenol index, Total acidity and some mineral composition of the wine (Fe, Cu, Na) (Luque de Castro. et al, 2005)

Most analytical methods for wine analysis which are recognized by the international community as official methods of analysis are manual methods with high robustness and precision. Recent methods of analysis may be based on modern automated instrumental techniques. Nevertheless, the manual methods are slow, tedious and require a high level of human participation. Thus their application is a balance between the numbers of parameter required for monitoring wine production, frequency of analysis.

The recent development of the technological tools for the wine analysis to more accurate and time efficient, which are more appropriate sensitivity, selectivity and precision, can circumvent the problem created by the large number of samples to be analyzed in order to guarantee proper monitoring of wine production.

9.2 Flowchart of the checking parameters for Quality Control

This is the schematic diagram where showing the proper routine to check the chemical parameters for Analysis



9.3 Oenological view of the wine chemical parameters

9.3.1 Density

As the grape must contains quite a high amount of sugars before fermentation, the grape must is denser than water (higher than 1.000 g/l). During alcoholic fermentation the yeasts convert sugar amongst others into alcohol and carbon dioxide. This causes a decrease of the density. By continuous measurement of the density, the winemaker can easily monitor the fermentation process. Density measure on specific temperature 20°C.

In grape juice the main sugars are glucose and fructose and also some other sugars but very small amount. The analysis of total soluble solids in grape juice give an indicator of the sugar content which represent 90-94 percent of total soluble solids.
Total soluble-solids in grape juice could measure by equipment like- hydrometer, refractrometer and also the Biosystem y15 (Enzymatic reaction based equipment).

The basic practices in the laboratory which measure by hydrometer easy and efficient. Hydrometer (based on Archimedes' principal that an object placed in liquid displaces a volume of liquid equal to its own weight) and also measure the specific gravity of the solution, which relates to the total soluble solids content of the grape juice (Iland et al, 1993)

9.3.2 Alcoholic Strength

The alcoholic strength by volume is the number of liters of ethanol contained in 100 liters of wine, both volumes being measured at a temperature of 20°C, expressed by the symbol '% vol. (OIV, 2016). The alcohol content influences several aspects. Amongst others, commercial aspects such as taxation and price/l in cases of bulk wine are important. Moreover, legal issues (maximum and minimum limits), defined to classify the product as “wine”, including the different possible styles.
The physical and sensory properties can also be modified by the alcohol concentration. This fact has to be taken into consideration when blending different wines, and by that changing

the alcohol degree (Zoecklein et al 1995).On the other hand, the alcohol content may also have an impact on the consumer behavior and is sometimes used as a marketing tool.
Alcohol content measure by density meter and NIR. In, Portugal alcoholic strength (A/V) are for Table wine $\leq$ 15% volume and Liqueurs/ Fortified wine $\geq$ 16% volume.

9.4.3. Total Acidity

Acids play an important role in winemaking and in the final product wine. They have a direct influence on the wine stability, pH level, color of the wine as well as on the sensory evaluation through the counter play with sugar and alcohol. They also play a crucial role in the energy metabolism of yeasts during alcoholic fermentation. Studies on acids in wine touch diverse areas such as sensory analysis, biochemistry and the microbiology of fermentation, viticultural practices, methods of wine processing, and the stabilization and preservation of the wine. The amount and composition of acids in grapes depend on many factors, e.g. grape variety, climate and/or soil. The most important acids in grapes are tartaric and malic acid, though citric, succinic and other acids are also found in wine. Depending on the wine growing region amounts of tartaric acid can range from 1 to 8 g/L in warm climate and up to 15 g/L in cool climate regions.
In wine there are numbers of organic acids, which vary in origin. There acids come from the grape must and must (Tartaric, Malic, Lactic, Citric acid) and other comes intermediate products or final products of alcohol fermentation (succinic, 2-ketoglutaric, 2- dimethylglicerine acid and hexane, octane and decanne acids). The wine acidity characterized by the following parameters which is known as titrable acidity , actual or real acidity which can defined by the pH value and buffer/puffer capacity (Rajkovic, Novakovic, & Petrović, 2007). By the IVV total Acidity express by the tartaric acid and the threshold level is $\geq$ 3,5 g/l OR $\geq$ 46,6 meq/litro.

9.4.4 Volatile Acidity

Volatile acidity is defined as the set of short chain fatty acids (acetic, formic, propionic and butyric) found in wine. These acids can be steam-distilled and detected by smell and taste. Because acetic acid comprises the majority of the VA, it is expressed as acetic acid. Another compound often discussed in the context of VA is ethyl acetate, which is produced by chemical modification (esterification) of acetic acid (J. Jacobson, 2006).

Volatile Acidity is the component to indicate the wine spoilage. Measuring volatile acidity is generally interpreted as acetic acid content (g/l). The traditional way to measure volatile acid is stream distillation process which includes all those steam distillable acids present in the wine. The main compounds are founded on this steam distillation process which are- carbon di-oxide (carbonic acid); sulfur dioxide (sulfurous acid) and in less volume compound are lactic, formic, butyric and propionic acids. Volatile Acidit/ Acidez Volatile by the IVV threshold level vary for the wines. For white wine is ≤ 18 meq./l, for red wine is ≤ 20 meq./ a for the fortified wine is ≤ 1,5 g/l.

9.4.5 pH

Potential of hydrogen (pH) is a numeric scale used to specify the acidity or basicity of an aqueous solution (Bates et al.1973). The pH level plays a main role in winemaking, thus measurements are taken throughout the winemaking process from juice to finished wine. It is directly related with physicochemical and microbiological stability and quality of the wine. Typical pH levels in wine range from 2.9 to 3.9. However, the optimum pH should be lower than 3,8, in order to guarantee no microbiological spoilage as well as color stability (Ribereau-Gayon, 2006).

9.4.6 Total Dry Extract

According to the OIV definition, the total dry extract (also referred to as total dry matter) includes all matter that is non-volatile under specified physical conditions. These physical conditions must be such that the matter forming the extract undergoes as little alteration as possible while the test is being carried out (OIV, 2017). From an oenological point of view the analysis of the total dry extract gives an idea of the sensory characteristics of a wine and its underlying vinification methods. Wines with a high amount of total dry extract are usually concentrated and full-bodied, because vinification methods with high extraction of mineral and organic compounds have been performed. Crushing, Destreming, skin contact and long vatting promote the extraction of mineral and organic substances from grapes, so they are bound to have an impact on the dry matter content (Ribéreau-Gayon et al., 2006). Besides this the total dry extract analysis is sometimes performed for exported wines or wines for auctions, because thereby fraud can be exposed. By the IVV rules the threshold level for white and rose is > 16 g/l and for the red is $\geq$ 18 g/l.

9.4.7 SO_2

Sulfur di-oxide is one of the main compound in the wine industry whose benefit is uncountable and enormous in wine industry all over the process from beginning of the grape processing till the end of final product. In wine laboratory measure this compound free SO_2 and Total SO_2..

9.4.7.1 Total, Free SO_2

In general SO_2 is used as a preservative throughout the food and beverage industry, considered as the safest antiseptic available. In finished wines, a large part of the present SO_2 comes from the additions during wine processing, while a smaller part is produced by the yeast itself (Ribéreau-Gayon et al., 2006). Sulfur dioxide appears in three different forms in wine: as sulfuric acid (H2SO3) (which does not exist in this form, is always appears in the ionic form of (HSO3−)), sulfite (SO32) and finally as sulfur dioxide (SO_2, the molecular form). This last form is the one of interest for winemaking, thus, it should be free, so as to interact in the mechanisms with the desired effects.The principal benefits of adding SO_2 are:

- Antimicrobial effects, by eliminating most strains of bacteria, including lactobacillus, pediococcus, and oenococcus, and inhibition of yeast growth for a period of time
- Antioxidant agent
- Protection of wine aromas by the binding with ethanol (Jacobson, 2006)

Sulfur Dioxide in stabilization wine

Wine with <5 g/l of residual sugar content (glucose + fructose)

Red Wine	$\leq$ 150 mg/l
White Wines	$\leq$ 200 mg/l

Wine with $\geq$ 5 g/l of residual sugar (glucose + fructose)

Red Wine	≤ 200 mg/
White Wine	≤ 250 mg/l

Fortified / Liqurous Wine

Sugar Content < 5g/l	≤ 150 mg/l
Sugar content ≥ 5g/l	

10 Advanced Analytical Equipment

In laboratory have some analytical equipment are very useful for the measuring the parameter for saving time. Those are very useful equipment for the different parameter of the wine and totally automation for reliable of the analysis and quality assurance of the products.

10.1 Fourier Transform Infrared Spectrometer (FTIR)

Fourier Transform Infrared Spectrometer is a resourceful tool for the qualitative and quantative determination of molecular compounds. FT-IR is a type of multiplex instrument that collects every component of the full electromagnetic spectrum simultaneously at detector. This wave-like pattern is collected in less than a second and contains all the frequencies that make up the infrared spectrum. To extract information regarding the concentration of each component in the original spectrum produced on a multiplex instrument, the information must be decoded into its individual components. An infrared spectrum is established through decoding that predominantly utilizes that classic mathematical tool known Fourier Transformation. The total analysis time from spectrum collection to spectrum processing with Fourier transformation takes 30 seconds. There is no required to sample preparation which make it fast and environmentally friendly analytical technique to use in the laboratory (Moreira et al, 2002)

It is an automated flow injection system with FT-IR spectroscopic detection which could measure- sugar, pH alcohol, Total Acidity, CO_2, glycerol, Sucrose, free amino nitrogen for all the Infrared spectroscopy,

10.2 Near Infrared spectroscopy (NIR)

Near Infrared spectroscopy based on spectroscopic techniques which offer simple , rapid and cost effective analysis throughout the wine industry production. The common and essential analysis from vinification to bottling like soluble solids (TSS), acidity measure, alcohol content and residual sugar, those analysis could be done by Nir with in short time and effective and accurately. Now a days there are lot of new technology which are used for analysis on different parameter for taking the accurate result. Recent scenario in wine industry is that NIR is useful to measure the alcohol content and residual sugar (Analysis of grapes and wine by near infrared spectroscopy (D. Cozzolino et al,1992)

10.3 Atomic Absorption Sceptroscopy

Another most importance of wine analysis is that wine has significantly contribute to the total dietary intake of some trace elements with the grapes. Wine is among that beverages which contributes to increasing the total dietary of trace elements. The maximum acceptable limit of the trace elements are authorized by the OIV. In the wine there are some elements are like (B, Co, Mn, Ni, Mo, se, Zn) which significant effects in human health but there are some compounds like As, Pb, Cd are toxic which has negative effects of the human health. The main trace elements are Aluminum, Iron those are mainly measure in the laboratory (Stafilov. T and Karadojova. I 2009),

For the trace elements analysis is made by Atomic Absorption spectrometry which is flame, Electrothermal and hybride generation modes is particularly suitable for the direct determination of trace elements in wine (Ponnada et al, 2013).

Figure 9: Flame Atomic Absorption Spectrophotometer (Roy)

11 Wine Stabilization

Wines after alcoholic and malolactic fermentation are turbid and unstable liquid media. After this wine need to be stable and clarified to preserve their quality until their consumption. The wine contain lot of compound at this periods like macromolecules which are diversity of particles, responsible for hazes and deposit. These particles are mainly microorganism (yeast, and bacteria), tartaric crystal, grape skin and pulp cell debris and aggregates of molecules/ macromolecules that between colloidal particles that form colloidal dispersions.

Wine is most consuming alcoholic drink among others alcoholic beverage. Now a days wine making is recognized by the region and the process and also using several producer with objective of marketing limpid and stable product and also for customer satisfaction. Wine stabilization is the vast and contain lot of different stability process before bottling. Which are physic chemical and microbiological stability. In the physical chemical stability are mainly Clarification, Tartaric stability, protein stability and after that prior to bottle for microbiological stability.

11.1 Tartaric Stabilization

The major physical instability in bottled wines remains the precipitation of the tartaric salts (KHT: Potassium hydrogen tartrate, CaT: calcium tartrate). These salts are naturally found and supersaturated in musts, but their solubility decreases and the presence of ethanol and the low temperatures. This unstable state can lead to the occurrence of KHT crystals in bottles with dramatic consequences on the final aspect of the wine. To overcome the problem of tartaric precipitation in the bottles of this salts is traditionally removed by cooling the wine to -4° C degree several days.

There are new methods to stable the wine against tartaric stabilization using Electro dialysis which is very fast and reliable method for the tartaric stabilization in the winery like JMF. The principle of electro dialysis for tartrate stabilization is based on the properties of membranes to transfer exclusively either cations or anions. Under the effect of an electric filed, anions (mainly TH and T-) will migrate towards the positive electrode (the anode) while cations (mainly K+) will be attracted by the negative electrode (the cathode). The anions are able to pass through the anion-selective membrane, but are not able to pass through the cation membrane, which blocks their path and traps anions in the brine stream. Similar, cations move in the opposite direction through the cation-selective membrane under a negative charge and trapped by the anion-selective membrane. Wine circulates along one side of the membrane, and on the other side an electrolyte circulates that removes that ions. The treated wine will constitute the dilute compartment, and the eliminated ions will constitute the concentrated or brine compartment (Rayess & Mietton-Peuchot, 2016)

The wine is recirculated in the electro dialyzer until achieving the reduction level of ions concentration.

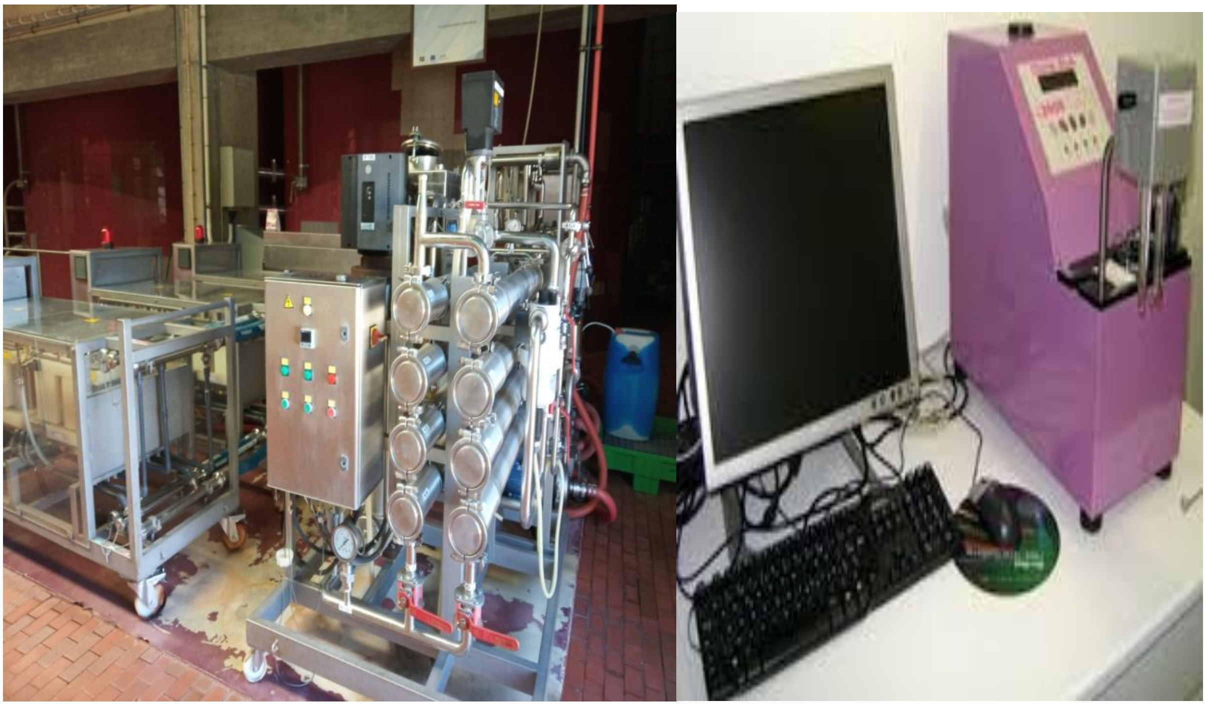


Figure 10: Electro dialysis and Check Stab (Roy)

11.1.1 Check Stab

The laboratory measuring instrument Check stab use for Tartaric Stability analysis and treating the wine based on IDT (Instability degree Test). Check Stab Equipment works with a conductivity cell of 2 electrodes in platinum platinato at constant 1,00 (mod, sentek, plates of 10 dimensions, millimeter * 10 milimeter approximately,); double scale of measure 3,000. 0 µs and 30,000 µs, automatic calibration of the conductivity, automatic compensation of the temperature to 0,0°C. With this equipment it is possible to determine the curves in presence and absence of KHT, therefore can determine the value of the Temperature of saturation, Ts and the measurement of conductivity variation when the wine is put in contact with a pre determine amount of KHT crystals at 0°C, These parameters allow verifying the state of tartaric stability of a wine.

The calibration of the probe is done with a standard solution of KCI of equal conductivity to 1278 µs/cm at 0°C (waiting for the temperature is become stable at 0, 0°C). In case in which the wine is clear and without dissolved gas, it does not require particular treatment dioxide preparation. In the case of sparkling wine or carbon di-oxide present during fermentation, the wine is degassed by mixing vigorously the solution. In the case of obvious turbidity of the wine, it undergoes centrifugation. In order to measure the conductivity variation, at a stable 0°C(Berta et al).

This check stab instrument work as adapted mini contact test with conductivity. For this test a wine sample measure the conductivity without adding potassium bitartarate (KHT) and then added 4 g/l KHT at 0°C under constant agitation. During crystal growth, the conductivity decrease due to K+ integration within the crystal lattice.

This laboratory equipment's methodology based on "**Adapted mini-contact test (associated to conductivity measurements"** for checking the tartaric salt stability of the wine.

11.2 Protein Stabilization

Protein stabilization is an important for the wine prior to bottle. The initial judgments are made by sight. If there is a deficiency of clarity (as may consider from protein instability for the white wine and also for the rose wine), it may be presumed that there is deficiency in other desirable attributes. This could be the problem of the wine stability.

The major source of protein in wine is the grape. Variety, vintage, maturity, condition of the fruit, pH and processing method of vinification affect the must and subsequent wine protein content. Protein nitrogen content of wine varies between 10-275 mg/l. it appears that about half of the total wine protein is bound to a minor quantity of grape phenolic (flavonoids) and this portion is thought to be responsible for protein haze (Zoecklein, et al. 1991).

White wines contain relatively large insoluble proteins which slowly precipitate from solution. Most white wines lack sufficient tannins to cause initial protein precipitation. Protein haze may be due to the fraction of residual wine proteins that have been rendered prone to precipitation by the interaction with minor quantities of reactive phenols.

Wine proteins can be characterized based upon size and electrical charge, the molecular weight of the proteins arrange from 11,00 to 28,00 Da As a certain pH, the positive and negative charges of each protein fraction are equal when these charges are equal, the protein is least soluble. (Zoecklein et all 1991.)

Wine sample filtered and heated by incubator to 80°C for two hours (minimum) and upto six hours and then, after cooling, examined by eye against a light source for the presence of haze in comparison with an untreated control sample of the filtered wine. A minimum of two hours cooling is required for the heated proteins to aggregate and precipitate. It is also advisable to use turbidity meter can be used for more objective comparison of the turbidity in two samples. In that case, wines that exhibit a turbidity increase of greater than a given criterion for Nephylometer Turbidity Units (NTU) after heating, as compared with the unheated control, can be considered to have failed the heat stability test. The NTU unit of the control sample is around 2-4 NTU for the white wine and red for the 5-8 NTU.

12 Microbiological stabilization

In wine microbiological the main phenomena to protect the wine from microorganisms like yeast, bacteria could be the cause of wine spoilage in various steps of winemaking and mainly at the time of bottling and after bottling. On that reason the microbiological analyses are consider most important for the end product. These test asses because of the effectiveness of the clarification and also for the residual yeast and bacteria which could be case of instability of the wine (Ribereau-Gayon et all, 2006).Additives such as sulfur dioxide (SO_2), dimethyl dicarbonate (DMDC), Sorbic Acid and others are used by winemakers. The objective of their usage is to stabilize the product from the beginning of their making process to bottling and furthermore until final consumption. SO_2 is the most powerful tool for microbial stabilization of wine and yet can't be replaced by any other molecule. However other products such as DMDC and sorbic acid can additionally be implemented in the winemaking process to further lower the risk of spoilage of the product post-bottling.

In the majority of situations, they provoke no stability or sensory problems. The simplest procedure to ensure limited microbial stability is racking, which removes cells that have fallen out of wine by flocculation, or have precipitated with tannins and proteins. The sediment includes both viable and nonviable microorganisms, such as yeast which slowly undergo autolysis and release nutrients that can favor subsequent microbial growth. Cold temperatures help maintain microbial viability, but can also retard or prevent growth and thus fermentation (Jackson, 2008). The addition of antimicrobial compounds or sterilization is required for long-term microbial stability, especially in sweet wines. The antimicrobial agent most frequently used is sulfur dioxide which may be added before and/ or after fermentation and various times during wine production. Concentrations of 0.8–1.5 mg/liter molecular sulfur dioxide inhibits the growth of most yeasts and bacteria. Dimethyl dicarbonate (DMDC) can kill microbes of an already filtered wine to a maximum of 500 germs/ml effectively without greatly modifying the wine's sensory attributes but its poor solubility, methanol output, and corrosive nature limit its more general use (Calisto, 1990). In the absence of sulfur dioxide or DMDC, bottled wines can only be securely stabilized against microbial growth by physical means, filter sterilization and heat-time treatments. High temperatures markedly increase the proportion of free SO_2 in wine. Pasteurization destroys most microbes but cannot inactivate the endospores of the Bacillus species, which may induce a "cosmetic" wine spoilage on rare occasions according to Boulton (1996). Sulfur dioxide is more effective at combating these bacteria. Membrane filters have replaced pasteurization in most situations partly because of their ease of use. In recent years, heating has mainly been used to stabilize sweet wines containing residual sugar by killing yeasts. Wine sterilization requires precautionary steps to avoid recontamination. This involves sterilizing all parts of the bottling line and the use of sterile bottles and corks (Boulton, 1996).

12.1 Sulfur di-oxide (SO_2) and Dimethyl dicarbonate (DMDC)

Those chemicals compound are truly beneficial for winemaking to stabilize the wine and gives more good perception of the wine. SO_2 has big history with wine. But for the DMDC which recently recognized by the OIV in making process.

12.1.1 Sulfiting during wine storage and bottling

After alcoholic fermentation the concentration of free SO_2 decreases due to combining compounds produced by yeasts, the wine soon exposes to increasing risks of chemical oxidation and microbial development. To ensure the protection it is important to measure free SO_2 level periodically and sulfiting when necessary, especially after malolactic fermentation and racking during barrel ageing. Ribéreau-Gayon et al (2006) recommended minimum free SO2 concentration in general to avoid oxidation and microbial risks in wine: 5—10 mg/L for red wine, 20 mg/L for white wine made of healthy grape, and 30 mg/L for white wine made from rotten grapes. For wines that are avoided MLF need the higher concentration of free SO_2 to inhibit bacterial development. Another situation is sweet wines with the high concentration of residual sugar and low alcohol, which requires the higher concentration of free SO_2 to inhibit refermentation. For example, 50 mg/L for 11% alcohol and 30 mg/L for 13% alcohol. The size of yeast population is also an important factor. Reduced a fraction of the population by fining or filtration can lower required free SO_2 to prevent refermentation in sweet wines (Ribéreau-Gayon et al. 2006).

12.2 Dimethyl dicarbonate (DMDC)

Dimethyl dicarbonate (DMDC), also known by its tradename Velcorin, is used as a chemical cold stabilization agent for wine and other beverages prior bottling (Reynolds, 2010). In the early 1970s a similar product, dimethyl dicarbonate (DMDC) or ethylpyrocarbonate (Baycovin), was authorized in the United States and Germany for three years (Ribéreau-Gayon, et al., 2006). Nevertheless, Baycovin was abandoned after concerns had been issued regarding the degradation byproducts as toxic and carcinogenic (Ribéreau-Gayon, Glories et al., 2006). DMDC, produced by Lanxess, is nowadays recommended by OIV in a maximal dose of 200 mg/L expressed as DMDC (OIV, 2015). It is a colorless liquid that breaks down in an aqueous solution, corrosive for skin and eyes and toxic in case of inhalation and ingestion (OIV, 2004). In 2007 Cosata have foun severall microbial species associated with wine were challenged against increasing concentration of DMDC. Where also showed that using 100mg/l potassium metabissulphite with DMDC which is better inactivation capacity then the single chemical DMDC. But DMDC has no effect on lactic acid and acetic acid a(Costa et al, 2008)

Calisto (1990), the hydrolysis of DMDC is rapid (Calisto, 1990). In 1 hour at 30 °C or in 5 hours at 10 °C, it decomposes to CO_2 and methanol, without modifying the wine's sensory attributes (Calisto 1990; Delfini et al, 2002).

12.2.1 Application of DMDC to wine

According to the OIV a treatment with DMDC has following objectives: (i) to obtain microbiological stability of bottled wine containing fermentable sugars, (ii) to prevent the development of unwanted yeast and lactic bacteria and (iii) to block fermentation of sweet, medium sweet, and medium dry wines (OIV, 2015).

DMDC can help the sector to reduce production costs by switching from hot fill to cold fill technology, especially in the manufacturing of fruit-juice-based beverages, it helps to preserve energy. In addition, thinner PET bottles can be used in the cold filling (Hightech Europe, 2011).

DMDC has a higher density (1.42 g/cm^3) than water and therefore would sink in the beverage rapidly to the bottom, allowing the microorganism to survive in the upper phase. In consequence, an appropriate dosing apparatus is needed which can be installed in new or already existing filling lines to ensure product homogenization and consequent inactivation efficiency. Below 17 °C, DMDC solidifies. Therefore, it must be heated up to 20 - 25 °C before adding it to the beverage. If this required temperature is not reached, the conversion to CO_2 and methanol is not fully achieved (or just slowed down in the lower part of the bottle), leading to over concentrations in the bottom part of the bottle. Germs can survive in the upper part of the bottle. Subsequently, dosing devices ensure temperature control and prevent overdosing.

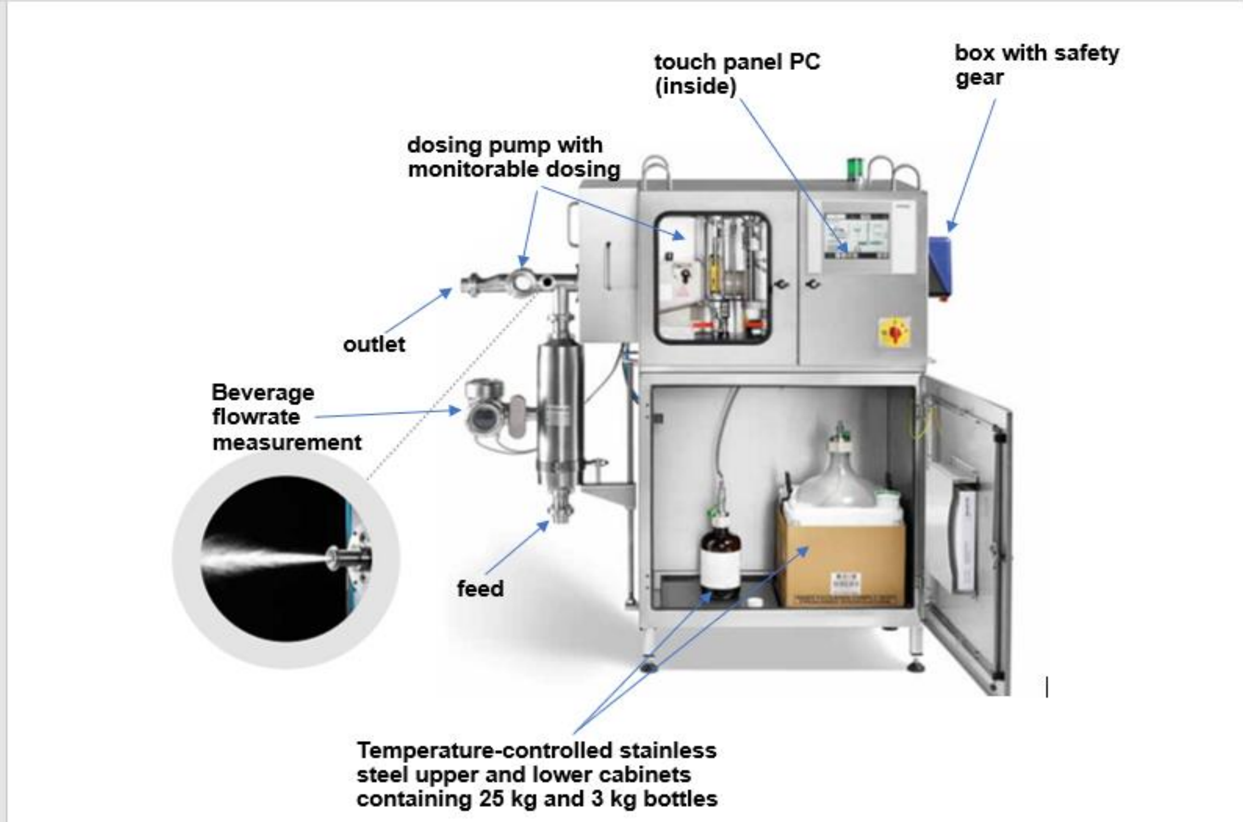


Figure 11: Dosing unit for the technical use of Velcorin (Lanxess 2018)

12.2.2 Risks and handling of application of DMDC

DMDC in its pure form is moderately toxic by ingestion, highly toxic by inhalation, irritating to the skin and eyes and combustible if exposed to an open flame. Due to these hazards, people are required to wear safety gear when handling DMDC and are given regular safety training (Hightech Europe, 2011).

A careful handling with this additive is essential. It is recommended to keep the product locked within the company and only trained personnel should be allowed the usage and handling of DMDC. A treatment with DMDC must be noted in the legal books of the company special indicator strips (Velcorin indicator paper) are supplied by the company Since DMDC can trigger asthma attacks in humans, these should be used before handling carefully.

13 Filtration Process

Cardboard & membrane filtration plates are widely used at the time of bottling in order to give clearness and ensure microbiological stability of wines. Cardboard filtration: Filter sheets made of cellulose plates are in general delivered in the form of squared cardboards of 40, 60, 100, or 150 cm^2 per side or round cardboards. Nevertheless, they can be found in any size and shape. They retain the particles by sieving and absorption. retention capacity, up to the total elimination of microorganisms and therefore, absolute sterility. The latter has a greater retention capacity, up to the total elimination of microorganisms and therefore, absolute sterility. Sterilizing plates are more susceptible to clogging than clarification plates as the flow is more restricted through tighter openings (Ribéreau-Gayon et al, 2006). Commercial requirements demand the offering of clear and stable wines, but on the other hand, the quality of wine can be affected by excessive and thoughtless treatments. Filtration is known for its potential adverse effects; specifically, it is alleged to thin all wines. Its use at the time of bottling is sometimes called into question for this reason. The wine can be saturated with oxygen at the outlet of the filter as well as during pumping which can negatively affect flavor as well as stability (Ribéreau-Gayon et al, 2006). Each molecule of oxygen can eventually cause the binding of one molecule of sulfur dioxide,

A well-done filtration has positive qualitative effects whereas, a poorly conducted filtration or over clarification may have a detrimental effect on quality. The impact of filtration on wines, like all wine treatments, depends on its performance conditions (Ribéreau-Gayon et al 2006).

13.1 Membrane filtration

This kind of technique is used just before bottling, when the wine must be sterilized or have low- microbial requirements. This technique traps particles depending on their size and according to the pore diameters of the membrane (retention value), range from 0.45-1.2µm, 0.45 µm removes bacteria, 0,65 µm removes yeasts. Membrane filters are supplied as ready to use cartridges and the flow rate depends on the number of cartridges installed in parallel in each unit. A pre-filter is used to protect the membrane and helps prevent fouling (Ribéreau-Gayon et al 2006). Two pre-filter categories: 1. In-depth pre-filters are coarse filters consisting of polypropylene glass fibers either alone, or mixed with diatomaceous earth (Kieselguhr) or cellulose. They have a high retention capacity and trap particles inside the filter layer by absorption and screening. 2. Surface pre=filters retain the particles on their surface and are made of cellulose esters or polypropylene layers. These also have a good specific retention. Pre-filters are not always defined by their retention value but rather are measured by the total quantity of particles that the filter is capable of retaining before it becomes blocked. This depends on the compactness of the filter; the more packed the fibers, the faster the filter will be clogged. The pre-filters improve the final filtration but cannot guarantee perfect clarification quality or total retention of microorganisms (Ribéreau-Gayon et al 2006).

Over the last some decades the wine consumption is increasing and the using technology in wine industry is needed to change with the time of modern generation. Last 30 years, membrane technologies have become an important tool on the food-processing industry. Nowadays, they are commonly used in the processing industry. There are lot new technology coming in the market among them most sought in cross flow filtration replaces the traditional filtration techniques as diatomaceous-earth filtration for wines clarification and for others uses also (sugar enrichment).

The cross flow filtration process is one of the most applied membrane process in wine industry. This technique is developed as an alternative to pre-coat filtration. These latters showed their limits quickly in terms of wine quality, wine loss and their limits quickly in terms of wine quality, wine loss and their implementation especially in clear dealing with huge volumes of wines.

Combination of clarification, Microbiological stabilization and sterile filtration in one single continuous operation. Reducing wine loss and energy coast by substitution of several treatments of traditional filtration in a single operation. Eliminating the use of Diatomaccous earth and sheers, could be reducing production cost and also wastes and improving hygiene and work safety. Continuous and highly automated processes (elimination of labor costs and saving time) and possibility of data recovery (El Rayess et al., 2011).

14 Vinification

JMF Cellar is one of the innovative cellar unit all over in Portugal. Four conveyers to take the grapes to destemer and crusher passing through the 5/4 pneumatic pressing machines. More than 400 tanks, divided for the Red and white. The process of vinification has done by the modern tools and automated technology.

Figure 12: Conveyor and Cellar(Roy)

14.1 Grape processing in cellar

Grapes have destemed, crushed and pressing have followed by natural process using potassium meta-bisulfite at transporting time (protect the grapes from oxidation). Then process the grapes with pectolytical enzyme for aroma and clarification (depend on grapes varieties). 90 percent of the harvest done by mechanical harvester in day light.

For ***white wine*** grapes have destemed then passing through cooling chamber and pressing 100 percent. After that put the must to tank for fermentation.

For ***red wine*** processing grapes have destemed, crusher and passing by the cooling chamber and put the grapes in tank for maceration and further vinification.

Figure 13: Pressing machine(Roy)

14.1 Clarification process for white grape must before fermentation

Taken the must of white grape in tank for clarification and began fermentation. To clarify the must from polysaccharide and solid particles, using rapid clarification which is pectolytical enzyme to suspend the polysaccharide/ solid particles in wine must. After this process wait one night to suspend solid parts at the top of wine after that, using floatation machine to clarification the wine within very small time for the white wine. Use gelatin form of powder compound mixture with water put in the equipment by sucking which help to clean the wine. This process take some hours.

Figure 14: Flotation machine(Roy)

14.2 Process of vinification

14.2.1 White Wine

The white wine must fermentation temperature is around 12°C-16°C for this tanks have refrigeration system for vinification of white grapes. In the white wine process the turbidity consider is one of the valuable parameter which should around 90-120 NTU. Inoculation at the density around 1100(g/cm$^{3)}$ and put the industrial yeast for the different varieties and desire products. Using normal yeast Saccharomyces cerevisiae and also Pichie kiuyveri.

14.2.2 Red Wine

The grapes have passed through the cooling chamber after destem the steams and taking the whole berries in the tank for maceration and started fermentation at the temperature 24°C-26°C. Using nitrogen compound as a nutrients of the yeast and performing others steps.

14.3 Correction at the time of vinification

All the tanks are equipped and automated. The Cellars tank all the automated and performing "remontage" by pumping over automatic by the pump (red wine). Performing "delestage" by the "Train".

Figure 15: Remonstrate by the train (Roy)

At the phase of running fermentation is the best time to using additive (nutriention) for the desire product at the end.

Using Sulfur di- Oxide of gaseous which consider most preferable for the wine free sulfur di oxide and take the rapid action than other type of Sulfur di-oxide compound (Powder or Liquid) and help to prevent oxidation, maintain pH and other positive effect.

An-other correction is a new in the wine industries is that marco-oxygenation for the defect odor like sulfuric smell for the white wine treatment. For this need an advance equipment for dosing Oxygen (O2). The dosing O2 is 6 gm/l.

Maceration time for the red wine around the 7days depend on the type of red wine is going produce. At the maceration period there are some practices done to make better quality of the wine.

15 Conclusion

To become an enologist and part of the JMF allover 6 months working in Vineyard, laboratory and in cellar. As a role of becoming master in the wine filed need to understand and perform all kind of jobs in the process of winemaking, Here, I learn lot of new technique with new machines and new process of wine makings.

This report based on four parts Mechanical Pruning, Laboratory, stabilization and harvest, where I worked and got knowledge though out the part of my internship. My main focus was on the cellar and laboratory where measuring the wines for quality control and also for the stabilization.

In the JMF where different brands of wines producing and measures the essential chemical parameters for the routine check-up for stabilization of the racked wine and quality control for the selling products. The parameters are pH, Density, Alcoholic Strength, Total Acidity, Volatile Acidity, Residual Sugar, Free and Total Sulfur di-oxide. The threshold level of the parameters are defined by the IVV. Measuring these parameters by advanced equipment like (Near Infrared Spectroscopy), Fourier Transform Infrared Spectrometer (FT-IR), Biosystem y15. Flame Atomic Absorption spectrophotometer.

In wine production process includes two major phase stabilization of the wine throughout aging and Microbiological stabilization for bottling (need to make sure stabilization after bottle). To prevent the contamination from the bacteria is the key aspect of prior to bottle. All the process need to be done in the proper hygiene environment. Modern equipments like cross flow filtration are used for the clarification process. Electrodialysis for the tartaric stability and for the chemical stabilization using DMDC dosing unit or SO_2. or filtration (depend on the wine styles).

In harvest period I have done fermentation controlling and vinification process. Jose Marie da Fonseca is already proved as a biggest wine producer in Portugal and exporting wines also in USA soil although not being the part of famous place like Porto and Douro or Madeira (maximum wine exporter in Portugal).

Fond of the company very much cause of new advance automated machines/ tools. It is very innovative which makes the vinification process efficient and less time consuming. JMF is the 1st winery in Setubal recognized by international by their Innovation tools and their business ideas. As by research I found that more than 50 percent of total volume of muscatel form Setubal in made by the JMF and their contribution in the region will be always recognized.

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