

Systematic analysis of wine legislation

OENOLOGICAL PRACTICES



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Wine
stirs the spring, happiness
bursts through the earth like a plant,
walls crumble,
and rocky cliffs,
chasms close,
as song is born.

*El vino
mueve la primavera,
crece como una planta la alegría,
caen muros,
peñascos,
se cierran los abismos,
nace el canto.*

Pablo Neruda

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Abstract

Wine serves as an example to evaluate the relationship between food science, food technology, and law. This thesis focuses on European wine legislation related to oenological practices. These practices are techniques used during wine production to get a wine of high quality as a final product. Nowadays, there are fifty-eight authorised oenological practices to ensure proper wine making processing, preservation, and refinement of the product. The use of some of the practices are abide by specific requirements depending on the geographical zone where are intended to be carried out. Moreover, wine is exempted to label the ingredient list, although this fact may violate the consumers' rights to be informed about the product they may purchase. The results obtained in this research have shown that the legislation related to oenological practices is being developed at the same time as the technological and scientific advances. However, some aspects of wine legislation need to be more accurate as it is the case of the legal definition of wine.

Keywords: wine, oenological practices, European legislation, wine labelling

Summary

The wine sector is one of the most regulated sectors due to the enormous economic interest that is behind it. Besides wine is regulated from “vineyard to glass”, wine production is more related to food science and technology and the analysis of the regulation related to the process is of high interest within that area. Consequently, this thesis research project focuses on oenological practices, which are those techniques that are applied within the vinification process to produce wine with certain characteristics.

The Law and Governance group of Wageningen University has not yet focused their research on product specific legislation. Therefore, a systematic evaluation of the different process operations to obtain a food product and the related legislation is of great interest for opening this research area. Wine is an excellent product to be analysed from a legal point of view, since it is regulated by specific legislations. Additionally, wine legislation is a perfect example to see how science, technology, and law are coordinated. Thus, the aim of the present Master thesis was to systematically analyse the former and current regulation of oenological practices in order to see the relationship between science, technology, and law.

The research has been carried out in different phases that include bibliographical search and analysis, together with personal interviews with professionals of the wine sector.

For a proper understanding of the topic, it is important to define wine from a legal perspective and discuss whether the definition is compatible with the authorised oenological practices or not. However, there are different legal definitions of wine in Europe. For instance, the European legislator defines wine as *a product obtained exclusively from the total or partial alcoholic fermentation of fresh grapes, whether or not crushed, or of grape must*;¹ whereas the International Oenological Codex (IOC) defines wine as *the beverage resulting exclusively from the partial or complete alcoholic fermentation of fresh grapes, whether crushed or not, or of grape must [...]*.² Even though both definitions are similar, their interpretation may differ in their application.

The European legislator divides the territory into three wine-growing zones: zone A, zone B, and zone C, which is then subdivided into zone C-I, zone C-II and zone C-III. Zone A includes the North of Europe, zone B middle Europe, and the C zones are in the Southern part of Europe. In relation to this division, the legislator distinguishes the application of certain oenological practices according to the zones, but does not justify the need for the division.

Throughout the last few decades, technology has become part of the wine making process due to the development of techniques that are feasible to address the quality of the final wine. Technological advances in the wine domain have allowed producers to improve the quality of their products. In this sense, the European legislator lays down fifty-eight oenological practices

¹ Annex III ('annex XIb'), Regulation 491/2009.

² OIV Code Sheet I.1.3-1.

that can be implemented to ensure proper wine making processing, preservation, and refinement of the product.

Moreover, besides the fifty-eight oenological practices established in the annex I A of the Regulation 606/2009, there are other practices incorporated in the text of the regulation. These practices are sweetening, and *coupage*. The former consists of the addition of sweeteners to obtain aromatised wine. The latter refers to mixing wines or juices of different origins, vine varieties, harvesting years, categories of wine or juice to obtain an improved wine with a better flavour and balance between acids.

Nowadays, wine is exempted to include the ingredient list on the label. In this sense, on March 2018, part of the wine industry published a self-regulatory proposal to respond to consumers' demands to make informed choices when buying a wine. Until now, the European Commission is evaluating the proposal and discussing the possibility of other regulatory approaches for this controversial topic.

The results have shown a lack of conceptualisation of wine between regulations. Legal definition of wine should be more accurate; otherwise, the actual definition may create controversy among the different interpretations. Therefore, nowadays, there are interpretations that argue that the addition of any substance to wine is incompatible with the definition.

On the other hand, if climate is the reason of the division of the European territory, it is inappropriate that the existing regulations diverge regarding climatic zones taking into account that nowadays we are facing climate change.

Finally, wine legislation is a great example of the coordination needed between scientist and the legislator. It is possible to state that European wine regulations move in consonance with the new scientific and technological advances. However, besides the strict regulations, there are a lack of certification bodies regarding the effectiveness of certain oenological practices such as the addition of yeast aiming to aromatise wine.

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List of abbreviations

EU	European Union
FIC	Food Information for Consumers
GFL	General Food Law
IOC	International Oenological Codex
MS	Member States
OIV	International Organisation of Vine and Wine
PDO	Protected Designation of Origin
Vol.	Volume
WPO	Wine Producers Operators

List of concepts

Concentrate grape juice: is the product obtained by partial dehydration of grape juice by different authorised methods.³

Juice (must): is the *liquid product obtained naturally or by physical processes from fresh grapes. An actual alcoholic strength of the grape must of no more than 1% volume is permissible.*⁴ From now on the word “juice” is used instead of “must” for a better understanding for readers. It must be said that by law, it is not possible to use the “real juice” for vinification purposes.⁵

Natural alcoholic strength by volume: is *the total alcoholic strength by volume of a product before any enrichment.*⁶

New wine still in fermentation: is the *product in which the alcoholic fermentation is not yet complete and which is not yet separated from its lees.*⁷

Partially fermented juice (must): is the *product obtained from the fermentation of grape must which has an actual alcoholic strength of more than 1% volume but less than three fifths of its total alcoholic strength by volume.*⁸

Rectified concentrated grape juice (must): is the *product obtained by partial dehydration of grape must by different authorised methods that has been de-acidified and treated to eliminate other components than sugar.*⁹

Total alcoholic strength by volume: is the *sum of the actual and potential alcoholic strengths.*¹⁰

³ 13, Annex III, ‘annex XIb’, Regulation 491/2009.

⁴ 10, Annex III, ‘annex XIb’, Regulation 491/2009.

⁵ B (2), Annex XVb, Regulation 491/2009.

⁶ 16, Annex I, Regulation 491/2009.

⁷ 2, Annex III, ‘annex XIb’, Regulation 491/2009.

⁸ 11, Annex III, ‘annex XIb’, Regulation 491/2009.

⁹ 14, Annex III, ‘annex XIb’, Regulation 491/2009.

¹⁰ 15, Annex I, Regulation 491/2009.

CHAPTER 1. INTRODUCTION

The wine sector is highly regulated, from “vineyard to glass”. As a Food Safety Law Master student, I find it of great interest to evaluate the regulation related to wine production and its relationship with the food science and technology behind it.

This thesis project focuses on European wine legislation related to oenological practices. An oenological practice is a method used to produce wine and determine the quality of the intrinsic attributes of the final product. The European law lays down the specific oenological practices that are authorised to ensure proper wine making processing, preservation, and refinement of the product.

It is worth mentioning that wine has numerous benefits for human health. It contains several bioactive compounds such as polyphenols and resveratrol, which help to prevent cardiovascular diseases such as myocardial infarction. As Professor González-Salgueiro says,¹¹ “wine results from living cells, and although in diluted state, it contains everything necessary for life”.

Legal background

The International Organisation of Vine and Wine (OIV) is a scientific intergovernmental organisation that contributes to wine legal harmonisation; for this reason, the OIV has elaborated an International Oenological Codex (IOC) aiming to improve vinification processes and commercialisation of wine, taking into account consumers interests.¹² The EU is member of the OIV.

In relation with the European Union, the European Commission is the core regulatory body, and, although, when a new standard is created it follows the recommendations established by the IOC; the European law takes preference over the IOC in the EU. In this sense, the OIV is not a regulatory body, it only provides recommendations, and hence the application of the IOC is not mandatory for the member Countries. Additionally, the applicability of European law is not unique, national regulatory bodies complement it. The European Commission sets the legal

¹¹ Blouin, J., & Peynaud, E. (2004). *Enología práctica: conocimiento y elaboración del vino*. Mundi-Prensa Libros. Pag. 53.

¹² <http://www.oiv.int> December 2017.

framework, then Member States must incorporate it into their legal texts. Therefore, the national standards could be more restrictive than the European law. For example, in Spain every territory that has wine under a Protected Designation of Origin (PDO) has stricter standards aiming to protect the special features of their wine.

This research only discusses European legislation and does not cover those legal provisions established in lower hierarchical level such as national legislation.

Problem formulation

The research of the Law and Governance group of Wageningen University has been focusing on the general aspects of food law since 2002. However, in their research, there is a knowledge gap of product specific legislation, which should be filled because it is also an important part of the food law domain. A systematic legal analysis of a specific product is a good starting point for incorporating this area of interest. Indeed, wine is the perfect product to be analysed even though it does fall under the General Food Law (GFL), it is also regulated by specific regulations.

Moreover, wine legislation is based on science and technology. Although, a certain background on science is necessary for a proper understanding of the topic, this thesis is focused on the evaluation of the oenological practices from a legal perspective and it is written in the most comprehensive approach, using the simplest vocabulary possible.

Objective

The aim of this research is to provide a systematic analysis of oenological practices legislation. Throughout the research, it is possible to realise that not all practices are regulated at the same level or in the same manner. Therefore, the research seeks to legally frame the different oenological practices, examine the reasons behind the law justifying the legal provisions, and suggest possible modifications of the current law.

The research deals with the updated current legal provisions, but due to further modifications it is convenient to review the actual consolidated version of the Commission Regulation (EC) No 606/2009 of 10 July 2009 laying down authorised oenological practices.

Furthermore, it is important to determine whether the legislation is in consonance with the new scientific advances; and wine legislation is a great example of the coordination needed between scientist and the legislator.

Research question

The main research question is: How are oenological practices being regulated in the European Union regarding science and technological advances?

To answer the main question, it was necessary to answer the following sub-questions:

- What is the legal definition of wine?
- How are wine-growing territories divided? Which consequence entails this division in relation to wine production?
- Do the regulations adjust to scientific and technological knowledge?
- Are the regulations well applied in practice?
- From a technical perspective, is it necessary to label oenological practices?

Methodology

The research was carried out in four phases. The first phase was to seek out wine literature such as current legislation, winemaking manuals, and winemaking scientific articles. The starting points were: Regulation No 606/2009 on authorised oenological practices, Regulation No 1308/2013 establishing a common organisation of the markets in agricultural products, and Regulation No 491/2009 on the Common Organisation of Wine Market. The second phase comprised of reading and analysing the information to solve the legal puzzle and preparation for the next phase.

The existing regulations do not provide enough information to know how oenological practices are applicable in practice, and consequently, not enough to accomplish the research objective; for this reason, the third phase was elaboration of a survey and personal interviews with wine experts that comprise Wine Producers Operators (WPO), oenologists, academics, and lawyers, to

understand the reason behind the legal provisions and their applicability in practice, and to know experts' opinions on the current legislation.

Finally, the fourth phase was the study, analysis, and comparison of the obtained answers.

Outline

First, for a proper understanding of the topic, it is essential to define wine from a legal point of view, and discuss whether the definition is compatible with the authorised oenological practices or not. For that reason, the existing legal definitions of wine in Europe are analysed in chapter 2 to find the most accurate and discuss if modifications are needed.

Chapter 3 is dedicated to discerning the reasons for the territorial division and debating its reliability and appropriateness according to the wine experts.

In chapter 4, the authorised oenological practices and their restrictions are discussed regarding red, white, and rosé wines. However, those practices are not discussed in the case of sparkling wines or liqueur wines. Moreover, each practice is explained according to its main application within the vinification process, but it should be said that some practices could be used in more than one operation. Additionally, certain practices are discussed more extensively than others considering their importance and interest. I have tried to explain step by step the wine making process for a non-professional in the field of wine. In this sense, as this is a regulation review, the complexity of the vinification process is not discussed.

Besides the fifty-eight oenological practices established in the annex I A of the Regulation 606/2009, there are other practices incorporated in the text of the regulation, which are sweetening, and *coupage*. These practices are discussed in chapter 5.

Chapter 6 opens the debate whether it is necessary to label the different oenological practices applied during the winemaking process or not in order to protect consumers' rights to be well informed about the products they might buy.

Chapter 7 is dedicated to discussion and conclusions of the research of this Master thesis.

CHAPTER 2. THE CONCEPT OF WINE

1. Definitions

The International Oenological Codex (IOC) defines wine as *the beverage resulting exclusively from the partial or complete alcoholic fermentation of fresh grapes, whether crushed or not, or of grape must [...]*.¹³

The European legislator defines wine as a *product obtained exclusively from the total or partial alcoholic fermentation of fresh grapes, whether or not crushed, or of grape must*.¹⁴ And, for the Spanish legislator wine is a *natural food obtained exclusively from alcoholic fermentation, total or partial, of fresh grapes, whether crushed or not, or of grape must*.¹⁵

2. The concept of wine

The concept of wine differs among the definitions mentioned above. Indeed, it is not clear whether the legislator intends for a literal or a general interpretation of the legal definition of wine, and whether the definition is compatible or not with the application of the different oenological practices.

Concerning the concept of wine: the Spanish legislator conceptualises wine as a *food*, the European legislator as a *product*, and the *Codex* as a *beverage*, but despite this wine still falls under the definition of food since the GFL defines a food as [...] *any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans [...]*,¹⁶ and wine as it is a partially processed product that humans may ingest.

With regard to the use of the word *beverage* or *product* neither of them should cause a legal applicability issue nor an interpretative issue, but instead they should be simply regarded as categorisation nouns. The verbs used, *resulting* and *obtained*, could be debatable for the interpretation of wine definition. The word *resulting* means that the wine is a consequence of the fermentation of grape products; while *obtained* means that wine is made from the fermentation

¹³ OIV Code Sheet I.1.3-1.

¹⁴ Annex III ('annex XIb'), Regulation 491/2009.

¹⁵ Article 2 (2) (e), *Ley 24/2003, de 10 de julio, de la Viña y del Vino*.

¹⁶ Article 2, Regulation 178/2002.

of grape products. In my opinion, the term *resulting* is the most accurate because it provides a better description of the winemaking process.

Moreover, the addition of certain additives among other substances is authorised. Based on the current legislation, additives are legally considered as ingredients and they have to be mentioned on the label,¹⁷ whereas the processing aid has to be mentioned if it is susceptible to cause allergy.¹⁸ But, for now, wine is exempted from providing the ingredient list. Therefore, the interpretation of the definition of wine is essential to determine whether oenological practices are likely to be considered. In this sense, all the three concepts of wine include the word *exclusively*, which may limit the addition of any substance that does not come from the grape, or might be understood in the way that the final product does not contain any substance that does not result from grapes. However, the opinions differ among the professionals within the wine field, hereafter they are referred to as “the experts”.

Amongst the experts who argue that the definition of wine is not compatible with the application of different oenological practices into winemaking processes, there is a general understanding that the definition is not wrong itself, but should be more accurate because nowadays the literal interpretation of the definition is incompatible with the applicability of oenological practices. The experts suggest that the definition could be completed regarding the final product placed on the market, adding at the end of the definition for example “apt for human consumption or free of residues”.

On the other hand, experts who are of the opinion that the definition is in fact correct in its current state and there is no need to adapt the definition gave different reasoning. First, grapes in their natural state contain all substances that can be legally added throughout the vinification process. Therefore, the added substances are not considered as exogenous substances as long as they are part of the grapes. Secondly, the definition only says that the grapes are fermented and does not specifically prohibit the addition of substances, then, based on the principle of legality, what is not prohibited is allowed. With this line of thought, the definition can also be considered as an open clause due to the word ‘*from*’, which indirectly says that there is a base product and from here it is possible to apply different techniques. Lastly, the residues of the treatments

¹⁷ Article 2 (2) (f), and article 9 (1) (b), Regulation 1169/2011.

¹⁸ Article 9 (1) (c), Regulation 1169/2011.

carried out on juice or wine are almost unquantifiable in the final wine, so the issue is not about the use of certain additives within the process but the traces left in the final product.

CHAPTER 3. WINE GROWING ZONES

It is well known that climate and *terroir* are key factors in the success of viticulture and wine production. Climate determines the optimum ripening of grapes to produce excellent wines. For this reason, a proper climate assessment must consider multiple factors that could interfere with the quality of grapes such as: solar radiation, variability of temperatures, altitude, latitude, bioclimatic indices, wind, etc.¹⁹

The European legislator decided to lay down a division of the European territory into different wine-growing zones,²⁰ and differentiates the application of certain oenological practices regarding the zones. Whilst, there is no legal statement justifying the territorial division, but, based on experts' opinions there is enough evidence to think that it is due to the diverse climatology of Europe. Therefore, it is important to discern the reasons for this division and discuss its reliability and appropriateness.

As is shown in figure 1, there are three wine-growing zones in Europe that are established in the annex of the Regulation 491/2009 and Regulation 1308/2013: zone A,²¹ zone B,²² and zone C, which are also divided into zone C-I,²³ zone C-II²⁴ and zone C-III, which is also divided into zone A and B²⁵ The most immediate reason for dividing European territory into growing zones is the diverse climatology of these wine-growing zones. As there was a lack of justification for this legislation, part of the survey and interviews were dedicated to understanding the opinion of the experts on this topic and to acquire information to decide whether the division is correct and appropriate or not.

¹⁹ Jones, G. V., Reid, R., & Vilks, A. (2012). Climate, grapes, and wine: structure and suitability in a variable and changing climate. In *The Geography of Wine* (pp. 109-133). Springer Netherlands.

²⁰ Appendix to Annex XIb, Regulation 491/2009.

²¹ Appendix to Annex XIb (1), Regulation 491/2009; and annex VII, part II, appendix I (1) Regulation 1308/2013.

²² Appendix to Annex XIb (2), Regulation 491/2009; and annex VII, part II, appendix I (2) Regulation 1308/2013.

²³ Appendix to Annex XIb (3), Regulation 491/2009; and annex VII, part II, appendix I (3) Regulation 1308/2013.

²⁴ Appendix to Annex XIb (4), Regulation 491/2009; and annex VII, part II, appendix I (4) Regulation 1308/2013.

²⁵ Appendix to Annex XIb (5) and (6), Regulation 491/2009; and annex VII, part II, appendix I (5) and (6) Regulation 1308/2013.

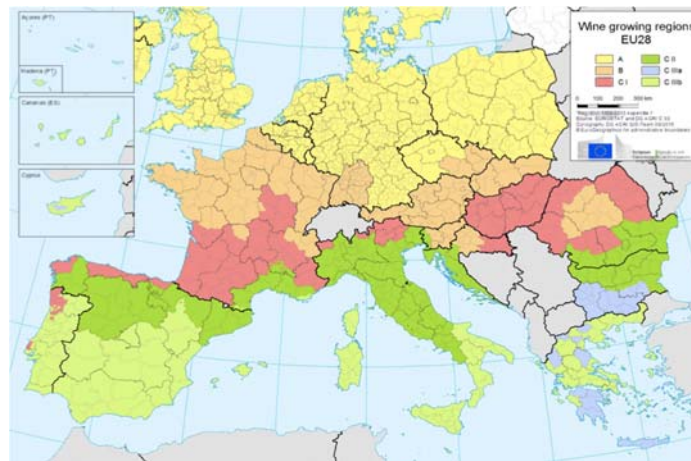


Figure 1. Wine – growing zones of Europe.
 (https://ec.europa.eu/agriculture/sites/agriculture/files/wine/statistics/wine-growing-regions_en.pdf)

It is important to highlight that climate and *terroir* factors show a significant variation even in the same geographic zone. For example, Spain is one of the countries with the highest altitudes in Europe with an average of approximately 630 metres, with different latitudes, which means the climate conditions of the different regions of Spain are completely diverse, and consequently the harvested grapes show very different characteristics. Navarra can illustrate this, where the weather is likely to be more similar to The Netherlands than the climate on the coast of Catalonia, whereas the winemaking conditions for Navarra are classified within zone C, which is the same as Catalonia but different from The Netherlands.

Moreover, nowadays, we are confronting a change in the environmental cycle that is influencing the viticulture calendar. The year 2017 is, so far, the shortest and earliest harvest season in viticulture history across Europe, especially in France, Spain and Italy that are the main wine producers. Furthermore, across most of the territories the grape-growers had to harvest their crop almost one month in advance and in the night due to high temperatures. During the night, the lower temperatures decelerate the ripening process of the grapes, therefore grape-growers choose to harvest at night to maintain the cooler conditions that the grapes require before fermentation.²⁶ Additionally, the poor weather conditions such as drought, hail and ice, have decreased the harvest of grapes. Fortunately, the quality of the harvest this year will be the same or even better than previous years, even though prices will increase as there has been a scarce harvest. Furthermore, viticulture has changed in the sense that it has developed mechanical and technological methods that can compensate for unfavourable climate conditions.

²⁶ Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. 394p. Page 35.

Some experts consider the delineation of the zones incorrect and even unnecessary. According to them, the delineation is not based on objective criteria and does not consider the advances in agricultural and technological techniques in wine production. Additionally, over the last decade, climate change has become more evident, which makes the delineation vague. Therefore, now it is incomprehensible that the application of certain oenological practices diverges regarding the mentioned zones.

On the contrary, other experts agreed with the delineation of the zones. They believe that the zones are established regarding their climatic similarity, based on temperatures, latitude and rainfall average criteria that may affect the cultivation.

Nonetheless, inside of the different zones there are enormous climate variations such as temperatures due to altitude, which can make the difference in terms of the quality of grapes. Moreover, from a legal perspective, the delineation sought tutelary protection and the production of a wine of specific quality when there is lack of technology and knowledge. However, nowadays, the technological advances in viticulture and oenology have surpassed the current legislation.

CHAPTER 4. OENOLOGICAL PRACTICES

Nowadays, technology is part of the winemaking process in the sense that there are techniques that help to increase the effect of sensorial compounds of wine among other functions. For example, now it is possible to carry out fermentation whilst controlling its temperature or selecting yeasts.

In this chapter I introduce and discuss different oenological practices regarding red, white and rosé wine (mainly red)²⁷ that are authorised by the European Commission. Each practice is explained according to its application within the winemaking process, but it should be said that some of the practices could be used in more than one step.

Certain practices are explained in more depth than others due to their importance and interest. Additionally, in all oenological practices the addition of water or alcohol is forbidden, except when it is necessary due to specific technical needs.²⁸

This thesis project does not focus on the complexity of the wine-making process, for that reason it is not discussed. Figure 2 illustrates the process followed to explain the overview of oenological practices from a legal perspective for a better understanding for the reader.

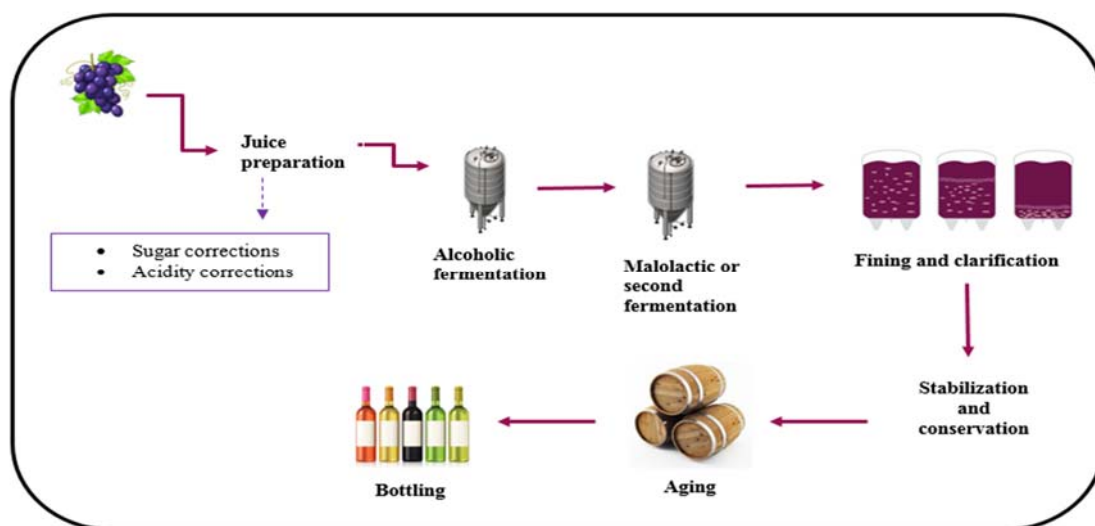


Figure 2. Overview of Chapter 4.

²⁷ It is the more complex process.

²⁸ Annex VIII, part II, A (1) and (2), Regulation 1308/2013.

1. Wine harvest corrections: juice preparation for the alcoholic fermentation

Grape variety and ripening determine the type and the quality of a wine. Consequently, grape ripening is a key factor in the optimal vinification process, which takes only one or two months depending on short-term climate variability. Bunches of grapes are highly sensitive to climatic changes, and this fact will determine the quality and maturity of grapes for producing a well-constituted wine.

These days, consumers demand wines that are aromatic and acidic at the same time. Finding the perfect balance between acidity and aroma is difficult because when ripening of grapes occurs, the sugar content increases, important aroma compounds can disappear and acidity levels decrease. As figure 3 shows, sugar levels increase while acidity decreases.

To correct the lack of quality, the addition of certain substances to the wine is allowed under legal limits and conditions. So, it is possible to correct the sugar content or acidity levels of the juice, among other practices.²⁹

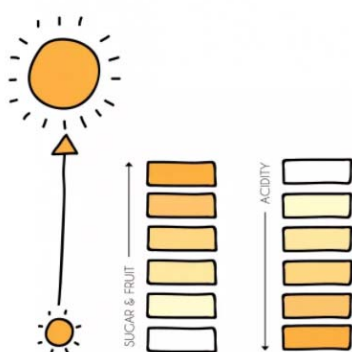


Figure 3. Natural relationship between sugar and acidity. (<http://wine-academy.wiine.me/lesson/the-seesaw-of-wine-sweetness-acidity/>)

Sugar and acidity corrections³⁰ are incompatible. For example, if an enrichment of the natural alcohol content is carried out, sugar cannot be removed from the juice afterwards and *vice-versa*. Also, sugar enrichment and acidification are mutually exclusive processes.³¹ These corrections are opposed and incompatible.

1.1. Sugar corrections

In years of frequent rains, grapes expand in size, become healthier and more aesthetically pleasing. However, their juice will contain lower concentrations of sugar to be fermented. In the

²⁹ Blouin, J., & Peynaud, E. (2004). *Enología práctica: conocimiento y elaboración del vino*. Mundi-Prensa Libros. Pages 75-108.

³⁰ Annex I A, appendix 10, Regulation 606/2009.

³¹ Annex IV-‘annex XVa. C (7), Regulation 491/2009.

same way, low temperatures during summer prevent bunches from ripening properly. Consequently, in both cases, the final wine will contain low natural sugar content, which is a key factor since sugar turns into alcohol through fermentation. For this reason, it is important to ensure sugars reach the desired natural alcohol strength, and produce a high-quality wine, by doing the following sugar correction methods.

1.1.1. Sugar enrichment or enrichment processes for the artificial increase of the natural alcoholic strength

For unforeseen meteorological circumstances, the Regulation 491/2009 establishes that, under specific climatic conditions, Member States from certain European wine-growing zones can allow producers to increase the natural alcoholic strength by adding fresh grapes, grape juice, grape juice in fermentation, new wine still in fermentation and wine obtained from authorised wine grape varieties. But, the increase of the natural alcoholic strength regarding wine-growing zones (see: Chapter 3) is limited as follows:³²

- Zone A: the natural alcoholic strength by volume cannot be increased by more than 3% vol.,³³ and the total alcoholic strength may not exceed 11,5% vol.³⁴ However, Member States may raise the total alcoholic strength limit by up to 12% vol. in red wines.³⁵
- Zone B: the natural alcoholic strength by volume cannot be increased by more than 2% vol.,³⁶ and the total alcoholic strength may not exceed 12% vol.³⁷ However, Member States may raise the total limit by up to 12,5% vol. in red wines.³⁸
- Zone C: the natural alcoholic strength by volume cannot be increased by more than 1,5% vol.³⁹, and the total alcoholic strength may not exceed 12,5% vol. in zone C I,⁴⁰ 13% vol. zone C II⁴¹ and 13,5% vol. in zone C III.⁴²

³² Annex IV-‘annex XVa. A (1), Regulation 491/2009.

³³ Annex IV-‘annex XVa. A (2) (a), Regulation 491/2009; and annex VIII, part I, A (2) (a), Regulation 1308/2013.

³⁴ Annex IV-‘annex XVa. B (6) (a), Regulation 491/2009; and annex VIII, part I, B (6) (a) Regulation 1308/2013.

³⁵ Annex IV-‘annex XVa. B (7) (a), Regulation 491/2009; annex VIII, part I, B (7) (a) Regulation 1308/2013.

³⁶ Annex IV-‘annex XVa. A (2) (b) Regulation 491/2009; and annex VIII, part I, A (2) (b), Regulation 1308/2013.

³⁷ Annex IV-‘annex XVa. B (6) (b), Regulation 491/2009; and annex VIII, part I, B (6) (b) Regulation 1308/2013.

³⁸ Annex IV-‘annex XVa. B (7) (a), Regulation 491/2009; and annex VIII, part I, B (7) (a) Regulation 1308/2013.

³⁹ Annex IV-‘annex XVa. A (2) (c), Regulation 491/2009; and annex VIII, part I, A (2) (c), Regulation 1308/2013.

⁴⁰ Annex IV-‘annex XVa. B (6) (c), Regulation 491/2009; and annex VIII, part I, B (6) (c) Regulation 1308/2013.

Member States can authorise increasing the limit by 0,5% vol. when climatic conditions have been exceptionally unfavourable, after making a request to the Commission.⁴³ And, regarding the production of wine under a specific Protected Denomination of Origin (PDO), Member States can fix the maximum for raising the total alcoholic strength.⁴⁴

Repealed legislations also demanded a minimum level of natural alcoholic strength to be able to carry out an artificial alcoholic increase. Moreover, the legislator differentiated not only between wine-growing zones but also considered the wine classification: table wines, wines to produce table wines or quality wines.⁴⁵ In this regard, the generalisation of the law does not affect the final product. For example, the difference between table red wine and quality red wine is one-step, which precedes the first fermentation (alcoholic fermentation). Quality red wine is produced from the first juice obtained by draining, and table red wine is produced from the liquid obtained by pressing the mass resulting from draining. This means that both types of wine are obtained from the same harvested grape.

In addition, the artificial alcohol enrichment limits have changed from 1999. The maximum percentages have decreased to 0,5% vol., and in years when climatic conditions have been exceptionally unfavourable, the limit/s was allowed to be raised by 1% vol. in zones A and B.⁴⁶ Now, in years of poor weather conditions, zone A can increase the limit to 3,5% vol., zone B to 2,5% vol., and zone C to 2% vol., and the authorisation to increase the limits is extended to all wine-growing zones,⁴⁷ not only for zones A and B. From the consumers' perspective, this is a positive fact because the obtained wine could be perceived as a more natural and healthier product. Consumers tend to understand that there is a relationship between the healthiness of a product and the number and intensity of human interventions into the product. In other words, a less processed product is perceived as more beneficial for health.

On the other hand, from the WPO perspective, the revision is favourable for those from zones C because sweetening helps to prevent future economic losses due to the low quality of the raw material. However, it is detrimental for operators from zones A and B, because they are not able

⁴¹ Annex IV-'annex XVa. B (6) (d) Regulation 491/2009; and annex VIII, part I, B (6) (d) Regulation 1308/2013.

⁴² Annex IV-'annex XVa. B (6) (e), Regulation 491/2009; and annex VIII, part I, B (6) (e) Regulation 1308/2013.

⁴³ Annex IV-'annex XVa. A (3) Regulation 491/2009; and annex VIII, part I, A (3) Regulation 1308/2013.

⁴⁴ Annex VIII, part I, B (7) (b) Regulation 1308/2013.

⁴⁵ See Regulation 1493/1999.

⁴⁶ Annex V, C (4), Regulation 1493/1999.

⁴⁷ Annex XV 'a, A (3), Regulation 491/2009

to enjoy exclusively this privilege any longer, and their climatic conditions are colder than zones C, which is unfavourable for the bunches. In this regard, based on the existing legislation, operators as a whole have to produce wine under the same circumstances.

Another requirement to be met is the methodology used for the alcohol enrichment. The legislator lays down different methods to increase alcoholic strength by volume depending on the product treated, as it is detailed in the following:

- For fresh grapes, grape juice in fermentation⁴⁸ or new wine still in fermentation, the increase in alcohol must be attained by adding dry sucrose, concentrated grape juice or rectified concentrated grape juice.⁴⁹
- For juice, the requisite has to be achieved by adding dry sucrose, concentrated grape juice, rectified grape juice, or by partial concentration, including reverse osmosis.⁵⁰⁻⁵¹
- For wine, it only can be reached by partial concentration through cooling.⁵²⁻⁵³

It must be taken into account that those processes are mutually exclusive where wine or grape juice is enriched with juice products.⁵⁴ In other words, it is only possible to use one of these techniques. For example, if a producer increases alcoholic strength for fresh grapes, they cannot enrich the juice of those grapes later by rectified grape juice.

The addition of juice products shall not increase the initial volume of freshly crushed grapes, grape juice, grape juice in fermentation or new wine still in fermentation by more than 11% in wine-growing zone A, 8% in wine-growing zone B and 6.5% in wine-growing zone C.⁵⁵

The concentration of grape juice or of wine subjected to the above-mentioned treatments, may neither produce a reduction of more than 20% of the initial volume, nor increase the natural

⁴⁸ In the Spanish version is referred as partially fermented juice, which, as I understand, the fermentation juice is in middle stage. And, juice in fermentation mean at any stages of fermentation.

⁴⁹ Annex IV-'annex XVa. B (1) (a) and (3), Regulation 491/2009; annex VIII, part I, B (1) (a) Regulation 1308/2013.

⁵⁰ It is a procedure to force two solutions of different concentrations to equal their concentrations, passing the concentrated solvent to the diluted solvent through a membrane.

⁵¹ Annex IV-'annex XVa. B (1) (b) and (3) Regulation 491/2009; and annex VIII, part I, B (1) (b) Regulation 1308/2013.

⁵² Concentration of must by cooling is a subtractive technique consisting of two phases. The first phase partially freezes the water of the grape harvest. The second phase separates the frozen water obtaining a high quality concentrated must.

⁵³ Annex VIII, part I, B (1) (c), Regulation 1308/2013.

⁵⁴ Annex IV-'annex XVa. B (2), Regulation 491/2009

⁵⁵ Annex IV-'annex XVa. B (4), Regulation 491/2009.

alcoholic strength by more than 2% vol.,⁵⁶ notwithstanding the established maximum levels for this.

Furthermore, producers, bottlers, processors, and merchants must enter in the register,⁵⁷ and notify the relevant authority all the treatments done to enrich the alcohol level before they are performed.⁵⁸

The notification will not be required in Member states in which the authorities carry out systematic analytical controls of all batches of products turned into wine.⁵⁹ This is reasonable because the main objective is met, which is to be aware of the modified quantities and the methods used.

1.1.2. Chaptalisation

Chaptalisation of wine is a technique that consists of adding an exogenous sweetener product to the wine harvest to boost the wine's final alcohol percentage. Usually sugar is in the form of sucrose (table sugar), derived from sugar-cane or/and sugar beet are used for that purpose.⁶⁰ In Europe, WPO are more likely to add sugar beet because it is more economical taking into account logistics and price of the product.

Moreover, as it is explained below, chaptalisation was and still is a controversial practice due to its authorisation only for certain wine growing-zones. In this sense and for a better understanding of the authorisation of chaptalisation, it is important to take into account the history of Europe. Germany, Belgium, France, Luxembourg, the Netherlands and Italy were the funders of European Union (EU), with France and Italy having a great wine tradition. France was the first country to use the chaptalisation. Its authorisation can be reasonable under the principle of customs and usages of the territory such as the use of resin to produce *retsina wine*, however, the legislator extrapolated the practice to all Member States (MS) instead of regulating it as an exception for French wines. In this line, it is important to mention that chaptalisation is beneficial for the

⁵⁶ Annex IV-'annex XVa. B (5), Regulation 491/2009.

⁵⁷ Article 29 (2) (b), Regulation 2018/273.

⁵⁸ Article 30 (2), Regulation 2018/273.

⁵⁹ Article 30 Regulation 2018/273.

⁶⁰ Togores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. Pages 458-459. And Blouin, J., & Peynaud, E. (2004). *Enología práctica: conocimiento y elaboración del vino*. Mundi-Prensa Libros. Pages 101-103.

fundamentals because it improves their production otherwise by nature they will not be able to market as much wine as they are currently placing on the market. Meanwhile, it is important to note that France and Germany are two of the largest producers of sugar beet worldwide.⁶¹

In addition, chaptalisation was and still is authorised only for the Northern part of Europe (wine growing zones A and B). Italy was not interested in the authorisation of the practice, and nowadays, together with Spain and other MS, they are trying to abolish the practice.

Chaptalisation as oenological practice

Chaptalisation is the addition of table sugar to wine when the sugar content of the grapes is not enough for a proper fermentation. The yeast of the grapes contains specific enzymes able to divide sugar into glucose and fructose, which are the sugars of grapes for fermentation⁶². In other words, chaptalisation changes directly the main compound of grape juice as well as its water to be able to carry on an alcoholic fermentation when the original product is not able to.

The European legislator opted to condition the addition of sucrose to the exclusive use of dry sucrose in the wine-growing zones A and B instead of a global authorisation. Wine Businesses Operators from Italy, Greece, Spain, Portugal, Cyprus, and South of France⁶³ (wine-growing zone C) are not allowed to use sugar. Exceptionally, French authorities could authorise the addition of dry sucrose, and it has to be notified to the Commission and other Estate members.⁶⁴

Experts believe that a global authorisation of chaptalisation is more appropriate not only because climate change made this practice only necessary in exceptional weather circumstances but also because these circumstances may also occur in other zones than the authorised ones. Consequently, its authorisation should not rely on the wine-growing zone. On the other hand, other experts disagree with the authorisation of the practice and believe that there are zones that by nature are not able to develop viticulture and we should respect what nature decided.

⁶¹ <https://www.statista.com/statistics/264670/top-sugar-beet-producers-worldwide-by-volume/> May 2018.

⁶² Ough, C. S. C. S. (1996). *Tratado básico de enología*. Page 72.

⁶³ Annex IV-'annex XVa. B (3), Regulation 491/2009.

⁶⁴ Annex IV-'annex XVa. B (3) *in fine*, Regulation 491/2009.

Furthermore, producers, bottlers, processors, and merchants have to notify, to the competent authority or, entered in the register the chaptalisation.⁶⁵ The notification will not be required in Member states in which the authorities carry out systematic analytical controls of all batches of products turned into wine.⁶⁶ This is reasonable because the main objective is met, which is to be aware of the modified quantities and the methods used.

The legal concept of wine vs. chaptalisation

The European legislator defines wine as *the product obtained exclusively from the total or partial alcoholic fermentation of fresh grapes, whether or not crushed, or of grape must*.⁶⁷ From this definition a question arises: is the definition compatible with the addition of sugar? The definition does not mention the word sugar.

When asking to experts in the wine field about chaptalisation the vast majority of the experts considered that this practice does not fit under the legal definition of wine. Almost all the experts disagree with the authorisation of chaptalisation, and strongly believe that it was authorised due to economic and political reasons and not to improve the vinification process. Moreover, chaptalisation directly affects the main component of the juice that the legislator should not be allowed to alter the content of by adding an exogenous substance.

Experts holding that chaptalisation suits the legal definition of wine believe the practice is just another oenological practice and should be used under the criteria of the producer. Additionally, it is necessary to contextualise chaptalisation among different types of wine and its alcoholic strength content, so that perhaps chaptalisation would fit into the framework of wine definition.

⁶⁵ Article 30 (2), Regulation 2018/273.

⁶⁶ Article 30, Regulation 2018/273.

⁶⁷ Annex III ('annex XIb'), Regulation 491/2009.

1.1.2. Sugar reduction

Sugar reduction mainly consists of removing sugar from the juice. It provides juice with a low content of sugar and consequently a wine with low alcohol strength.⁶⁸ The reduction could be legally carried out by two different techniques: harvest anticipation and physical techniques. Harvest anticipation or the used grape varieties with a longer maturity cycle can provide a low alcohol strength wine content. This practice is not recommended because it reduces the maturity potential and may introduce undesirable substances into the wine.⁶⁹

Physical techniques are based on removal of sugar from a juice by membrane coupling linking microfiltration or ultrafiltration to nano-filtration or reverse osmosis.⁷⁰⁻⁷¹ It can be used for the following purposes:⁷²

- to reduce the sugar content of a fermentation juice,
- to preserve the components of the juice, other than sugars
- to obtain a wine with a lower ethanol content.⁷³

The treatment is performed in two phases. In the first phase, the juice is prepared for the second phase. Ultrafiltration is usually applied at this stage, which separates the macromolecules greater in size than the membrane's cut-off threshold. Ultrafiltration, as other sieves, separates particles or molecules depending on the size of the pore; when juice passes through the sieve, large particles or molecules will be removed, which is necessary to continue with further operations.

In the second stage, the sugar of the juice is concentrated by nano-filtration or reverse osmosis. Organic acids and the non-retained water of the grapes during the process can be added to the juice. However, there is an absolute ban on the addition of other types of water because not only will they affect the quality of the wine, but also it is a fraudulent action pursued by law.

⁶⁸ OIV-OENO 450A-2012.

⁶⁹ Togores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. pag 470.

⁷⁰ OIV-OENO 450B-2012.

⁷¹ Annex IA. Appendix 16, Regulation 606/2009.

⁷² Togores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. Page 470.

⁷³ Togores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. page 473.

1.2. Acidity corrections

1.2.1. De-acidification

De-acidification is the reduction of acid content in a wine by physical, chemical or biological methods. Physical de-acidification reduces tartaric acid before bottling. Biological de-acidification is performed using selected yeast, such as *Schyzosacharomyces* sp, to increase the effectiveness of the treatment. However, it is difficult to control the activity of yeasts and collateral damage may occur.⁷⁴

In years of defective ripening or when unfavourable weather necessitates the early harvesting of grape bunches, the natural de-acidification may not be enough. Consequently, an artificial de-acidification becomes necessary. This method is mostly used in cold and temperate climates such as Germany; in this sense, it is only possible to carry out a de-acidification of fresh grapes, grape juice in fermentation, new wine still in fermentation and wine in wine-growing zones A, B, and C I.⁷⁵ However, it is a technique that should be used only when the grape harvest is very acidic, otherwise, it could cause negative effects on the wine, such as a loss of components that determine the organoleptic characteristics of wine.

The legislation for de-acidification is stricter than other corrections. Consumers' protection could be a reason as de-acidification can cover up a disease of the grapes, which will not affect the consumers' health, but is still a fraud because the product will not meet expected qualities.

Chemical de-acidification is a method used for juice preparation for alcoholic fermentation. At this stage, the treatment is more effective. The method consists of the reduction of acid levels and increases the pH by adding certain substances. One substance is **neutral potassium tartrate**, which is rarely used for juice de-acidification because of its low effectiveness. The chemical reacts with tartaric acid, creating molecules of potassium bitartrate that insolubilise and precipitate.⁷⁶ Another substance is **potassium bicarbonate**, which also reacts with tartaric acid forming potassium bitartrate. In this case, the chemical will insolubilise more effectively than calcium carbonate, which is another chemical used as a de-acidifier (see below).⁷⁷

⁷⁵ Annex VIII, part I, C (1) (a), Regulation 1308/2013.

⁷⁶ Togores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. page. 474.

⁷⁷ Togores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. page. 474.

On the other hand, **calcium carbonate** and **calcium tartrate**, which react with tartaric acid resulting in neutral potassium tartrate, that insolubilises and precipitates. The reaction of calcium carbonate may elongate over time and create calcium residues; and the addition for red wines is performed after alcoholic fermentation and before racking.⁷⁸ Calcium tartrate is also used for tartaric stabilisation.

L (+) tartaric acid is only accepted for products that are from *Elbling* and *Riesling* wine varieties and are obtained from grape harvest in the Northern area of wine-growing zone A.

Another technique is to add a homogeneous preparation of tartaric acid and calcium carbonate in equivalent proportions and then finely pulverise.

Moreover, the acidity can also be reduced by electro-membrane (or electrodialysis) treatment, which aims to control the reduction of titrable acidity increasing the pH. It is a physical method, which only extracts the organic acids from juice or wine under the action of electric fields using anion-permeable membranes and bipolar-impermeable membranes. The resulting wine must contain at least 1 g/L of tartaric acid.⁷⁹ The de-acidification by electrodialysis has to be recorded on the register.⁸⁰

The legislator allows the de-acidification of products other than wine if it is carried out in a single operation. However, if authorisation from the Member State is given, it is possible to de-acidify in several stages for better vinification.⁸¹

Finally, European legislation allows de-acidification in all areas except wine-growing zone C III b (e.g. middle South of Spain).⁸² In addition, the substances shall only be added to fresh grapes, grape juice, grape juice in fermentation, new wine still in fermentation and wine.⁸³ The reduction, must be carried out up to a limit of 1 g/L expressed as tartaric acid, or 13,3 milliequivalents per litre⁸⁴ and must be performed in a winery of the wine growing area where the grapes in question come from.⁸⁵

⁷⁸ Togoeres, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. pages. 473-474.

⁷⁹ Appendix 17, Regulation 144/2013.

⁸⁰ Annex I A, appendix 17 (6), Regulation 606/2009; and article 147 Regulation 1308/2013.

⁸¹ Article 11, Regulation 606/2009.

⁸² Annex IV-'annex XVa. C (1), Regulation 491/2009.

⁸³ Annex IV-'annex XVa. C (1), Regulation 491/2009; and annex VIII, part I, C (4) Regulation 1308/2013.

⁸⁴ Annex IV-'annex XVa. C (4), Regulation 491/2009.

⁸⁵ Annex IV-'annex XVa. D (3), Regulation 491/2009.

1.2.2. Acidification

In temperate regions, although it is not a habitual technique, the acidification is needed when the high temperatures accelerate the maturity process or in late harvest, when the acid of the grapes have been metabolised.

Acidification aims to increase the titrable acidity and thus pH reduction. This will encourage a proper winemaking process and increases the compounds that determine the organoleptic quality of wine. European regulations permit the acidification of fresh grapes, grape juice in fermentation, new wine still in fermentation and wine in wine-growing zones C.⁸⁶ Also, in years of exceptional climatic conditions, Member States can authorise the acidification of products from wine-growing zones A and B under the same conditions as in zones C.⁸⁷

There are two techniques to increase the acidity of juice or wine: directly or indirectly. Direct acidification, is carried out by adding one of three authorised organic acids. One is **tartaric L (+) acid**,⁸⁸ which is the most abundant acid in grapes. Additionally, it is the main acidifying authorised organic acid. Based on the Regulation, the substance has to originate from agricultural substances and be extracted specifically from wine products.⁸⁹

A second acid is **malic acid** (major L malic acid, DL malic), which is rarely used as an acidifier because it can be metabolised by yeast within fermentation increasing the malic acid content of juice and wine. Additionally, acidity levels could decrease during the second fermentation (or malolactic fermentation) causing instability and high risk of bacteria/yeast contamination, so the acidity may be corrected again. In addition, the acid is only used to correct the acidity of juice.⁹⁰ Moreover, **lactic acid**, unlike malic acid, provides biological stability to juice and wine, if an appropriate dose is added.

Last but not least, the legislator establishes two physical treatments aiming to control the increase of titrable acidity and reduction in pH of juice and wine: electro-membrane and cation exchangers. The acidification by means of **electro-membrane treatment** is a physical method for

⁸⁶ Annex VIII, part I, C (1) (b) (c) Regulation 1308/2013.

⁸⁷ Annex IV- annex' a, C (6), Regulation 491/2009; and annex VIII, part I, C (6) Regulation 1308/2013.

⁸⁸ For more information about the substance see: Regulation (EU) 231/2012 of 9 March 2012 laying down specifications for food additives listed in Annexes II and III to Regulation (EC) No 1333/2008 of the European Parliament and of the Council Text with EEA relevance.

⁸⁹ Annex I A, appendix 2 (2), Regulation 606/2009.

⁹⁰ Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. 394p.

ionic extraction of juice or wine under electric fields using cation-permeable membranes and bipolar-impermeable membranes.⁹¹ The bipolar membranes must be impermeable to anions and cations of the juice or wine. During the process the membranes must only extract the cations, in particular, K^+ from the juice or wine.⁹²

The other treatment is increasing acidity through **partial physical extraction of cations by cation exchangers**. In this case, the treatment must focus on the elimination of excess cations using cation exchange resins regenerated in the acid cycle.⁹³ The resin is a type of membrane that is charged with acid containing positive charges that can modify organoleptic characteristics. When wine passes through, the resin will take in the protons (H^+) and become more acidic.⁹⁴

The European legislator allows acidification of juice products if it is carried out in a single operation. However, if authorisation of the Member State is given, it is possible to acidify in several stages for better winemaking process.⁹⁵

The increase of acidity of products other than wine has to be carried out by introducing up to a maximum of 1,5 grams per litre expressed as tartaric acid, or 20 milliequivalents per litre.⁹⁶ While in wine, the maximum acidity is 2,5 grams per litre expressed as tartaric acid, or 33,3 milliequivalents per litre.⁹⁷ These limits have not been modified by successive wine regulatory modifications. Moreover, de-acidification must be performed in a winery of the wine growing area where the grapes in question come from.⁹⁸

1.3. General requisites

The European legislation establishes a set of logistic and administrative requisites. Firstly, sugar correction operations and acidification corrections must be performed before the 1st of January

⁹¹ OENO 360/2010 and 361/2010.

⁹² Appendix 14, Regulation 606/2009.

⁹³ Appendix 15, Regulation 606/2009.

⁹⁴ Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. 394p. page 141.

⁹⁵ Article 11, R. 606/2009.

⁹⁶ Annex IV-‘annex XVa. C (2), Regulation 491/2009; and annex VIII, part I, C (2) Regulation 1308/2013.

⁹⁷ Annex IV-‘annex XVa. C (3), Regulation 491/2009; annex VIII, part I, B (3) Regulation 1308/2013.

⁹⁸ Annex IV-‘annex XVa. D (3), Regulation 491/2009.

(zone C) or after the 16th of March (zones A and B); except concentration by cooling that can be done throughout the year⁹⁹ and finished wine that can be de-acidified at any time.¹⁰⁰

Secondly, the law only obliges the Wine Producer Operator to declare each of the operations of correction of the alcoholic strength, enrichment, and of acidity to the competent authority.¹⁰¹ Moreover, when one of these treatments has been performed, the treatment shall be registered.¹⁰²

2. Maceration and alcoholic fermentation

It is not only the quality of the grapes that is important in vinification, the winemaking process also has to be considered, as it is important to look after the whole process to obtain a desirable product. However, fermentation is a decisive step in the vinification process that will determine the quality of the product.

In this step, many factors are involved, for example the temperature of the casks is crucial for the fermentation process.¹⁰³ The optimum grape bunch temperature to initiate fermentation is between 20-25° C; otherwise it will be necessary to have human intervention in the process, whether to activate it or to prevent halts.¹⁰⁴ In addition, it is important to assure the complete metabolism of sugars and prevent alcoholic fermentation overlapping with malolactic fermentation. In this sense, oxygen is also important because it helps yeast to grow and convert sugars into alcohol.

This section provides a brief general introduction to oenological practices used to control maceration and alcoholic fermentation, and consequently to obtain the greatest wine. It is important to mention that the practices are not exclusively for a specific operation and can be performed within more than one operation.

⁹⁹ Annex IV-'annex XVa. D (6), Regulation 491/2009.

¹⁰⁰ Annex IV-'annex XVa. D (6) and (7), Regulation 491/2009.

¹⁰¹ Article 30 (2), Regulation 2018/273.

¹⁰² Article 29 (2) (a) (b) (c), Regulation 2018/273.

¹⁰³ Fermentation is a biological process by which certain substances are transformed into different ones as a result of the activity of some microorganisms.

¹⁰⁴ Togados, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 778-779.

2.1. Aeration or oxygenation of wine

Despite yeast not needing oxygen to carry on the alcoholic fermentation of sugars; sometimes oxygen is needed to guarantee a proper fermentation. Oxygen, among other advantages, helps to prolong the alcoholic fermentation, and thus aids the multiplication of yeast. In other words, oxygen is needed for the growth of yeast, which are performing fermentation, although fermentation is an anaerobic process. The absence of oxygen may halt the fermentation before the sugars are completely metabolised. So, it is recommended to aerate the juice at the beginning of fermentation.

The most common method to perform grape or juice oxygenation is by pumping the juice.¹⁰⁵ This technique homogenises the juice and mixes the added substances, if this is the case, with the juice or wine. Another technique is the micro-oxygenation, which introduces a predetermined amount of oxygen per unit of time into the juice. Thus, the yeast will have the exact dose of oxygen for their optimum growth and metabolism.¹⁰⁶ The legislator does not establish any condition or limit for aeration or oxygenation using gaseous oxygen.

2.2. Addition of yeast

Traditionally, alcoholic fermentation is carried out by the yeast of bunches spontaneously. As there is no specific natural yeast on grapes, the distribution of yeast is at random.¹⁰⁷ Thus, some yeast lead to a proper fermentation and others can be detrimental for the quality of the wine. For microbiological safety and with the purpose of controlling the fermentation process, **active yeast** can be added for wine production, whether dry or in suspension.¹⁰⁸ There are yeasts that have been previously selected for oenological purposes and can only be added to the following products:

- Fresh grapes
- Grape juice

¹⁰⁵ Part of the juice in fermentation is extracted from the bottom of the tank, and is pumped over into the top of the tank. The force of the fall facilitates the dissolution of oxygen. Also, it is recommended to leave the extracted juice into a container to increase the surface in contact with the air. Then, the juice will be pump over the top of tank.

¹⁰⁶ Togados, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. page 520.

¹⁰⁷ Blouin, J., & Peynaud, E. (2004). *Enología práctica: conocimiento y elaboración del vino*. Mundi-Prensa Libros. Page 120.

¹⁰⁸ Annex I A (5), Regulation 606/2009.

- Partially fermented grape juice
- Partially fermented grape juice obtained from raised grapes
- Concentrated grape juice
- New wine still in fermentation

The use of **inactivated yeast** at the beginning of alcoholic fermentation or maceration will help to preserve tannins from grape skins and seeds; thus, benefitting aroma compounds that are characteristic of great wines.¹⁰⁹

On the other hand, **yeast cell walls**¹¹⁰ stimulate alcoholic fermentation and absorb certain toxic compounds that could be produced, for example, by yeast within the fermentation when oxygen levels are low. **Fresh lees**,¹¹¹ sound and undiluted, contain yeast from recent vinifications and are added to wine to produce dry wines. These lees are also used for ageing purposes because of their benefits for the intrinsic characteristics of wine.

Regarding limits of the yeast addition, the European legislator does not establish maximum limits of the content of yeast (active-inactive) for wine production, while yeast walls are limited up to 40 g/hl., and fresh lees up to 5% of the volume of the treated product.

2.3. Fermentative activators

Fermentative activators are substances that can be produced by the yeast itself or be part of the harvest and are essential for yeast metabolism and vital functions.¹¹² When the fermentation takes longer than usual, it is necessary to add fermentative activators to nourish the yeast, with the possibility of using microcrystalline cellulose¹¹³ as an excipient. The following authorised compounds can be used as fermentative activators:

- **Diammonium phosphate** or **ammonium sulphate**. It is not allowed to add more than 1 g/l (expressed in salts).

¹⁰⁹ Tógores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. page 538.

¹¹⁰ Annex I A (15), Regulation 606/2009.

¹¹¹ Annex I A (21), Regulation 606/2009.

¹¹² Tógores, J. H. (2011). *Tratado de enología I*. Mundi-Prensa Libros. page 523.

¹¹³ In this case the substance it is not consider as an additive.

- **Ammonium bisulphite**. It is not allowed to add more than 0,2 g/l (expressed in salts). For this substance, the legislator increases the restrictions laying down limits also for the content of the substance in the final product. So, the wine placed on the market cannot contain more than 150 mg/l for red wines and 200 mg/l for white and rose wines. Notwithstanding, these limits increase depending on the sugar content of the wine, expressed as the sum of glucose and fructose, of not less than 5 g/l to 50 ml/l and to 100-200 ml/g for specific wines (e.g. wines entitle to the protected designation of origin).¹¹⁴
- **Thiamine hydrochloride** (vitamin B₁). It does not only accelerate the alcoholic fermentation but also reduces the dose needed of sulphur dioxide. As a whole, it is not allowed to add more than 0,6 g/l (expressed as thiamine).
- **Yeast auto-lysates**. The EU legislator does not establish limits.

Basically, the previously cited compounds provide nitrogen to the juice. In other words, the compounds will provide additional nutrients and vitamins needed for the optimum development of the yeasts.

Those compounds can only be added to the following products:

- Fresh grapes
- Grape juice
- Partially fermented grape juice
- Partially fermented grape juice obtained from raisined grapes
- Concentrated grape juice
- New wine still in fermentation

The addition of **tannins** is also an interesting practice for red grapes because of their antibacterial properties. They protect the harvest against halts in fermentation and prevent overlaps of alcoholic and malolactic fermentations.¹¹⁵

Tannins are added when the phenolic ripening¹¹⁶ is deficient, the grapes are young, or fungus has altered the bunches. Usually the addition is carried out in two phases: at the beginning of the

¹¹⁴ Annex I B, Regulation 606/2009.

¹¹⁵ Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 780.

¹¹⁶ This process is done at the same time as alcoholic fermentation and gives aroma to the wine.

alcoholic fermentation and when the fermentation is finishing. Also, the legislator establishes that tannins may only be added to partially fermented juice for direct human consumption as such and to wine.¹¹⁷

2.4. Use of sulphur dioxide or sulphuric anhydride

Sulphur dioxide is a gas with multiple properties that can be beneficial for the vinification process. It can be used as antioxidant, antiseptic, disinfectant, and clarifier of colour. Despite this, incorrect application of the chemical could cause an unpleasant aroma and the flavour of rotten eggs. Consequently, throughout the vinification process, it is possible to correct sulphur dioxide content of juice products or new wine in fermentation¹¹⁸ by **physical processes** such as dragging or heating in vacuum to avoid intrinsic wine damage.

According to European legislation, the content of sulphur dioxide in the market product is limited to the following quantities:

- 150 mg/l for red wines
- 200 mg/l for rosé and white wines

The maximum limits can be increased by 5 g/l regarding sugariness of wine (glucose + fructose). Additionally, for wines with protected designation of origin, the content of sulphur dioxide can be raised to 300 to 400 mg/l. As has been mentioned before, usually the limits differ regarding wine-growing zones, but in this case, the limit may differ due to wine product such as white wine.

2.5. Heat treatments¹¹⁹

Temperature control, heating or chilling, can be used for different purposes depending on the objectives to be met. Chilling is used during alcoholic fermentation to reduce temperature and control fermentation and yeast growth. Moreover, it is used as pre-fermentative treatment for

¹¹⁷ Annex I A, 25 Regulation 606/2009.

¹¹⁸ Annex I A, 8 Regulation 606/2009.

¹¹⁹ Tógores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. Page 842-844.

racking juice and extracting aromas from grapes. After alcoholic fermentation, it is used for tartaric stabilisation purposes.

Heating treatment or pasteurisation is rarely used because it can easily damage organoleptic characteristics of wine, although it is convenient for juices from rotten grapes. Pasteurisation is a treatment used for microbiological control and stabilisation of wine. Different techniques exist to sterilise wine like ordinary pasteurisation, flash-pasteurisation or hot bottling. In the malolactic fermentation phase, the optimum temperature is 20 – 23 °C and if it is lower, the juice needs to be heated.

3. Malolactic fermentation or second fermentation

After alcoholic fermentation, malic acid is transformed into lactic acid by lactic bacteria, which come from grape skins. This process is known as malolactic fermentation or second fermentation. It is a natural process that modifies wine characteristics. Although usually the modification is beneficial, it can be detrimental for the final wine because lactic bacteria interfere with other compounds such as sugars, acids other than malic, among others. Fortunately, nowadays, this process, among others, can be controlled and so, can be activated when needed.¹²⁰

Addition of **lactic acid bacteria** or other malolactic fermentation activators is an oenological practice authorised to carry out malolactic fermentation. The substances can be added to wine, fermenting wine at the end of the alcoholic fermentation or during malolactic fermentation.

Based on appendix 22 of the Regulation 606/2009, the activators must be *microcrystalline cellulose (E-460) or products derived from the degradation of yeasts*.¹²¹ These substances can neither produce biogenic amines above the legal limits, nor be harmful to human health and must not be detrimental to the compounds that determine the organoleptic characteristics of wine.

¹²⁰ Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. Page 840.

¹²¹ Autolysates, inactivated yeast, yeast walls. Besides the English version and the OIV code is a close clause, the Spanish version is an open clause because the sentence ends with “etc”.

In order to control growth and activities of bacteria, **lysozyme** may be added to the juice. This antibacterial enzyme was temporarily banned due to the lack of data about its effects.¹²² When data were available, it was confirmed that the addition of this substance helps in the stabilisation of wine and increases the quality of wines because it reduces sulphur dioxide content.¹²³ Therefore, now it is authorised under certain limits according to technological needs. The dose added to juice may not exceed 500mg/l. When juice and wine are treated with lysozyme the total amount cannot exceed 500 mg/l.¹²⁴ Lysozyme might also be used for conservation purposes as it is a microbiological stabiliser.

4. Fining and clarification

Juices or new wines contain many particles and substances in suspension that after fermentation will sediment in the tank. However, not all substances in suspension will be naturally eliminated and it is necessary to remove them. From the consumers' perspective, it is believed that if the wine has signs of turbidity, it means that the quality of the wine is low and has an unpleasant flavour, although, in numerous cases this judgement is not correct and turbidity does not affect organoleptic qualities. Consequently, a high-quality wine has to be clear and without sediments due to marketing and consumers' demands.¹²⁵

Dry charcoal is used for decolouring white wines, oxidise wines and/or correcting organoleptic characteristics. For example, dry charcoal (animal or vegetable origin) is used to obtain white juice made by red grapes.

Usually, dry charcoal is used in doses from 10 to 50 g/hl¹²⁶ and not higher than 100 g/hl¹²⁷. Moreover, it can only be applied to juice products, new wines still in fermentation, and white

¹²² Commission Regulation (EC) No 1622/2000 of 24 July 2000 Laying down certain detailed rules for implementing Regulation (EC) no 1493/1999 on the Common organisation of the market in wine and establishing a community code of oenological Practices and processes.

¹²³ Commission Regulation (EC) No 2066/2001 of 22 October 2001 amending regulation (EC) No 1622/2000 as regards the use of lysozyme in wine products.

¹²⁴ Annex I A (18), Regulation 606/2009.

¹²⁵ Blouin, J., & Peynaud, E. (2004). *Enología práctica: conocimiento y elaboración del vino*. Mundi-Prensa Libros. Page 306.

¹²⁶ Tógores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1095.

¹²⁷ Annex I A (9) (3), Regulation 606/2009.

wines¹²⁸. Thus, the compound should not be used for decolouration of red or rosé wines or their juices. Moreover, since 2018 the use of dry charcoal must be registered.¹²⁹

The use of **acacia** or **Arabic gum** is authorised in the oenological industry to clarify and protect the colour of wine by preventing the precipitation of colorants (in colloidal status) and phenolic compounds.¹³⁰ It is a preventive technique that is applicable only in fermented juice for direct consumption and wines. The addition is usually carried out after the last wine filtration and before bottling. Moreover, the dose of the compound is not legally limited,¹³¹ but a maximum dose of 200 mg/l is recommended.

Furthermore, acacia is used to block ferric colloid precipitations.

There are other clarifying compounds that are used for fining by pre-coating. The technique consists of enabling substances to flocculate and sediment by dragging particles in suspension to the bottom of the deposit. The compounds are the following:

- **Edible gelatine** is a natural protein present in mammals that is used for reducing tannin levels in wine with an astringent and bitter flavour.¹³² Gelatine is one of the most used organic compounds for red wine clarification,¹³³ but it is less widely used in white wine because they usually contain a lower amount of tannins.
- **Isinglass** is a protein clarifying organic compound that eliminates phenolic compounds and bitter tannins. Isinglass is extracted from a fish bladder or from the skin or cartilage of fish. It is an unconventional source that is difficult to prepare¹³⁴ but it has the advantage that barely it eliminates the colour of wine.¹³⁵ It is mostly used for white wines, which do not contain a large amount of particles in suspension,¹³⁶ resulting in a soft-shiny wine.
- **Casein** and **potassium caseinates**: Although milk was used since the ancient times to eliminate bitter flavours caused by phenolic compounds, now it is not authorised.

¹²⁸ Annex I A (9), Regulation 606/2009.

¹²⁹ Article 20 (2) (d) Regulation 2018/273.

¹³⁰ Togados, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1095.

¹³¹ Annex I A (28), Regulation 606/2009.

¹³² Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. Page 164-165.

¹³³ Togados, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1095-1096.

¹³⁴ Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. Page 165.

¹³⁵ Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. Page 166.

¹³⁶ Togados, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1097.

However, it is possible to clarify wine with casein powder.¹³⁷ Casein eliminates polyphenolic compounds that are oxidised or susceptible to oxidation and eliminates bitter flavours. Casein is an excellent wine clarifier (mainly whites), although now this traditional technique is likely to be replaced by other techniques that are not categorised as allergenic and don't have to be mentioned on the label.

- **Egg albumin (egg white):** It is a protein-clarifying agent used to obtain fined great red wines and to reduce astringent tannins. However, it is not recommended for white wines.¹³⁸ Moreover, egg white is considered as an allergen that has to be labelled, so producers prefer to employ other clarifying agents to avoid risks.
- **Bentonite:** It is a mineral from volcanic ashes. And, besides bentonite has a large application in white or rosé wines with low amount of tannins, it is rarely used as clarifier for red wines.¹³⁹ Moreover, bentonite is also used to stabilise wine from soluble proteins of wine.¹⁴⁰
- **Kaolin:** It has the same origin and similar characteristics as bentonite, but it is less effective, so the dose must be higher to get the same effect.¹⁴¹
- **Tannin:** It is not an organic clarifier *per se*, but it is capable of coagulating proteins, and staining the salts of wine blue. In other words, tannin is a macromolecule that bonds with proteins and precipitate.¹⁴²
- **Silicon dioxide as a gel or colloidal solution:** it is a mineral compound that together with gelatine clarifies wine separating tannins and proteins. Usually, it is used in white wines with a low amount of tannins, but it is rarely used for red wines.¹⁴³
- **Chitosan and chin-glucan** have to be derived from *Aspergillus niger*. These substances facilitate clarification and prevent breaking-off proteins. The legislator limits the addition

¹³⁷ Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1097.

¹³⁸ Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1098.

¹³⁹ Ough, C. S. C. S. (1996). *Tratado básico de enología*. Page 128.

¹⁴⁰ Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. 394p. page 173-178.

¹⁴¹ Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. Page 1090.

¹⁴² Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. Page 1101-1103.

¹⁴³ Ough, C. S. C. S. (1996). *Tratado básico de enología*. Page 129.

of the substances to 100g/hl maximum¹⁴⁴ and establishes applications other than clarification such as:¹⁴⁵

- o Reduce heavy metals: no more than 100 g/hl
- o Prevent ferric casse and copper casse: no more than 100 g/hl
- o Reduction of contaminants, specially ochratoxin A: no more than 500 g/h
- o Reduction of undesirable microorganisms, basically *Brettanomyces* sp., this treatment can only be performed with chitosan at no more than 10 g/hl.

Moreover, the sediments have to be removed by physical processes.

- **Yeast protein extracts** are an ancient practice that reduce turbidity of wines by precipitating the particles in suspension. This method also eliminates excess of tannins and does not affect wine colour.¹⁴⁶ Moreover, the maximum dose is 30 g/hl for white and rosé wines and 60 g/hl for red wines.¹⁴⁷

Synthetic clarifying compounds are also used for the clarification of wine, but are less suitable than organic ones. However, because of their solubility they can eliminate polyphenolic compounds. One type is the **polyvinylimidazole-polyvinylpyrrolidone (PVI/PVP)**, which is a copolymer that reduces the content of heavy metals in juice or wine and corrects the defects caused by high concentrations of them.¹⁴⁸ The addition of PVI/PVP is limited up to 500 mg/l in total, and has to be recorded in the register. Additionally, the treatment has to comply with the following conditions:¹⁴⁹

- *Copolymers must be eliminated by filtration no later than two days after their addition and taking into account the precautionary principle.* Probably this is due the substances that are formed after the second day can be eliminated.¹⁵⁰
- *In the case of cloudy musts (juices), the copolymer must be added no earlier than a maximum of two days before filtration.*

¹⁴⁴ Annex A I, 10 (2), Regulation 606/2009.

¹⁴⁵ Annex A I, 44, 45, and appendix 13, Regulation 606/2009.

¹⁴⁶ OIV-OENO 417-2011

¹⁴⁷ Annex A I, 10 (2), Regulation 606/2009.

¹⁴⁸ Togoies, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1103-1104.

¹⁴⁹ Annex A I, 54 and appendix 20 Regulation 606/2009; and article 29 (2) (I) Regulation 2018/273.

¹⁵⁰ Personal interview.

- *The treatment has to be recorded in the registers.*

Another authorised copolymer is the **polyvinylpolypyrrolidone (PVPP)**, which was the first synthetic clarifier for wine.¹⁵¹ It is primarily used for white wines to absorb phenolic compounds that produce rosé coloration; and improves and prevents defect results of PVP.¹⁵² Its addition is limited up to 80g/hl.¹⁵³ No further conditions are regulated for this polymer.

Physical techniques can also be used to clarify wine to eliminate particles in suspension. These techniques are **centrifugation** and **filtration**. The former is used for fining juice before alcoholic fermentation.¹⁵⁴ The latter is used to eliminate particles in suspension from wine.¹⁵⁵ In both cases the use of coadjutants is permitted if it does not leave undesirable residues in the treated product.¹⁵⁶

Regarding filtration, during this treatment the use of **filter plates containing zeolites γ -faujasite** to adsorb haloanisoles is allowed,¹⁵⁷ which are substances that can cause undesirable flavours in wine (e.g. mould).¹⁵⁸ This treatment should be performed on clarified wines.¹⁵⁹

The use of **enzymes** is authorised in *maceration, clarification, stabilisation, filtration and to reveal aromas*. They are normally used as coadjutant for cleaning the juice and to facilitate the pressing. Additionally, enzymes weaken the skin of red grapes facilitating colour extraction, which is important for a red wine's maceration phase. In white wines, enzymes liberate aromas from grapes.¹⁶⁰ Enzymes used for oenological practices must meet the requirements established in the European regulations.

¹⁵¹ Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. Page 168.

¹⁵² Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1104 -1105.

¹⁵³ Annex A I, 16, Regulation 606/2009

¹⁵⁴ Ough, C. S. C. S. (1996). *Tratado básico de enología*. Page 132-133.

¹⁵⁵ Ough, C. S. C. S. (1996). *Tratado básico de enología*. Page 133.

¹⁵⁶ Annex A I, 3 (3), Regulation 606/2009.

¹⁵⁷ Annex A I, 57 Regulation 606/2009.

¹⁵⁸ Resolution OIV-OENO 444-2016

¹⁵⁹ Annex A I, appendix 23 (a), Regulation 606/2009.

¹⁶⁰ Personal interview.

5. Stabilisation and preparation for bottling

5.1. Heavy metals

Heavy metals not only can influence the colour of wine but also can cause harm to human health, for example, lead can cause neurotoxicity.¹⁶¹ Therefore, it is important to remove heavy metals from wine.

Ascorbic acid

Ascorbic acid is used to prevent wine oxidation by adding the compound to fresh grapes, juice products or wine in fermentation. In the past, the addition of ascorbic acid was limited up to 150 g/h,¹⁶² for juice and wine products. This fact highly limited the treatment to prevent/avoid iron casses. In this sense, ascorbic acid was not considered as an efficient substance to eliminate iron.¹⁶³ Now, science has demonstrated that the addition of ascorbic acid is an innocuous practice that could only influence red wine colour. So, it is allowed to add *quantum satis* subject to the condition that the wine placed on the market must not contain more than 250 mg/l of ascorbic acid.¹⁶⁴

Citric acid

The addition of **citric acid** is restricted up the limit of 1,0 grams/l in the final wine to be placed on the market.¹⁶⁵ The acid is applied to partially fermented juice for human consumption and wines to prevent iron casse. After this treatment, it is important to avoid bacteria contamination that could spoil wine¹⁶⁶ because bacteria can metabolise the acid and cause unpleasant aroma.

Potassium ferrocyanide and calcium phytate

Potassium ferrocyanide and **calcium phytate** may be added to partially fermented juice for direct consumption, and wines to eliminate the excess of heavy metals such as lead, zinc or

¹⁶¹ <https://efsa.onlinelibrary.wiley.com/doi/abs/10.2903/j.efsa.2010.1570> May 2018.

¹⁶² Annex IV, Regulation 1622/2000.

¹⁶³ Tógores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1205.

¹⁶⁴ Annex A I, 19 (3), Regulation 606/2009.

¹⁶⁵ Annex A I, 24, Regulation 606/2009.

¹⁶⁶ Tógores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1205.

copper, but especially iron. There is no legal limit dose of using potassium ferrocyanide, but Regulation 2018/273 requires registration of this treatment.¹⁶⁷

On the other hand, despite the fact that calcium phytate is not toxic, it is limited to 8g/hl and it is not authorised for rosé and white wines.¹⁶⁸ This treatment requires aerating the wine and it might cause colour oxidations to these wines since they are very susceptible to oxidation.¹⁶⁹ After the addition of these substances wine must contain residues of iron.

5.2. Tartaric stabilisation acid

Tartaric acid is the predominant acid in wine, in the sense that 90% of the acid in wine is tartaric. It can be partially insolubilised by calcium cations and potassium, forming salts such as potassium tartrate or calcium tartrate. The solubility of these salts decreases and is related to temperature, acidity, and alcohol strength content of wine. At low temperatures, salts will precipitate and sediment, which is not appealing for general consumers; on the contrary at higher temperature salts are more soluble.¹⁷⁰ On the other hand, the acidity will determine whether the salt is in its tartrate form or bitartrate form, which also influences the solubility of the product.¹⁷¹

Tartaric acid can be combined with **potassium tartrate** or **potassium hydrogen tartrate**, and **calcium tartrate** to balance the acidity of wine, which will precipitate when the substances are mixed. Besides, the substances can be combined with partially fermented juice for direct human consumption and wine, only calcium tartrate is limited up to 200 g/hl.¹⁷²

There are specific treatments that can stabilise wine and inhibit tartaric precipitations. One treatment is the addition of **metatartaric acid**, which holds up tartaric precipitation of bottled wines. Its maximum legal dose is 100 mg/l and can be added to partially fermented juice for direct human consumption and wine.¹⁷³

¹⁶⁷ Article 29 (2) (e), Regulation 2018/273.

¹⁶⁸ Annex I A, 26, Regulation 606/2009.

¹⁶⁹ Personal interview.

¹⁷⁰ Togoies, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1213 – 1217.

¹⁷¹ Personal interview.

¹⁷² Annex A I, 30, Regulation 606/2009.

¹⁷³ Annex A I, 27, Regulation 606/2009.

Potassium hydrogen tartrate and calcium tartrate combine with tartaric acid can also form insoluble salts that can also cause tartaric precipitations. To avoid this fact, juice or wine can be treated by **electrodialysis**. This treatment separates anions or cations from juice or wine when passing through semipermeable membranes under the action of an electrical field.¹⁷⁴ As it is shown in Figure 4 membranes with opposite charge have to be arranged alternately. The cation-permeable membranes extract anions (K^+ , Ca^{++}); and anion-permeable membranes extract cations (tartrate anions).¹⁷⁵ It is important that membranes are fabricated with authorised materials and the juice does not cause danger to human health.¹⁷⁶⁻¹⁷⁷ Moreover, the legislator lays down the following requisites to be met for membrane utilisation:¹⁷⁸

- The pH reduction of the wine cannot be no more than 0,3 pH units,
- The volatile acidity reduction has to be less than 0,12 g/l (2 meq expressed as acetic acid),
- The treatment must not affect the non-ionic constituents of the wine, in particular polyphenols and polysaccharides,
- The reduction of alcoholic strength is limited up to 0,1% vol.,
- The treatment is to be carried out under the responsibility of an oenologist or qualified technician.
- The treatment must be registered¹⁷⁹.

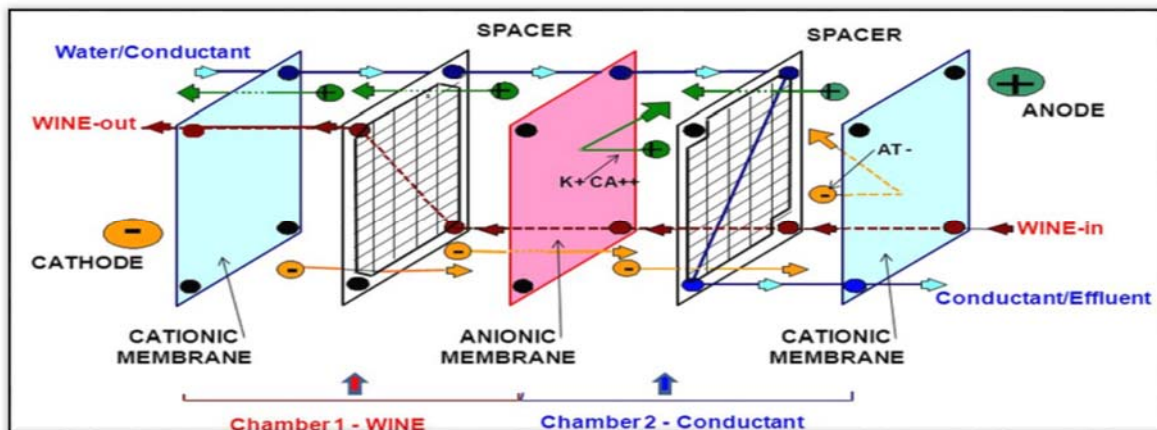


Figure 4. Electrodialysis treatment. (<http://slideplayer.com/slide/3501361>)

¹⁷⁴ Togores, J. H. (2011). *Tratado de enología II*. Mundi-Prensa Libros. page 1232-1234.

¹⁷⁵ Annex A I, appendix 7, Regulation 606/2009.

¹⁷⁶ See: Commission Regulation (EU) No 10/2011 of 14 January 2011 on plastic materials and articles intended to come into contact with food Text with EEA relevance.

¹⁷⁷ Annex A I, appendix 7, (1) (4), Regulation 606/2009.

¹⁷⁸ Annex A I, appendix 7 (2), Regulation 606/2009.

¹⁷⁹ Article 29 (2) (f), Regulation 2018/273.

The use of **cation-exchangers** can also inactivate potassium hydrogen tartaric and/or calcium tartaric contained in partially fermented juice or wine. In this case, wine can be cooled previously and the wine treated with cation exchangers must be the minimum fraction to obtain stabilisation. The treatment has to be carried out with acid-regenerated cation-exchange resins. These resins have to comply with the stipulations of the Regulation No 1935/2004 on materials intended to come into contact with food¹⁸⁰, and should not modify intrinsic attributes of wine.

Moreover, the use of cation-exchangers has to be performed under the supervision of an oenologist or qualified technician and be recorded in the register.¹⁸¹

Ion exchange resins can only be used to treat grape juice intended for manufacture of rectified juice. They also have to meet the requirements laid down in the Regulation 1935/2004. These resins can only be manipulated under the supervision of an oenologist or technician and in authorised installations.¹⁸² And, since February 2018, ion exchange resins must be registered.¹⁸³

Use of **cellulose gums** (carboxymethylcellulose). This substance is an alternative solution to cold stabilisation treatment because it does not influence wine quality and its pH, and what is more important for WPO, its cost is low. However, only wine and sparkling wines can be treated with these gums and the dose used has to be less than 100 mg/l.¹⁸⁴ Although the European legislator does not specify the type of wine to be treated, the OIV recommends this to be used only for white or sparkling wine.¹⁸⁵

Mannoproteins are substances obtained from dead yeast of vinification processes that ensure not only tartaric stabilisation but also protein stabilisation. Their addition is authorised with no limitation for partially fermented juice for direct human consumption, and for wine, liquor wine, and sparkling wine.¹⁸⁶ Also, its use is recommended for white and rosé wines.

Racemic acid when interacting with calcium becomes calcium racemate, which is a slightly soluble salt and consequently precipitates eliminating an excess of calcium. The acid should be added to wine or partially fermented juice directly for human consumption. Moreover, the use of

¹⁸⁰ Annex A I, appendix 12, Regulation 606/2009.

¹⁸¹ Article 29 (2) (f), Regulation 2018/273.

¹⁸² Annex A I, 20, appendix 4. Regulation 606/2009.

¹⁸³ Article 29 (2) (f) Regulation 2018/273.

¹⁸⁴ Annex A I, 42, Regulation 606/2009.

¹⁸⁵ OENO 2/08.

¹⁸⁶ Annex A I, 35, Regulation 606/2009.

the compound is specifically approved if the addition of the compound is carried out under the supervision of an oenologist or technician accredited by the national authority in whose territory is performed.¹⁸⁷

Potassium polyaspartate has been recently authorised as a food additive, consequently it can also be used to produce wine and help in the tartaric stabilisation of wine. This substance inhibits the formation of tartrate crystals in wines, so not to alter its colour. However, its addition is limited up to 10 g/hl, and it is recommended to treat red wines with bentonite before adding potassium polyaspartate.¹⁸⁸

5.3. Odour and flavour

Wine contains sulphur compounds, which come from the sulphites added during the vinification process, and could provide rotten egg aroma to wine. For this reason, before bottling, even though when wine does not show any defective organoleptic characteristics, it is highly advisable to analyse and balance copper concentration by adding if necessary, **copper sulphate** to juice or wine. The addition of copper sulphate (or cupric citrate) is legally limited up to 1 g/hl provided that copper content of treated juice/wine does not exceed 1 mg/l.¹⁸⁹

Another substance used to avoid sulphur odours from fermentation or storage is **silver chloride**, which can only be added to wine through an inert support¹⁹⁰ (e.g. kaolin). Also, it is limited up to 1 g/L if the residue in the final product does not exceed 0,1 mg/L. If so, the residue has to be eliminated by physical techniques, and treated by a specialised oenologist or technician.

The legislator requires the treatment to be recorded in the register¹⁹¹ because silver chloride has been used fraudulently.

Sometimes the levels of ethanol in wine are excessive and it is necessary to perform a **correction of alcohol content of wine** in order to balance its flavour, but not to correct organoleptic defects. This treatment can be accomplished by *separation techniques applied separately or in combination*

¹⁸⁷ Annex A I, appendix 5 Regulation 606/2009.

¹⁸⁸ Annex A I, appendix 24, Regulation 606/2009.

¹⁸⁹ Annex A I, 31, Regulation 606/2009.

¹⁹⁰ Support that does not react.

¹⁹¹ Annex A I, appendix 21, Regulation 606/2009; and article 29 (2) (m) Regulation 2018/273.

with others such as distillation or partial vacuum evaporation. The reduction is limited to 20% and the total alcoholic strength by volume of the final wine has to be less than 8,5% vol. for zones A and B or 9% vol. for zones C.¹⁹² Additionally, this treatment may not be carried out if one of the sugar corrections operations has been previously applied. When the treatment has been performed must be registered.¹⁹³

During ageing, a microbiological deterioration of wine caused by 4-ethylphenol and 4-ethylguaiacol can occur. Those compounds come from the *brettanomyces* or *dekkera* yeast (saccharomycetaceae family) that put an undesirable aroma into wine such as horse-sweat aroma and cover up the real aroma of wine.¹⁹⁴ To avoid this effect, wine is treated with a **membrane technology coupled with activated carbon** to reduce excess of 4-ethylphenol and 4-ethylguaiacol. This treatment must be entered in the register.¹⁹⁵

6. Conservation (microbiological stabilisation)

Bubbling is a technique that drags oxygen from wine, because it can react with some compounds causing oxidations and allow the growth of microorganisms, among other negative effects. Consequently, the addition of inert gases¹⁹⁶ avoid the presence of a reactive gas. The inert gases used in bubbling should be **argon, nitrogen**, although carbon dioxide could be added to juice or wine for the same purpose.

Carbon dioxide can only be added to partially fermented juice for direct human consumption or wine. The addition of carbon dioxide is limited up to 3 g/l for still wine¹⁹⁷ placed on the market, while the excess pressure has to be less than 1 bar at 20 °C. If the pressure is above 3 bars, the wine will be categorised as sparkling wine.

¹⁹² Annex VI, part II, 1.a, Regulation 1308/2013.

¹⁹³ Annex A I, appendix 10, Regulation 606/2009.

¹⁹⁴ Rankine, B. (1989). Manual Práctico de Enología. Ed Acribia. Zaragoza. 394p. Page 298.

¹⁹⁵ Annex A I, appendix 19, Regulation 606/2009; and article 29 (2) (k) Regulation 2018/273.

¹⁹⁶ These gases are present in the atmosphere and do not react with juice or wine.

¹⁹⁷ Wine that does not contain carbon dioxide, it is not sparkling nor aerated semi-sparkling wine.

Membrane contactors can be used to manage dissolved gas in wine, except when carbon dioxide is added in sparkling wines¹⁹⁸. This treatment can be performed after alcoholic fermentation until bottling as an alternative of bubbling.¹⁹⁹ Moreover, this treatment must be registered.²⁰⁰

For conservation purposes **sorbic acid** is used in potassium sorbate form due to its solubility. The maximum legal dose in the final product is 200mg/l. It is used for its antimicrobial, especially fungicidal properties, inhibiting the development of the mycelia, as well as the germination of the spores and yeast multiplication. The salt is mainly used for sweet wines and does not modify the final *bouquet* of wine.

On the other hand, **dimethyldicarbonate (DMDC)** is used just before bottling for microbiological stabilisation when the new wine contains fermentable sugars. Thus, it is possible to prevent undesirable yeast and lactic bacteria growth. In the past, the legislator required that sugar content was less than 5g/l, and the addition to be done in containers of 60 litres or less. These two requisites are no longer in force due to OIV recommendations.²⁰¹ Now, the addition of DMDC to juice or wine cannot be more than 200 mg/l and should not be detectable in the wine placed on the market. Moreover, the addition has to be recorded in the register.²⁰²⁻²⁰³

Discs of pure paraffin impregnated with allyl isothiocyanate are used to create a sterile atmosphere. This technique is a traditional antibacterial method permitted exclusively in Italy. The European legislator just required that Italian producers use the antibacterial disc for partially fermented juice for direct consumption and wine and no residues of the method must be present in wine. Also, the technique has to be carried out in containers holding more than 20 L.²⁰⁴

On the other hand, Greece allows adding **Aleppo pine resin** as a preservative to obtain *retsina* wine. The resin must be added before fermentation or, *where the actual alcoholic strength by volume does not exceed 1/3 of the overall alcoholic strength by volume during fermentation*.²⁰⁵ Also,

¹⁹⁸ Annex A I, 52, Regulation 606/2009.

¹⁹⁹ Resolution OIV-OENO 499-2013.

²⁰⁰ Article 29 (2) (j), Regulation 2018/273.

²⁰¹ Commission Regulation (EC) No 606/2009. Consolidated version: 01/08/2010.

²⁰² Annex A I, 34, and appendix 6. Regulation 606/2009. The English version of the appendix establish that DMDC may be added to block fermentations of sweet, semi-sweet or semi-dry wines while the Spanish version says sparkling wines instead of semisweet. This fact is confusing for WBP to know whether DMDC may be added semi-sweet or sparkling wine, which are completely different products in the wine sector.

²⁰³ Article 29 (2) (g) Regulation 2018/273.

²⁰⁴ Annex A I, 33. R. 606/2009.

²⁰⁵ Annex A I, 14, appendix 3, Regulation 606/2009.

the national Greek law determines the grape varieties that can be used to add Aleppo pine resin to and produce *retsina* wine.

7. Ageing

Ageing is a complex process that changes sensorial characteristics of a wine. Traditionally, this process takes place inside wooden barrels, where tannins, phenolic acids and volatile compounds of the wood are combined with wine. This process stabilises wine colour and increases its final quality.

Ageing by wooden barrels is an expensive and prolonged technique. Nowadays, there are other alternatives to the barrel that simplify the aging process such as the use of **oak chips**, which is an economical and more efficient alternative, compared to traditional techniques. The addition of oak chips is subjected to certain conditions and requirements. In this line, the pieces of oak wood must come from the *Quercus* species, and may be used only in their natural state, or heated to a low, medium or high temperature, but without any combustion nor can they be carbonaceous or crumbly to the touch. The burning of wood will create polyphenols and a smoked smell into wine; however, it is not allowed to increase wine's natural flavour or phenolic compounds.²⁰⁶ Therefore, it is permitted to heat the wood but not burn it.

The use of oak chips has to be mentioned on the label to avoid consumer believing that the wine has been made in wood barrels. To avoid the misleading of consumers the label must include: the origin of the botanical species of oak, heating intensity, the storage conditions, and safety precautions.²⁰⁷ It is not a requirement from the legislator to mention that wine is made by oak chips, although this information is necessary to differentiate the wines aged with oak chips from those produced by traditional techniques and to help the consumer to recognise the value of the latest.

Moreover, since 2018 the use of oak chips must be entered in the register.²⁰⁸

²⁰⁶ Annex A I, appendix 9, Regulation 606/2009.

²⁰⁷ Annex A I, appendix 9, Regulation 606/2009.

²⁰⁸ Article 29 (2) (h), Regulation 2018/273.

One inconvenience that could occur during ageing is the formation of ethyl carbamate. This is a carcinogenic and genotoxic compound caused by the excess of urea ($> 1 \text{ mg/l}^{209}$).²¹⁰ The addition of **urease** to partially fermented juice for direct consumption or wine reduces the levels of urea.²¹¹ The dose of urease depends on the quantity to be treated, for example for 1 L of wine the maximum dose is 75 mg of enzyme preparation not exceeding 375 units of urease.²¹² After the treatment, it is mandatory to eliminate residues by wine filtration.²¹³

²⁰⁹ Annex A I, appendix 8 (4), Regulation 606/2009.

²¹⁰ (OENO 2/95).

²¹¹ Annex A I, 37, Regulation 606/2009.

²¹² Annex A I, appendix 8 (5), Regulation 606/2009.

²¹³ Annex A I, appendix 8 (5), Regulation 606/2009.

CHAPTER 5. OTHER WINE RELATED PRACTICES

Besides the authorised oenological practices discussed in previous chapters, there are other practices incorporated in the text of the Regulation 606/2009. These practices are sweetening, and *coupage*; and the legislator decided to regulate them apart from the other practices.

1. Sweetening

Sweetening consists of adding sweetener substances to equilibrate flavour characteristics and obtain aromatised wine.²¹⁴ However, not all sweeteners are authorised for this purpose, it is only possible to carry out this practice by adding: grape juice, concentrated grape juice, and rectified concentrate grape juice. Moreover, the addition of a sweetener cannot enrich more than 4% vol. the total alcoholic strength.²¹⁵ Another technical limitation is that the sweetening of wine can only be executed at the production and wholesale stages.²¹⁶

The sweetening has to be notified to the national competent authority by any natural or legal person intending to carry out the practice.²¹⁷ The notification must be made in writing 48 hours before sweetening,²¹⁸ and must include the following information:²¹⁹

- *The quantity and the total and actual alcoholic strengths of the wine to be sweetened,*
- *The quantity and the total and actual alcoholic strengths of the grape juice or the quantity and density of the concentrated grape juice or rectified concentrated grape juice to be added, as the case may be,*
- *The total and actual alcoholic strengths of the wine after sweetening.*

²¹⁴ OIV-OENO 439-2012.

²¹⁵ Annex I D, Regulation 606/2009.

²¹⁶ Annex I D. 4 Regulation 606/2009.

²¹⁷ It is interesting to see that in the Spanish version the person who has to notify the competent authority is the person that is carrying out the sweetening, and not the person that has the intention to do it, as the English version establishes.

²¹⁸ Annex I D. 5 (b) Regulation 606/2009

²¹⁹ Annex I D. 5 (d) Regulation 606/2009.

When a company carries out above a certain limit of sweetening operations in its production process, the company can notify in a single document several operations or a specified period. Such notification requires that the business keeps a written record of each sweetening operation and provide the same information as the standard notification.²²⁰

2. Wine blending or *coupage*

Based on article 7 of the Regulation 606/2009, wine blending or *coupage* is the mixing of wines or juices of different origins, different vine varieties, different harvest years or different categories of wine or juice. However, those techniques used for increasing the natural alcohol strength, or the techniques used for sweetening, which also consist of adding the mentioned sweeteners, are not considered as wine blending.²²¹

Wine blend is important regarding the vinification process in order to obtain a standardised and improved final wine. It can result in a wine with better flavour and balance between acids because the different vine varieties can complement each other.²²² However, wine blending cannot be performed randomly, it is important to take into account oenological and legal factors.

In Europe it is only possible to combine those products that can also be used to produce wine according to Regulation 491/2009 and Regulation 606/2009. Additionally, only white and red wine with Protected Designation of Origin can be blended to produce rosé wine.²²³ Moreover, the legislator banned the blending of a European wine with wines from a third country; and the blending between wines from third countries in European territory.²²⁴

²²⁰ Annex I D. 5 (c) Regulation 606/2009.

²²¹ Article 7 (3) Regulation 606/2009.

²²² Rankine, B. (1989). *Manual Práctico de Enología*. Ed Acribia. Zaragoza. 394p. pages 149-152.

²²³ Article 8, Regulation 606/2009.

²²⁴ C, Annex XVb, Regulation 491/2009.

CHAPTER 6. LABELLING VS OENOLOGICAL PRACTICES

The Food Information for Consumers (FIC) Regulation aims to protect consumers' health and their information rights, and for that reason the legislator decided to standardise the information that must be provided to consumers regarding their food products. Consequently, consumers are aware of any potentially unwanted substance and maintain their diets according to their own criteria. In this sense, the legislator requires that food products must indicate the following information:²²⁵

- Food name
- Ingredient list
- Substance that can cause allergy or intolerances
- The amount of certain ingredients
- The date of minimum durability or the 'use by' date
- Storage and/or use conditions
- The name or business name and address of business
- Instructions for use
- Nutrition declaration
- The country or place of origin
- The actual alcoholic strength by volume (only for beverages containing more than 1,2% vol.)
- The net quantity of the food

Part of the vinification process includes the addition of certain additives among other substances that are legally considered as ingredients and must be labelled according to the FIC.²²⁶ However, this Regulation exempts alcoholic beverages containing more than 1,2% vol. of alcoholic strength from the mandatory ingredient list or nutritional declaration (i.e. calories).²²⁷ In this sense, Member States can adopt national measures until there is a European legislation on this

²²⁵ Article 9 (1), FIC Regulation.

²²⁶ Article 2 (2) (f), FIC Regulation.

²²⁷ Article 16 (4) FIC Regulation.

matter.²²⁸ In fact, twelve Member States (e.g. Austria) require alcoholic beverages to indicate their ingredients list.²²⁹

The FIC Regulation also sets the duty for the Commission to write a report about whether the alcoholic beverages should be covered, especially with regard to the energy value, and otherwise explaining the reasons that justify the possible exemptions.²³⁰ Consequently, in March 2017 the Commission published a report that supports the idea that consumers should be informed about what exactly they are going to drink in order to make more informed choices; and invites the alcoholic beverages industry to draft a self-regulatory proposal to respond to consumers' expectations.²³¹

Indeed, last March 2018, the alcoholic beverages industry published a self-regulatory proposal on the provision of ingredients and nutrition information in answer to the Commission's invitation. The annex of this proposal includes specific rules for wines and aromatised wine products.

The proposal suggests providing such information through a traditional label or by off-label (web-link, a QR code, or a bar code). The wine sector is more likely to opt for the smart technologies due to its great advantages when it comes to complying with and complementing labelling requirements. For instance, off-label options will allow consumers to receive the information in the language they wish.

Regarding the ingredient list, the wine sector notes that wine is an agricultural product that depends on the harvest characteristics of the year, and changes and evolves even after bottling. Thus, as it is shown in the previous chapters, sometimes it is necessary to use certain authorised substances to produce a desired wine. Therefore, the wine sector suggest that processing aids used during the wine-making process should be excluded from the ingredient list, as well as those natural substances used for wine harvest corrections. In this sense, as Figure 5 shows, the appendix I of the annex lists those additives that, when used, should be included in the ingredient list.

²²⁸ Article 41 FIC Regulation.

²²⁹ Report from the Commission to the European Parliament and the Council regarding the mandatory labelling of the list of ingredients and the nutrition declaration of alcoholic beverages. (2017).

²³⁰ Article 16 (4) FIC Regulation.

²³¹ Report from the Commission to the European Parliament and the Council regarding the mandatory labelling of the list of ingredients and the nutrition declaration of alcoholic beverages. (2017).

Appendix I
List of oenological additives that may be included in the list of ingredients¹

Preservatives		Stabilising Agents	
Potassium sorbate	INS 202	Metatartaric acid	INS 353
Liquid sulfur dioxide	INS 220	Gum arabic	INS 414
Potassium anhydrous sulphite	INS 224	Sodium Carboxymethylcellulose	INS 466
Potassium hydrogen sulphite	INS 228	Yeast mannoproteins	
Ammonium hydrogen sulphite		Others	
Ascorbic acid	INS 300	Caramel	INS 150a-d
Lysozyme	INS 1105		

Figure 5. List of oenological additives that may be listed.

Based on the proposal, WPO will have three options to justify the ingredient list of their wine:²³²

1. based on the wine-making process
2. based on the historical wine-making process
3. based on all the authorised wine-making processes

Now, the Commission is evaluating the proposal and will decide whether to approve the proposal or to look for further options when legislating this matter.

The fact of labelling the ingredient list entails different opinions either in favour or against it. The experts that were in favour of providing more information to consumers had different reasoning. They consider that all substances that are added during the wine making process must be indicated in the label without a distinction between foods. Additionally, this fact is even more relevant if wine is conceptualised as food. Moreover, it is also important that the information provided should not lead to error or confusion.

On top of that, listing ingredients would push WPO to opt for a traditional vinification processing, which would involve less additives or other chemical substances and producers would work under the circumstances that nature provides to them. With the same grape harvest, it is possible to obtain wines completely different regarding the physical techniques that are applied; consequently, the addition of extra substances is not needed.

Other experts believe that it is not necessary to inform consumers about the additives used as technologic coadjutants, arguing that the final wine does not contain those substances. Most of the substances that are added disappear and are eliminated within the vinification process, and

²³² Wine and aromatised wine products annex to the self-regulatory proposal from the European alcoholic beverages sectors on the provision of nutrition information and ingredients. 12 March 2018.

the residues left are minimal. However, the significant residues of substances and those substances that are added just before bottling are part of the final wine and so should be mentioned on the label. If every substance that has been in contact with wine along the vinification process is labelled, a vast majority of consumers will be afraid of consuming wine due to their lack of technical knowledge. So, a list of ingredients would scare consumers, and retailers' sales would decrease, even though the wine is safe to consume.

Unfortunately, at the time of the interviews the proposal was not yet published, and I could not discuss the proposal with the experts. Additionally, the research was limited to the experts' opinions and lack of social science point of views. The research does not focus on the impact of the wine label in a consumer perception.

CHAPTER 7. DISCUSSION AND CONCLUSIONS

At the beginning of this Master thesis, I formulated a main question and some sub-questions for my research. The sub-questions are a pathway to answering the main question. Therefore, I proceed to answer the sub-questions while I answer the main research question: How are oenological practices being regulated in the European Union regarding science and technological advances?

What is the legal definition of wine?

After analysing the definitions of wine and the opinions given by the experts in the survey, it is possible to determine that there is a lack of conceptualisation of wine. In my opinion, for a proper legal harmonisation of wine regulations, it is essential to determine what exactly is wine. Nowadays, wine can be understood as a food, a beverage, or a product and this could lead to legal applicability issues.

On the other hand, some of the oenological practices consist of the addition of certain substances that can be either natural components of grapes or not. But not all substances that are authorised as oenological practices are a natural component of grapes. Consequently, the word *exclusively* should not be part of the definition, but now it remains.

I agree with the experts who suggested that it is recommendable to make the definition more accurate by adding the mention *free of residues*. So, wine could be defined *as a product free of residues obtained from the total or partial alcoholic fermentation of fresh grapes, whether or not crushed, or grape must*.

How wine-growing territories are divided? Which consequence entails this division in relation to wine production?

Wine-growing zones are divided into three zones: zone A, B, and C. The last zone it is subdivided into zone CI, CII, and CIII, which is further, subdivided into zone CIII A and CIII B. This division will determine the rules to be followed when producing wine, in the sense that oenological practices are applied differently due to the wine-growing zone.

Although, the territorial division lacks legal justification, it is logical to think that it is based on climate disparity. However, nowadays we are facing a climate change, which is a process that we cannot stop and is causing adverse consequences from all perspectives. Therefore, it is not reasonable that existing regulations diverge regarding climatic zones, if climate is the reason of the division of the European territory.

I would suggest that the legislator lays down general regulations appointing parameters for all the European territory with no differentiation between them. However, some experts disagree with this opinion. They argue that a general legislation could lead to a loss of wine product variability, which is one of the characteristics of the wine world.

In my opinion, the territorial division is a rather outdated measure, which maybe worked in the past to balance climatic conditions and provide equality among wine producers when producing wine. However, nowadays technology has evolved considerably to surpass this measure. Now, when the wine-harvest is not in its optimal condition, producers can make use of technology to produce a quality wine.

Do the regulations adjust to scientific and technological knowledge? Are the Regulations well applied in practice?

European oenological practice regulations follow the OIV recommendations and move parallel with science and new technological developments. For this reason, the list of the authorised oenological practices is established in the annexes, where their modification procedure is faster, otherwise it will not be possible to keep up with science and technological advances.

Moreover, it is difficult to understand why the legislator is so rigid regarding oenological practices when most of the authorised practices are untraceable in the final product. This fact together with the complexity of the law could lead to the non-applicability of the law in practice. In this sense, perhaps it is more preferable to improve wine related controls and ensure that the final product is safe for consumers' health and give more freedom to WPO regarding vinification processes.

An example regarding consumers' health is the fact that wine can contain biogenic amines, which in high doses can cause a toxic effect and produce allergy. The problem is that, during fermentations, it is possible that yeasts metabolise into biogenic amines, which is a natural and difficult to control process. Additionally, the harmful effect of the amines increases when combined with alcohol, accelerating their absorption or inhibiting their degradation in the human body, causing headache or stomach-ache. Therefore, it is possible that wines placed on the market could contain biogenic amines. In this respect, the European legislation does not set down the maximum dose of biogenic amines in the final product, so the legislation should be improved due to consumers' health protection.

Moreover, even though the ageing of wine in a barrel is permitted, the legislation does not establish the life time of a barrel. I would suggest that further modifications should be stricter establishing a maximum period of time for using a barrel for ageing purposes. Barrels lose their properties during their use, and a prolonged and excessive use can be detrimental for the final wine. Thus, it can lead to disappointing consumer expectations. For example, the label can inform to consumer that the wine has been ageing in a barrel for 4 years, which can be true, however if the used wood is recycled its properties will not be appreciated in the final wine.

Regarding chaptalisation, from my humble perspective, I believe that WPO should produce wine in accordance with the products that nature gives and if their land is appropriate for viticulture perhaps they should invest in other agricultural products that meet the conditions of the land. And if so, it is difficult to understand why chaptalisation is still authorised as an oenological practice when there are enough technological advances regarding viticulture that would overcome any climate adversity.

I would recommend WPO wager on circular economy in the sense of maximising the recycling surpass of wine production. The problem is that it is relatively easy to work with sugar instead of grape juice, which is more difficult due to logistics predominantly. Additionally, sugar lobbies have a great interest on this practice and would not support its elimination.

From the legal perspective, chaptalisation does not make any sense, as oenological practices are adapted to the different wine-growing zones; for example, in zone C it is not possible to carry out a chaptalisation by the legal reason if their climate is warm enough to obtain grapes rich in sugars for fermentation. In this sense, today, chaptalisation may be considered discriminative and

legalises unfair competition considering the large agricultural and oenological developments of techniques that substitute chaptalisation such as the addition of rectified juice.

Hopefully, further legal modifications will ban this practice for all wine-growing zones. This method not only increases the volume of production, but also allows placing on the market wines that in other circumstances cannot be placed due to insufficient alcohol strength. But, nowadays this privilege is only for specific countries such as Germany or Austria.

From a technical perspective, is it necessary to label oenological practices?

From a technical perspective, it is not necessary to label oenological practices. All the experts said that a clear majority of substances added during the vinification process are barely perceptible in the final wine. For this reason, some experts believe that these substances should not be considered as additives but as processing aids. Per this, the use of egg albumin should not be labelled because residues are marginal. Egg albumin is a coadjutant used during vinification for clarification, and it is eliminated from wine afterwards. And it does not matter if marginal residues remain because they will not be injurious to consumers' health. However, egg albumin is considered an allergen, therefore it should be mentioned on the label because the use of allergens must be labelled.²³³

From my perspective, the same criteria have to be applicable for all substances. First, because consumers may not share specific health sensitivities; and second, if the dose of an added substance is as imperceptible as the experts argue, it should not be a risk for any consumer.

On the other hand, consumers have the right to be informed about what they are buying and consuming. For this reason, the Commission must take appropriate measures to assure this. In this sense, the Commission invited alcoholic beverage sectors to elaborate a self-regulatory proposal, and they accepted the invitation publishing a proposal. In my opinion, the proposal is based on their own interest and does not provide appropriate tools for consumers to be well informed.

²³³ Articles 9 (1) and 16 (4), FIC Regulation. See: REGULATION (EU) No 579/2012 laying down certain detailed rules for the implementation of Council Regulation (EC) No 479/2008 as regards protected designations of origin and geographical indications, traditional terms, labelling and presentation of certain wine sector products.

Firstly, not all alcoholic beverage industries have participated in the elaboration of the proposal. Which is not only unfair but also could lead to disputes between the sector as they might have other ideas to label the list of ingredients.

Secondly, the proposal does not provide harmonised rules, but rules divided into specific sectors: beer, spirits, and wine. This leads to thinking that each sector is looking for its own benefit when elaborating the proposal. For instance, the wine sector exempts the labelling of those natural substances used to correct grape composition. Unsurprisingly, the sugar added to the juice for enrichment for the artificial increase of the natural alcoholic strength is also exempted from being listed because it is used to correct the wine harvest.

As was discussed in the previous part, adding table sugar during the wine-making process generates enormous controversy among WPO, let alone that this type of sugar is not naturally in the grapes. I do not understand why this practice is still encouraged by the industry when there are other options for enrichment that preserve the essence of the grapes (e.g. rectified concentrated juice).

Finally, the fact of providing the information using an off-label could not be pleasant for consumers, since they will not get the information instantly by reading the label. Furthermore, the wine sector takes for granted that all consumers have unlimited access to the internet or know how to use new technologies.

Annex I. Questionnaire

(The questionnaire was used for individual and anonymous interviews)

Dear respondent, I am conducting a systematic analysis of wine legislation as part of my MSc thesis. The study focuses on oenological practices and their restrictions applicable to the production and commercialization of wine. The purpose of this questionnaire is to know the professionals' opinion of the wine sector regarding European wine legislation.

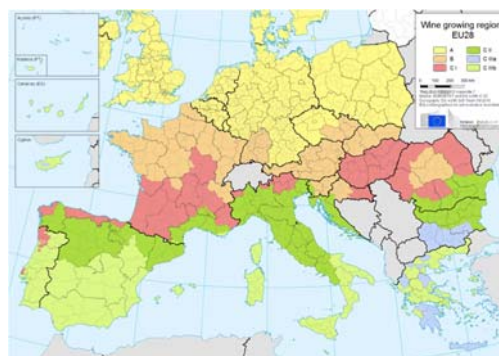
Mi Master tesis consiste en realizar un análisis sistemático de la legislación del vino. El estudio se centra en las prácticas enológicas del vino, así como sus restricciones aplicables a la producción y comercialización del vino. El objetivo de este cuestionario es poder conocer la opinión de profesionales del sector vitivinícola respecto a la legislación europea sobre el vino.

Personal data / *Datos personales*: :

Name / *Nombre*:

Position / *Cargo*:

Do you consent the use of this information for educational purposes? *¿Consiente el uso de esta información para fines educativos?*



Yes / *Si*

No / *No*

1. The European legislator lays divides the territory into different wine-growing zones. Do you consider the delineation is correct? Why?

El legislador europeo divide el territorio en diferentes zonas vitícolas. ¿Considera que la delimitación es correcta? ¿Por qué?

2. Certain oenological practices are different regarding to wine-growing zones. For example, the limits for the increase of alcohol strength differ regarding zones. Are these differentiations justified? Why?

Determinadas prácticas difieren en función de la zona vitícola en la cual se vaya a efectuar la práctica en cuestión. Por ejemplo, los límites establecidos para el aumento artificial del grado alcohólico natural difieren en relación a las zonas vitícolas. ¿Dicha diferenciación está justificada? ¿Por qué?

3. For certain oenological practices, such as the addition of yeast, the legislation does not establish a limitation. Should the legislator set down limits for all oenological practices?

Ciertas prácticas enológicas, como la adición de levaduras, no tienen establecido límite alguno. ¿Debería el legislador limitar todas las prácticas enológicas?

4. According to the law, wine is a product obtained exclusively from the total or partial alcoholic fermentation of fresh grapes, or grape must. However, the addition of certain additives and coadjutants is authorised. Based on the current legislation these substances are legally considered as ingredients. Consequently, should be mentioned on the label. But the law set down an exception for alcoholic beverages.

La ley define el vino como un producto obtenido exclusivamente de la fermentación alcohólica total o parcial, de uva fresca, estrujada o no, o de mosto de uva. No obstante, la adición de determinados aditivos y coadyuvantes está autorizada. Dichas sustancias son legalmente consideradas como ingredientes y por lo tanto deberían ser mencionadas en el etiquetado. Sin embargo, la ley excepciona esta obligación para las bebidas alcohólicas.

- Is the definition compatible with the authorised additives as an oenological practice? And oenological practices in general?

¿La definición compatible con la autorización del uso de aditivos como práctica enológica? ¿Y con las prácticas enológicas en general?

- Should consumer be informed about the ingredients of the wine? Why?
¿Debería informarse al consumidor sobre los ingredientes del vino? ¿Por qué?
- Does chaptalisation fits under the legal concept of wine?
¿La chaptalización encaja dentro del concepto legal de vino?
- Is it necessary to adapt the legal definition of wine taking into account the naturalness of the wine in practise?
¿Se debería adaptar la definición legal del vino, teniendo en cuenta la pureza del vino en la práctica?

5. Chaptalisation of wine is a controversial practise mainly because is only authorised for certain wine-regions,

La chaptalización del vino genera controversia como practica autorizada, principalmente porque solo está prevista para zonas vitícolas específicas.

- What is your opinion about this practice?
¿Qué opina sobre esta práctica?
- How producers feel affected in practice?
¿Cómo afecta a los productores en la práctica?

6. What you would regulate differently regarding oenological practices? Why?

¿Qué regularías de manera diferente sobre las prácticas enológicas? ¿Por qué?

