



Commission of the European Communities



AGRICULTURE

Agrimed research programme

***The enrichment of wine
in the European Community***

Report

EUR 13239 EN

Commission of the European Communities



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The enrichment of wine in the European Community

Edited by

J. De Hoogh and G. Klein Essink (economic aspects)

and

P. Dupuy (technical aspects)

Sponsored by the

Commission of the European Communities

Directorate-General for Agriculture

Coordination of Agricultural Research

as part of the Agrimed programme

**Published by the
COMMISSION OF THE EUROPEAN COMMUNITIES**

**Directorate-General
Telecommunications, Information Industries and Innovation
Scientific and Technical Communication Unit**

L-2920 Luxembourg

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Cataloguing data can be found at the end of this publication

Luxembourg: Office for Official Publications of the European Communities, 1991

ISBN 92-826-2000-X

Catalogue number: CD-NA-13239-EN-C

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Printed in France

PREFACE

According to art. 20, par. 1 of Regulation 822/87 the European Commission was commissioned to undertake a thorough study of the possibilities of using concentrated grape must, whether or not rectified, and sucrose for enrichment. This study should in particular cover the oenological aspects of the various permitted methods, the economic aspects of the use of sucrose or concentrated grape must, whether or not rectified, and the methods for monitoring this use. In paragraph 2 of the above mentioned article it is stated that the Commission should submit a report detailing the results of this study to the Council before 1 September 1989.

The study was conducted in the framework of the AGRIMED research programme.

With regard to the technical part of the study, in 1987 the European Commission contacted three experts, one in each country selected for the study:

- Professor Luciano USSEGLIO-TOMASSET, Head of the Istituto Sperimentale per l'Enologia, Asti, Italy;
- Dr. Friedrich MEIDINGER, Head of the Board of the Staatliche Lehr- und Versuchsanstalt für Wein- und Obstbau, Weinsberg, F.R.Germany;
- Dr. Pierre DUPUY, Honory Research Director of the Institut National de la Recherche Agronomique, Dijon, France.

These experts were asked to organize experiments comparing enrichment with sucrose and with rectified concentrated must (RCM). These experiments were performed in various vineyards in the three countries, taking into consideration the local practice of oenology used by small and large producers. Their objective was to detect if practical reasons, not showing up in the laboratory experiments presented a technical hindrance to the utilization of RCM.

Dr. P. DUPUY has been asked to collect the data and to edit the report on the technical and oenological aspects of the enrichment of wine. The results of the research have been used, where necessary and possible, in analyzing the economic aspects of the enrichment of wine.

As far as the economic part of the study is concerned, in the course of 1987 the

European Commission contacted research institutes in the F.R.Germany, France and Italy:

- . Forschungsanstalt Geisenheim (FAG), Geisenheim - Professor Dr. D. HOFFMANN, Dr. M. ENGEL (Fachgebiet Betriebswirtschaft und Marktforschung) -
- . Institut National de la Recherche Agronomique (INRA), Toulouse - Professor Dr. J. DUBOS (Université des Sciences Sociales), Dr. E. MONTAIGNE (INRA/École Nationale Supérieure Agronomique, Station d'Économie et Sociologie Rurales de Montpellier) -
- . Centro per lo Sviluppo Agricolo e Rurale, Assisi - Dr. F. VENTURA, Dr. A. MIL-LUCCI.

These institutes were asked to undertake a study for the respective Member States of the economic aspects, both at micro and macro level, of the use of various means of enrichment, against a background of efforts to restore the market balance in the wine sector of the Community. Special emphasis should be placed on the economic consequences of a possible ban on the use of sucrose as a means of enrichment.

Subsequently, the Commission invited the Wageningen Agricultural University in the Netherlands - Professor Dr. J. DE HOOGH, Ir. G. KLEIN ESSINK, Dr. G. VAN DIJK (Working Group on Agricultural Policy) - to coordinate and evaluate the activities of the three research institutes mentioned above, and to take care of the final editing of the study.

These matters were agreed upon in a contract between the European Commission and the Wageningen Agricultural University, the latter being responsible for contracting the three research institutes mentioned above. The legal and administrative design of these contractual relationships took more time than was expected. For this reason research at these institutes could not commence until February/March 1988, which was considerably later than the European Commission had in mind when the first preparations for the study were made.

Because of this delay the study could not be finished within the time mentioned in art. 20 of Reg. 822/87. Therefore, an interim report based on the then available, but still incomplete results of the different contributory studies was delivered in July 1989.

The final report, presented here, is divided into three parts.

In Part I DUPUY reports on the research into the technical and oenological aspects of the enrichment of wine.

Part II, edited by DE HOOGH and KLEIN ESSINK, gives an overview of the economic

- . HOFFMANN, D. and M. ENGEL, 1989. *Economic aspects of enrichment of wine in the F.R.Germany*. Forschungsansalt Geisenheim, Fachgebiet Betriebswirtschaft und Marktforschung, Geisenheim, F.R.Germany.
- . DUBOS, J. and E. MONTAIGNE, 1989. *Economic aspects of enrichment of wine in France*. Institut National de la Recherche Agronomique de Toulouse (Université des Sciences Sociales), Toulouse, France.
- . VENTURA, F. and A. MILLUCCI, 1989. *Economic aspects of enrichment of wine in Italy*. Centro per lo Sviluppo Agricolo e Rurale, Assisi, Italy.

In Part III DUPUY, DE HOOGH and KLEIN ESSINK give a survey of the organization and implementation of the control measures concerning the enrichment of wine in the EC, and indicate related problems.

In Part IV a summary is given of the main conclusions of the various studies.

It goes without saying that the responsibility for the different parts of this report lies with the respective (final) editors. Their main considerations and recommendations in this final report are also supported by the experts who conducted the studies in the various Member States.

The Editors

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by *P. Dupuy (editor), F. Meidinger*
L. Usseglio-Tomasset

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THE EUROPEAN COMMUNITY**

by *J. de Hoogh, G. Klein Essink (editors)*

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PART I

**TECHNICAL AND OENOLOGICAL ASPECTS OF
THE ENRICHMENT OF WINE**

by

**P. Dupuy (editor)
F. Meidinger
L. Usseglio-Tomasset**

1. HISTORY OF THE ENRICHMENT OF WINE

1.1 Introduction

In his book, 'l'Art de faire le vin' the French chemist Chaptal (1756-1832) introduced the technique of adding sucrose to grape must as a method of increasing the alcoholic strength. Chaptal proposed to use cane sugar and beet sugar for the enrichment of wine, because these sugars could be entirely fermented.

The advantages of enrichment by sucrose, which process was afterwards called chaptalization, were clearly described by Chaptal:

- Possibility to produce good wines in case of unfavourable climatic conditions.
- Possibility to pick the grapes without having to wait until they had reached the maximum sugar content: this was important for the vineyards in the northern regions.
- Improvement of the quality of wine, not only because of a higher alcohol content but also because of the fact that the grapes could be picked at their maximum aromatic potential.
- Possibility to produce wines which, because of their higher alcohol strength, could be stored for a longer period of time.
- Possibility to produce acceptable wines in vineyards in the northern regions, where the climatic conditions for viticulture were less favourable.

Chaptal recommended to enrich wines by means of sucrose up to an alcohol grade of 10.6% vol. (10.5° Baumé), which was then the average alcohol grade in favourable seasons.

Even at that time the oenologists realized that enrichment of wine was a profitable practice. Mr. Rozier, a member of the French Academy of Agriculture, calculated that the benefits of the enrichment of wine were higher than its costs. Therefore this practice was proposed as a means to increase the profits in the wine industry.

In the beginning the enrichment of wine was limited because the cane sugar imported from tropical countries was not easily available. As soon as the production of beet sugar was widely established in Europe, the enrichment of wine became a common practice.

In 1819 Chaptal relates that a landlord using his method in Hungary had increased the production of his vineyard by 300%.

1.2 Diffusion of the technique

In France the addition of sucrose -- also called chaptalization -- became a common practice in the northern vineyards. At that time the grapes were picked in Paris earlier than in the Languedoc because of less favourable weather conditions in the north in autumn.

In the beginning of the 19th century, wine producers were of the opinion that wines should be produced exclusively from grapes. Therefore Chaptal developed a process to extract sugar from grape must concentrate. He obtained a dry sugar, but this method was never applied because of its high cost. However, grape must concentrate was generally used as a means of enrichment.

In the cool climate vineyards in the F.R.Germany, Luxembourg and Austria, chaptalization was also applied, because of the above mentioned advantages. In 1828 the German chemist L. Gall proposed to enrich wine by sucrose dissolved in water -- also called 'Nass-zuckerung'. By this technique a lack of grape sugar and an excess of acids can be adjusted. The method was generally adopted in the F.R.Germany and remained legal until 1985.

At the beginning of the 19th century there were no legal restrictions as to the extent of chaptalization. The producers agreed on limiting enrichment to the average alcohol grade of 10.6% vol., as reached in normal years.

Around 1830 sucrose became less expensive and dextrose produced from potato starch became available. Chaptalization was not only used in bad vintages, but was also used as a steady way of producing wines of an alcohol content higher than the one in wines naturally produced in years of favourable conditions.

The Congrès des Vignerons held in Dijon in 1845 reported on the situation in Burgundy, where chaptalization was commonly used. At that time the average alcohol content was 13.33% vol. in Burgundy and 9.77% vol. in Bordeaux. The application of chaptalization allowed the production of Pinot wine in the plains of Burgundy, where traditionally the

vineyard had been planted with Gamay. These chaptalized wines had less bouquet than those which had not been chaptalized. At the end of the congress a motion to ban chaptalization in Burgundy was carried by the producers because of its fatal effects on the wine sales.

In 1879 due to the devastating effect of the phylloxera on the French vineyards, the volume of wine production was reduced by half. At that time sucrose was used everywhere during the second fermentation in case of red wine. The Ministry of Agriculture estimated the volume of wine, produced by this second fermentation to be 2 million hl, approximately 10% of the total volume of production. Therefore, the Minister of Agriculture asked the chemist J.B. Dumas in 1882 to write a report on the control of chaptalization. The conclusions of this report were:

- Enrichment of wine by sucrose should be encouraged.
- In order to secure a higher quality of wine, crystallized beet sugar and cane sugar should be applied.
- For the control of enrichment, it is not necessary to label sucrose.
- The tax on sugar should be maintained at 0.25 FF/kg.

The Minister of Agriculture followed the conclusions of Mr. Dumas, and the status quo as to the control of chaptalization was maintained. The fact that no action was taken contributed to the crisis in the French wine sector which lasted from 1901 to 1907. At that time large quantities of sucrose were used for the normal wine production and for the production of second fermentation wines. This practice was legal until 1962.

In France enrichment was regulated by the law of 4 August 1929. The southern vineyards which had suffered from the utilization of sucrose in the production of second fermentation wine asked for a ban on enrichment by sucrose in their regions. Enrichment by sucrose was subsequently limited to the northern vineyards. It was presented as an exceptional practice for years of exceptional climatic conditions as proposed by Chaptal. As a result of the law a series of enrichment surveys was established.

When the EC regulations had substituted the national rules in 1970, the reference to exceptional vintages disappeared. Instead, areas which needed the application of different levels of enrichment depending on climatic zones were defined. The three wine-growing zones A, B and C, defined by Reg. (EC) 816/70 were delimited. According to this regulation the allowed level of enrichment may be extended by 1% vol. in years of exceptional bad climatic conditions.

In Italy chaptalization has mainly been applied during the second fermentation of wines. This was mentioned by Cauda and Botteri in 1875. The application of sucrose was banned by law in 1925. Enrichment by concentrated grape must was regulated in 1965 and was limited to the amount needed to reach the level of normal alcohol content in the wine produced in the area.

In the F.R.Germany, where ever since the 19th century the enrichment of wines has been a steady practice, a review of the classification of wines took place in 1971. A new category was created -- the so-called 'Wein mit Prädikat' or 'Qualitätswein eines bestimmten Anbaugebietes mit Prädikat (Q.b.A.m.P.)' -- which consists of wines produced without enrichment. These wines have a higher natural alcoholic strength than the Qualitätswein eines bestimmten Anbaugebietes (Q.b.A.). This kind of production, however, existed already before 1971.

This overview of the history of enrichment shows that the utilization of sucrose has entailed some crises on the wine market. In order to be able to cope with severe situations different limits of enrichment were specified. These limits were evaluated and adjusted to the circumstances.

2. TECHNICAL ADVANTAGES OF ENRICHMENT

2.1 Introduction

Nowadays the enrichment of wine is aiming at the following:

1. To obtain the same alcohol content in the wine, whatever the climatic conditions of the vintage, resulting in a relative stability in the value of wine in case of exceptionally bad climatic conditions. Such enrichment refers to the special measures laid down in the EC regulations.
2. To obtain annually wines which otherwise would only be obtained in very favourable vintages. This goes not only for the red wines which have to age, but also for southern white wines. For these white wines the grapes must be harvested before complete ripening in order to keep the desired acidity.
3. To compensate for the decrease of sugar produced by the increase of the yields. A technical alternative to enrichment could be the introduction of new varieties with a higher sugar content. Such new high-yielding varieties exist in the F.R.Germany, but they do not have the same flavour or the same characteristics as the old ones, as for example Riesling.

In the current situation dodging the production regulations such as the minimum natural sugar content of musts, results in the production of adulterated wines.

2.2 Yields and vineyard management

Experiments conducted both in the past and recently show that the sugar content of the grapes decreases when the yield of the vineyard increases. This is because the decrease of the sugar is low compared with the increase of the yield, so that the growers may want to increase their yield rather than to try and get a higher sugar content. The possibility of enrichment by sucrose stimulates this course of action. In Figure 1 an example of the relationship between sugar and yield is shown. The data are derived from experiments with the grape variety Gazmu. The experiments reported by Stoev (1966) took place in Bulgaria and lasted for three years.

It is known that in some places deep soils, well supplied with water, can produce very high yields. However, in the Appellation vineyards, where pilot delimitation has taken

place the high productivity soils have been excluded from the production of quality wines. The content of sugar is, however, not the only criterion for the quality of the wine. The variety of the grape, its bouquet, and a balanced acidity are also important elements for the quality, but less easily quantified.

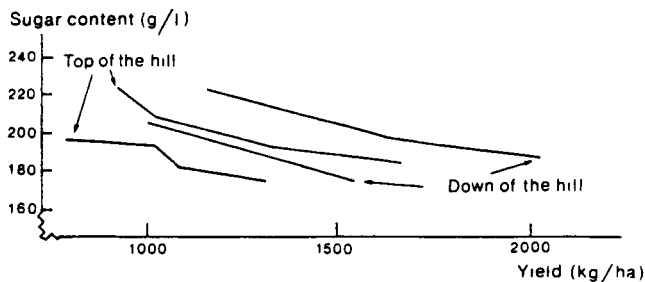


Figure 1: Decrease of the sugar content (g/l) with increase of yield (kg/ha)

Source: Stoev, 1966.

Two alternatives have been proposed to prompt wine-growers to produce wines of a better quality:

1. Limit the yields. This solution has been chosen because low yields are more likely to be associated with high quality than high yields. This measure has been adopted by many countries for quality wines produced in a delimited area, e.g. in the F.R.Germany in the State Rheinpfalz a regulation limiting the yields was introduced in 1989.
2. Set a lower limit on the sugar content of the grapes. General values have been laid down as general rules by the EC, which exclude grapes that do not come up to standard. More exacting values have been adopted by the countries for the production of their quality wines.

Both alternatives mean to exclude part of the possible production and to encourage the wine-growers to apply some limitations in the management of vineyards. Generally, the rules for quality wine production adopt both limitations: maximum yields and minimum sugar content (Figure 2).

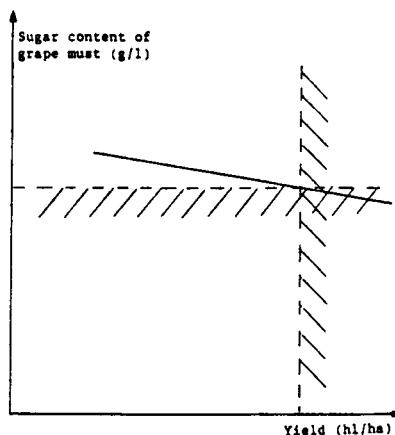


Figure 2: Limitation of the production of quality wine vineyards

2.3 Actual increase of the alcohol content of the wine

Though all official statistics of the production of wine do not give information about the alcohol content, it is likely that the mean alcohol content was increased in the past. This increase can be observed in a series of analyses concerning the same type of wine.

A local investigation was carried out in France on 36,863 samples of wine which had been analyzed for the Corbière wine label. These data cover the years 1972 to 1988 (Table 1). It should be noted that Corbière had been a Vin Delimité de Qualité Supérieure (V.D.Q.S.) label until 1985: its minimum alcohol content was 11.5% vol. In 1985 Corbière became an Appellation d'Origine Contrôlée (A.O.C.) region and the minimum alcohol content was increased to 12% vol. for red wines, the bulk of their production. In this region, enrichment by rectified concentrated grape must (RCM) is legal but enrichment by sucrose is forbidden.

The results show that from 1972 to 1988 the alcohol content increased. The large fluctuations which have appeared after 1982 have been attributed to the planting of new varieties which were more susceptible to the climate than the former variety Carignan.

The data from Table 1 can be interpreted as a linear increase of the alcohol content (Figure 3) or as an adjustment of the production to the new standard of the A.O.C. (Figure 4). Professionals are in favour of the latter interpretation. From the figures of this series it can not possibly be decided whether the increase of the alcohol content in the wine was obtained by changing the viticultural practice or by using enrichment which has been subsidized by the EC from 1979 onwards.

Another way to determine the mean alcohol content of wines is to refer to the surveys of alcoholic beverage consumption, e.g. the publication of the French Secrétariat d'État à la Consommation (Ministry of Health):

Year	1925	1955	1980
Wine consumption (l/head of population p.a.)	170	135	85
Alcohol consumption (l/head of population p.a.)	18.0	17.0	16.5

Table 1: Alcohol content of wines (% vol.) from the Corbière region (France), in the period 1972 - 1988

Year	Number of samples	Average alc. content	Standard deviation	Max. alc. content	Min. alc. content
1972	2,580	11.42	0.44	16.10	10.60
1973	2,811	11.63	.49	15.10	10.70
1974	1,693	11.71	0.52	14.60	10.50
1975	2,092	11.72	0.52	15.20	10.55
1976	2,299	11.68	0.49	14.20	10.20
1978	1,066	11.76	0.51	14.95	10.75
1979	1,546	11.72	0.52	14.65	10.80
1980	2,030	11.88	0.58	14.90	10.35
1981	2,182	11.68	0.47	15.00	10.30
1982	2,814	12.26	0.60	15.95	10.75
1983	2,557	12.21	0.55	15.30	10.75
1984	1,989	12.01	0.41	14.75	10.50
1985	2,643	12.46	0.53	14.95	10.65
1986	2,727	12.30	0.47	15.55	10.65
1987	2,982	11.97	0.34	15.35	10.81
1988	2,841	12.24	0.40	14.75	10.90

Source: Institut Nationale de la Recherche Agronomique (INRA), 1989.

In 1925 the bulk of the alcoholic beverages consumed was wine. The average alcohol content of this wine can be estimated at: $170/18 = 10.58\%$ vol.. At present the alcohol content of commercial wine reaches 12% vol. as shown by a survey of the alcohol content of the label made in a department store in Saarbrücken (F.R.Germany) in June 1989. The data suggest that the wide-spread enrichment has partly contributed to this evolution:

Origin	Number of wines	Alcohol content (% vol.)		
		minimum	maximum	average
F.R.Germany	12	9.5	11.5	10.62
Italy	6	10.0	12.0	11.25
France	27	10.5	13.5	11.94

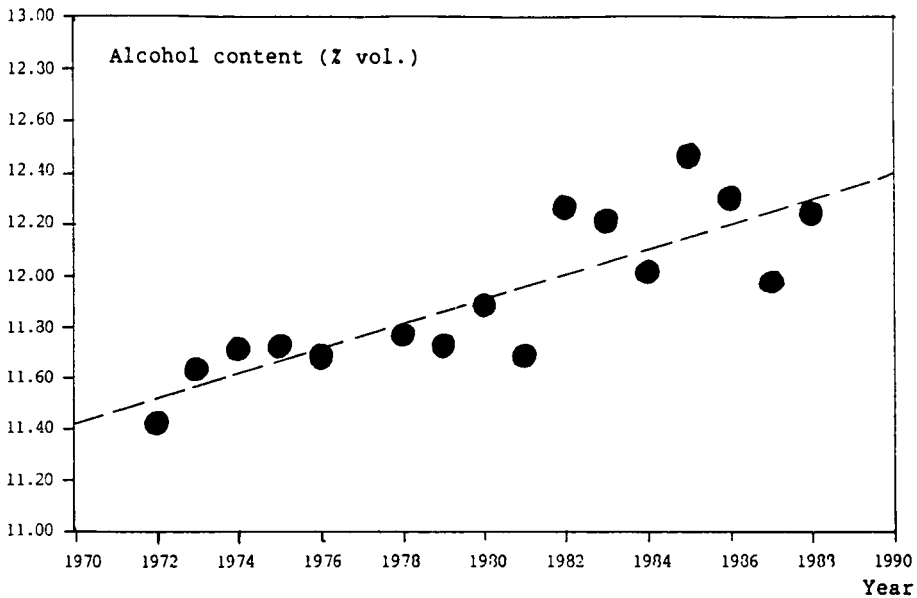


Figure 3: The potential natural alcohol content of wine grapes in the wine-growing region of Corbière (France), in the period 1970 - 1988 (Linear regression)

Source: INRA.

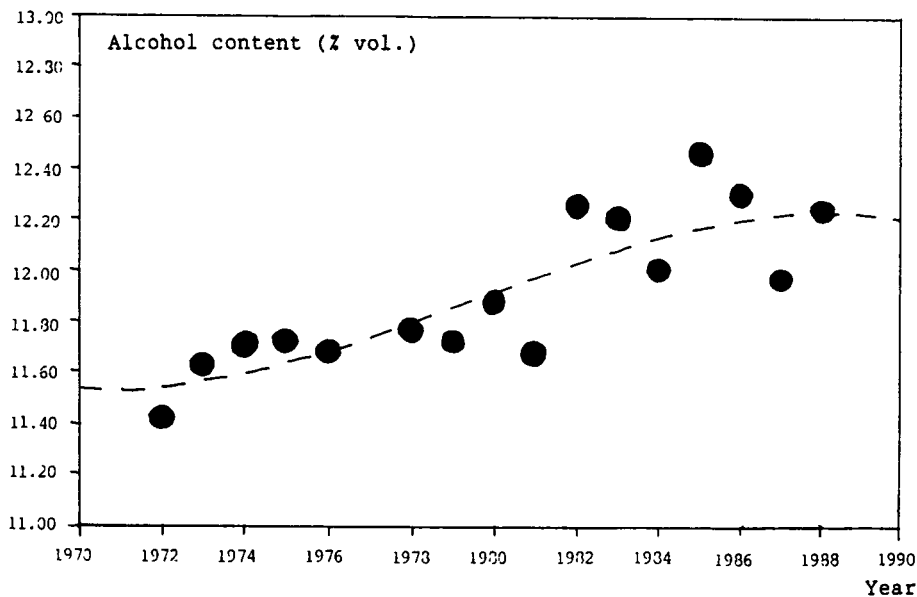


Figure 4: The potential natural alcohol content of wine grapes in the wine-growing region of Corbière (France), in the period 1970 - 1988

Source: INRA.

3. TECHNOLOGY OF ENRICHMENT

The technology of the process of enrichment by adding sucrose or concentrated grape must (CM) or RCM can be readily seen in Figure 5 and 6. It differs for a red wine produced by maceration of the solid parts of the grapes, and for a white wine or a red wine produced by heat treatment, because in this case the operation affects only a liquid.

For enrichment by sucrose a scale is needed to measure the quantity of sugar, also a mixing vat to dissolve the sugar into the must and a pump to transfer the enriched must into the tank. Enrichment by concentrated grape must (CM) or RCM needs a special pump to pump these viscous products into the tank and another pump to homogenize the content of the tank. The volumes are measured by a gauge.

In the case of fermentation with carbonic maceration only, it is difficult to add all the CM or RCM at one time because the quantity of liquid in the tank is small and the content of the sugar would be too high to support fermentation. Since the regulations require that enrichment be done at one time, it is more convenient to enrich the wine after pressing. Some professionals hold the opinion that a better quality of wine could be obtained if a fractionated enrichment of the crushed grapes was carried out during the phase of carbonic maceration.

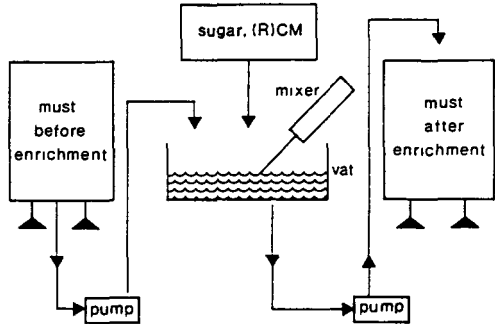


Figure 5: Technology of enrichment of white wine

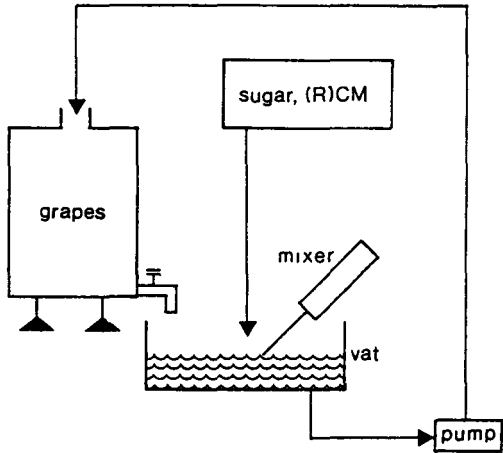


Figure 6: Technology of enrichment of red wine with maceration

The sugar concentration in CM or RCM is easily determined with a hand refractometer. Everywhere wine-growers use this instrument to determine the sugar content in the grapes. They need to buy a second instrument (200 - 250 Ecu) with a scale for higher sugar concentrations. Some experts point out that RCM is less easy to handle than crystallized sucrose because it is a viscous product. The containers of 20, 100 and 200 l have to be flushed with grape must to recover all the RCM which is left at the bottom and walls of the tank. Currently, the emptied containers cannot be re-used, so this poses a difficult problem as to waste-disposal.

The microbiological stability of RCM can be affected by the condensation of water on the surface. In some cases in tanks which were not properly stored fermentation of RCM occurred. In fact, under the EC regulations RCM containing more than 1% vol. alcohol may not be sold on the market.

When RCM of 67° Brix is stored over a year a part of the glucose will crystallize on the bottom of the tank. The precipitate cannot be pumped and has to be heated to dissolve the solids in order to obtain a homogeneous product. Such a crystallization occurred during the 1987 experiments carried out within the framework of the study on the oenological aspects of the enrichment of wine (See Section 8). Therefore, for the experiments carried out in the F.R.Germany in 1988 a RCM of 61° Brix was chosen. In this case no difficulties with crystallization were reported. A producer of RCM noticed that RCM of 61° Brix does not even crystallize when the product is exposed to low temperatures during storage.

4. CALCULATION OF THE ENRICHMENT

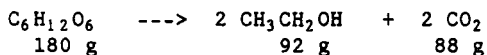
4.1 Alcoholic yield of fermentation of sugar

The calculation of the quantity of sugar which has to be added to enrich a must to a certain level has been a point of discussion. The oenologists who organized the experiments in the three countries have clarified this in the present Section.

In order to calculate enrichment it is necessary to choose a rate of conversion of sugar into alcohol. Some professionals claim that the values of this rate are controversial. Different rates have been adopted by different authorities, which brought about further discussions on the subject. These rates have been used to elaborate different tables, some of which have been adopted by the governments. Therefore it is necessary to explain the different ways of calculating the yield of alcoholic fermentation. In this paper the yields have been expressed in terms of the weight in grammes of monosaccharides necessary to obtain one per cent of alcohol per litre: X g for 1% alcohol vol./l. In the F.R.Germany, however, oenologists are not familiar with this formula and therefore some calculations are given in the German notation as proposed in the reports on the oenological aspects of the enrichment of wine in the F.R.Germany.

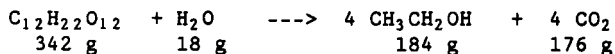
Theoretical yield

The transformation of dextrose into ethyl alcohol was described in 1810 by Gay Lussac in the following equation:



The yield of this equation is 15.65 g of glucose or fructose to obtain 1% vol. alcohol/l.

When sucrose is fermented the equation is:



The yield is 14.87 g of sucrose to obtain 1% vol. alcohol/l. The difference in yield between the fermentation of sucrose and grape sugar (or glucose or fructose) is caused

by the fact that one molecule of water is necessary to ferment a disaccharide such as sucrose.

In the practice of fermentation these calculated yields are never reached for two reasons:

- In addition to alcohol and carbon dioxide there are also secondary products (glycerol, succinic acid, etc.).
- During the fermentation part of the alcohol is lost by the release of carbon dioxide.

Yields given by different yeasts

The different strains of yeasts produce different quantities of secondary products. This implies that they give different yields of alcohol.

Fermentations carried out in the laboratories using pure strains of yeasts, allow the measurement of their yield in conditions in which the loss of alcohol can be neglected. In one experiment three strains of *Saccharomyces cerevisiae* gave yields of 16.71 - 16.64 - 16.59, figures which do not differ very much.

Less alcoholgenic species of yeasts, such as *Kloeckera*, *Hansenula*, give lower yields, about 18 - 20 g glucose for 1% vol. alcohol. This difference is due to the part of the sugar which is metabolized in an aerobic pathway and does not produce alcohol.

When fermentation of a must is obtained with the spontaneous flora of the grapes, the winemaker does not control the yeasts. However, it is certain that the larger part of the sugar is fermented by *S. cerevisiae*, because only this yeast is active when the alcohol content is higher than 4 - 5% vol. alcohol. Sugar added for enrichment after the beginning of the fermentation will be fermented only by *S. cerevisiae*. When a commercial starter of *S. cerevisiae* or *S. bayanus* is used, the other species of yeasts are eliminated from the beginning of the fermentation. These commercial strains are selected for their high yields in alcohol.

In the last phase of fermentation the yield is higher because the synthesis of yeast biomass has stopped. The winemaker can influence the quantity of yeast produced during the fermentation by limiting aeration and especially by adding a large quantity of starter. In this case the yeasts have been produced outside the process and they do not use up the sugar present in the must. The active dry yeasts, which have a high alcohol yield and

which can be used in large quantities, allow the winemaker to obtain higher yields than before.

Loss of alcohol during fermentation

The carbon dioxide escaping from the fermentation tank contains alcohol vapour. It has been calculated that a litre of must at 10% will be flushed away with 5 litres of carbon dioxide during its fermentation.

Since recuperation devices were installed in some cellars, it has been possible to determine the loss of alcohol. It was found that more alcohol is lost in case of an increase in temperature of fermentation. This could be explained by the increased vapour tension of the alcohol.

When open tanks are used, a direct evaporation of alcohol occurs in addition to the flushing away by carbon dioxide. The total loss amounts to 0.2% and even more if the temperature of the tanks goes up to 37 - 40° C.

In modern cellars this loss is more limited because closed tanks are used and the temperature is checked. This is illustrated in Table 2 by the experiments of enrichment of white wine at different temperatures (in closed stainless steel tanks of 1,030 hl each). This table shows that the yield of fermentation is correlated with the duration of the fermentation. The duration of the fermentation is a good representation of the mean temperatures of the fermentation process.

Table 2: Yields observed in the cooperative cellar 'Producteurs de Blanquette' (Limoux, France)

Duration of fermentation (hour)	Yield (g/% vol.)
282	15.4
225	15.5
212	15.5
180	15.9
176	15.7
153	16.0
152	16.2
114	17.0

Yield of fermentation of sugar in the oenological practice

Determinations were conducted in the Soviet Union by Tiurina (1960). The alcohol yield for red wines produced in open tanks was 17.86 g grape sugar by 1% vol. alcohol: for white wines produced in closed tanks this value was 16.67 g by 1% vol. alcohol. In modern cellars the yields are higher. For example, in the cooperative cellars in the South of France, which produce mainly red wine, the recording was done in hectolitre x degree

and the value of 17 g was taken as the basis for the conversion of sugar into alcohol. At the end of the year the balance sheet indicated that more alcohol had been obtained. This is evidence that the value of 17 g is too high.

The traditional tables of evaluating the probable alcohol content from the refractive index or the density of the must, use a conversion factor of 17 g for white wine. In the new table proposed by Prof. S. Brun, which has recently been examined by the Office International de la Vigne et du Vin (International Organization for Viti- and Viniculture) (O.I.V.) a conversion factor of 16.85 is used.

In France the automatic refractometers used in the cooperative cellars are graduated in potential alcohol content adopting a conversion factor of 17.6 grape sugar of 1% vol. alcohol. These instruments are controlled by the Service des Poids et Mesures which has adopted this conversion factor.

Probable yield fermentation of sugar added for enrichment

In France oenologists use the following figures to define the enrichment of alcohol:

- 18 g sucrose for 1% vol. alcohol/l, for red wine production.
- 17 g sucrose for 1% vol. alcohol/l, for white wine production.

This difference is due to the fact that in the case of red wine production part of the alcohol remains in the marc.

In the F.R.Germany the oenologists use the figure of 0.24 kg sucrose for 1 g of alcohol in 100 l of must. The increase of volume due to the addition of sucrose is included in this figure which corresponds to 20 g sucrose per degree of alcohol.

When enrichment is carried out by sucrose, these accepted figures are much higher than in reality. All the figures which were reported previously refer to the yield of grape sugar and not of sucrose. It has already been explained that the yield of fermentation of sucrose is 5% higher than for grape sugar.

There is no evidence that the yields of the sugars added for enrichment are different from those of the sugars which are the normal constituent of the grape. It was to be expected that the sugar added to a fermentation already in progress would not be used to produce cell biomass and would give a little more alcohol.

4.2 Conversion tables

In the wine industry the probable alcohol content of the wine is calculated from the sugar present in the must. The sugar content is approximated from the density or the refractive index of the must, while taking into account that not all soluble dry matter is made up of sugar. There are some slight differences between the standards of dry matter which were chosen by various authors.

To establish a correspondence between the sugar content and the alcohol potential, it is necessary to choose a conversion factor. We have already seen that this choice is a matter of opinion. Therefore, it can be concluded that the relationship between density and probable alcohol content can be defined only by approximation. Several tables have been published which vary slightly, but which caused some confusion among the wine-growers. The fact that the tables refer to different parameters, such as: density, specific weight, refractive index, Oechsle grade, alcohol in g by litre, in % volume, or in alcoholic grade according to Gay-Lussac, only added to this confusion.

In the F.R.Germany the way of calculating the probable alcohol content is based upon the so-called Oechsle degree of the grape must. The formula is:

$$\text{Alcohol (g/l)} = (1.25 * \text{° Oechsle}) - (0.5 * \text{dry matter})$$

In books on oenology tables of correspondence give the conversion factor of alcohol into grape sugar:

$$\begin{aligned} \text{Alcohol weight} &= 0.47 * \text{grape sugar weight or} \\ 1\% \text{ alcohol volume} &= 17 \text{ g of grape sugar} \end{aligned}$$

The same difficulties arise with the tables giving the probable alcohol content of concentrated grape must or rectified concentrated grape must.

Tables of the O.I.V.

In 1986 the O.I.V. discussed the refractometric method for the determination of sugar in must, concentrated must and rectified concentrated must. These discussions were held in order to come to an agreement as to the standardization of the analytical methods. As a result of these discussions, tables for oenological use have been proposed.

Table II of the O.I.V. standards gives the correspondence between the refractive index and the content of sucrose expressed in % mass/mass and g/litre. Table III gives the same correspondence for inverted sugar. This table is nearest to the oenological reality, because grape sugar is, like inverted sugar, an equimolecular mixture of glucose and fructose. From these tables Brun has calculated the probable alcohol content, using the conversion factor of 16.85 g of sugar for 1% vol. alcohol by litre.

Tables of the Commission

The working group acting within the framework of the Mediterranean Agriculture Research Programme (AGRIMED) which edited the book on Rectified Concentrated Must (1984) proposed to use the table of Plato to calculate the sugar content of RCM.

Later the Commission of the EC started to grant aid for the use of (R)CM in wine-making. The aid was calculated on the basis of the volume of alcohol produced by concentrated grape must and therefore it was necessary to know the applied volume of CM and its sugar content. To administer these things the officials need a conversion table giving different sugar contents of (R)CM on the one hand and the expected volume increase of alcohol on the other hand. In the first year in which aid was granted (1982) each Member State used its own conversion table, which led to small differences. The Commission then issued a table to overcome such problems. This table gives the official correspondence between the refractometer value in % of dry matter for 100 grammes and the probable alcohol increase in % volume, e.g. fermentation of 16.378 g grape sugar gives an 1% increase in alcohol content per litre.

The table also gives information about the fermentation of concentrated grape must. CM contains also non-sugar components. The table is based on the assumption that a concentrated grape must with 180 g sugar per l contains 15 g dry matter of other components. It was assumed that the content of non-sugar parts relates itself proportionally to the sugar in concentrated grape must.

The table published in Reg. 3786/86 of 11 December 1986 is used to calculate the amount of aid to be granted to the wine-growers and only serves an administrative purpose.

Conclusion

The multiplicity of conversion tables induces the opinion that the competent authorities hesitate to evaluate the quantity of sugar in (R)CM. The potential users of (R)CM consider this an inconvenience compared to the use of sucrose.

The conversion factor of sucrose to alcohol that is accepted by the different authorities varies from 16.378 g (the EC standard) to 20 g (the F.R.Germany standard). This leads to the opinion that the alcohol yield of RCM is doubtful.

This consideration does not hold for the enrichment by sucrose, because the product does not contain water. The yield which has been accepted by the authorities of 18 g or even 20 g for 1% alcohol is favourable for the user. The yield of 16.38 g which is applied by the EC to the users of RCM is less favourable. Because no systematic balance on enrichment by sucrose is performed, wine-growers believe that enrichment by sucrose is perfectly mastered and that all the uncertainties are linked to enrichment by (R)CM.

4.3 The formula to calculate enrichment by (R)CM

The precise calculation of enrichment is done by application of the following formula which takes into account:

- the dilution produced by the addition of CM or RCM.
- the content of sugar in CM or RCM.
- the content of sugar in the must to be enriched.

The amount of must concentrate needed to increase the alcoholic strength depends directly on its Brix number. This is the number of grammes of sugar per 100 grammes of product. This Brix number determines the potential alcoholic strength with reference to one of the tables already examined. The amount of (R)CM needed to achieve a certain increase in the alcoholic strength of grape must is calculated by means of the following formula:

$$V_{(R)CM} = \frac{V_{\text{grape must}} * (d_2 - d_1)}{d_{(R)CM} - d_2}$$

in which: $V_{(R)CM}$ = required quantity of (R)CM (hl).
 $V_{\text{grape must}}$ = quantity of grape must to be enriched (hl).
 d_2 = alcoholic strength after enrichment.
 d_1 = natural alcoholic strength before enrichment.
 $d_{(R)CM}$ = potential alcoholic strength of (R)CM.

This formula shows that the quantity of product needed to increase the alcohol content of the wine by 1% depends on the natural sugar of the must. For example, if we use a (R)CM of 67° Brix, corresponding to 54.4% vol. alcohol, we must add:

$$\frac{1 * (9 - 8)}{(54.4 - 9)} = 2.20 \text{ l to enrich 1 hl from 8\% vol. to 9\% vol. and}$$

$$\frac{1 * (13 - 12)}{(54.4 - 13)} = 2.41 \text{ l to enrich 1 hl from 12\% vol. to 13\% vol.}$$

In the F.R.Germany the calculation of enrichment is based on the potential alcohol of the must measured in Oechsle degrees and converted into g/l alcohol.

For the calculation of the enrichment before fermentation is started 0.24 kg of sucrose are used on average to increase 1 g/l alcohol to 1 hl. This formula is justified by the following demonstration. For 1 % vol. alcohol (= 8 g/l) the weight of sucrose is $0.24 * 8 = 1.92$ kg sucrose by hl of must. Because the volume of the solution has increased due to the enrichment by $1.92 * 0.62 = 1.19$ l the total volume is 100 l (must) + 1.19 l (dissolved sucrose) = 101.19 l. For this reason the quantity of sucrose must be increased by $1.92 * 1.01194 = 1.94$ kg.

For the calculation of the enrichment of young wine after the fermentation has started 0.21 kg of sucrose is used on average to increase 1 g/l alcohol to 1 hl. For 1 % vol. alcohol (= 8 g/l) the weight of sucrose is $0.21 * 8 = 1.68$ kg sucrose per hl of must. Because the volume of the solution has increased due to the enrichment by $1.68 * 0.62 = 1.04$ l the total volume is 100 l (must) + 1.04 l (dissolved sucrose) = 101.04 l. For this reason the quantity of sucrose must be increased by $1.68 * 1.10104 = 1.703$ kg.

The usual practice of enrichment performed in the F.R.Germany confirms these calculations. The oenologists recommend to calculate the enrichment on the basis of the

maximum allowed level of enrichment subtracted by 5 - 8 g/l in order not to exceed the legal limits.

In France, the figures of 17 g for 1% vol. alcohol for white wine and 18 g/l for 1% vol. alcohol for red wine are accepted by the authorities to calculate enrichment by sucrose or (R)CM, without differentiating the time of enrichment (before and after fermentation).

5. VARIATION OF VOLUME PRODUCED BY ENRICHMENT

It must be emphasized that the volume of the wine is not exactly the same as the volume of the must irrespective of the type of wine produced. The reason for this is of a physical nature. For example, of a must containing 170 g/l of sugar with a density of 1.075 and 75° Oechsle the composition is as follows:

Before fermentation			After fermentation		
	Weight	Volume		Weight	Volume
Sugar	170 g	: 1.57 = 108.28 ml	Alcohol	80 g	= 100 ml
Extract	22 g	: 1.57 = 14.01 ml	Extract	22 g	= 14 ml
Water	808 g	808.00 ml	Water	808 g	= 808 ml
	<hr/> 1,000 g	<hr/> 920.29 ml		<hr/> 910 g	<hr/> 922 ml
Density	= $\frac{1,000}{920.29} = 1.075$		Density	= $\frac{910}{922} = 0.987$	

If the wine is not enriched, the volume of the wine will be very close to the volume of the must, but the density of both will be quite different. For this reason it is generally accepted to consider the volume of the must as the volume of the wine.

Enrichment by sucrose produces an increase in the volume of the wine due to the new volume of alcohol. The increase varies with the quantity of sucrose added, and is larger if the calculation is done to adjust the alcohol content to the volume of the obtained wine. In such a calculation the reference is not the volume of must, but the volume of the fermenting product, which is higher than the volume of must.

The following increase in volume is given by the table concerning the enrichment by sucrose published in *Technologie des Weines*, by G. Troost (1980). This table adopts a conversion of 20 g sucrose for 1% alcohol per l:

Increase of alcohol	Increase of volume
20 g limit zone B	3.0 ‰
28 g limit zone A	4.2 ‰
36 g exception zone B and A	5.5 ‰
40 g exception zone A for red wine	6.1 ‰

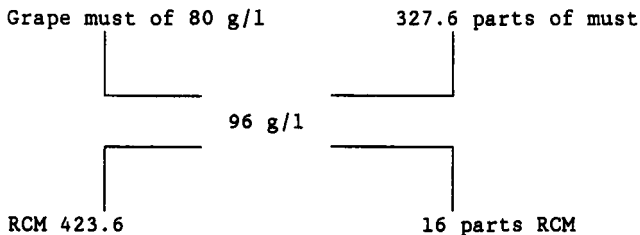
Enrichment by RCM produces a supplementary increase in the volume of the wine due to the quantity of water it contains. One kilogram of RCM of 67° Brix contains 670 g of sugar and 330 g of water, whereas 1 kg RCM of 61° Brix contains 610 g of sugar and 390 g of water. By obtaining an increase of 1% vol. alcohol produced from 1.7 kg sugar by hl this means a supplementary increase in volume of:

$$1.7 * (330 / 670) = 0.837 \text{ l in the case RCM of } 67^\circ \text{ Brix is applied and}$$

$$1.7 * (390 / 610) = 1.087 \text{ l in the case RCM of } 61^\circ \text{ Brix is applied}$$

This supplementary volume would even be larger if the volume of the obtained wine had been taken as a reference of calculation and if the figures proposed by the German oenologists had been used. The following calculation using the rule of mixtures, or the Cramer cross, refers to the same example.

$$\begin{aligned} 67^\circ \text{ Brix} &= 892.0 \text{ g/l sucrose} \\ &= 0.475 * 892 = 423.6 \text{ g alcohol} \end{aligned}$$



x l of RCM are necessary to enrich 100 l of must, respecting the proportion of:

$$\begin{aligned} x &= 4.88 \text{ l RCM (67° Brix), specific weight } 1.3288 \\ &= 4.88 * 1.3288 = 6.48 \text{ kg} \end{aligned}$$

1 kg RCM of 67° Brix contains 0.33 kg of water.

The supplementary increase of volume will be $6.48 * 0.33 = 2.14 \text{ l}$. Referring to the first calculation the supplementary increase of volume is only 1.674 l.

6. NEW METHODS OF ENRICHMENT

In addition to the use of sucrose, CM and RCM other enrichment methods have appeared recently. Until now they have been at an experimental stage, but they have to be taken into account because in the near future they could introduce new possibilities of enrichment. The EC legislation will have to reject or to approve these new methods of enrichment. It will also be necessary to determine the extent to which they will be used.

Vacuum evaporation

New small installations producing concentrated must have been introduced recently. They give concentrates of a good quality because of the reduction of the evaporation temperature by vacuum.

A pilot has been constructed in a workshop near Bordeaux, which is able to evaporate 100 l/hour of water. The vacuum is created by a water ring pump. Heating of the must to 35 - 40 °C is obtained with a heat pump. With the use of this pilot it is possible to increase the potential alcohol content from 10% vol. to 15% vol. It is not possible to obtain a must sufficiently concentrated to be biologically stable.

The cost of 1 hl of water evaporated is around 130 Ecu, which is 50 times the cost of the same evaporation conducted in a modern factory. The investment for the machine amounts to 40,000 Ecu.

According to the results obtained in 1988 wines enriched by this technique have the same disadvantages as those enriched by concentrated musts: the acidity has increased. Production of quality wines remains possible if the concentration is applied to the less acid musts. For this reason the machine will not be useful in enriching crops obtained during years of bad climatic conditions. The size and the cost of the machine make it suitable only for wine estates that produce quality wines.

Crystallization of water

After freezing the must or the wine the ice crystals can be separated. This process is expensive and produces wines of limited quality. It has almost completely been abandoned.

Cryo extraction

A variant of the former process is cryo extraction, which implies the pressing of frozen berries allowing the extraction of more concentrated grape must.

The grapes are frozen at around -6 °C and then pressed. The least ripe berries remain unpressed and a selection of the richest must is possible. A normal press can be used. For freezing the grapes are placed on a plastic tray and stored in a cold room for 15 - 20 hours. The price of an installation at the estate level is said to be some 70,000 Ecu, but less expensive equipment will be available. There are twenty such installations in France, in the Bordeaux region, where sweet wines are produced. Demonstrations have been given in the Loire valley and the Alsace. Until now the technique has been used for the production of sweet white wines of a so-called 'appellation': Sauternes, St. Croix du Mont, Coteaux du Layon. Producers of these expensive wines can afford a treatment which is estimated to 0.1 - 0.2 Ecu per bottle of wine. The oenological results are good for sweet wines, because the sensation of 'body' is increased in wines enriched through this method. There is no analytical explanation for this.

It is possible that cryo extraction could also be advantageous for dry white wines, because it has the same effect on the flavour as pellicular maceration.

This brings about a debate as to decide whether these techniques are compatible with the definitions of the Appellations d'Origine, whether they should be limited to sweet wines, whether they will be good for the image of these expensive wines.

Cryo extraction leaves an important quantity of juice in the marc, which can be recovered to produce dry wine or even sweet wines if enriched by sucrose. This point must be taken into account to avoid overstepping the production of Vins de Qualité Produits dans des Régions Déterminées (VQPRD). The legal status of cryo extraction is not clear in view of the oenological practices within the EC.

Reverse osmosis

The principle of this method is to press the water of the must through a membrane. Two types of installations have been constructed in France:

1. Sté Degrémont has constructed installations to produce fresh water from sea water, using membranes. With this experience a pilot for wine has been constructed and experimented with since 1984 in the Bordeaux region and afterwards in Champagne and the Alsace. The process is presented as a means to reduce the volume of the must produced. In the present module, the enrichment is limited to 28° Brix. The oenological results are satisfying.
2. Separa Systems is a joint venture of Dupont de Nemours and FMC. They have gained experience in concentrating orange juice to the level of 40° Brix. They use fibres which sustain higher pressures than membranes. A pilot incorporating micro-filtration and reverse-osmosis has been experimented with in Beaujolais, in Burgundy and in the Alsace. The pilot can extract 100 l/n of water and concentrate a must until 43° Brix.

From an oenological point of view, this type of enrichment gives acceptable results, but also an increase of the acidity of the wine. This point is no longer a drawback for some wines of 'Appellation' which are poor in acidity and in fact need acidification.

The price of such installations have not been communicated, but it seems that it could be around 250,000 Ecu. The interest of such installations is that the enrichment can be done at the estate level.

In the F.R.Germany the research institutes in Geisenheim have been experimenting with reverse osmosis.

In Italy there have also been experiments with reverse osmosis within the framework of a research project financially supported by the EC and the Italian company Samprogetti. The results of experiments in Pavia (Italy) with the varieties Barbera and Riesling were satisfactory.

Consequences

The new techniques which have been presented are based on:

- Water elimination (subtractive enrichment).
- Equipments which can be employed at estate level.

This last point is of great interest to the wine-growers, who expect that these oenological practices will remain at their own initiative within the limits of the production of VQPRD.

All these new methods have been authorized by the service responsible for the exposure of frauds. Authorization has been given for experiments limited to volumes of wine less than 50,000 hl under EC regulation 822/87.

Some of these methods are at an experimental stage and it is difficult to know whether the wine-growers are really interested. Cryo concentration has gone through this phase, since 20 installations have been running in France over the last season.

We know that all these methods will be more expensive than the existing alternatives, sucrose or RCM. They have, however, advantages which are of interest to the wine-growers:

- The wine-grower will be able to control the volume of his production afterwards.
- Addition of extraneous products is no longer necessary.
- They are compatible with the production of several appellations at the same estate, keeping the crops separated.
- Since these techniques decrease the volume of the wine produced, it is generally accepted that they include their own limitations. For this reason they could be left out of the regulations.

The wine-growers will use the experiments on these methods in progress and the limited knowledge as an argument for postponing the decisions concerning the ban of sucrose.

At present only the enrichment by sucrose, concentrated must and rectified concentrated must are used on large volumes of wine. Producers of VQPRD prefer to use sucrose, but it is clear that, besides rectified concentrated musts, other physical enrichment techniques are already available and up to now they have not been affected by the EC regulations.

7. AGEING OF WINES ENRICHED BY RCM

An objection against the enrichment by RCM was that the impact of this process on the ageing of wines was unknown. This objection was limited to the small fraction of quality wines which had normally aged. Furthermore, this hypothesis has not been scientifically underpinned.

This point was investigated during experiments conducted within the framework of the AGRIMED - programme. Organoleptic assessments have been repeated both during the ageing of the wine in barrel and in bottle during the conservation of bottle wine.

The samples of a previous experiment conducted in Alsace in 1982 with RCM of different origins were assessed again in November 1989.

Until now no difference between enrichment by sucrose and enrichment by RCM has been found in the experiments in which this parameter has been controlled.

It can be concluded that the enrichment by RCM has no impact on the ageing of wine.

8. DESCRIPTION OF THE DIFFERENT EXPERIMENTS

To facilitate a quick overview of the numerous experiments concluded in the three countries during the vintages 1987 and 1988, each experiment has been described in the same simplified manner. The original records remain available. Each experiment is described as follows:

- The producer identifies the name and the address of the cellar where the experiment has been conducted.
- The names of the oenologists, who have supervised the experiment and established the report, are indicated.
- The type of wine making is indicated, especially for the red wines where different techniques are possible. The variety of the grape and the density of the must, often expressed in ° Oechsle are reported. The potential alcohol production is found in the tables for white wine currently used by the oenologists.
- The volume is that of the must used in the experiment. For red wine the weight of the grapes has been indicated and the volume of wine has been calculated, using the ratio accepted by the local practice.
- The extent of enrichment used in the calculation is indicated. Such calculations have been done by the local oenologists using the methods they were accustomed to. The results of these calculations are given in kilograms of sucrose added and in litres of RCM, with an indication of its concentration in Brix.
- The most important results of the wine analyses are reported:
 - . the alcohol content expressed in g/l or in % volume.
 - . the residual sugar, which indicates the completion of the fermentation.
 - . the volatile acidity as an indication of the unsatisfactory conditions of fermentation.
- The sensory evaluation of the wine has been done by different methods. Triangle tests evaluate the differences - if any - between two wines. The duo-trio test is a modification of the former, in which a reference sample is identified and compared with two other samples, one of which identical to the reference.
- Grading or scoring evaluation consists in establishing the differences between samples of wines with the help of rating scales in use in all wine-growing regions, e.g. the 5-points DLG system. Ranking is done by means of arranging a series in order of preference. When statistical computations of these results have been completed, the significant results and the non-significant results are indicated.

- The rate of calculation has been made afterwards. It indicates the quantity of sucrose in grammes and the quantity of grape sugar in grammes which were thought necessary to obtain 1% vol. alcohol. In order to make such calculations it is necessary to accept some agreements. For sucrose the quantity of sugar added is divided by the volume and the desired enrichment. For RCM the potential alcohol is that which has been indicated in the table of the EC, which accepts a conversion factor of 16.378 g of grape sugar for 1% vol. alcohol. Then the calculation of the quantity of RCM is done by using the rule of proportion for the mixtures, which takes into account the increase of volume. This calculated quantity is compared with the used quantity of RCM and their ratio permits the adjustment of the conversion factor which is then reported.
- The measured enrichment differs from the calculated enrichment positively or negatively as reported.
- The commentary gives the conclusions of the experiments and emphasizes some peculiar points. The list of the different experiments is given in Table 3. A total volume of 15,905 hl of wine was obtained from 145 tanks.

Table 3: Experiments with enrichment of red wines (R) and white wines (W) in number and volume (hl) in wine-growing regions in France, the F.R.Germany and Italy carried out in 1987 and 1988

Member State and region	Colour and no.	Volume	Member State and region	Colour and no.	Volume
France 1987			F.R.Germany 1987		
Clos Vougeot	(R) 2	68	Schwarzriesling MÖglingen	(R) 4	192
Riesling Alsace	(W) 2	200	Riesling MÖglingen	(W) 4	336
		Total = 268	Trollinger MÖglingen	(R) 4	300
			Silvaner Edenkoben	(W) 4	450
France 1988			Riesling Trier	(W) 4	82
Margaux	(R) 2	182	Riesling Weinsberg	(W) 4	9.6
Bordeaux	(R) 2	420	Schwarzriesling Weinsberg	(R) 4	9.4
Entre deux Mers	(W) 2	420	Portugieser Bad-Durkheim	(R) 4	440
Bordeaux	(R) 3	3.4			Total = 1,819
Bordeaux	(W) 4	4.8	F.R.Germany 1988		
Bordeaux	(W) 3	1.4	Spätburgunder Breisach	(R) 4	44
Bordeaux	(W) 3	1.4	Müller-Thurgau Breisach	(W) 4	64
Beaujolais	(R) 2	60	Schwarzriesling MÖglingen	(R) 4	336
Beaujolais	(R) 2	447	Riesling MÖglingen	(W) 4	336
Beaujolais	(R) 2	105	Trollinger MÖglingen	(R) 4	336
Morgon	(R) 2	85	Riesling Bernkastel	(W) 4	2,118.5
Limoux	(W) 4	4,020	Silvaner Edenkoben	(W) 4	480
Vosne Romanée	(R) 2	63	Portugieser Bad-Durkheim	(R) 4	420
Clos Vougeot	(R) 2	73	Schwarzriesling Weinsberg	(R) 4	8.8
Bourgogne	(W) 4	8.4	Riesling Weinsberg	(W) 4	8.8
Beaune	(R) 2	13.5			Total = 4,152.1
Gewürtztraminer					
-Alsace	(W) 3	373			
Riesling Alsace	(W) 2	322			
Riesling Alsace	(W) 3	312			
Riesling Alsace	(W) 2	181			
		Total = 7,075.9			
Italy 1987					
Cortese Piemonte	(W) 3	470			
Cortese Piemonte	(W) 2	200			
Barbera Asti	(R) 3	490			
Barb.Alessandria	(R) 2	300			
Nebbiolo Alba	(R) 2	350			
Nebbiolo Barolo	(R) 2	390			
Niosola Trentino	(W) 2	300			
Teroldego					
Mezzolombardio	(R) 2	90			
		Total = 2,590			

In total 49 experiments in 150 tanks totalling 15,905 hl

9. CONCLUSIONS

Experiments were conducted in France, the F.R.Germany and Italy during the vintages 1987 and 1988. Their objective was to compare enrichment by sucrose and by RCM. More than 60 trials were conducted covering the different types of production and practices of each wine-growing region. The following conclusions can be drawn.

1. When a correct formula or table has been used, there is no difficulty in obtaining the desired enrichment by sucrose or RCM. Using RCM it is essential to include the dilution effect. The experiments conducted in Italy have resulted in actual enrichments very close to the calculated enrichments. In this case the calculations were done by the researchers of the wine Institute of Asti. The same has happened in the F.R.Germany where a directive for the calculation was established by F. Meidinger from the Staatliche Lehr und Versuchsanstalt für Wein und Obstbau, Weinsberg. In France no directive was given for the calculation of enrichment, with each oenologist using his own method of calculation. In this case the differences between the observed enrichments and the calculated enrichments were bigger. Some mistakes were made by the technicians when they used the same calculation for a dry product as for a liquid product (containing water).
2. In 1988 RCM of good quality was available in each wine producing region on a normal commercial basis.
In the F.R.Germany only one importer operated on the market in 1988. It is important to remember that in this country the use of RCM was banned until 1987. The European Court of Justice in Luxembourg ruled the change of German regulations in 1988.
In Italy two production plants of RCM were closed because they were suspected of mixing with sucrose. Legal action has been taken.
3. In the regions where RCM is produced wine-growers do not meet with distribution problems. In the Northern regions, however, difficulties in obtaining RCM within the desired period, have occurred. Such problems do not arise in the distribution of sucrose.

4. Difficulties in pumping RCM have been observed in cellars which were not accustomed to handling concentrated must. Such difficulties do not exist where concentrated musts are normally used, because RCM can be handled with the same pumps as concentrated must.
5. Crystallization of glucose occurs sometimes in RCM of 67° Brix, but not in RCM of 61° Brix.
6. Utilization of RCM in the cellar practice does not require more expensive equipment than the utilization of sucrose. Some cellars prefer RCM because no specialized silos for the dry storage of sucrose are needed. Others prefer sucrose to RCM
7. Enrichment by RCM increases the volumes of the wine, more than the utilization of sucrose. It was calculated that:
 - 1 hl of wine 10% vol. alcohol enriched to 12% vol. by sucrose produced 1.8 litres more than the non-enriched wine or 2.44 according to the calculation accepted in the F.R.Germany.
 - 1 hl of the same wine enriched by RCM of 67° Brix (695.3 g sugar/kg) produced 3.6 litres more than the non-enriched wine or 4.8 l according to the calculation accepted in the F.R.Germany.
 - 1 hl of the same wine enriched by RCM of 61° Brix produced 4.4 litres more than the non-enriched wine or 5.8 l according to the calculation accepted in the F.R.Germany.
8. There is a difference in interpretation of the ways in which the enrichment is calculated. In some countries (France, Italy) the enrichment is calculated on the basis of the volume of the must, whereas in other countries (F.R.Germany) this is done on the basis of the volume of the must and the volume of the added sugar.
9. Among oenologists there is no agreement on the quantity of sugar which is required to produce 1% vol. alcohol. This confusion can be explained by:
 - The presence on the market of CM and RCM of different densities.
 - The different tables given in various parameters which were published to help the professionals and which were not expressed in the same units.
 - The transformation factor adopted in these tables to convert sugar into alcohol, 16.378 g (EC) to 20 g (F.R.Germany) of sugar by alcohol %.

These factors contribute to the fact that the calculation of enrichment by CM or RCM appears to be more difficult for the wine-grower. A comprehensive discussion of this point is given in the report.

10. The trials performed in various cellars proved that there may be a discrepancy between the calculated enrichment and the obtained enrichment. This holds for enrichment by both sucrose and (R)CM. Deviations of approx. 0.5% vol. have been observed. This is much higher than the tolerance approx. 0.1% vol. accepted by the administration. In some cases these differences can result in non-payment of aid.
11. Sucrose or RCM are fermented at the same rate and with the same yield. In both cases the quantity of unfermented sugar will remain low if the fermentation is properly controlled.
12. The composition of wines enriched by RCM is chemically identical to those enriched by sucrose.
13. In some cases the organoleptic tests have found small differences between the samples enriched by sucrose and the sample enriched by RCM. None of the samples was preferred to the other. There is no concrete evidence that RCM changes the organoleptic quality of the wine.
14. It has been stated that enrichment by RCM instead of sucrose could affect the wine during maturation. Since the results of this research do not cover a regular period of maturation this argument can be neither confirmed nor confuted.

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PART II

**ECONOMIC ASPECTS OF THE ENRICHMENT OF WINE
IN THE EUROPEAN COMMUNITY**

by

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1. MAIN CHARACTERISTICS OF THE EC WINE MARKET

1.0 Introduction

Since the establishment of a common wine market in the EC in 1970 the position of wine as an agricultural commodity has slowly gained momentum within the Community. In 1974 the production value of table wine was approximately 3.8% (EC - 9) of the total EC agricultural production value. Currently this percentage is 5.4% (1988). The entry into the EC of the southern wine producing countries Greece, Spain and Portugal has certainly contributed to this increase. On the one hand the production of wine increased until 1985 and has currently stabilized, while on the other hand the consumption is still decreasing (Section 1.1). The objectives and instruments of the common wine policy and its financial consequences in respect of the wine surplus are illuminated in Section 1.2.

1.1 Trends in wine production and consumption

In the early seventies supply and demand for wine were balanced. This situation changed rapidly after the big harvest boom by the end of the seventies (see Figure 1).

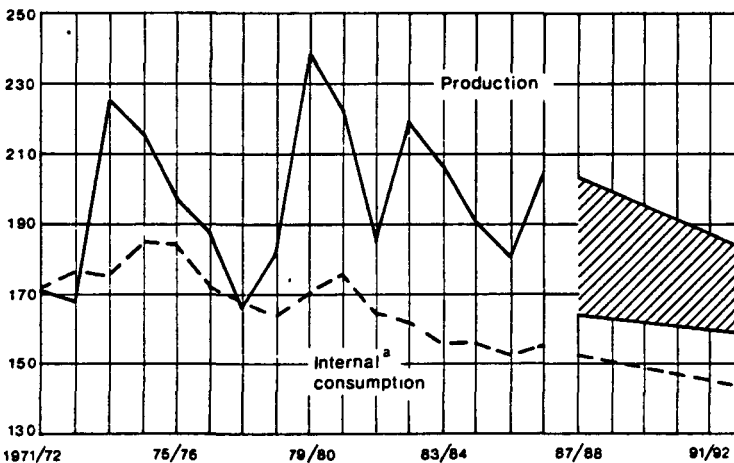


Figure 1: Production and consumption of wines (1,000 hl) in the EC - 12, in the period 1971/72 - 1992/93

^a Internal consumption excluding the quantities distilled with subsidies. The shaded part from 1987 to 1992 indicates the volume of surplus wine accumulated in this period = 200 million hl.

Source: European Community, 1987.

In the past decade the chronic character of the imbalance of supply and demand became apparent. From Table 1 it can be seen that since 1970 on the one hand the production of table wine has decreased, while on the other hand the volume of production of Vins de Qualité Produits dans des Régions Déterminées (VQPRD) and other wines has increased. The system of the classification of wines in the EC and the Member States is shown in Appendix 1.

The growth in production is not the result of an increase in the total wine-growing acreage, although in the period 1970-1976 the acreage of vineyards grew from 2,257,000 ha to 2,411,000 ha. From then onwards the total acreage decreased, so that by 1986/87 it was 2,184,000 ha (Table 2). In Appendix 2 some developments in total acreage of vineyards in a few wine-growing regions can be found. Since the fifties the average wine production per hectare has grown substantially. The use of new and improved cultivation techniques, preventive agents and methods of soil treatment as well as new varieties of vines have greatly influenced the growth in yield over the years (Table 3).

Table 2: Developments in acreage of vineyards in Member States, since 1970/71 (1,000 ha)

Member States	1970/71	1973/74	1976/77	1979/80	1982/83	1985/88
F.R.Germany	71	81	86	88	89	93
France	1,198	1,196	1,205	1,131	1,064	997
Greece	-	-	-	101	91	86
Italy	987	1,091	1,119	1,122	1,095	985
Luxembourg	1	1	1	1	1	1
Portugal	-	-	-	-	-	(320)
Spain	-	-	-	-	-	(1,432)
EC - 10	2,257	2,369	2,411	2,443	2,340	2,162

Source: Commission, 1988a.

On the demand side of the market, the consumption of wine has clearly decreased over the last few decades (Table 4). The consumption of table wine decreased especially in favour of quality wines and other drinks: in 1980/81, 34 litres of table wine and 10 litres of quality wine were consumed per head of the population in the EC, while the consumption per capita in 1987/88 amounted to 26 and 13 litres, respectively.

Table 1: Wine production in the European Community, in the period 1971/75 - 1981/89 (1,000 hl)

Member States	1971/75			1976/80			1981/89					
	table	vqprd	other	total	table	vqprd	other	total	table	vqprd	other	total
F.R.Germany	622	7,600	-	8,222	354	7,961	-	8,315	745	9,580	-	10,325
France	45,892	13,642	9,762	69,296	42,844	15,492	9,363	67,699	38,404	19,430	9,091	66,925
Greece	3,807	536	772	5,155	4,857	283	226	5,366	4,397	331	94	4,822
Italy	63,586	5,881	94	69,561	64,844	8,435	745	74,024	60,224	8,207	2,771	71,202
Luxembourg	78	67	-	145	38	55	-	93	35	119	-	154
Portugal	-	-	-	-	-	-	-	-	5,956	2,360	-	8,316
Spain	-	-	-	-	-	-	-	-	18,381	8,445	3,976	30,802
United Kingdom	7	-	-	7	6	-	-	6	10	-	-	10
EC - 6	110,185	27,190	9,856	147,231	108,086	31,943	10,108	150,137	99,418	37,336	11,862	148,616
EC - 10	113,992	27,726	10,628	152,345	112,943	32,226	10,334	155,503	103,815	37,667	11,956	153,438
EC - 12					128,152	48,472	15,932	192,556				

Sources: Commission, 1988a; Information of the Commission (DG VI/E/3).

Table 3: Developments in yields of vineyards in Member States, since 1951/52 (hl/ha)

Member States	1951/55	1961/65	1971/75	1976/80	1981/85	1986/88
F.R.Germany	49.7	76.5	102.4	103.6	115.4	110.3
France	40.1	48.2	58.1	59.2	65.2	72.2
Greece	-	-	38.9	44.2	47.8	47.6
Italy	31.4	39.0	64.1	66.4	67.3	75.2
Luxembourg	98.5	118.3	133.0	81.1	136.6	127.2
Portugal	-	-	-	-	-	31.3
Spain	-	-	-	-	-	27.7
EC - 10	35.7	43.9	62.4	64.0	67.5	53.7 ^a

^a EC-12.

Source: Commission, 1988a.

Table 4: Consumption of wine per capita in Member States, since 1951/52 (l/head/year)

Member States	1951/55	1961/65	1971/75	1976/80	1981/85	1986/88
Belgium	8	8	14	18	18	18
Denmark	-	-	10	13	18	20
F.R.Germany	8	14	22	25	25	26
France	135	121	105	97	83	77
Greece	-	-	46	44	34	31
Ireland	-	-	2	3	3	4
Italy	99	108	100	93	73	69
Luxembourg	26	30	43	44	58	56
Netherlands	1	3	9	12	14	14
Portugal	-	-	-	-	-	64
Spain	-	-	-	-	-	51
United Kingdom	-	-	5	7	9	10
EC - 6	68	69	50 ^a	48 ^a	42 ^b	42 ^b

^a EC - 10; ^b EC - 12.

Sources: Commission, 1988a; Information of the Commission DG VI/E/3.

The consumption of wine in countries where no wine is produced shows a slight increase, a development that may continue if, in a couple of years' time, a harmonization of Excise and Value Added Tax (VAT) on wine is achieved. At the moment, however, there is a great imbalance between the Member States of the EC with regard to the level of Excise and VAT – for instance, a litre of Greek red table wine costs 0.30 Ecu in Greece, while the Irish consumer has to pay 4.77 Ecu for the same wine, without taking the distribution costs into account (Commission, 1988a).

1.2 EC wine policy and related problems

The EC (Common) Wine Policy (CWP) was laid down in the Council Regulations 816/70 and 817/70 of 28 April 1970, together with subsequent amendments a collection of some hundreds of articles. These so-called basic regulations were reviewed twice, in 1979 (Reg. 337/79 and 338/79) and in 1987 (Reg. 822/87 and 823/87). The legislation covers two different products, table wines and quality wines. It regulates production, transformation and marketing and lays down the rules for trade and intervention.

The CWP seeks to stabilize markets and to ensure a fair standard of living for the agricultural community concerned (Preamble Reg. 822/87). Ideally, the CWP aims to achieve these goals by finding a balance between wine production and market outlets especially by promoting quality. It also provides for price support measures. This is achieved through market intervention, which either temporarily holds wines back from the market by means of storage contracts or removes them permanently by distillation. Price support is only available for table wines.

Originally in 1970 the instruments of the CWP were restricted to distillation and storage. In the second half of the seventies production outpaced consumption (Figure 1) and new instruments for the realization of the aims of the CWP were sought and introduced. The measures of 1976 aimed at a reduction in acreage. The planting of new vines was forbidden for two years, and premiums were given for uprooting table vines in favour of vines producing quality wines. In some cases wine-growing activities were abandoned altogether for a certain period in favour of other agricultural activities. In the short term these policies, however, did not result in a large reduction in the volume of production. In the early eighties the Council decided therefore in view of the still growing surpluses to introduce an old French intervention regulation: the obligatory distillation of wine. Under the basic regulation 822/87 the distillation measures can be of a compulsory and optional nature.

The compulsory distillation of:

- by-products of the vinification process (lees and marc) (art. 35);
- wine produced from grapes for dual purposes (table grapes and vine grapes) (art. 36);
- table wine (art. 39). If the total production of table wine has exceeded the EC consumption over 16 months, wine-growers are obliged to take part of the harvest to the distillery. If the surplus of table wine on the market is smaller than 10% of the average yearly consumption of table wine, the wine will fetch 50% of the guide price

on distillation. If the surplus is larger than this quantity, a lower buying-in price will be paid on distillation for the quantity exceeding it. In 1986/87 this still amounted to 40% of the guide price, but this will be further lowered in the coming years to 7.5% of the guide price in 1990/91.

The optional distillation of wine by means of:

- preventive distillation (art. 33). A maximum of 13% of the wine-growers' harvests can be distilled voluntarily at 65% of the guide price. The strengthening of the principle that the EC interventions must guarantee a price for table wines of at least 82% of the guide price. With the installation of compulsory distillation in 1984 this measure was transformed into support distillation, up to a maximum of 4 million hl.
- support distillation (art. 41). If the situation on the wine market requires so, it can be decided to take a maximum of 6.2 million hl of table wine off the market for a guaranteed minimum price of 82% of the guide price.
- garantie de bonne fin (art. 42). Wine-growers storing wine with EC support for nine months were guaranteed a good price by this measure. The buying-in price of distillation of these wines is 90% of the guide price for white wines and 91.5% for red wines. In 1990/91 this guaranteed measure will be cancelled.

Table 5 shows the total volume of table wine distilled under these EC regulations in the period 1970 - 1988 per Member State. In Table 6 the volume of table wine distilled is subdivided according to the different measures.

Yet another problem has arisen with the large scale distillation of wines into alcohol: the storage and the stocks of alcohol. To avoid distortions, wine alcohol cannot be sold on markets for alcohols from agricultural commodities such as beet sugar and corn (Preamble Reg. 822/87). So the alcohol has to be stored. The storage costs of alcohol of preventive distillation measures have to be paid by the Member States. In 1988 the total storage costs for the European Agricultural Guidance and Guarantee Fund (EAGGF) amounted to 352 million Ecu per annum (Table 7). The expenditures of the EAGGF, Section Guarantee, increased from 28 million Ecu in 1971 (1.8% of the total expenditures for agriculture of the Guarantee section) to 1,659 million Ecu in 1988 totalling 6.2 % of 26,844 million Ecu being the Guarantee expenditure on agriculture in 1988.

In July and September 1989, the Commission of the European Communities tried to sell the alcohol supplies by public tender. Currently the community stocks contain approximately 10.5 million hl of pure alcohol. The costs of the alcohol amount to about 88 - 90

Ecu/hl, but the selling price is estimated to be 10 Ecu/hl. The sale will thus imply great losses.

Table 5: Distillation of wine under EC regulations, since 1970/71 (million hl)

Campaign	F.R. Germany	France	Greece	Italy	Spain	Total
1970/71	-	.481	-	2.952	-	3.433
1971/72	.003	2.976	-	.536	-	3.515
1972/73	-	-	-	-	-	-
1973/74	.049	3.145	-	1.027	-	4.221
1974/75	.016	11.162	-	7.846	-	19.024
1975/76	.131	1.070	-	.967	-	2.168
1976/77	.062	4.655	-	.673	-	5.390
1977/78	.009	.404	-	.616	-	1.029
1978/79	.017	.020	-	1.632	-	1.669
1979/80	.009	9.395	-	8.827	-	18.231
1980/81	.036	8.660	.179	14.053	-	22.928
1981/82	.038	3.005	1.023	9.837	-	13.903
1982/83	.385	11.903	.380	10.245	-	22.913
1983/84	2.490	10.810	1.350	22.503	-	37.153
1984/85	.050	11.650	1.080	17.149	-	29.929
1985/86	.505	10.970	.585	12.228	-	24.288
1986/87	.465	7.770	.443	18.745	12.633	40.056
1987/88	.506	13.774	.352	21.024	16.462	52.118
1988/89 ^a	.390	7.680	.635	15.100	1.893	25.698

^a Provisional.

Sources: Commission, 1988a; Information of the Commission (DG VI/E/3).

Table 6: Distillation of wine under EC regulations, since 1970/71 (million hl)

Campaign	By-products	Double dist.	Obligatory dist.	Preventive dist.	Exceptional dist.	Garantie de bonne fin	Total
	art.35	art.36	art.38	art.39	art.41	art.42	
1970-76	-	-	-	-	32.360	-	32.360
1976/77	1.568	.138	.400	4.047	-	-	6.153
1977/78	.028	-	.132	.824	-	.553	1.537
1978/79	.020	-	1.288	.504	-	.361	2.173
1979/80	1.350	1.088	.477	2.144	6.836	6.836	18.731
1980/81	-	.951	1.462	.633	6.034	14.348	23.428
1981/82	-	-	.772	.414	6.138	6.934	14.258
1982/83	-	2.692	1.642	27.313	4.843	6.772	23.262
1983/84	-	3.387	1.665	22.851	-	9.386	37.296
1984/85	-	1.965	5.750	8.300	2.334	11.802	30.151
1985/86	2.402	2.976	1.619	15.959	1.869	9.460	24.285
1986/87	3.019	2.965	10.338	12.927	3.561	7.246	40.056
1987/88	7.412	4.189	14.406	14.676	3.630	7.805	52.118
1988/89 ^a	5.774	1.430	5.378	5.774	2.886	4.456	25.698

^a Provisional.

Sources: Commission, 1988a; Information of the Commission (DG VI/E/3).

Table 7: EAGGF expenditures in the wine sector, since 1971 (million Ecu)

Campaign	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988 ^a	
Export restitution	1	1	1	-	1	4	1	2	5	26	26	32	20	19	19	11	27	36	
Distillation	4	26	2	15	102	86	52	21	23	195	315	400	454	941	664	462	696	748	
Storage of wine	19	29	6	26	36	53	37	37	24	76	91	108	142	136	88	71	75	92	
Support for use of grape must ^b	-	-	-	-	-	-	-	-	9	2	28	31	42	127	148	83	115	99	
Storage of alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	9	352
Other intervention	4	1	3	1	-	8	-	4	0	1	0	0	0	1	1	1	4	253	
Total	28	57	12	42	139	151	90	64	61	300	460	571	658	1224	922	632	926	1580	

^a Provisional.

^b Support for (R)CM used in the production of British and Irish wines and grape juice included. These expenses are relatively small compared with the support for the use in wine-making in total.

Sources: Commission, 1988a; Information of the Commission (DG VI/E/3).

2. THE ENRICHMENT OF WINE IN THE EC

2.0 Introduction

Enrichment of wine was for the first time officially discussed in France at the end of the nineteenth century. At that time the French chemist Chaptal in his book 'L'Art de faire du vin' (1801) introduced the technology of enrichment of grape must. According to Chaptal, the aim of enrichment was:

- to obtain good wines in years of bad climatic conditions; to harvest grapes before they have reached the maximum sugar strength, and to pick the grapes at their maximum potential aromatic strength, thus improving the degustation of wine;
- improve the conservation of wines;
- to offer a special technique to those regions where the climatic conditions are less favourable for viticulture.

Since then the aims and practices of enrichment in the wine-growing regions of Europe have evolved in different directions. In Section 2.1, the history of the legislation on enrichment in the Member States before the establishment of the common wine market is illuminated. In Section 2.2 the evolution of the EC legislation on enrichment is described.

2.1 National regulations on enrichment

F.R.Germany

The first legislation regarding enrichment of wine in the F.R.Germany was enacted in 1909. Two wine quality categories were defined: the natural wines for which enrichment was forbidden and the other wines for which this practice was allowed. It was allowed to enrich by crystallized sugar or by sugar dissolved in water. All kinds of sugars could be used, such as beet, cane, invert sugar and starch sugar. The maximum alcoholic strength of wine after enrichment was for the first time defined in the German Wine Law of 1930. Nevertheless it was not until 1941 that legislation on the maximum range of enrichment was adopted in all wine producing regions. In 1969 some important points in the German Wine Act of 1930 regarding enrichment were reviewed. It was decided that

enrichment should take place before 1 April every year and that a maximum should be set to the increase of the natural alcoholic strength. As a result of this law a new system for the classification of wine was introduced based on minimum grape must specific weights (° Oechsle). Distinction is made between table wine, quality wine and quality wine with predicate, such as Kabinett, Spätlese, Auslese, Beerenauslese and Trockenbeerenauslese. Quality wine with predicate may not be enriched under any circumstances, neither by sucrose, concentrated grape must (CM) or rectified concentrated grape must (RCM), or by any other method of enrichment. Table wine and quality wine may be enriched, however. On 19 July 1971 the wine legislation of the F.R.Germany was adapted on several points to the EC market regulation of 28 April 1970, leaving the system of wine quality categories intact.

France

Under the French legislation of 4 August 1929, the use in wine-making of sugar is forbidden in some regions in the South-West of France, namely Agen, Bordeaux, Pau and Toulouse, and in the regions of Aix-en-Provence, Bastia, Nîmes and Montpellier in the South of France. However, this legislation allows the exception granted by Ministerial Decree on a yearly basis, for the use of sugar in the production of VQPRD. In the other regions, chaptalization (enrichment by sucrose) is allowed (although in these cases too, a ministerial decree has to be applied for every year) providing that certain stipulations are followed regarding the minimum alcoholic strength, its maximum increase and a maximum total alcoholic strength after enrichment.

When regulation 816/70 was revised to 337/79, some (minor) changes were made in the French legislation of 1929. Since 1979, for table wine produced in the Appellation regions, where chaptalization had been permitted since 1929, only enrichment by must has been allowed. Besides, the new legislation permits certain VQPRD wines produced in the regions Ardèche and Côtes du Rhône to be enriched by sucrose. Whether these changes in the French enrichment legislation are in accordance with the EC legislation is not certain.

Italy

Following the Royal Decree no. 2033 of 15 October 1925, the use in wine-making of sugar solutions (except solutions of grape sugar) was forbidden. Concentration or addition of concentrated must were the only permitted methods for increasing the

alcoholic strength. Chaptalization was not allowed in order to protect viticulture in Central and Northern Italy. In 1965 following the Presidential Decree no. 162/65, the enrichment of wine was further restricted by introducing a maximum enrichment level of 2% vol. In years of bad weather, the increase could be fixed at a maximum of 3%. Article 5 of this Decree allowed the use of sugar solutions in sparkling wines.

Luxembourg

Under the legislation of 24 July 1909 in respect of wine and wine beverages, the enrichment by means of beet sugar, raw sugar, invert sugar and grape sugar is allowed in Luxembourg. The enrichment is closely related to the grape varieties applied in Luxembourg. The enrichment may not exceed the maximum alcoholic strength of 10% vol. for Elbling, 10.9% vol for Rivaner, Sylvaner and Muscat Ottonel, 11.3% vol. for Auxerrois, Pinot Blanc, Chardonnay and Riesling, 11.5% vol. for Pinot Gris and Gewürztraminer and 12.0% vol. for Rosé and Red wine of Pinot Noir or Gamay.

Portugal

Following Decree 418/83 of 25 November 1983 only the enrichment of wine from the Vinhos Verdes region is allowed in Portugal. The means of enrichment for this type of wine are either (rectified) concentrated grape must or concentration by freezing. The minimum natural alcoholic strength of Vinhos Verdes must be 7% vol. and the enrichment may not exceed 2.5% vol.

The elaboration, circulation and application of rectified concentrated grape must in the Vinhos Verdes region was settled by Decree 156/84 of 20 March 1984. At present, at the request of other regions, the legislation of enrichment covering all Portuguese wine-growing regions, is under study. In the meantime this permission has been regulated for years of bad maturation of grapes.

Spain

The Spanish legislation regarding the enrichment of wine is laid down in law 25/70 of 2 December 1970 and by Decree 835/72 of 23 March 1972. Under this legislation the enrichment of wine by means of sucrose, concentrated grape must etc. is forbidden. However, the use of sugars, syrups and concentrated grape must in producing liqueur wines, aromatized wines, sparkling wines and wines produced by second fermentation is allowed in special cases.

The required minimum natural alcoholic strength of wines is set at 9% vol. except for the so-called 'Enverados and Chacolís wines'.

2.2 EC regulations on enrichment

Under art. 19 of the first regulation laying down the rules for the common organization of the market in wine, Reg. 816/70, the increase in natural alcoholic strength may only be effected:

- a) in respect of fresh grapes, grape must in fermentation or new wine still in fermentation, by adding sucrose or concentrated grape must;
- b) in respect of grape must, by adding sucrose or concentrated grape must or by partial concentration;
- c) in respect of wine suitable for yielding table wine, and table wine, by partial concentration through cooling.

Paragraph 3 of article 19 continues: "The addition of sucrose provided for in paragraph 1 (a) and (b) may only be made by dry and only in wine-growing regions in which it is traditionally or exceptionally practised in accordance with legislation existing at the date on which this regulation enters into force (28 April 1970)".

The preceding article, number 18 of this regulation is also of importance with respect to the enrichment of wine in the EC: "Where climatic conditions have made it necessary in certain wine-growing zones of the Community, the Member States concerned may permit the natural alcoholic strength, actual or potential, of fresh grapes, grape must in fermentation, new wine still in fermentation, obtained from the vine varieties covered by article 16, as well as wine suitable for yielding table wine and table wine, to be increased".

The legislation regarding enrichment also contains clauses which regulate the minimal natural alcoholic strength before enrichment, the maximum allowed increase of this level and the maximum total alcoholic strength after enrichment. The maximum volume increase brought about by enrichment has also been fixed. The above conditions regarding enrichment apply in different ways to the various wine-growing areas of the EC (Figure 2). The conditions on which these zones are based as well as the text of the legislation concerning the enrichment of wine according to Reg. 822/87 are given in Appendix 3.

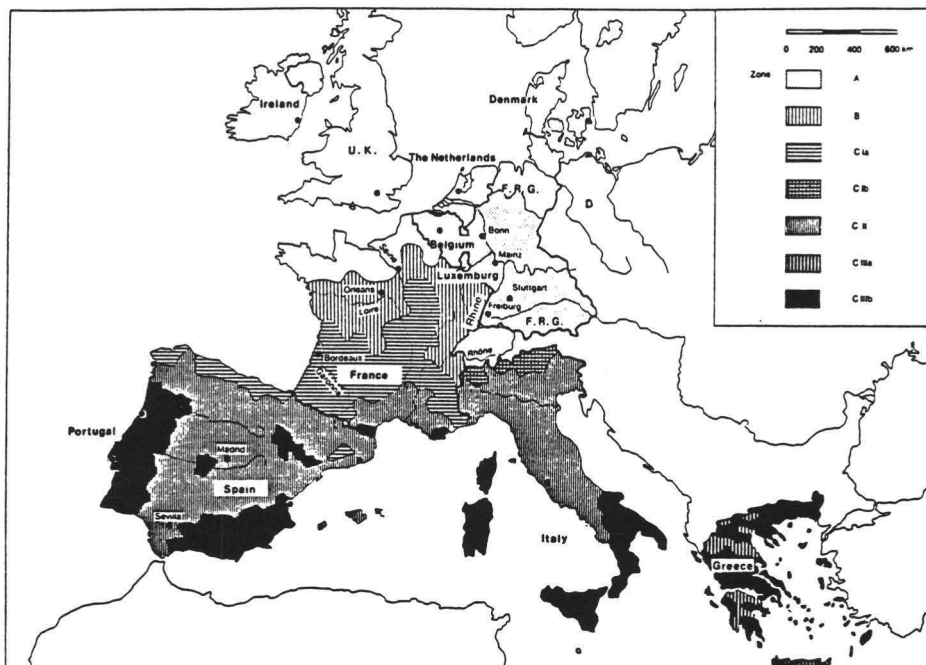


Figure 2: Classification of wine-growing zones in the EC
 Source: Wine Information Centre, 1987.

Article 38 of regulation 816/70 contains a provision for measures to be taken in exceptional situations resulting from natural disasters. The weather conditions in 1977 induced the Council for the first time on the basis of this article 38 to grant aid to the worst-hit producers for the use of concentrated must to increase the natural alcoholic strength of grape must (Reg. 2212/77).

Only producers with a yield lower than 50 hl/ha could apply for this aid. The action programme 1979-1985 for a gradual restoration of balance on the wine market contained some important proposals aiming at changing Reg. 816/70 on the subject of enrichment of wine and the sales potentials for wine-growing producers (COM(78) 260 final). The Commission wrote: "The measures are seen as a first step to replace sucrose by rectified concentrated must for enrichment and for the production of sparkling wine and aromatic wine". These proposals by the Commission were partly adopted in a Council decision to change regulation 337/79 (Reg. 453/80): Article 14, paragraph 1 was amended to: "If it appears necessary on the basis of crop forecasts to enrich a considerable proportion of

production, aid may be granted for concentrated grape must and rectified concentrated grape must produced within the Community".

When the basic regulation 816/70 was reviewed for the first time in 1979 the changes regarding the enrichment were of a minor nature: only the number of the article was changed (art. 33 of Reg. 337/79). By Reg. 453/80, however, rectified concentrated grape must was added as a means of enrichment.

In 1979 the Council decided once more to grant aid to producers of wine grapes for table wine, whose harvest was less than 70 hl/ha (Reg. 130/79). Aid allowing the use of (R)CM was also available in the wine years 1980/81 (Reg. 2728/80) and 1981/82 (Reg. 3326/81), to producers whose yield was lower than 80 hl/ha.

2.3 Considerations and proposals of the Commission

In the autumn of 1981 the Commission presented new proposals concerning the enrichment of wine in the Community (COM(81) 408 final). It considered that "the increase in the natural alcoholic strength by volume is not carried out in the same economic conditions by all Community producers on account of the different oenological practices allowed according to article 33 of Reg. 337/79". In order to eliminate such discrimination and to achieve the progressive abolition of the use of sucrose for enrichment, the prices of the various products used for enrichment should be aligned with the price of concentrated grape must, according to the Commission. For rectified concentrated grape must this could be achieved by granting aid and, in respect of sucrose, by imposing a levy.

The Economic and Social Committee (ESC) refused to agree to a levy on sucrose¹. The European Parliament (EP) was also of the opinion that a levy on the use in wine-making of sucrose should not be allowed².

¹ Advice on Commission proposal COM(81) 408 final (190th meeting on 23-24 September 1981).

² EP Resolution on Commission proposal COM(81) 408 final (plenary session on 9 April 1981).

In 1982 the Council decided to grant aid for the use in wine-making of concentrated grape must and rectified concentrated grape must (Reg. 2144/82). With the introduction of this regulation, article 14 of regulation 337/79 was altered and the aid was now institutionalized. This meant that it was no longer dependent on climatic conditions and could be granted every year. The proposed less-than-80 hl/ha-yield condition was also abandoned.

Without far-reaching changes in the years 1982 to 1984 this aid was granted for the use in wine-making of concentrated grape must, whether or not rectified (Reg. 2530/82, 2406/83, 2393/84).

In 1983 the Commission again placed the enrichment question on the order-paper of the Council (COM(83) 639 final). The proposal was to restrict the granting of aid for (R)CM in wine-making to those producers who could prove that their yield was not higher than a certain maximum. The Commission was of the opinion that the system of granting unlimited aid "is not a tenable one in the medium term either from the point of view of the sector's economy or in view of the financial consequences. In terms of the sector's economy, the combined effect of these provisions threatens in the short term to cause further market distortions and, in the medium term, to lead to higher yields and wine with a lower natural strength, which because of the aid, can be raised to the required alcoholic strength for consumption on favourable terms (explanatory memorandum)". Besides, according to the Commission, "in budget terms the Community may have to face a major rise in expenditure in respect of concentrated grape must and rectified concentrated grape must used for enriching vintages, probably coupled with an increase in wine surpluses, which still have to be absorbed via distillation measures. A similar situation, on an even larger scale, applies in the context of enlargement, with similar consequences as regards wine surpluses". Table 7 (Section 1.2) and Table 8 show that the payments of aids for the use in wine-making of (R)CM increased rapidly in the period 1979 - 1985.

In July 1984 the Commission presented its report on the situation and prospects of the wine sector (COM(84) 440 final). With regard to the enrichment of wine it is stated that "the only possible objection to a ban on the use of sucrose is one of a socio-economic nature. Although the loss of an acquired right is rarely welcome, the improved market balance that will result from the removal of large quantities of must (4 to 5 million hl) to be used for enrichment will clearly justify these producers losing the advantage they have enjoyed so far. Apart from compulsory measures this is the only way in which a genuine brake can be put on the rush to excessive yields. The Commission can therefore

Table 8: Volume of subsidized (R)CM for purposes of enrichment (1,000 hl) in Member States, in the period 1977 -1989

Campaign	Volume of CM		Volume of RCM		Italy	Total	Aid for the use of (R)CM for enrichment (Ecu/% vol/hl)
	France	Greece	France	Greece			
1977/78						152	. 0.87 Ecu
1978/79						197	. 1.16 for CM from Italian zone CIII and Corsica
1980/81			799				. 1.04 from other zones
1981/82			751				. 1.45 for CM from zone CIII
							. 1.25 for CM from other zones
							. 1.52 for CM from zone CIIIA/b
							. 1.32 for CM from other zones
1982/83			1,288				. 1.52/1.32 for CM (see 1981/82)
							. 1.69 for RCM from zone CIII and from facilities that began production prior to 30 June 1982
1983/84	464	15	1,001	6	65	68	. 1.49 for RCM other than above
1984/85	709	18	1,075	15 Ibid.
1985/86	452	16	565	33	61	94	. Ibid.
1986/87	496	19	797	71	147	218	. Ibid.
1987/88	524	40	611	102	288	390	. Ibid.
1988/89*	190	43	..	103 Ibid.

* Not all statistics available yet.

Source: Il Corriere Vinicole, 1987; Information of the Commission DG VI/E/3.

only repeat its previous proposal (COM(83) 639 final), but with the following concession: "from 1985/86 the aid for must would be progressively reduced and a levy would be charged in regions where chaptalization is allowed on all wine marketed by those producing more than 80 hl/ha".

In a following proposal the Commission (COM(84) 515 final) stressed the effects of the Council's decision to subsidize (R)CM: "A situation had thus been arrived at in which all producers found it more advantageous to enrich their wines (the price of each additional degree of alcohol obtained by adding sucrose or 'subsidized' musts is now appreciably lower than that per degree of alcohol on the market or even from the cheapest distillation)". Until the moment of banning chaptalization and abolishing the aid arrangements, in the regions where the use of sucrose is authorized, the proposal of the Commission will provide for "introducing a tax on all the wine marketed by producers who achieve yields on their holdings in excess of 80 hl/ha; the proceeds of the tax will be used to finance intervention expenditure in the wine sector. Lastly, in order to avoid helping producers who have obtained the highest yields but the lowest natural alcoholic strengths, this proposal specifies the maximum quantity of sucrose which may be used per hectare under cultivation". In order to avoid major administrative complications, the tax should apply solely to wine from holdings which, since they produce very high yields per hectare, normally enrich a large proportion of their produce under the preamble of COM(84) 515 final. This proposal by the Commission was soon followed by three other amendments from the EP and ESC. In the third amendment (COM(84) 775 final), however, the proposed levy on wines enriched with sucrose was withdrawn.

2.4 Decisions of the Dublin Summit

In the decrees of the European Summit in Dublin on 3 - 4 December 1984 the Council asked the Commission to undertake a study on the possibilities of the use of concentrated grape must and sugar and to report on this in 1990 (Council decisions, 1984). For the exact wording of the specifications for the study we refer to the Preface of this report. The European Parliament did not share the opinion of the Council and the Commission with regard to this study³. It considered it superfluous to embark on a study

³ EP Resolution on Commission proposal COM(84) 775 final (plenary session on 14 February 1985).

on increasing alcoholic strength of wine, given the wealth of detailed information already processed by the Commission. The European Parliament brought the tax proposed earlier on wines enriched with sucrose again up for discussion by its reaction to the third proposal of the Commission to amend regulation 337/79 (COM(84) 775 final): "In wine-growing regions where the addition of sucrose is authorized in accordance with Article 33, a tax shall be levied in respect of wines produced on holdings where the yield per hectare exceeds 65 hectoliters. The tax shall be levied when the wine is sold for the first time, including when it is delivered for the purpose of distillation". Moreover, the EP was of the opinion that "the Community will not be able to introduce the tax on sucrose as the definitive replacement for the aid for concentrated musts until it has effective instruments for monitoring the movement and the use of sugar in the Community".

The decree of the Dublin Summit in 1984 to introduce compulsory distillation of table wine also influenced the granting of support for the use in wine-making of concentrated grape must and rectified concentrated grape must. Only those producers who have fulfilled their obligation with regard to distillation, will be eligible for the proposed aid (Reg. 2273/85). The above condition has been maintained in the consecutive regulations on the granting of support (Reg. 2556/86, 2287/87 and 2240/88, respectively).

Even before the Dublin Summit, the Council had decided on reducing the buying-in price of enriched wines destined for distillation (Reg. 1208/84). This measure intended to eliminate the economic advantages for table wine producers who increased the alcohol content of their wines by subsidized (R)CM and subsequently handed the wines in for distillation. The reduction was applied (in a fixed manner) by deciding on a buying-in price for all producers, based on the average natural alcohol content normally obtained in all wine-growing areas. This was done since there was no officially recognized method of analyzing whether or not enrichment of wine had taken place. Besides, it would be very difficult to link the extent of enrichment applied by every individual producer to the wine handed in for distillation. The natural alcohol content may vary considerably from season to season in all regions and therefore, the average natural alcohol content has to be determined for every selling season (Reg. 2395/84).

In 1987/88 it was decided to differentiate the reduction of the buying-in price of wine not only on the basis of the wine-growing region, (as done in previous regulations) but also on the basis of the different distillation regulations (Reg. 2351/87). According to the Commission in previous harvest years the regulation had not yielded the expected results. In 1988/89 again the regulations regarding the reduction of the buying-in price for

distillation were amended (Reg. 2728/88). The reduction was set at one amount of money for all distillations and differentiated as to wine-growing zones A, B and C.

3. ECONOMIC ASPECTS OF ENRICHMENT OF WINE

3.0 Introduction

In Chapter 2 it was shown that the enrichment of wine by sucrose, CM or RCM is common practice in many wine-growing regions of the Community. Under the circumstances and given the regulations in force, enrichment of wine is clearly an attractive and possibly even an indispensable activity for many wine producers.

In this chapter, data on the economics of the enrichment process as seen from the viewpoint of the wine producers and derived from the studies of the three contributing research institutes, have been compiled. Within the framework of the study mandate it is important to pin-point the determining factors in the wine-grower's decision whether or not to proceed with enrichment by adding sucrose, CM or RCM. It is an economic decision that is made by weighing up the cost and benefits of enrichment as experienced by the wine producer. Therefore, it is in fact a micro-economic analysis of the profitability of enrichment versus wine production without enrichment⁴. This analysis can explain the extent and development of enrichment activities in the various wine regions of the Community. Chapter 4 deals with the short-term and long-term effects that the enrichment activities of the wine producers have on the economics of the wine sector as a whole and on the policy pursued for this sector.

In Section 3.1 the bases for the cost-benefit analysis are given. Sections 3.2 - 3.4 present the data on costs and benefits of enrichment derived from the studies in the F.R.Germany, France and Italy. Attention is also given to the indirect effects of compulsory distillation on the profitability of enrichment. In certain (southern) wine-growing areas the wine-grower can evade the obligation to distil (to a greater or lesser extent) by concentrating a part of his own yield. In Section 3.5 the data of the three Member States are compared.

⁴ In this comparison the only difference between the with- and without cases is the enrichment practice. All other elements of the production process are supposed to be the same (*ceteris paribus*' condition). So, in this cost-benefit analysis no allowance is made for alternative viticultural practices to control the potential alcoholic strength of the must, for example by changing the time of harvesting the grapes.

3.1 Costs and benefits of enrichment

The cost factors of the enrichment process consist of, on the one hand, the means of enrichment, costs of labour and energy (variable costs) and on the other hand, the fixed costs of durable equipment (fixed costs). The benefits of enrichment are determined by the increase in volume as a result of adding the means of enrichment (the volume effect) and the possible increase in price as a result of the higher alcoholic strength (the price effect). In formula:

$$P = B - C \quad (1)$$

in which: P = net benefits of enrichment per hl,
 B = benefits of enrichment per hl,
 C = costs of enrichment per hl.

$$B = (p_2 * dV) + (V_1 * (p_2 - p_1)) \quad (2)$$

in which: p_1 = wine market price before enrichment per hl,
 p_2 = wine market price after enrichment per hl,
 dV = increase in volume due to enrichment, in hl,
 V_1 = volume of grape must before enrichment, in hl.

$$C = C_f + C_v + C_{\text{sucrose},(R)CM} \quad (3)$$

in which: C_f = fixed costs (depreciation and interest) per hl,
 C_v = variable costs (labour and energy) per hl,
 $C_{\text{sucrose},(R)CM}$ = costs of means of enrichment per hl.

To facilitate a comparison of the costs and benefits of enrichment in the Member States concerned, the calculations are given in Ecus. The rates of exchange are the green rates of exchange in September 1987: 1 Ecu = 2.385 DM ; 7.437 FF and 1,603 LI.

3.2 Profitability of enrichment in the Fed. Republic of Germany

Hoffmann and Engel (1989) investigated the costs of enrichment both in two wineries at wine-estate level, and in a large cooperative. They based their calculations on an

increase in alcoholic strength of 3.5% vol. and relate, therefore, the costs and benefits to this level of enrichment. They emphasized that wines with a natural sugar content of more than 9 - 10% vol. (70 - 78° Oechsle) are not enriched in the F.R.Germany. Therefore, they assumed that German table wines and quality wines of a lower natural alcohol content than the above-mentioned are enriched at the maximum allowed level of 3.5% vol. Hoffmann and Engel investigated the profitability of the enrichment of wine on the basis of average market prices for bulk wine in various wine-growing areas and purchasing costs of the means of enrichment.

The technology of the enrichment process in the F.R.Germany is no different from the production programmes of white and red wine presented by Dupuy in Part I, Section 3, with the exception of the large wine cooperatives. These large-scale firms often have to invest in special equipment (Figure 3).

At wine estate level it is very difficult to isolate the costs of depreciation of equipment at the different stages of the vinification process, because the equipment is not only used for enrichment but also for other processes. In Table 9 the calculated costs of enrichment by sucrose (the current practice of enrichment in the F.R. Germany) are given. These costs are mainly determined by the means of enrichment. Moreover, the costs of labour, energy and equipment are considerably lower for the cooperative than for the two wineries due to the difference in scale.

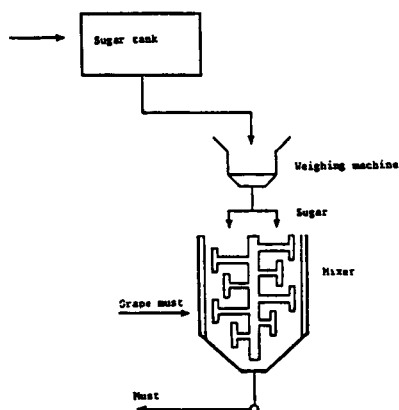


Figure 3: Technology of enrichment in large cooperatives in the F.R.Germany
Source: Hoffmann and Engel, 1989.

In Table 9 the costs of enrichment by RCM have also been estimated to find out what effect a ban on sucrose would have on the economics of the enrichment of wine in the F.R.Germany (see Chapter 5). On the basis of the study on the technical aspects of enrichment (Part I), it has been assumed that replacing sucrose by RCM will not necessitate new investments. The costs of labour, energy and equipment are, therefore, not dependent on the means of enrichment used. In Table 10 the level of these processing costs is taken from the costs for the cooperative given in Table 9.

Table 9: Costs of enrichment at wine-estate and cooperative level in the F.R.Germany (Ecu/3.5 % vol./hl)

Costs	Wine-estate		Cooperative
	3 ha (300 hl/yr.)	10 ha (800 hl/yr.)	(350,000 hl/yr.)
Fixed costs (equipment)	-	-	0.03
Variable costs:			
. Labour	1.36	0.94	0.02
. Energy	0.05	0.03	0.00
. Sucrose ^a	4.99	4.99	4.99
Total (3.5% vol.)	6.40	5.96	5.04
(1% vol.)	1.83	1.70	1.44

^a Market price of sucrose: 0.71 Ecu/kg; in the F.R.Germany 2.0 kg is required for a 1% increase in alcoholic strength.

As to the benefits, in Table 10 only those benefits resulting from the increase in volume are given. As those benefits are heavily dependent on the market prices of the wine concerned, the volume effect has been calculated for a few price ranges of bulk wine. In Table 11 a survey is given of the prices for musts destined for the production of bulk wines in various areas.

Benefits as a result of a possible price effect have not been included, as in the F.R. Germany there is no such effect. Given the natural circumstances under which viticulture is practised in the F.R.Germany and the legal regulations concerning the minimum natural alcohol content of the grapes, it is very difficult to estimate the price effect of enrichment (i.e. the difference between the market price before and after enrichment). About 64 % of the annual German wine production has to be enriched, because it does not contain the required minimum potential alcoholic strength (Table 12). Without enrichment these table wines and so-called Q.b.A. wines have, in theory, no market value at all. Therefore, one may consider the enrichment of wine with a natural alcoholic strength of less than 9% vol. as a *conditio sine qua non*.

In actual practice table wines and Q.b.A. wines with an alcohol level of 9% vol. hl or less are unsaleable. The enrichment of quality wines up to 9% vol., before selling them as 'low alcohol wines' has so far proved unacceptable. This is closely related to the fact that, in general, enriched wines have less bouquet, a lower mineral content and a relatively unbalanced acid composition. From a marketing point of view, quality wine

should have an alcoholic strength of at least 10.5% vol. So the enrichment of wine to an alcohol degree higher than 9% vol. is considered necessary in view of the market requirements.

Table 10: Net costs of enrichment of wine by means of sucrose and subsidized or non-subsidized RCM (3.5% vol.) in the F.R.Germany (Ecu/hl)

	Sucrose	RCM	
		non-subs.	subs.
Benefits			
Volume effect ^a at a wine market price of:			
. 50 Ecu/hl	2.10	4.29	4.29
. 84 Ecu/hl	3.53	7.21	7.21
. 117 Ecu/hl	4.91	10.04	10.04
Costs			
Labour	0.05	0.05	0.05
Means of enrichment	4.99	19.51	19.51
Subsidy ^b	-	-	7.08
Total costs (3.5% vol.)	5.04	19.56	12.48
(1% vol.)	1.44	5.59	3.57
Net costs at a wine market price of:			
. 50 Ecu/hl	-2.82	-13.93	-7.47
. 84 Ecu/hl	-1.45	-11.27	-4.81
. 117 Ecu/hl	-0.12	-8.69	-2.23

^a Calculation of the required quantity of the means of enrichment according to the formula in Part I, Section 5 (See also Appendix 4). The market price of RCM of 61.7° Brix (48.8% vol.) is estimated by Hoffmann and Engel at 1.74 Ecu/kg (4.66 Ecu/% vol./hl).

^b Subsidy for RCM (1.69 Ecu/% vol./hl) from Zone CIII.

It is evident from Table 10 that, in all cases, the costs of enrichment are not covered by the benefits resulting from the volume effect. This also applies to the use of the relatively cheap means of enrichment, sucrose. The fact that in the F.R.Germany enrichment takes place on a large scale gives an indication of the extent to which other factors enforce an increase in the alcohol content. As mentioned above, those factors include in particular the legal requirements and the quality demands of the market. Furthermore, Table 10 shows that the use of RCM, even if this means of enrichment is subsidized, will make enrichment considerably more expensive in the F.R.Germany.

Table 11: Market prices of bulk wines (without VAT) in some wine-growing regions in the F.R.Germany, on every 15 March in the period 1983 - 1988 (Ecu/hl)

Year	Q. b. A. wines		Kabinett wines (Q. b. A. m. P.)		Spätlese wines (Q. b. A. m. P.)				
	Rheinhessen ^a	Rheingaub ^b	Mosel ^c	Rheinhessen	Rheingau	Mosel	Rheinhessen	Rheingau	Mosel
1983	42	78	65	42	-	69	105	-	136
1984	42	67	65	42	78	80	73	132	105
1985	84	97	71	92	-	84	126	-	138
1986	84	105	67	92	-	84	109	-	117
1987	38	105	52	42	126	59	73	168	-
1988	43	103	55	48	-	-	103	-	-

^a Bereich Nierstein; ^b Riesling wines; ^c Bereich Bernkastel, Riesling wines.

Table 12: Production of table wines, Q. b. A. and Q. b. A. m. P. wines in the F.R.Germany, in the period 1975 - 1988 (1,000 hl)

Wine-growing region	Table wines			Q. b. A. wines			Q. b. A. m. P. wines		
	1975/79	1980/84	1985/88	1975/79	1980/84	1985/88	1975/79	1980/84	1985/88
Ahr	2	2	1	17	21	18	19	9	7
Mittelrhein	4	4	0	27	39	34	31	19	21
Mosel-Saar-Ruwer	71	142	25	547	778	889	601	457	357
Nahe	15	23	3	197	126	141	139	250	205
Rheinhessen	27	47	7	923	1,150	1,042	996	877	886
Rheinpfalz	83	198	73	1,355	1,662	1,431	961	671	678
Baden	69	70	41	724	780	741	599	378	362
Württemberg	28	60	14	582	721	545	266	220	306
Franken	15	15	1	180	256	220	97	119	134
Rheingau	5	8	1	115	132	104	104	73	99
Hess. Bergstraße	2	1	0	16	18	11	12	9	13
F.R.Germany	321	570	166	4,683	5,983	5,176	3,735	3,082	3,071

Source: Hoffmann and Engel, 1989.

3.3 Profitability of enrichment in France

Dubos and Montaigne investigated the costs and benefits of enrichment on the basis of a sample investigation at cooperatives and private wine-growing farms in five regions. For this purpose France was divided into the viticultural areas Alsace, Pays de Loire, Bourgogne-Beaujolais, Sud-Ouest (Aquitaine and Midi-Pyrénées) and the Midi (Languedoc-Roussillon and Sud-Est). In these regions different rules hold for the natural alcoholic strength of grape must, the extent of enrichment and the means of enrichment. These differences influence the costs of enrichment per degree of alcoholic strength. In Table 13 some of the results of Dubos and Montaignes' research are presented. It is obvious that the costs of enrichment differ from farm to farm and from region to region.

In calculating the costs of enrichment in France (Table 14), it is assumed that there are no essential differences in the enrichment technology of sucrose and (R)CM. In the Alsace, Bourgogne, Pays de la Loire and Sud-Ouest, the mixing equipment normally used for enrichment by sucrose is also used for enrichment by (R)CM. In the Midi the depreciation costs are higher because of the higher purchasing costs of equipment for enrichment (a storage tank, pipe lines and a pump). The labour costs and other variable costs and the costs of depreciation have been deduced from calculations by Dubos and Montaigne (1989).

According to equation 3 (Section 3.1) the benefits of enrichment are determined by the volume and price effect. Especially in France for table wines the price effect is the combination of alcohol content and the market price per degree of alcohol content:

Alcohol content (% vol.)	Market price (Ecu/% vol./hl)
< 10.0	2.26
10.0 - 10.9	2.37
11.0 - 12.0	2.44
> 12.0	2.48

Source: Office National Interprofessionnel des Vins (ONIVINS, 1988a).

Table 13: Costs of enrichment of wine by sucrose and RCM at wine-growing farms in the viticultural regions featured in the French research programme (Ecu/ℓ vol./hl)

Wine-growing region and zone	Alsace (B)	Pays de Loire (B)	Beaujolais (CI)	Bourgogne/Maconais (CI)	Sud-Ouest (CI)	Midi (CII/III)
Sample size (no.)	6	14	6	15	20	12
Enrichment by sucrose						
- costs of enrichment	1.21 - 1.98	1.38 - 2.07	1.32 - 1.74	1.12 - 1.74	1.24 - 1.80	-
- costs as a part of the selling price (%)	1.3 - 2.4	0.7 - 5.3	0.9 - 2.5	0.2 - 2.4	1.0 - 2.8	-
- net costs taking the benefits of the volume increase into account	-2.30 - 0.01	-0.40 - 1.15	-2.48 - 0.41	-10.44 - 0.26	0.08 - 1.49	-
Enrichment by RCM						
- costs of enrichment	3.58 - 4.15	3.39 - 7.56	3.74 - 3.97	3.70 - 3.91	3.41 - 3.93	4.03 - 4.1
- costs taking the aid for RCM into account	1.57 - 2.70	1.21 - 5.22	2.04 - 2.84	2.00 - 2.22	1.75 - 1.83	2.62 - 2.9
- net costs taking the aid for RCM and the benefits of the volume increase into account	-6.40 - -0.42	0.03 - 2.37	-6.22 - -0.43	-23.31 - -1.18	-0.70 - 2.78	-

Table 14: Costs of enriching wine by means of sucrose, CM and RCM to a supposed average level in French wine-growing regions (Ecu/hl)

Costs	Alsace, Pays de Loire (B) 9.0-11.5% vol.	Bourgogne/Maconais, Sud-Ouest (CI) 10.0-11.5% vol.	Midi (CII/III) 10.0-11.5% vol.			
	Sucrose	Sucrose	CM	RCM	CM	RCM
Means ^a	3.04	1.84	5.78	7.57	5.78	7.57
Special tax	0.46	0.27	-	-	-	-
Processing ^b	0.22	0.13	0.13	0.13	0.64	0.64
Depreciations ^c	0.07	0.04	0.03	0.04	0.25	0.25
Total	3.79	2.28	5.95	7.74	6.67	8.76
Subsidy ^d	-	-	-2.27	-2.76	-2.62	2.76
Total cost	3.79	2.28	3.68	4.98	4.05	6.00

^a Purchasing costs of sucrose: 0.71 Ecu/kg. 1.7 kg sucrose per hl is required for 1% vol. increase. Pot. alcoholic strength CM 44.18% vol., RCM 54.4% vol. Market prices of CM and RCM 2.49 and 3.63 Ecu/% vol./hl (ONIVINS, 1988b), with packaging materials included 2.98 and 4.12 Ecu resp.

^b Costs of labour and energy; in the Midi the costs are the mean of the costs of enrichment with a quantity of 50 hl and 100 hl RCM; in the other regions the energy costs are not included.

^c Depreciation costs in cooperatives in the Midi and in private cellars in the other regions (See depreciation costs in F.R.Germany, Table 9).

^d Subsidies on CM produced outside zone CIII and from zone CII/III 1.32 Ecu/% vol./hl (Bourgogne and other regions) and 1.52 Ecu/% vol./hl) resp., on RCM from CIII or produced in factories in operation before 30.6.1982 1.69 Ecu/% vol./hl (in all regions). The subsidies in this table include a loss of interest due to delay of payment of subsidy of 11% of the total costs per annum (payments of subsidies are made 12-15 months after the intervention office has received the request). So, subsidies on CM: 1.17 / 1.35 Ecu/% vol./hl, on RCM 1.50 Ecu/% vol./hl.

Using the above-mentioned market prices for table wine and the data given in Table 14, the profitability of enriching by CM and RCM has been estimated for a wine-growing farm in the Midi (Table 15). This region is chosen because it produced mainly table wine which for a large part is enriched by subsidized (R)CM. In 1987/88 90% of the total production in the Midi-region was made up of table wine - approx. 27 million hl - and at least 35% of it was enriched by (R)CM⁵.

⁵ Statistics on the subsidized use in wine-making of (R)CM in France and in the Languedoc-Roussillon in the period 1980 - 88, submitted by ONIVINS in 1989 on request of the final editors of this report.

Table 15: Profitability of enrichment of table wine by CM and RCM, whether or not subsidized, in the Midi (Ecu/Z vol./hl)^a

	CM	RCM
Benefits (B)		
Volume effect	0.78	0.60
Price effect	3.14	3.14
Total	3.92	3.74
Costs (C)		
Purchase costs	3.85	5.05
Other variable and fixed costs	0.59	0.59
Total	4.44	5.64
Profitability (B - C)	-0.52	-1.90
Subsidy	1.75	1.84
Profitability with aid	1.23	-0.06

^a For information on the costs, the benefits and the aid reference is made to Table 14.

In Table 15 it is obvious that enrichment by CM in the Midi is profitable. In this model enrichment by RCM is slightly unprofitable both with and without aid.

The profitability of the enrichment of table wine by CM and RCM sold as table wine is rather small compared with the sales of enriched wine as country wine (Vin de Pays) or as quality wine. In the latter situation, the price effect of the benefits of enrichment is much greater (Table 16).

For the enrichment of wine in the viticultural region Sud-Ouest the same limits as in the Midi apply for increasing the alcoholic strength. In the Sud-Ouest, however, the use of sucrose is not forbidden for the production of VQPRD wines. The difference in profitability between enrichment by sucrose and (R)CM in the Sud-Ouest has been investigated (see Table 17). The calculations are based on the average market prices of table wines or country wines obtained by some wine-growing farms in this region; before enrichment: 2.77 Ecu/% vol./hl and after: 3.40 Ecu/% vol./hl.

Table 16: The price effect of the enrichment of (table) wine sold as table wine, country wine, or quality wine in the Midi (Ecu/hl)

	Wine market price (Ecu/Z vol./hl)		Price effect (Ecu/hl)
	non-enriched		
Quality wine enriched from 10.5 - 11.5% vol.	2.76	3.86	15.4
Table wine enriched from 10 - 11% vol. and sold as country wine	2.49	3.36	12.5
Table wine enriched from 10 - 11% vol.	2.49	2.62	4.0

Source: Dubos and Montaigne, 1989.

Table 17: Profitability of enrichment of wine from 10.0 - 11.0% vol. by sucrose, CM and RCM, whether or not subsidized, in the Sud-Ouest (Ecu/Z vol./hl)

	Sucrose ^a	CM	RCM
Benefits (B)			
Volume effect	0.35	1.09	0.84
Price effect	9.70	9.70	9.70
Total	10.05	10.79	10.54
Costs (C)			
Purchase costs	1.41	3.85	5.05
Other variable and fixed costs	0.11	0.11	0.11
Total	1.52	3.96	5.16
Profitability (B - C)	8.53	6.75	5.38
Subsidy	-	1.51	1.84
Profitability with aid	8.53	8.26	7.22

^a See Table 14 and 15; Volume increase if wine is enriched by sucrose: 0.93 l/Z vol./hl.

Enrichment by sucrose, CM and RCM is very profitable in the Sud-Ouest region: 7.2 - 8.5 Ecu/% vol./hl. The use of CM has become almost as profitable as that of sucrose because of the subsidy, but in spite of the higher subsidies the net benefits of enrichment by RCM are lagging behind those of enrichment by CM and sucrose.

If the net benefits of enrichment in the Midi are compared with those in the Sud-Ouest it is clear that the benefits in the former region are smaller than in the latter. This is mainly the result of a difference in market prices before and after the enrichment of wines (the price effect). Here also, the level of the market prices plays an important part. In the Midi mainly table wine is produced and its market prices are generally lower than in other areas researched. In those regions the production of quality wine plays a more dominant part.

Nothing definite can be said about the profitability of enrichment in the wine-growing areas of the Alsace, Bourgogne, Beaujolais and Pays de Loire, because no data of the market prices before and after enrichment are available. The price effect of the benefits of enrichment could therefore not be determined. In the French regions of zone B (Alsace and Pays de Loire), however, enrichment of wine is often a necessary condition for table wine production. In many cases the wine would not meet the minimum alcoholic strength for consumption (9% vol.) without enrichment. Calculating the profitability of enrichment in these areas is a difficult matter as, without enrichment, the wine has no direct market value.

In France the profitability of enrichment, whether or not aid has been granted, can not be determined only by the price and volume effect and the costs of enrichment. For the enrichment of table wine, compulsory distillation plays a very important part. From 1985 onwards, wine producers have been obliged to submit a percentage of their crops to distillation. The annual level of compulsory distillation is based on the ratio of levels of table wine production and consumption, but it is left to the individual Member States to implement this EC regulation (Table 18).

Table 18: Compulsory distillation of table wine (in output percentages) in relation to yield (hl/ha) in France, Italy and Spain in 1987/88

Yield	France	Italy	Spain
40	-	4.0	44.4
65	-	12.0	60.8
90	14.4	20.3	70.0
100	25.4	24.8	72.5
115	54.8	30.9	72.5
130	95.4	40.6	72.5
145	96.7	42.6	72.5

Source: Agri Service Intern., 1988.

In France the obligatory distillation quota per firm is strongly dependent on the yield per hectare. The percentage of the crop to be distilled increases progressively depending on the yield per hectare.

It is of interest that in France in calculating the yield per hectare on which the level of compulsory distillation is determined, only about 60% of the must used for concentration is included in the calculation⁶. Because of this wine-growers with a relatively high yield per hectare can decrease their obligatory quota for distillation in a profitable way by enriching their wines by home-produced (R)CM. Table 19 gives the results of calculations that clearly show how, as a result of these distillation regulations, the enrichment of table wine becomes profitable instead of unprofitable, or (where enriched wine is sold as Vin de Pays) very profitable instead of unprofitable (see Appendix 5 for the calculations).

Table 19: Gross-income of a wine-growing farm in the Midi (15 ha) selling not enriched table wine, or selling table or country wine, enriched by using purchased RCM (exogenous) and home-produced RCM (endogenous) (Ecu/ha)

	No enrichment	Enrichment by	
		Exogenous RCM	Endogenous RCM
Table wine	2,274	1,544	3,005
Country wine	-	1,838	3,558

Two conclusions can be derived from these data:

1. The French way of implementing the compulsory distillation provided a (further) stimulus for enriching table wine especially by home-produced (R)CM⁷.
2. This stimulus is counterproductive to the aim of the distillation regulation, i.e. to reduce high yields, and will hamper the achievement of a market balance.

⁶ In 1989, however, the French government abolished this possibility.

⁷ It is necessary to take into account the influence wine-growers have on their yields before and after enrichment. Farming methods such as short pruning, low-nitrate fertilizers, and pollarding can be used to limit an expected yield. However, the final yield depends also on the climatic conditions (rainfall, pathology, temperature). According to Dubos and Montaigne (1989) the current compulsory distillation scheme does not induce high yields, a priori, but one has to consider that the final yields are uncontrolled. With short pruning, using less nitrate fertilizer or pollarding one cannot sufficiently control final yields. Therefore the regulations concerning the compulsory distillation and the reduction of yield by producing (R)CM from one's own grape must ought to pay more attention to the annual variations in yields.

3.4 Profitability of enrichment in Italy

Ventura and Millucci held an inquiry into the use of (R)CM for purposes of enrichment, the costs and benefits of enrichment and the average market prices among 76 wine-growing farms from 10 different Italian wine-growing areas of which some characteristics are given in Table 20. The results of the inquiry are summarized in Table 21. The analyses of the survey do not cover the whole of Italy because the questionnaires sent to the southern regions have not been returned yet. The Italian viticultural areas all belong to the C-zones. With the exception of Trentino Alto Adige (CI), all regions belong to zone CII.

Table 20: Table wine and quality wine production (1,000 hl), the average alcohol content (% vol.) of wines and the extent of enrichment by subsidized (R)CM in some wine-growing regions in the Italian survey (1986/87)

	Northern region			Central region		
	Emilia Romagna	Trentino A'Adige	Piemonte	Umbria	Toscana	Lazio
Table wine production	7,801	711	2,996	851	2,689	4,751
Enriched part (%)	49	75	20	10	12	22
. by subs. CM (%)	45	53	13	6	10	19
. by subs. RCM (%)	4	22	7	4	2	3
Alcohol content						
. before enrichment	10.0	10.2	10.3	10.5	10.2	9.9
. after enrichment	11.7	12.0	12.0	11.0	11.6	11.6
Quality wine production	682	717	1,010	159	1,137	584
Enriched part (%)	25	75	14	30	14	46
. by subs. CM (%)	23	20	2	25	10	35
. by subs. RCM (%)	2	55	12	5	4	11
Alcohol content						
. before enrichment	10.2	10.5	11.3	11.1	11.4	9.2
. after enrichment	11.6	12.3	12.7	12.6	12.6	10.5

Source: Ventura and Millucci, 1989 (elaborated data from the Italian Ministry of Agriculture and the Intervention Office (AIMA)).

Ventura and Millucci calculated the profitability of enrichment by CM and RCM in the wine-growing farms (Table 21). In analyzing the technology of the enrichment process employed at the viticultural farms, it became evident that the equipment (pipes and pumps) was also used for other operations in the vinification process. The costs of

depreciation of this equipment were, therefore, not included in the costs of enrichment by CM, RCM and sucrose.

The data from the random survey of the costs and benefits of enrichment show that the average increase in the natural alcoholic strength, the costs of the means of enrichment as well as the prices of wine before and after enrichment differ in the regions. In Tuscany, for instance, mainly Chianti Classico is produced. At the 12 Tuscany farms covered in the inquiry (results of the 1986/87 campaign) approximately 80% of the total volume of production was enriched by about 1% vol. The enrichment was indispensable in order to reach the minimum alcoholic strength required by the different wine regulations. The market price of this wine is much higher than that of table wine which, on average, is lower in alcohol by one degree. Without enrichment the wine would have to be sold as table wine at a much lower price. Therefore the profitability of enrichment in Tuscany is very high.

In Umbria enrichment is only applied by producers of quality wine. The minimum alcoholic strength of the DOC (Denominazione di Origine Controllata) wine from this area is 12% vol. In fact, here enrichment has the same status as in Tuscany. In Emilia Romagna mainly table wine is enriched, the market prices of which are considerably lower than those of quality wine. According to Ventura and Millucci, wines from this area with an alcoholic strength of 9.5% vol. cannot easily be sold. In this case enrichment appears to be a condition for selling it. Although in the Lazio region the market prices of wine are somewhat higher, table wine is, nevertheless, enriched to quality wine. In Piemonte it is mainly table wine, the so-called Barbera wine, that is enriched by a high average alcoholic strength (1.8% vol.). According to Ventura and Millucci this is necessary in view of the relatively high quality of other wines produced in this area.

What in Section 3.3 has been said about the relationship between enrichment and distillation in France applies even more to Southern Italy. The total amount of grape must destined for concentration, is not included when the yield is determined. Because of this the percentage of the crop that has to be compulsorily distilled is often considerably lower than it should be. So especially in the South, where must prices are lower than 2.8 Ecu/% vol. hl, it is profitable to direct must for the production of (R)CM to the (northern) markets and, moreover, it stimulates increases in yield per hectare. The effectiveness of compulsory distillation as a means to restrict viticultural yields is seriously undermined in this way (Ventura and Millucci, 1989).

Table 21: Profitability of enrichment of wine in some Italian wine-growing regions (CII-zones) (Ecu/hl)

	Northern region			Central region			
	Emilia Romagna	Trentino A'Adige	Piemonte	Umbria	Lazio	Toscana	
Sample size (no.)	6	5	4	2	2	1	
Extent of enrichment (% vol.)	1.1 - 1.8	1.3 - 1.9	1.7 - 1.9	1.6	1.2 - 1.7	1.0	
Wine price (Ecu/hl)							
. without enrichment	31.9 - 34.1	34.3	28.1 - 31.5	30.3	26.8	30.6	
. with enrichment	37.4	34.7 - 49.9	35.6 - 39.9	43.7 - 46.8	32.3 - 36.1	62.4	
Costs of enrichment taking the aid for (R)CM into account (Ecu/% vol./hl)	0.19 - 0.52	0.76 - 1.73	0.60 - 1.10	0.37 - 0.54	0.45 - 0.77	0.21	
Profitability of enrichment (Ecu/hl)	3.31 - 5.55	0.41	5.90 - 11.9	15.6 - 25.9	5.86 - 9.26	31.8	

Source: Ventura and Millucci, 1989.

3.5 Comparison of the costs of enrichment of wine

As shown in the preceding sections, the costs of enrichment of wine differ in the various wine-growing regions where the research was performed. The extent and the applied means of enrichment are the determining cost factors of the enrichment process. In Table 22 the costs of enrichment in the different regions are compared.

Table 22: Costs of enrichment without aid in some wine-growing regions of the EC (Ecu/Z vol./hl)

Member State and wine-growing region	Range of enrichment (Z vol.)	Deduced costs ^a (Ecu/Zvol./hl)		
		Sucrose ^b	CM ^c	RCM ^d
F.R.Germany	8.0 - 11.5	1.44	-	5.59
France				
. Alsace, Pays de Loire	9.0 - 11.5	1.52	3.96	5.16
. Bourgogne/Maconais	10.0 - 11.5	1.52	3.96	5.16
. Beaujolais, Sud-Ouest				
. Midi	10.0 - 11.5	-	4.44	5.64
Italy	10.0 - 11.5	-	3.54	4.00

^a The costs are derived and deduced from Tables 10, 14 and 17.

^b In the F.R.Germany the processing costs of enrichment are estimated at 0.06 Ecu/Z vol./hl lower than in France. In France, however, a tax on the use of sucrose is levied (0.18 Ecu/Z vol./hl).

^c In the Midi the costs of durables (depreciation and processing) are somewhat higher than in the other regions. The potential alcoholic strength of CM applied in France is 44.2Z vol.. The CM price ex winery in Italy was 2.70 Ecu/Z vol./hl in 1987/88 (Ventura and Millucci), the volume of CM of 44.2Z vol. required to enrich wine from 10.0-11.0Z vol. is 3.11 l. According to Ventura and Millucci the processing and depreciation costs of enrichment are neglectable in Italy.

^d In Italy the price of RCM ex winery is on average 3.31 Ecu/Z vol./hl. The volume of this RCM (of 57.8Z vol.) required to enrich wine from 10.0-11.0Z vol. is 2.09 l.

From Table 22 it can be derived that the costs of enrichment by sucrose and (R)CM per alcohol degree in France and the F.R.Germany are approximately the same. There are small differences between the potential alcoholic strength of the applied RCM, and costs of transport and trade. In Italy the costs of enrichment are somewhat lower than in the other countries because the costs of the applied means of enrichment are lower and the processing costs are negligible.

4. PROFITABILITY OF ENRICHMENT AND THE SURPLUS PROBLEM

4.0 Introduction

As pointed out in Section 2.2 the phenomenon of enrichment has often been associated with the growing over-production of table wine within the Community. It is because of this that we will try and look systematically at to what extent and in what ways the enrichment of wine -- given the existing rules and practices -- is (has been) an influence on the extent and the development of wine production in the different areas within the EC.

4.1 Chaptalization and the supply of wine

In the first place, attention will be given to enrichment by sucrose (chaptalization). This practice is allowed in the F.R.Germany and in parts of France, and is being applied there on a large scale. As will be explained in Section 5.1, the yearly use of sucrose in Germany is estimated to vary from 12,000 to 50,000 tons with an average of 39,000 tons. The use of sucrose (declared and non-declared and non-authorized) in France between 1984 and 1987 was estimated as averaging 98,500 tons. An important proportion of this amount is indispensable in these areas, because the natural sugar strength in the must is often too low to meet the minimum alcoholic strength required by both regulations and market. Without the possibility of enrichment the wine production in these zones of the EC would have remained below the present level for many years. Wine enrichment, therefore, is a *conditio sine qua non* for the existing wine cultivation in these areas.

In other words, by adding sucrose larger quantities of wine can be raised to the minimum (commercial) standards of alcoholic strength. From this point of view it has often been assumed that there is a **direct** connection between the traditional practice of chaptalization in wine-growing zones A and B and the surplus problem on the common wine market. Such a connection, however, is not easily proven because from the market point of view wine is anything but a homogeneous product. Also the wine market regulations make a clear distinction between table wine and VQPRD wines with different market ordering rules. Only for table wines intervention regulations (optional and compulsory distillation) are in force. So, oversupply (in budgetary terms) manifests itself mainly in

the market of (non-enriched) table wines, whereas the supply of enriched quality wines on average is in balance with the demand, as Hoffmann and Engel (1989) indicate.

An indirect effect of chaptalization on the extent of the wine production has been suggested by the European Commission (and others) in calculating how much grape must would be needed to replace the amount of sucrose used for enrichment. This way of calculation lies behind the opinion that prohibiting the use of sucrose would probably result in a substantial reduction of the wine pool and, in this way, could help to solve the over-production problem. This point of view prompted the European Commission to commission this study on the economic implications of a possible ban on chaptalization. Section 5 concentrates on these implications.

4.2 Short-term and long-term effects

It should be pointed out here that the approach described above is of a strictly static nature. The given situation in wine cultivation and the given practice of enrichment form the starting point for the investigation. Only the effect of replacing the added amount of sucrose by grape sugar will be brought to light. The impact of the possibility for enrichment with sucrose on the development of wine cultivation in the areas under discussion over a period of time, remains hidden. Given the fact that there are possibilities to compensate for the deficiency in the natural sugar strength of must, it appears that from a point of view of both plant breeding and cultivation methods, more attention is paid to ways of increasing the hl per ha ratio than of acquiring a sufficient sugar strength. However, it is difficult to prove this tendency statistically, because in the course of time many more factors have influenced the developments. Besides, data on the natural sugar strength and on the extent of enrichment are only available in aggregated forms and are generally thought to be rather unreliable.

Although the hypothesis that, in the long run, enrichment will have an effect on the natural sugar strength and on the height of yields can not easily be verified, it is nevertheless widely supported. It can be found, for instance, in the papers on enrichment of the European Commission, the European Parliament and also of the Economic and Social Committee. Here we refer to Section 2.3. The fear has been expressed time and again, especially in considerations concerning the subsidized use of CM and RCM (in order to make these means of enrichment more competitive with cheap sugar), that yields might increase and the natural sugar strength decrease. There is wide concern, if

this happens, that the wine-growing potential will be artificially enlarged, which will again intensify the surplus problem.

4.3 Attractiveness of enrichment

This long-term effect on the volume of the wine production in the EC is, of course, not restricted to enrichment by means of sucrose. It will occur to the same extent when other methods of enrichment are used that lie within, or have come within the economic reach of wine producers. In Section 2 a description is given of the ways in which the production and use of CM and RCM were encouraged and supported in the eighties. From Section 3.2 it is clear that, for France and Italy, thanks to the support given, the enrichment by CM and RCM has become a profitable occupation for many wine producers. Assuming that these means of enrichment are produced within the EC, in the short run the effect of this enrichment will be for the total wine production to decrease in volume, but to go up accordingly in alcoholic strength and probably to fetch a higher market price per litre. It is impossible to predict, without making many calculations and suppositions, whether at EC wine sector level this higher market price will offer sufficient compensation for this decrease in volume plus the costs of concentration, rectifying and transport, etc. It is likely, on the other hand, that the supply on the (table) wine market will be smaller, which may be seen as a positive contribution to the market balance. Nevertheless, as previously stated, this approach is also static in that it does not take into consideration the long-term effects of the profitability of enrichment on the structural developments in European wine cultivation. A strong indication of this long-term effect can be seen in Central Italy, where the increased use of CM is accompanied by an expansion of the wine production as a result of growing yields per hectare (Ventura and Milluci, 1989).

These long-term effects on yield development, and therefore on the development of the total wine volume, do not square with the efforts to correct high yields per hectare under the wine market regulations. Compulsory distillation introduced in 1985, results in a strong decrease in the marginal value yield of wine above a certain yield per hectare (in France this was about 90 hl/ha in 1987/88). However, as indicated in Section 3.3, the effect of this measure is weakened, because the French and Italian wine producers manage to evade the compulsory distillation at very low cost by concentrating part of their own production. So, there is a curious anomaly in the EC and national regulations concerning wine !

4.4. Conclusion

From this section it may be concluded that as far as enrichment is concerned, chaptalization (enrichment with sucrose) is certainly not the only relevant factor with respect to the balance on the European wine market. In the long run, it is the phenomenon of enrichment as such which is more relevant, regardless of the method used. The various measures that directly or indirectly make enrichment profitable, all add to the surplus problem in the wine sector.

5. IMPACT OF A BAN ON ENRICHMENT BY SUCROSE

5.0 Introduction

In this Section an analysis is given of the consequences a possible ban on the use of sucrose for enrichment will have on the total volume of the (table) wine production and on the incomes of wine-growers in the different regions. This analysis only covers the three countries involved in the detailed studies. Information as to other wine-producing EC countries, in particular Greece, Spain, Portugal and Luxembourg was not sufficiently available to base a similar study on. This is unfortunate, since it means that this study cannot be seen as representative of the EC wine sector as a whole.

It is known that in Greece a substantial part of the total volume of production is enriched by subsidized CM. In 1987/88 and 1988/89 the volume of subsidized CM amounted to on average 42,000 hl per annum. Approximately 30% of the total Greek production (4.7 million hl) could have been enriched from 10 to 11% vol. by this amount of subsidized CM. It is beyond doubt that banning chaptalization and abolishing aid will affect incomes and production.

In Spain so far enrichment of wine has been illegal. So, a ban on chaptalization and a discontinuation of subsidies on RCM will not immediately affect the wine production and the incomes of the wine producers. However, indirectly this change in policy may put the competitive position of the Spanish viticulture at a disadvantage, although this effect is difficult to quantify.

In Portugal some wines may be enriched by (R)CM. If the subsidies were to be discontinued, in the long run, i.e. after the completed entry of Portugal into the EC wine market on January 1991, the producers involved will be the worse for it.

The position of the viticulture in Luxembourg is to a large extent comparable with that in the F.R.Germany and in Northern France.

In calculating the effects on the volume of wine production a simplification has been made by expressing the need for means of enrichment in RCM only. This simplification does not mean to suggest that in case of a ban the enrichment will only take place by means of RCM. CM will definitely be used to a great extent.

The effect of such a change in enrichment legislation on the EAGGF expenditure is illuminated in Section 5.4. The consequences for the sugar industry of a drop in sales to the

wine sector are discussed in Section 5.5. In Section 5.6 the opinions of governments and interest groups on banning chaptalization are presented.

5.1 Actual use of means of enrichment

Before the question is broached as to which effects from a ban on chaptalization can be expected on the volume of production in the EC, the present use of (grape) sugar for enrichment and the production of sparkling wines has been analyzed. It is assumed that the use of sucrose for the production of sparkling wines will also be forbidden if it is decided to ban the use of sucrose for enrichment. In Table 23 the results of the calculations are shown with regard to the average annual use of sugar in the Member States.

Hoffmann and Engel (1989) estimated the annual use of sucrose for enrichment purposes to be 39,000 tons (for the period 1979/88). This calculation is based on the average natural sugar strength, the maximum allowed enrichment in the German wine-growing regions (3.5% vol.) and the quantity of Kabinett wines (a Q.b.A.m.P. wine), which is declassified to Q.b.A. wine. The use of sugar for the production of sparkling wines is estimated at 13,000 tons per year. No data on the use in wine-making of (R)CM in the F.R.Germany are available.

The data reported by Dubos and Montaigne (1989) on the use of sugar in France are based on four sources:

- Figures of the sugar industry on the sale of sucrose in the wine sector in the period 1983/87 (35,445 tons).
- Estimate of the amount of over-chaptalization in a "normal year" by means of surveys determining the actual practice at wine-growing farms with respect to enrichment (24,558 tons).
- Estimate of the non-declared and non-authorized use of sucrose in regions where chaptalization is forbidden, based on the need for enrichment (75,530 tons) minus the use of (R)CM (37,047 tons) in 1987/88.
- Estimate of the use of sucrose in the production of sparkling wines (18,240 tons in 1986).

Based on the above sources, Dubos and Montaigne estimate the need for sucrose in a "normal" year to be 116,700 tons.

Contrary to the situation in France and the F.R.Germany the sugar industry in Italy is not obliged to give data on the sales of sucrose in, for instance, the wine sector. Ventura and Millucci (1989), therefore, estimate the use of sucrose by starting from the average alcoholic strength of wine and the maximum enrichment allowed in the Italian wine-growing regions: allowing for a rather wide margin, the estimate is between 5,500 and 45,000 tons. The use of sucrose in producing sparkling wines is estimated by Ventura and Millucci at 13,200 tons per annum.

Table 23: Estimated use of sucrose (1,000 ton) and (R)CM (1,000 hl) for enrichment, and use of sucrose for the production of sparkling wines in the F.R.Germany, France and Italy

Member States	Enrichment of wine by			Use of sucrose for the production of sparkling wines (1,000 ton)
	Sucrose	CM ^a	RCM ^a	
F.R.Germany	39 ^b	-	-	13
France	99	530	40	18
Italy	20 ^a	842 ^d	99 ^d	13
Total	158	1,372	139	44

^a The average subsidized utilization in wine-making of CM (43.9% vol.) from 1983-87 and RCM (54.4% vol.) in the period 1984/87.

^b According to the so-called delivery statistics (Ablieferungsstatistik) of the German Wirtschaftliche Vereinigung Zucker e.V. (1987) the sales of sugar for enrichment of wine amounted to on average 64,750 tons per year in the period 1977-1987. This figure includes the supply of on average 10,000 - 12,000 tons per year to sparkling wine producers.

^c Ventura and Millucci (1989) estimated the illegal use of sucrose for enrichment under three hypotheses which lead to an estimate ranging from 6,000 to 45,000 tons.

^d According to the Italian Intervention Agency (AIMA) and the 'Repressioni Frodi' the total volume of (R)CM used is approximately 15% higher than the subsidized volume. These are the declared volumes for which no aid was granted because of faults in the aid request.

5.2 Impact on the volume of production

5.2.1 F.R.Germany

If a ban on chaptalization does not lead to the discontinuation of aid and the costs of enrichment by RCM will not be higher than before, Hoffmann and Engel expect that the effects on the volume of the production of wine can be neglected. The total demand for means of enrichment will not change very much. If the current demand for sucrose is

converted into RCM (1 hl RCM (54.4% vol.) equals 77.8 kg sucrose) the total demand for RCM will be 501,285 hl RCM. If the use of sucrose for the production of sparkling wines is also forbidden, the demand for RCM will increase by 167,095 hl.

As illuminated in Section 3, Hoffmann and Engel (1989) calculate that replacing sucrose by non-subsidized (R)CM will lead to considerably higher costs for enrichment in the F.R.Germany. For wines (bottled wines and bulk wines) in the net-price range of 0.50 - 0.84 Ecu/l this will mean an increase in production costs of 15 - 25%. This type of wine constitutes approximately 45% of the wine production in the F.R.Germany and is mainly produced in Rheinhessen, Rheinpfalz, Mosel-Saar-Ruwer and Nahe. Assuming that this increase in costs can be passed on to the consumers, Hoffmann and Engel calculate a substantial decrease in sales possibilities. For this part of the German wine market the sales might drop by 20 - 25% (about 1 million hl). If on the other hand the producers are assumed to bear the rise in costs themselves, some of them will likely be forced to stop wine production. In that case Hoffmann and Engel estimate a reduction of output of also some 1 million hl. So, both situations will lead to a decrease in the volume of wine production of about 1 million hl.

For the other part of the German wine production (e.g. high-priced Q.b.A. wines and quality wines with predicate) Hoffmann and Engel do not expect a substantial reduction of output. Empirical data on the (negative) correlation between yield and natural sugar content show that the natural sugar content can be increased only at the cost of a substantial yield reduction. For that reason Hoffmann and Engel consider it very unlikely that higher costs of enrichment will prompt wine-growers to decrease their yields.

So, the total impact of a ban on chaptalization and an abolition of aid on (R)CM is limited to a reduction of 1 million hl of cheaper (enriched) wines. The demand for RCM for purposes of enrichment can then be estimated at 411,311 hl (1 million hl wine * 7 kg sucrose per hl (3.5% vol. increase) = 7,000 tons sucrose).

In switching from sucrose to RCM the volume of the remaining enriched wines will increase by about 5% because of the bigger volume effect of (R)CM, assuming that this RCM is imported from other Member States.

5.2.2 France

Using data supplied by Dubos and Montaigne (1989), the impact of a ban on chaptali-

zation on the need for RCM has been analyzed for situations both with and without a subsidy on the use of (R)CM.

In the first case, the use of (R)CM will probably increase by a volume equal to the present demand for sucrose. According to Table 23 this is 117,000 tons of sucrose, which converted into RCM is 1.50 million hl⁸. Assuming that this need for RCM could be met by the domestic production, 8.59 million hl wine of 10% vol. would have to be rectified and concentrated for this purpose⁹. The difference in volume increase between enrichment by sucrose and RCM is on average 0.926 l/% vol. hl (the volume of RCM required to obtain an increase in alcoholic strength depends, however, on the initial alcoholic strength (See Appendix 5)). The total effect on French wine production will then be a decrease of 7.20 million hl (8.59 - (1.50 * 0.926)).

Abolishing the subsidies on (R)CM will mainly affect the following wines:

- Wines with an appellation for which the market price, mostly, covers the enrichment costs. For these wines the utilization of grape sugar for enrichment will probably decrease only slightly and is estimated at 630,252 hl RCM.
- Wines for which enrichment is a *conditio sine qua non*. This category covers about 5 million hl with an average enrichment of 2% vol. The need for RCM is 183,824 hl (5 mill. hl * 2% vol./ 54.4% vol.).
- Table wines that are expected to fetch a higher price as a result of enrichment (Section 3.3). In view of the relatively high costs of RCM it may be assumed that this will apply mainly to the very good country and table wines. To be exact 7 million hl of wine with an average alcoholic strength increase of 1% requires 128,676 hl RCM (7 million hl * 1% vol./ 54.4% vol.).
- Assuming an unchanged demand for sugar for the production of sparkling wines of 18,200 kg, or 233,933 hl RCM the total demand for RCM is: 630,252 + 183,824 + 128,676 + 233,933 = 1.177 million hl.

5.2.3 Italy

A ban on chaptalization in Italy would not entail a changeover to other means of enrichment, because at present the use of sucrose is not allowed. In discussing the possible

⁸ 1 hl RCM of 54.4% vol. equals 77.8 kg of sucrose.

⁹ Concentration and rectification of 8.59 million hl grape must of 10.0% vol. including 5% losses gives 1.50 million hl RCM of 54.4% vol.

effects of an abolition of aid on the national sale of (R)CM, Ventura and Millucci (1989) distinguish between the enrichment of quality wine and table wine:

- Enrichment of wine with a price strictly related to the compulsory alcoholic strength (e.g. Chianti Classico) sold in bottles is very profitable both with and without aid (Section 3.4). This holds especially for wines from the North and Mid-North. In view of the profitability the total enrichment (in degrees of alcohol) will probably not decrease if the subsidies are abolished. On the other hand, there might be a shift in the origin of RCM from the South to the North.

According to Ventura and Millucci's calculations (1989) the use of self-produced must for the production of (R)CM is becoming more profitable in comparison to must from the South. The decrease in demand for (R)CM from zone CIII for enrichment of table wines is estimated at 9 million potential degrees of alcohol (165,441 hl RCM).

For the enrichment of quality wines, Ventura and Millucci expect that there will be a slight increase (28,000 hl) in the demand for RCM from the South.

- The abolition of subsidies will probably greatly affect the profitability of the enrichment of table wines of a stable market price, no higher than 2.62 Ecu/% vol./hl, whether or not the alcoholic strength changes. Below that market price enrichment of these so-called bulk wines mainly from Central and Southern Italy will become unprofitable. About 6.35 million hl falls into this category with an average enrichment of 1.5% vol. This brings the total decrease in demand for RCM in Italy to 175,092 hl. At present the total demand for enrichment expressed in alcohol degrees, is 47.7 million % vol., or 876,838 hl RCM, which is somewhat higher than the average declared subsidized and non-subsidized use of (R)CM (Table 23).

In the years to come the illegal use of sucrose may make way for enrichment by CM, because by Martin's method, chaptalization is detectable to a certain extent. This development, however, is not related to any decision concerning the maintenance or abolition of subsidies. Ventura and Millucci estimate the illegal use of sucrose converted to RCM at 58,824 - 367,647 hl.

The legal sale of sucrose for the production of sparkling wines amounts to about 13,200 tons (169,620 hl RCM). It is supposed that if chaptalization is banned the total demand for RCM will not differ from the current average demand for sucrose.

Should subsidies be abolished, the total (legal) demand for RCM in Italy will be: 867,838 - 165,441 + 28,000 - 175,092 + 169,620 hl RCM = 724,925 hl.

However, the withdrawal of aid would have important consequences for the overall demand of stopped musts indispensable to produce not only RCM but also CM. The amount of sugar (expressed in degrees of alcohol) required to meet the needs would decrease by about 15.5 million degrees equal to 1.5 million hl of starting musts, which would be put on the table wine market or intended for distillation.

As to the effects of a ban on chaptalization on the production of RCM for the home market are concerned, the decrease in demand for RCM is expected to be rather small (16%). This is largely compensated for by the use of RCM in the production of sparkling wines. An even larger proportion of this drop in sales on the home market will be compensated for by an increase in the sales of RCM in other Member States such as the F.R.Germany.

5.2.4 European Community

On the basis of the above-mentioned estimates in the studies by Hoffmann and Engel, Ventura and Millucci and Dubos and Montaigne, a calculation has been made of the probable changes in the demand for (grape) sugar should a ban on chaptalization be enforced (Table 24).

Table 24: Present use of sucrose (1,000 tons) and RCM (1,000 hl) for enrichment in sparkling wines and the use of RCM (1,000 hl) in case chaptalization is banned and subsidies, whether or not are abolished

Member States	Present situation		A ban on chaptalization		
	Enrichment by Sucrose ^a	RCM ^b	Enrichment by RCM subs.	non-subs.	Producing sparkling wines by RCM
F.R.Germany	52	-	501	411	167
France	117	444	1,710	943	233
Italy	33	852 ^c	877	556	169
Total	202	1,296	3,088	1,910	569

^a Use of sucrose for the production of sparkling wines included.

^b The volume of CM converted into RCM by multiplying by (12.85/16.85).

^c A declared but non-subsidized volume of RCM (111,000 hl) yearly used is included.

Assuming that the subsidies will be maintained, Table 24 shows that the demand for RCM for purposes of enrichment will grow from 1.296 to 3.088 million hl -- or to 3,657 million hl including the use for the production of sparkling wines -- in case of a ban on the use of sucrose. Because of the replacement of sucrose by RCM the production of table wine in the EC could then decrease by 13.5 million hl¹⁰. Assuming that the average use of sucrose for the enrichment of table wines and VQPRD wines in the EC comes to 75,000 tons, the European Commission estimated that the effect of a ban on sucrose on the total table wine production will amount to 4 million hl (Commission, 1988). According to the estimates by Hoffmann and Engel, Dubos and Montaigne, and Ventura and Millucci, however, the impact of this proposed change in policy on the table wine production will be considerably stronger. This difference is based on the estimate of the use of sucrose in the wine sector and the average demand for subsidized (R)CM. The International Confederation of European Beet Growers (I.C.E.B.) estimated the supplies from the sugar industry to the wine sector amount to 200,000 tons (I.C.E.B., 1988). This estimate is reasonably in line with the figures supplied by the above researchers.

According to the estimates in Table 24 an estimated total of 20.9 million hl of grape must (potential table wine) will have to be concentrated, both if chaptalization is banned and if the subsidies are maintained.

If the subsidies are abolished, the replacement effect of sucrose on the table wine production will be considerably smaller. In that situation only 6.8 million hl of grape must of a potential alcoholic strength of 10% vol. need to be concentrated. So, the replacement effect is 6.7 million hl smaller than if the subsidies are maintained.

With regard to meeting the demand for grape sugar it is necessary to know the situation in the potential production regions of grape sugar. At the moment, the production of RCM is concentrated in France and Italy because of the difference in subsidies given for the use of (R)CM either from zone CIII or produced outside this region in facilities which began production prior to 30 June 1982. One may expect, however, that whether or not subsidies are abolished, the production of RCM will move to the regions with the lowest production costs, where the price for must per potential alcohol degree is lowest. The French and Italian producers of RCM will be confronted with strong competition from Spain, Greece and Portugal and possibly even from third countries. For the time

¹⁰ $(3.657 - 1.296)$ million hl * 54.4% vol. / (10.0% vol. * 0.95) = 13.52 million hl grape must.

being, however, imports of (R)CM from the last countries are prohibited under the present wine legislation (Reg. 822/87, art. 70).

5.3 Impact on the wine-growers' income in the different regions

5.3.1 Influencing factors

The impact of a possible ban on the use of sucrose for enrichment of wine on the incomes of wine producers in the EC will depend on various unpredictable factors. Therefore it is also difficult to predict the effects on the incomes of wine producers. Yet, the following considerations are relevant:

1. Firstly, if the use of sucrose is banned, it will be important whether the aid for the use of (R)CM will be maintained or abolished. If it is abolished, the economic effects on wine cultivation will, of course, be more far-reaching because then the enrichment process will become considerably more expensive. It seems realistic to suppose that the EC will discontinue this subsidy, presumably in stages.
2. The impact on incomes will depend largely on the wine-growing regions. In the wine zones A and B, where it will be necessary to replace sucrose by (R)CM, the natural alcoholic strength is relatively low. If the subsidies on (R)CM are withdrawn, it is clear that the production costs of wine in these regions will rise more than in those where the natural sugar strength is higher.
3. Another important factor for the regional effects on incomes is the production location within the EC of the (R)CM needed to replace sucrose in zones A and B. The regional specialization within the EC in respect of the supply of (R)CM determines the regional differences in price for this means of enrichment. In regions where (R)CM is needed the price will be somewhat higher than in regions where it is produced because of additional transport costs.
4. It is evident that higher costs of enrichment will have a relatively stronger impact on the lower-priced segments of the wine market (Table wine, Country wine, and also some VQPRD wines).

5. Finally, to assess the effects on incomes in the different wine regions and segments of the wine market it is important to know whether the higher costs of enrichment will be accompanied by an increase in the market price of the wine. As already mentioned in Section 5.2, such a situation could result from the effects of a ban on sucrose on the volume of the wine production. The factors involved are very complex. In fact, it is the total effect of the combined factors (1) to (4) which manifests itself in the change in the volume of production, given on the one hand the wine producers' pattern of supply and, on the other hand, the nature of the consumers' demand for wine.

The influencing factors listed above show that much insight and knowledge is needed before concrete statements can be made about the effects on incomes. The investigations by Hoffmann and Engel, Dubos and Montaigne, and Ventura and Millucci give relevant information on several of the fields, although it is still difficult to draw a balanced overall picture. In the following sections the information resulting from the respective country studies will be put together and evaluated in relation to the EC wine market.

5.3.2 F.R.Germany

A ban on sucrose together with the abolition of the subsidies on (R)CM will imply a deterioration of the competitive position of wine cultivation in the northern regions of the EC and affect especially the F.R.Germany. Here the climatic conditions are such that the need for enrichment is greater than in the wine-regions further south.

According to the calculations made in Section 3.2, in the F.R.Germany the costs of enrichment will increase by 0.11 - 0.17 Ecu per litre. For the bulk wines in the price category of 0.50 - 0.84 Ecu per litre there will be an increase in production costs of 15 - 25%. Significant structural problems can be expected because of that, especially for wine cultivation in Rheinland-Pfalz (Rheinessen, Rheinpfalz, Mosel-Saar-Ruwer and Nahe).

Assuming that this increase in costs can be passed on to the consumers, Hoffmann and Engel forecast a substantial decrease in sales. Drop in sales of 20 - 25% could occur especially for the cheaper wines. For quality wines this percentage would be lower. Alternatively, if it is assumed that the increase in costs will not be passed on to the consumer, these increases will entirely be at the expense of the producers. The relative drop in producer income will always be greater than the estimated percentage of increase of the total production costs, because partly these costs are not actual income components but expenditures.

Whichever of the two suppositions is correct (Hoffmann and Engel suppose a mixture of the two), in both cases there will be painful disadvantages for the economic position of the wine-growers in the F.R.Germany.

It will not be possible to produce the RCM needed to replace sucrose in Germany because, according to Hoffmann and Engel, there will be no permanent surplus of must available for the production of RCM. For the German wine sector as a whole this implies that there will be a considerable increase in the purchase price of the means of enrichment.

5.3.3 France

Dubos and Montaigne are not very specific in their report as to what the effects might be on wine producers' incomes if the use of sucrose is banned and the subsidies on (R)CM are withdrawn. But they do provide a number of important guidelines for the approach of the economic consequences of such a policy change for the entire French wine sector. Dubos and Montaigne make an estimate of the extent of enrichment of wines in France if this enrichment can only take place by means of non-subsidized (R)CM. The changes that will take place in the value added of the French wine-producing sector as a result of the policy changes can be deduced from a cost-benefit analysis of the expected enrichment compared with current practices. The outcome of the above estimate can be seen in Table 25. Not all the variables could be quantified in the calculation model due to lack of information. They are indicated as *Pro Memoria* (P.M).

It must be pointed out that in this calculation the production of CM and RCM is taken as part of the wine-producing sector. It is also assumed, in line with Dubos and Montaigne, that the required amounts of CM and RCM are supplied in France.

From Table 25 it is evident that the total income of the French wine producing sector (value added) will decrease by at least 72 million Ecu if chaptalization is banned and aid for the use of (R)CM is abolished. Three observations are relevant here:

- (a) The estimated loss of 72 million Ecu is a minimum because the decrease of benefits from the price effect has not been quantified (See note f in Table 25). This *Pro Memoria* entry, however, is not negligible. From Tables 15, 16 and 17 it can be seen that in the Midi and Sud-Ouest the price effect makes enrichment economically rather attractive.

Table 25: Effect of banning sucrose and abolishing subsidies on the value added of the French wine production sector - an estimation (million Ecu)

	Enrichment under current conditions	Enrichment under supposed new conditions	Changes of costs and benefits
Costs			
Purchase of sucrose: 117,000 ton at 823 Ecu/ton	96.3	-	- 96.3
Loss of the proceeds of must used for the production of 440,000 hl RCM	36.8 ^{a)}	Loss of the proceeds of must used for the production of 1,175,000 hl RCM	+ 61.7
Total costs	133.1	Total costs 98.5	Net decrease of costs - 34.6
Benefits			
Volume effect from adding 99,000 ton sucrose	69.0 ^{b)}	No volume effect (no adding of exogenous means of enrichment)	- 69.0
Price effect from enriching by adding 117,000 ton sucrose and 440,000 hl RCM	P.M. ^{c)}	Price effect from enrichment by adding 1,175,000 hl RCM	P.M. ^{f)}
Subsidies for the use of CM and RCM	37.2	No subsidies	- 37.2
Total benefits	106.2	Total benefits -	Net decrease of benefits - 106.2
			Change of value added - 71.6

^{a)} 2.5 million hl of must of 10% vol. is needed to produce 440,000 hl RCM of 54.4% vol. Market value per hl must: 1.47 Ecu/% vol. (obligatory distillation price). Total loss of proceeds: $2.5 \times 10^6 \times 10 \times 1.4 = 36.8$ million Ecu.

^{b)} Volume increase from adding sucrose: 0.926 l per kg sucrose. Total volume effect of 99,000 ton sucrose (the quantity of sugar used for the production of sparkling wines is not included): $99 \times 10^6 \times 0.926 = 916,740$ hl wine of which 825,000 hl are assumed being produced in zones A, B and C realizing 80 Ecu/hl in the market, whereas 91,740 hl are produced in the other C zones realizing 2.45 Ecu/% vol./hl. Total market value of the volume effect: 69 million Ecu.

^{c)} In total the equivalence of 136,000 ton sucrose (of which 37,000 ton as RCM) has been added (without the quantity of sucrose used for the production of sparkling wines). If the average rate of enrichment is supposed to be 1.5% vol., 53.3 million hl has been enriched. It was not possible to estimate the price effect.

^{d)} To produce 1.175 million hl RCM (see Table 24) 6.7 million hl of must of 10% vol. is needed. The market value per hl is set at 1.47 Ecu/% vol./hl. So that the total loss of proceeds amounts to: $6.7 \times 10^6 \times 10 \times 1.47 = 98.5$ million Ecu.

^{e)} The equivalence of 1.175 million hl RCM of 54.4% vol. is 91,500 ton of sucrose. If the average rate of enrichment is supposed to be 1.5% vol., in total 36 million hl wine have been enriched. The price effect could not be estimated.

^{f)} According to the calculations made in footnotes c and e under the supposed new conditions less wine will be enriched. So in any case there is a decrease of benefits out of the price effect.

- (b) The changes in income (value added) estimated in this way apply to the entire French wine-growing sector. Changes in the income positions of different groups of French wine producers remain hidden, though such changes will certainly occur. As determined for the wine cultivation in Germany (see Section 4.2.2), it is clear that costs of enrichment will generally increase in the northern regions of France more than in the southern regions. It also seems that the (R)CM to be used as a replacement for sucrose will be produced in the South, thus contributing to the value added of that region.
- (c) The supposition that France will be able to supply its own needs in (R)CM is arbitrary given the situation in the EC certainly after 1992. If other Member States are able to supply cheaper (R)CM, the value added of the French wine-growing sector will probably be lower. The use of (R)CM from other Member States will then lead to purchasing costs that will be higher than the volume effect of the imported (R)CM and the sales of the must which, in that case, will be released for the production of wine.

Dubos and Montaigne (1989) propose the introduction of a -- as they call it -- quota system for the production of RCM to overcome (partly) the negative effects of banning chaptalization for the French wine-growing sector. A system analogous to the compulsory distillation could be set up. Wine-growers would then be obliged to hand in part of their harvest (yield) for concentration (and rectification). At present the wine producer benefits from the aid for the use of (R)CM in wine-making, while in the proposed system aid could be granted to wine-growers, who are not necessarily also wine producers. In this way the national surplus of wine could be destined for the domestic demand for means of enrichment and possibly for other Member States. Dubos and Montaigne elaborate this idea of introducing a quota system.

5.3.4 Italy

Contrary to the situation in the F.G.Germany and France a ban on enrichment by sucrose in the EC will have no direct impact on the Italian wine cultivation, because sucrose has not been officially allowed there for a long time. The only factor that will be a direct influence on the economics of enrichment is the abolition of subsidies. Nevertheless, a ban on sucrose will affect the Italian wine sector indirectly, namely in as far as an increase in demand for (R)CM to replace sucrose may create new sales possibilities.

In the study on Italy, Ventura and Millucci (1989) make a clear distinction between the production of CM and RCM for the home and international market on the one hand and the use of CM and RCM in Italy for enrichment, on the other hand. Under the present circumstances Southern Italy is an important supplier of must for concentration to be used for the enrichment of wine in the North. Besides, the South supplies wine producers in the North with cheap wines and they in turn, use this wine to satisfy compulsory distillation regulations. In the North with the present subsidies and the rules for compulsory distillation, enrichment is profitable (see Section 3.4). Ventura and Millucci show that above a certain price for wine (3.74 Ecu/% vol. hl) it is more profitable to buy (R)CM than to concentrate one's own must (or to have it concentrated).

In the research the extent of both the need for enrichment and the market demand for (R)CM has been investigated in the event of a withdrawal of all support. To this end the income per hectare has been calculated for six possible decisions by wine-growers with respect to enrichment. On the basis of this comparative analysis, Ventura and Millucci conclude that withdrawal of support will not decrease the enrichment activities in the North. The North will be able to meet partly its own needs of (R)CM to the detriment of the production of must for concentration in the South.

Regarding the effects on the wine-growers' incomes Ventura and Millucci hold the opinion that it will be mainly the producers of table wine, especially those in the Mid-North, who will suffer. They will be obliged to carry on with enrichment but at higher costs. In the South, it also will be mainly the producers of low-priced table wine who will suffer considerable losses. In total the loss in income for the Italian wine-growers will amount to about 62 million Ecu, i.e. the amount of the subsidies presently given. This loss in income could be compensated for if part of the wine that is distilled at present will be used for the production of RCM for the international market. Must destined for that market will fetch a considerably higher price. Ventura and Millucci calculate that Italy would have to acquire 60% of the potential European RCM market in order to compensate for the above-mentioned loss in income (62 million Ecu). Ventura and Millucci think such a large share of the market improbable, because of the competition from other Mediterranean Member States.

5.3.5 Some conclusions

From what has been said so far, it can be concluded that a ban on sucrose and the abolition of subsidies on (R)CM will certainly make enrichment considerably more expensive, but they will only partly reduce the extent of the enrichment in the EC. Wines with too low an alcoholic strength cannot be put on the market without enrichment. In many other cases enrichment even without aid will still remain economically profitable, partly because of the influence of the current practice of compulsory distillation.

Abolition of the support for (R)CM will mean a loss of income for the EC wine sector amounting to the total aid (118 million Ecu on average in the period 1984/87). Some compensation for this loss could be an increase in the value added as a result of replacing sucrose with (R)CM and of the related increase of retail prices. The effect of this will probably be limited, and certainly difficult to estimate.

Such an estimate of the short-term effects on the EC wine sector does not indicate the distribution of these income effects over the various wine producing regions in the Community. It is difficult to determine these politically very relevant distribution effects exactly, because of the uncertainty with respect to the production locations of CM and RCM within the Community (only three countries were studied !) and the price development of these means of enrichment. However, it can be concluded, that the northern wine regions will suffer most with respect to their competitive position -- and this will affect the relative income position of the wine producers there.

5.4 Consequences for the EAGGF budget

In the period 1984-1987 the EAGGF spent on average 118 million Ecu per annum on aid for CM and RCM (Section 1.2 Table 7). Based on figures in Table 24 these expenses will increase to 284 million Ecu¹¹ (336 million if aid is also granted for RCM in producing sparkling wines) should chaptalization be banned and aid maintained. In other words, in the latter case the expenditure for aid will increase by 218 million Ecu, but alternatively the supply of table wine will decrease, which will lead to savings on the

¹¹ On the basis of the aid (1.69 Ecu/% vol./hl) for the use in wine-making of RCM (54.4% vol.).

EAGGF expenses for distillation. If sucrose is completely replaced by RCM an estimated amount of 13.5 million hl grape must of 10% vol. will have to be concentrated to produce 2.36 million hl RCM (See Section 5.2.4). Departing from the buying-in price for wines destined for compulsory distillation in 1987/88 (1.47 Ecu/% vol./hl), 199 million Ecu less need to be spent on the buying-in of table wine to be distilled. The savings on communal aid for the distilleries to distill the table wine are estimated at 58.1 million Ecu¹². The average costs of the storage of alcohol are 10 Ecu/hl alcohol of 100% per annum: assuming that 1.35 million hl alcohol of 100% would have to be stored for one year the savings will be 13.5 million Ecu. If the alcohol is sold after this year the revenues will be approx. 10 Ecu/hl: the total revenues would have been 13.5 million Ecu. So, the total savings on the costs of distillation will amount to 257 million Ecu. On balance, the expenses of the EAGGF will decrease by 39 million Ecu (218 - 257).

If the subsidies on (R)CM are abolished the EAGGF will save 118 million Ecu which under the present policy is granted as support (see above). The savings on compulsory distillation will be less, because only part of the sucrose will be replaced by grape sugar. The savings on distillation costs (including the savings because of the discontinuation of aid given to distilleries, and the storage expenditure minus the sales of the alcohol) would amount to about 129 million Ecu. In case of a ban on chaptalization and the abolition of aid, the EAGGF expenses will all in all decrease by an amount of approximately 247 million Ecu.

In summary, the consequences of banning chaptalization for the EAGGF expenditure (in million Ecu) can be shown as follows:

	A ban on chaptalization	
	Maintenance of aid for (R)CM	Abolition of aid for (R)CM
Aid for (R)CM	+ 218	- 118
Costs of distillation	- 257	- 129
Total (million Ecu)	- 39	- 247

¹² Aid granted for the distillation of table wine into alcohol is approximately 0.43 Ecu/% vol./hl.

5.5 Consequences for the sugar sector

For the sugar sector a ban on chaptalization will be a painful blow to the sales of sugar to the wine sector. The present average sales of sugar amount to about 1.5% of the total production in the EC (13.2 million tons in 1987/88). If the production of sugar is kept on the same level, the unsold amounts will have to be exported, which for the EC sugar producers will imply an additional financial burden of 50 - 100 million Ecu, depending on the price level on the world market. In the long run the national production quotas are likely to be lowered.

5.6 Governments and interest groups: their views for and against

The conclusions in Sections 5.2 and 5.3 with respect to the economic effects of a ban on chaptalization in the three Member States may account for the attitude of these countries towards the intended policy changes.

Hoffmann and Engel are very brief in reporting the opinions in the F.R.Germany: "In the F.R.Germany all groups are against CM and RCM. Furthermore, nobody sees any advantage except that of solving some wine surplus problems by means of high administration costs". The German wine sector is very afraid of RCM because they expect a destruction of the traditional German wine-system whereby the highest prices are paid for non-enrichment of quality wines (Q.b.A.m.P.). Hoffmann and Engel (1989) point out that the (non)-enrichment of these wines is very difficult to control.

Dubos and Montaigne pay much more attention to the subject. First, they conclude that the intention to ban sucrose is supported in Italy, Spain and the non-producing Member States. Only Germany, Luxembourg and France are opposed to the idea. Dubos and Montaigne then continue by giving ample attention to the points of view of the various interest groups in their country.

The professional organizations in the AOC wine sector are very radical in their rejection of a ban on chaptalization. Enrichment by sucrose is considered a normal, traditional oenological practice in the production of AOC wines. In these circles it is feared that the replacement of sucrose by (R)CM will lead to over-enrichment, because contrary to sucrose the amount of (R)CM added cannot be checked. Furthermore, the 'neutrality' or 'purity' of sucrose is seen as a qualitative advantage over concentrated must.

The wine-growing organizations in the table wine sector take a somewhat different view. They prefer the status quo to be maintained, e.g. chaptalization for quality wines and subsidized enrichment by (R)CM for table wines. They believe that a ban on sucrose will pose a threat to aid and therefore they prefer enrichment by sucrose to be maintained in those regions where it has been allowed of old.

Dubos and Montaigne also mention the wishes and opinions of parties engaged in sugar beet cultivation and the sugar industry. They are in favour of a general freedom of choice of enrichment methods throughout the EC, but they prefer the production of RCM to be fitted into the system of national quotas to which the production of sucrose and iso-glucose is submitted.

The French government in the person of the Minister of Agriculture has taken a rather cautious stand on this matter, on which interests and opinions differ so widely.

According to Ventura and Millucci in Italy the government and producer organizations are of the opinion that in the Community enrichment both qualitatively and quantitatively has to be reduced. This could be achieved by:

- increasing the costs of enrichment;
- a revision of geographical borders in some viticultural regions and a control of the minimum alcoholic strength;
- an extension of the control systems;
- labelling the use of the means of enrichment on the bottle.

The enrichment of wine by RCM is regarded as a method to obtain wine exclusively produced from grapes. There are no technical reasons preventing the replacement of sucrose by RCM. The use of RCM as a substitute for sucrose would involve an increase of the costs of enrichment in all Member States on the one hand, while on the other hand the common surpluses of table wines would be reduced. At present, however, the market for table wines is in great difficulty. The use in wine-making of RCM gives an opportunity to balance the wine supply in years with a large production.

According to the majority of experts on Italian viticulture and wine industry, the minimum alcoholic strength should be set at 8.5% vol. in the EC, with some exceptions on grounds of particular historical-cultural conditions in the Member States concerned.

In Luxembourg wine-growers are familiar with the use in wine-making of sucrose. Concentrated grape must is not applied because this adds too many acids already present in wine. In the event of a ban on chaptalization, the wine-growers in Luxembourg will oppose the possible obligatory use of rectified concentrated grape must, because RCM is

expensive, it causes a higher increase in volume than sucrose, its concentration is not thought to be constant and difficulties in the application are expected¹³.

In Portugal from the second entry phase in 1991 onwards, the economic consequences of a ban on sucrose in the EC will involve the loss of subsidies on the use of concentrated must¹⁴.

The Spanish government has always been - and still is - opposed to the practice of the (artificial) enrichment of wine. This stance is reflected in the current legislation, which emphasizes the qualitative aspects of the wine cultivation to the natural ecological circumstance in the various Spanish wine-growing areas¹⁵. Also the EC, at least in theory, considers enrichment an exceptional and limited practice (art. 18 Reg 822/87). In practice, however, the enrichment of wine entails a production increase within the Community. Directly so, because of the volume of the added products. Indirectly, however, and more importantly, because in this way an augmentation of the yields is prompted. These negative aspects of enrichment particularly apply for the use of beet sugar as a means of enrichment, as this is a sector foreign product. The application of beet sugar affects the essence of the final product, because it no longer meets the definition of wine as a product of the fermentation of fresh grapes or grape must. Besides, it is clear that the use of this product does not in any sense contribute to balancing the wine-market, but on the contrary leads to even more surpluses. Traditionally, because of its low cost and its intrinsic qualities, sucrose was the most applied product in the enrichment of wine in the EC. When RCM - a product exclusively made from grapes - was introduced onto the market, the former status of sucrose changed. In Spain the need is felt to take these aspects into account when considering a ban on chaptalization within the framework of the revision of the regulation with respect to the increase of the natural alcohol content planned for 1990.

¹³ Letter of mr. J.P. Huberty, Ingenieur-chef de division of the Institut Viti-Vinicole REMICH (Luxembourg) of 11 September 1989 in reply to the request of J. De Hoogh and G. Klein Essink of the WAU for information on the legislation of enrichment of wine and the opinions on a possible ban of chaptalization in Luxembourg.

¹⁴ Letter of mr. C. Ghira, President of the Instituto da Vinha e do Vinho (Lisboa, Portugal), of 4 October 1989 in reply to the letter of J. De Hoogh and G. Klein Essink of the WAU of 14 September 1989 on the legislation of enrichment of wine and the opinions on a possible ban of chaptalization in Portugal.

¹⁵ Letter of mr. S. Menéndez de Lurca, Vice-President of the Dirección General de Política Alimentaria of the Ministerio de Agricultura Pesca y Alimentación (Madrid, Spain) of 6 October 1989 in reply to the letter of J. De Hoogh and G. Klein Essink of the WAU of 14 September 1989 on the legislation of enrichment of wine and the opinions on a possible ban of chaptalization in Spain.

6. CONSIDERATIONS AND RECOMMENDATIONS

In the previous sections (of Part II) empirical evidence and considerations concerning enrichment procedures and their economic consequences were highlighted. Below a number of conclusions and recommendations are presented:

(a) Banning the chaptalization of wine could eventually reduce supplies of table wines by an estimated 13 million hl. This means that such a measure would cause market supplies to decrease by an amount equivalent to one-third of the quantity of wine which, in recent years, has been denaturated by compulsory and optional distillation. The substitution of sucrose by grape sugar can thus result in a reduction of distillation costs of roughly 260 million Ecu. Of course, these estimates only hold if subsidies for CM and RCM continue and increases in enrichment costs in the production zones A and B are compensated. Only under these conditions will the extent to which wine is enriched equal the current level of enrichment. Hence the higher costs of subsidizing RCM by around 220 million Ecu must be set against the advantage of decreased distillation costs.

(b) On balance the EAGGF expenditures would decrease by about 40 million Ecu per year. It is evident that by using grape sugar instead of sucrose to limit the total wine supply by about five percent, the Community's aim of lowering the budget costs of the EC wine policy will only marginally be supported. Besides, in this scenario of banning sucrose and maintaining the subsidies on (R)CM the economic attractiveness of enriching wines would not substantially change. Indeed, the possibility to compensate for low natural sugar strength in the grapes at relatively low costs will stimulate technical developments in wine-growing which will increase volume yields still further, rather than enhance the natural sugar strength of the grapes. It will only take a few years for these technological trends towards high-yielding varieties to overtake the initial one-time effect of a ban on sucrose in order to decrease supply.

(c) The withdrawal of subsidies on CM and RCM can substantially reduce the profitability of enrichment, and this will result, of course, in much less enrichment being carried out than at present. Similarly, less sucrose will be substituted for RCM, so that the savings on distillation costs will also be less. It is self-evident that this must be set against the fact that there will be no expenditures for subsidies. On balance the EAGGF expenditure would decrease by about 250 million Ecu per year. However, of greater

importance is the long run effect that the lower profitability of enrichment will reduce the incentives to boost wine production (in volume) per hectare. This is in accordance with the general aim to restore the market balance of table wines.

(d) There is little doubt that a ban on chaptalization and the discontinuation of subsidies will meet with severe political resistance within the Community. Such policy measures will adversely affect the economic position of many wine-growers in the EC, and what is more, these negative consequences will be unequally distributed with respect to region, wine quality and class. The Community cannot allow a policy change to cause such effects, and it would be very difficult to carry out such a decision in those regions where chaptalization is a long-standing and authorized practice.

(e) The above considerations not only cast doubts on the effectiveness of banning chaptalization, but they also put forward the question of whether the Community is in an authoritative enough position to enforce this type of measure. On these grounds it is obvious that banning sucrose will not be the most recommendable policy to curtail surpluses of table wines.

(f) In the face of the above conclusion the question arises as to whether there are alternative measures with regard to enrichment which support the control of surpluses (in addition to the instruments which are already in use such as subsidies for uprooting vineyards, acreage controls, compulsory distillation linked to yields). Generally speaking, one has to consider measures designed to reduce the need for enrichment or to make it less attractive, irrespective of which enrichment procedure is applied. At first sight such an approach would seem to be nonsensical: to refrain from enrichment will tend to result in an increase of the supply of (non-enriched) wines. But this effect is essentially short term and is likely to be only of limited importance. In the longer term, if the opportunities for enrichment are restricted, wine producers will direct their attention more to the natural quality of their wines. An adjustment of production strategies in this direction will eventually contribute to the restoration of the market balance, probably substantially. In this context two lines of action are applicable:

- . to introduce stricter limitations on enrichment (see g);
- . to make enrichment a less profitable option (see h and i).

(g) The authorization for enrichment has become a regular, yearly practice, while non-enrichment is more an exception to the rule. Enrichment should be more directed to its previous aims by tightening-up the restrictions with respect to the minimum alcoholic

strength, the increase of the alcoholic strength by enrichment and the maximum alcoholic strength of wine offered on the market.

(h) In Section 3 it was concluded that production for concentration and endogenous enrichment is stimulated very much in Italy and France by the way in which compulsory distillation measures are put into effect. It seems desirable to reduce this incentive. This can be accomplished by taking must which is destined for concentration fully into account for the determination of average yields per hectare and the amount of wine that has to be delivered for distillation. Producers would then be unable to avoid the full penalty on high yields, and the aim of the distillation measure to link distillation to level of yields would be fulfilled.

(i) Enrichment can also be discouraged by reducing or abolishing altogether subsidies on the utilization of (R)CM. Such a measure, however, would be considered as putting the C zones at an unfair disadvantage if enrichment by sucrose was allowed to remain undisturbed in the A and B zones. A levy on wine enriched by sucrose could be introduced to correct a distortion of this type. A more acceptable compensatory measure seems to be a tightening-up of restrictions for enrichment (as recommended sub g), especially in regions where the natural alcoholic strength of grapes is relatively low.

(j) Enriching wine would also become less attractive if consumers preferred non-enriched wines and if these wines were made recognizable in the market. The price premium due to this preference would favour the competitive position of those (Southern) regions and producers who are able to supply wines of the natural alcohol content required by the market.

A consumer research on perceptions and preferences with respect to enrichment of wine, undertaken in the F.G.Germany, France and the UK (See Appendix 6), shows that a relatively large proportion of the wine drinking respondents were of the opinion that wines should not be enriched at all. The printing on the label of the bottle the addition of sugar or must concentrate was supported by a substantial part of the interviewees. These preliminary analyses underline the desirability of a more in-depth market research into consumer perceptions and preferences. Such market studies could provide the basis for the idea having non-enriched wines distinguished from other enriched wines. This would boil down to indicating on the bottle whether or not wine is enriched and if so, also information on the degree of enrichment and the means applied should be given.

(k) In the economic analysis of the consequences of banning chaptalization for the EC hardly any attention could be paid to the viticultures in Greece, Spain and Portugal in general and to the enrichment of wines in these countries in particular. It is very much to be regretted that the integration into the study and its conclusions of the viticulture of these integral parts of the common wine producing sector was impossible.

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APPENDIX 1: WINE QUALITY CLASSIFICATION IN THE EC

Member State	Table wine	VQPRD ^a
F.R.Germany	. Landwein	. Qualitätswein bestimmter Anbaugebieten mit Prädikat (Q.b.A.m.P.): Kabinett, Spätlese, Auslese, Beerenauslese, Trockenbeerenauslese, Eiswein
	. Other table wine	. Qualitätswein bestimmter Anbaugebieten ohne Prädikat (Q.b.A.)
France	. Vin de Pays	. Appellation d'Origine Controlée (A.O.C.)
	. Vin de consommation courante (V.C.C.)/ Vin de Table (V.d.T.)	. Vins Délimités de Qualité Supérieure (V.D.Q.S.)
Greece	. Traditional wine (Retsina)	. Onomasia proleuseos elenchomene (O.P.E.)
	. Mark wine	. Onomasia proleuseos apoteras poiotos (O.P.A.P.)
	. Inos Topikos	
Italy	. Vino typico	. Denominazione di Origine Controllata e Garantita (D.O.C.G.)
	. Other table wines	. Denominazione di Origine Controllata (D.O.C.)
Luxembourg	. Table wine	. Marque National du vin Luxembourgeois (M.N.)
Portugal	. Table wine	. Denominação de Origem controlada (D.O.C.)
		. Denominacao de Origem (D.O.)
		. Indicação de Proveniência Regulamentada (I.P.R.)
Spain	. Table wine	. Denominación de Origin Calificada (D.O.C.)
		. Denominación de Origin (D.O.)

^a VQPRD = Vins de Qualité Produits dans des Régions Déterminées
Source: Commission, 1988a.

APPENDIX 2: DEVELOPMENTS IN ACREAGE OF VINEYARDS IN FRANCE AND IN F.R.GERMANY (1,000 ha)

France, in the period 1955 - 1987

Wine-growing zone and region	1955	1958	1961	1964	1967	1970	1973	1976	1979	1982	1985	1987
Zone B												
Ile-de France	0.6	0.7	0.7	0.4	0.2	0.1	0.1	0.1	0.0	0.0	0.1	0.0
Champagne	10.1	13.0	13.0	14.1	16.3	17.8	19.5	22.3	23.1	22.5	23.5	24.2
Picardie	0.6	0.6	0.6	0.6	0.7	0.8	1.0	1.2	1.4	1.5	2.0	1.6
Centre	67.0	60.4	59.4	55.8	51.4	41.9	42.2	35.5	33.1	30.3	28.8	26.3
Bourgogne	34.0	30.7	29.6	27.7	23.9	23.0	23.0	22.2	22.9	23.7	24.0	23.7
Lorraine	4.0	3.9	3.4	3.2	2.9	1.2	1.1	0.8	0.6	0.7	0.5	0.4
Alsace	14.6	12.3	12.3	12.9	12.8	11.2	12.0	11.9	12.2	13.0	13.2	13.0
France-Comté	6.9	4.1	3.7	4.2	2.8	2.2	2.2	2.1	2.2	2.2	2.2	2.1
Pays de la Loire	77.9	74.8	75.9	70.9	67.7	61.3	59.7	56.7	53.1	48.8	47.1	44.2
Zone C1a												
Poitou-Charentes	100.0	95.1	94.8	99.1	99.2	96.1	101.0	120.8	117.1	106.2	100.5	95.6
Aquitaine	226.9	202.5	198.3	197.1	190.0	167.2	154.2	156.5	141.7	135.4	136.1	134.5
Midi-Pyrénées	174.4	148.5	140.5	132.9	119.6	103.3	98.1	96.1	82.0	67.6	59.1	52.9
Limousin*	5.2	5.0	5.0	2.6	2.6	1.7	1.6	1.4	1.2	1.2	1.0	1.0
Rhône-Alpes*	93.2	88.3	84.7	82.6	78.2	74.5	75.8	71.1	67.4	64.5	62.2	61.3
Auvergne	20.2	18.6	15.1	12.5	11.8	8.4	9.5	6.5	6.0	4.8	4.4	3.7
Zone CII/CIIB												
Lang.-Roussillon	447.2	421.0	425.1	421.0	417.5	434.4	419.5	433.1	419.0	385.9	370.4	373.6
Prov.-Alp.-Côte d'Azur	139.7	127.5	116.5	122.6	124.9	141.0	129.8	139.9	130.1	108.7	104.1	113.7
Corse	7.6	7.9	6.0	10.0	17.0	22.5	30.0	27.2	24.1	20.8	15.8	11.0
France	1,432	1,315	1,285	1,712	1,240	1,209	1,180	1,205	1,137	1,040	995.0	982.0

* Some vineyards also located in other zones.

Source: Statistical year books of the French Ministry of Agriculture, several years.

F.R.Germany, in the period 1950 - 1987:

Region	1950/54	1955/59	1960/64	1965/69	1970/74	1975/79	1980/83	1985	1986	1987
Ahr	484	539	562	536	491	461	375	397	378	386
Mittelrhein	1,185	1,247	1,226	985	882	822	726	749	744	741
Mosel-Saar-Ruwer	7,590	8,881	9,198	9,930	11,014	11,732	11,467	11,623	11,984	12,169
Nahe	2,814	3,807	4,083	3,813	4,019	4,279	4,208	4,307	4,313	4,304
Rheinhesen	11,664	13,641	15,522	16,045	18,472	20,570	21,549	22,978	23,135	22,931
Rheinpfalz	12,304	14,124	15,960	17,469	19,346	20,619	20,128	20,766	20,590	20,834
Baden	5,754	6,185	8,241	8,956	10,799	13,572	14,640	14,851	14,811	14,762
Württemberg	6,691	6,732	6,715	6,385	6,772	7,918	8,999	9,575	9,326	9,251
Franken	2,634	2,594	2,483	2,285	2,860	3,707	4,268	4,672	4,708	4,783
Rheingau	1,998	2,226	2,621	3,074	3,005	2,914	2,668	2,742	2,708	2,740
Hess. Bergstraße	207	209	211	221	293	364	346	360	362	375
F.R.Germany	53,757	59,706	66,912	69,798	78,083	87,113	89,472	93,020	93,059	93,276

Source: Kalinke, 1985 and Statistisches Bundesamt, 1988.

APPENDIX 3: THE ENRICHMENT OF WINES UNDER REG. (EC) 822/87

Reg. (EC) 822/87 is laying down the general rules for the common organization of the market in wine. The art. 18, 19 and 20 to the enrichment of wine in the EC.

Article 18

1. Where climatic conditions so require in certain wine-growing zones of the Community, the Member States concerned may permit an increase in the natural alcoholic strength by volume (actual or potential) of fresh grapes, grape must in fermentation, and new wine still in fermentation, obtained from the vine varieties referred to in Article 69, as well as wine suitable for yielding table wine and table wine.

An increase in natural alcoholic strength by volume may not be authorized in respect of the products referred to in the first subparagraph unless their minimum natural alcoholic strength by volume is as follows:

- in wine-growing zone A : 5% vol
- in wine-growing zone B : 6% vol
- in wine-growing zone C I (a): 7,5% vol
- in wine-growing zone C I (b): 8% vol
- in wine-growing zone C II : 8,5% vol
- in wine-growing zones C III : 9% vol

The increase in minimum natural alcoholic strength by volume shall be achieved by means of the oenological practices referred to in Article 19 and may not exceed the following limits:

- in wine-growing zone A : 3,5% vol
- in wine-growing zone B : 2,5% vol
- in wine-growing zone C : 2% vol

2. In years when climatic conditions have been exceptionally unfavourable, the limits on increases in the alcoholic strength by volume provided for in the third subparagraph of paragraph 1 may be raised to the following levels:

- wine-growing zone A : 4,5% vol
- wine-growing zone B : 3,5% vol

3. The wine-growing zones referred to in this Article shall be as set out in Annex IV.

4. Detailed rules for the application of this Article, and in particular the decisions authorizing the increases provided for in paragraph 2, shall be adopted in accordance with the procedure laid down in Article 83.

Article 19

1. The increase in natural alcoholic strength by volume provided for in Article 18 may only be effected:

- a) in respect of fresh grapes, grape must in fermentation or new wine still in fermentation, by adding sucrose, concentrated grape must or rectified concentrated grape must;
- b) in respect of grape must, by adding sucrose, concentrated grape must, rectified concentrated grape must or by partial concentration;
- c) in respect of wine suitable for yielding table wine and table wine, by partial concentration through cooling.

2. The processes mentioned in paragraph 1 shall be mutually exclusive.

3. The addition of sucrose provided for in paragraph 1 (a) and (b) may only be performed by dry sugaring and only in wine-growing regions in which it is traditionally or exceptionally practised in accordance with legislation in force on 8 May 1970.

4. The addition of concentrated grape must or rectified concentrated grape must shall not have the effect of increasing the initial volume of fresh crushed grapes, grape must, grape must 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 zones C.

If Article 18 (2) is applied, the limits on increases in volume shall be raised to 15% in wine-growing zone A and to 11% in wine-growing zone B.

5. The concentration of grape must, of wine suitable for yielding table wine or of table wine subjected to this process, shall not have the effect of reducing the initial volume of these products by more than 20% and in no case shall it increase by more than 2% vol their natural alcoholic strength by volume.

6. In no case shall the abovementioned processes have the effect of raising to more than 11,5% vol in wine-growing zone A, 12% vol in wine-growing zone B, 12,5% vol in wine-growing zones C I (a) and C I (b), 13% vol in wine-growing zones C II and 13,5% vol in wine-growing zones C III the total alcoholic strength by volume of the fresh grapes, grape must, grape must in fermentation, new wine still in fermentation, wine suitable for yielding table wine or table wine subjected to those processes.

However, for red wine, the total alcoholic strength by volume of the products mentioned in the first subparagraph may be raised to 12% vol in wine-growing zone A and 12,5% vol in wine-growing zone B.

7. Wine suitable for yielding table wine and table wine may not be concentrated when the products from which they were obtained have themselves been subjected to the processes mentioned in paragraph 1 (a) and (b).

8. Detailed rules for the application of this Article shall be adopted in accordance with the procedure laid down in Article 83.

Article 20

1. The Commission shall make a thorough study of the possibilities for using concentrated grape must, whether rectified or not, and sugar for enrichment. The study shall cover in particular the oenological aspects of the various permitted methods, the economic aspects of the use of sucrose or concentrated grape must, whether rectified or not, and the methods for monitoring such use.

2. In 1990 the Commission shall present to the Council a report on the conclusions of the study referred to in paragraph 1, together with any appropriate proposals. The Council shall then decide on the measures to be taken with regard to the increase of the natural alcoholic strength by volume of the products referred to in Article 18 (1).

3. Implementation of the study referred to in paragraph 1 shall be financed by the Community. The appropriation relating to it shall be fixed under the budget procedure. The cost is estimated at 2 million ECU.

Viticultural zone	Table wine				Quality wine				Limit of Enrichment		Max. volume increase (CM/RCH)			
	Minimum natural alcoholic strength for consumption	Minimum total alcoholic strength for enrichment	Maximum total alcoholic strength without enrichment	White and Rosé wine	Minimum natural alcoholic strength	Minimum total alcoholic strength for consumption	Normal years (degrees)	Exceptional weather conditions (degrees)	Normal years (f)	Exceptional weather conditions (f)				
A. Belgium, Luxembourg, The Netherlands United Kingdom and F.R.Germany without Baden	5	8.5	15	11.5	12	12	12.5	12	6.5	9	3.5	4.5	11	15
B. In F.R.Germany: Baden; In France: Alsace, Lorraine, Champagne, Jura, Savoie and Valle de Loire	6	8.5	15	12	12.5	12	12.5	12.5	7.5	9	2.5	3.5	8	11
C.Ia. In France: regions of Central Quest	7.5	9	15	12	12.5	12	12.5	12.5	8.5	9	2	2	6.5	6.5
C.Ib. In Italy: regions of Vall d'osta and the provinces of Sondrio Bolzano, Trento and Belluno	8	9	15	12.5	12.5	12.5	12.5	12.5	9	9	2	2	6.5	6.5
C.II. In France: Mediterranean regions; In Italy: all regions except those of Cib and CIII	8.5	9	15	13	13	13	13	13	9.5	9.5	2	2	6.5	6.5
C.III. In France: Corsica and parts of Pyrenées Orientales and dept. of Var; In Italy: regions of Calabria, Basilicata, Puglia, Sardegna and Sicilia; Greece	9	9	17	13.5	13.5	13.5	13.5	13.5	10	10	2	2	6.5	6.5

APPENDIX 4: VOLUME INCREASE OF WINE (1) DUE TO ENRICHMENT BY RCM OF 62°
BRIX AND 67° BRIX

61.7° Brix

Final alcohol content (% vol.)							
13	-	-	-	10.050	7.538	5.291	2.717
12	-	-	9.804	7.538	5.155	2.646	-
11	-	9.569	7.353	4.902	2.513	-	-
10	9.346	7.177	4.902	2.513	-	-	-
9	7.009	4.785	2.245	-	-	-	-
8	4.673	2.392	-	-	-	-	-
7	2.336	-	-	-	-	-	-
6	-	-	-	-	-	-	-
	6	7	8	9	10	11	12
	Initial alcohol content (% vol.)						

67° Brix

Final alcohol content (% vol.)							
13	-	-	-	8.811	6.757	4.608	2.358
12	-	-	8.621	6.608	4.505	2.304	-
11	-	8.439	6.466	4.405	2.252	-	-
10	8.246	6.329	4.301	2.203	-	-	-
9	6.198	4.219	2.155	-	-	-	-
8	4.132	2.110	-	-	-	-	-
7	2.060	-	-	-	-	-	-
6	-	-	-	-	-	-	-
	6	7	8	9	10	11	12
	Initial alcohol content (% vol.)						

APPENDIX 5: MODEL CALCULATION OF THE GROSS-INCOME OF A WINE-GROWING FARM IN THE MIDI (15 ha), ENRICHING WINE OR NOT IN 1987/88 (VOLUME OF PRODUCTION (2000 hl))

	No enrichment	Enrichment by	
		exogenous RCM	endogenous RCM
*Volume of must destined for:			
. production of wine (hl)	2,000	2,000	1,650
. production of RCM (hl)	-	-	350
*Production of RCM (hl)	-	-	62
*Agronomic rendement (hl)	-	-	279
*Concentration reduction (hl)	-	-	70
*Volume of production (hl)	2,000	2,000	1,859
Yield (hl/ha)	133	133	124
*Obligation to distill (%)	85.6	85.6	71.3
in volume of production(hl)	1,712	1,712	1,325
*Reduction for wine-lees (hl)	51	51	40
*Preventive distillation (hl)	195	195	195
*Compulsory distillation (hl)	1,466	1,466	1,090
*Volume of RCM required for enrichment (hl)	-	73	61
*Volume of wine sales (hl)	339	412	776
Revenues (Ecu)			
*Sales of wine at the market			
. selling as table wine	8,100	11,732	22,099
. selling as country wine	-	16,132	30,386
*Sales of wine in respect of:			
. preventive distillation	4,285	4,611	4,611
. compulsory distillation	21,723	23,569	17,524
*Value of produced RCM	-	-	0,197
Total revenues			
. selling table wine	34,108	39,903	44,431
selling country wine	-	44,312	52,718
Costs of enrichment (Ecu)			
*Means of enrichment: RCM	-	21,768	-
*Elaboration/transport of RCM	-	-	3,560
*Variable and fixed cost of the enrichment process	-	0,931	0,769
Total	-	22,699	4,329
*Subsidy	-	5,957	4,978
Total costs of enrichment		16,742	-0,651
Gross-income ((total revenues - costs of enrichment)) / ha)			
. selling table wine	2,274	1,544	3,005
. selling country wine	-	1,838	3,558

Assumptions

- * Average alcoholic strength before and after enrichment in Languedoc-Roussillon in 1987/88 are 10.08 and 11.65% vol., respectively (ONIVINS, 1989);
- * The volume of RCM (54.4% vol.) produced from e.g. 350 hl grape must (10.08% vol.) is, 5 % for losses included: $((350 \text{ hl} * 10.08\% \text{ vol.} * 0.95) / 54.4\% \text{ vol.}) = 62 \text{ hl RCM}$;
- * The agronomic rendement of producing RCM from grape must is calculated by multiplying the volume of RCM produced by a factor 4.5;
- * In 1987/88, the French wine-growers could reduce their agronomic yield by subtracting 20% of the volume grape must, destined for production of RCM, from the sum of the volume of grape must destined for production of wine and the agronomic yield of RCM production;
- * For the relation between compulsory distillation and yield is referred to page II - 27 and Agri Service International (1988);
- * The maximum quantity which can be subtracted from the obligation to distill wine because of wine-lees is 3%;
- * The maximum quantity of wine to be distilled within the preventive distillation regulation is 13 hl/ha;
- * In 1987/88, the buying-in price for preventive distillation was 2.18 Ecu/% vol./hl, while the reduction of the buying-in price of this distillation is 0.15 Ecu/% vol./hl, in the case aid for RCM in wine-making is granted; for compulsory distillation the prices were 1.47 and 0.09 Ecu/% vol./hl resp.;
- * The volume of RCM required for enrichment of wine is calculated according to the formula in PART I, page I - 19;
- * Market prices of table wine of 10.0 - 10.9% vol.: 2.37 Ecu/% vol./hl, and 11.0 - 11.9% vol.: 2.44 Ecu/% vol./hl (see also Section 3.3, page II - 27), of country wine: 3.36 Ecu/% vol. (Table 13);
- * Average market price of RCM in 1987/88 was 3.63 Ecu/% vol./hl (ONIVINS, 1988a);
- * The costs of elaboration and transport RCM is approximately 1.06 Ecu/% vol./hl (Dubos and Montaigne (1989));
- * For the variable and fixed cost of enrichment is referred to Table 11, page II - 14;
- * The aid for the use of RCM, produced in facilities which began production prior to 30 June 1982 or in zones CIIIIa and CIIIIb, was 1.69 Ecu/% vol./hl, and with the loss of interest (11% on yearly basis) included this subsidy was 1.50 Ecu/% vol./hl.

**APPENDIX 6: CONSUMER RESEARCH ON WINE AND WINE ENRICHMENT PERFORMED
IN THE F.R.GERMANY, FRANCE, AND THE UNITED KINGDOM**

Introduction

In August/September 1988 Forschungsanstalt Geisenheim (Fachgebiet Betriebswirtschaft und Marktforschung) carried out a research on consumer attitudes with respect to 'wine' in the F.R.Germany. Three issues related to wine enrichment were embodied in the research: whether they thought enrichment of wine to be allowed under the European wine laws and, if so, for which of the European wine quality categories, and what their attitudes were regarding the quality of the wine and the purpose of enrichment of wine.

The Wageningen Agricultural University (Working Group on Agricultural Policy) decided then, on the basis of the results of the German consumer study, to perform also a consumer research in the United Kingdom and in France. The following three issues were added to the questionnaire: the knowledge of the European wine quality categories, the opinion on the bearing of the alcohol content on the quality of the wine and the need to indicate the addition of sugar or must concentrate on the label of the wine bottle.

The complete results of the German consumer study can be obtained from Forschungsanstalt Geisenheim (Fachgebiet Betriebswirtschaft und Marktforschung, Geisenheim (F.R.Germany), whereas the complete results of the studies performed in the UK and in France can be obtained from the Wageningen Agricultural University (Working Group on Agricultural Policy), Wageningen, the Netherlands. Below the aggregated results of the studies are given.

Method

F.R.Germany

The fieldwork of the consumer study was done by GFM-GETAS (Gesellschaft für Marketing-, Kommunikations- und Sozialforschung mbH, Hamburg, F.R.Germany) under 3,010 respondents.

The survey was based on a representative sample of the inhabitants of the F.R.Germany and West Berlin of aged 14 or more. They were selected in a minimum of 630 sampling points, by a random location method.

Respondents were interviewed at home by interviewers organized by GFM/GETAS according to GFM/GETAS detailed instruction about the survey and administrative procedures.

United Kingdom

The fieldwork of the consumer study was done by RSGB (Research Surveys of Great Britain, London, United Kingdom) under 2,000 respondents in November 1989.

The survey was based on a representative sample of adults, i.e. males and females aged 16 or more. They were selected in a minimum of 130 sampling points, by a random location method.

Respondents were interviewed at home by interviewers organized by RSGB's Regional Organisers according to RSGB's detailed instruction about the survey and administrative procedures. The back-checking procedures which were carried out met the requirements of the Market Research Society Interviewer Card Scheme.

After clerical inspection, coding and data entry, key data were edited by computer and corrector by reference to the questionnaires. In the course of tabulation weights were used to allow for sampling variation.

France

The fieldwork of the consumer study was done by SOFRES (Paris, France) under 2,385 respondents in November/December 1989.

The survey was incorporated in a omnibus survey 'Enquêtes Statistiques Periodiques'.

The survey was based on a representative sample of adults, i.e. males and females aged 19 or more. They were selected in sampling points by a random location method. France was divided into five types of agglomeration: rural agglomeration, 2,000 - 20,000 inhabitants, 20,000 - 100,000 inhabitants, more than 100,000 inhabitants and Paris and surroundings.

Data processing took place by the computer programme 'QUANTUM'.

Questionnaire and results

I would now like to ask you some questions about drinks.

SHOW CARD K1

Q.1 I am going to read out a list of drinks. Please take your answer from this card to tell me how often on average you have drunk these drinks in the last twelve months.

RESULTS in United Kingdom (sample size 2000)

	daily	several times a week	once a week	about once a month	once or twice a year	not at all/ not stated
. Beer (lager, bitter, ale)	4%	20%	15%	10%	7%	44%
. Soft drinks, e.g. lemonade, mineral water, fruit juice	29%	32%	16%	8%	3%	13%
. Wine	2%	9%	18%	19%	13%	40%
. Sparkling wine incl. champagne	0%	1%	3%	9%	28%	58%
. Fortified wines or vermouth, etc. e.g. Port, Sherry, Martini	1%	2%	5%	10%	24%	57%
. Spirits, e.g. Brandy, Whisky, Gin	2%	6%	12%	16%	20%	44%

RESULTS in France (sample size 2385)

	daily	several times a week	once a week	about once a month	once or twice a year	not at all/ not stated
. Beer (lager, bitter, ale)	5%	9%	13%	18%	16%	40%
. Soft drinks, e.g. lemonade, mineral water, fruit juice	47%	22%	13%	9%	3%	7%
. Wine	26%	9%	15%	13%	5%	33%
. Sparkling wine incl. champagne	0%	0%	3%	24%	51%	21%
. Fortified wines or vermouth, etc. e.g. Port, Sherry, Martini	0%	3%	15%	27%	20%	34%
. Spirits, e.g. Brandy, Whisky, Gin	1%	1%	5%	15%	18%	61%

Q.2b And how many of these litres (Amount given in Q.2a) were white wines ?

(If percentages, please convert into litres!)

(If "no white wines", please insert "0")litres of wine

RESULTS

	France	F.R. Germany	United Kingdom
Sample size	1585	2263	1201
Litres of white wine			
0	42%	9%	17%
1	17%	7%	17%
2	11%	7%	11%
3 - 5	15%	18%	17%
6 - 10	7%	21%	13%
11 - 20	4%	18%	13%
21 - 30	2%	7%	5%
31 - 40	1%	3%	2%
41 - 50	1%	3%	4%
over 52	1%	7%	2%

Q.3 SHOW CARD K2

On which of these types of occasion do you drink (any) wine the most often?

ONE CODE ONLY

	France	United Kingdom
Sample size	1585	1201
During meals at home	48%	47%
With meals in restaurants	15%	25%
When relaxing at home/or watching TV	17%	19%
In bars/pubs	19%	5%
Other (Code and write in)	0%	4%
Not stated	1%	1%

Q.4 When you drink wine (Ocation give in Q.3) do you prefer wine which is ...?

READ OUT:

	France	United Kingdom
Sample size	1585	1201
. Low alcohol (8-9.9% alcohol volume)	13%	9%
. Intermediate (10-11.9% alcohol volume)	62%	53%
. A high alcohol wine (12% or more alcohol volume)	23%	29%
Not stated	2%	9%

Q.5a SHOW CARD K3

European wines are divided into quality categories. Which of these categories have you heard of?

Q.5b Do you think that European wine laws allow producers to add sugar or "must concentrate" before fermenting wine as a way of increasing its alcohol content?

yes 1 continue with Q.5c
no 2 continue with Q.6

	France	F.R.Germany	United Kingdom
Sample size	1585	2263	1027
Allowed	22%	40%	37%
Forbidden	74%	59%	34%
Not stated	4%	1%	29%

Q.5c	Q.5a heard of		Q.5c allowed to add must concentrate/sugar			
	France (1585) Yes No	UK (1201) Yes No	France (353) Yes No	F.R.Germany (907) Yes No	UK (378) Yes No	
French table wines	91% 9%	76% 24%	69% 31%	78-86% ^a 14-22%	62% 38%	
German table wines	7% 93%	73% 27%	35% 65%	59-65% ^b 35-41%	60% 40%	
Italian table wines	34% 66%	65% 35%	49% 51%	-	57% 43%	
Spanish table wines	21% 79%	63% 37%	45% 55%	-	56% 44%	
German quality wines ('QbA') from designated regions	5% 95%	32% 68%	21% 79%	48% 52%	31% 69%	
German quality wines with special attributes (e.g. Kabinett, Spätlese, Auslese)	2% 98%	31% 69%	20% 80%	23% 77%	33% 67%	
French quality wines which are 'Appellation d'origine contrôlée' (AOC)	82% 18%	36% 64%	48% 52%	36% 64%	32% 68%	
Italian quality wines which are 'Denominazione di origine controllata' (DOC)	14% 86%	22% 78%	31% 69%	40% 60%	28% 72%	
Spanish quality wines with the term 'Denominacion de origen' (DO)	9% 91%	21% 79%	28% 72%	-	27% 73%	
Not stated	2%	14%	-	-	21%	

^a All imported table wines and country wines resp. thought to have sugar or must concentrate added

^b German table wines and country wines resp. thought to have sugar or must concentrate added

Q.6 SHOW CART K4

Here are some statements other people have made about the addition of sugar or must concentrate. Please read them and tell me which one comes closest to your own opinion? There is no right or wrong answer, it's just opinion we want.

ONE CODE ONLY

RESULTS

	France	F.R. Germany	United Kingdom
Sample size	1585	2263	1027
. Wine, in general, should not have sugar or must concentrate added to it	62%	58%	27%
. I think it is acceptable to add sugar or must concentrates to ordinary /everyday wines but not to those of higher quality	18%	27%	25%
. If a slight increase in the alcohol content due to adding sugar or must concentrate results in a better tasting wine, I would accept this procedure for all wines	15%	14%	30%
Not stated	5%	1%	18%

Q.7 "ASK ALL"

SHOW CARD K5

Taking your answer from this card. What bearing would you say alcohol content has on the quality of the wine?

ONE CODE ONLY

RESULTS

	France	United Kingdom
Sample size	1585	1201
. The quality of wine increases in direct proportion to the alcohol content	20%	14%
. Alcohol and quality of wine have no connection	52%	41%
. When the alcohol content is lower, the other components, (e.g. bouguet, minerals and acids) become more important for the quality of the wine	12%	12%
. Good wines need a high alcohol content and a lot of other components	8%	12%
Not stated	8%	21%

Q.8 SHOW CARD K6

The current European wine laws allow the addition of sugar and must concentrate to wine as a way of increasing the alcohol content.

How important is it to you if this addition is printed on the label of the bottle? Please tell it for (a) sugar, (b) must concentrate.

RESULTS

	France		United Kingdom	
	Q.8a SUGAR	Q.8b MUST CONCENTRATE	Q.8a SUGAR	Q.8b MUST CONCENTRATE
Sample size	1585	1585	1201	1201
Very unimportant	4%	4%	19%	18%
Less important	6%	6%	6%	7%
Neither important nor unimportant	6%	8%	22%	23%
Fairly important	27%	26%	20%	19%
Very important	56%	55%	25%	23%
Not stated	1%	1%	8%	9%

PART III

ASPECTS OF CONTROL OF THE ENRICHMENT OF WINE

by

**P. Dupuy
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PREFACE

This part of the report on the enrichment of wine in the EC deals with the aspects of control. It is the result of cooperation between the final editors of the economic study, DE HOOGH and KLEIN ESSINK and the final editor of the technical study DUPUY. Within the group of experts on the economic and oenological aspects of enrichment of wine in the EC, the absence of experts on wine (enrichment) control was very much regretted. When the studies started in March 1988 it was intended to consider the relevant economic and technical aspects of the control of wine enrichment in the economic study and the technical study respectively. Later it was decided to publish a special part on the aspects of control. For that reason the editors attended a meeting of the Management Committee on control in the wine sector, organized in Brussels in October 1989. Several experts in the field of control in the different Member States explained the current specifically national problems as to the control of enrichment of wine and illuminated the problems a ban on the use in wine-making of sucrose could entail.

1. INTRODUCTION

In controlling the enrichment of wine, the process should be inspected as to the following conditions:

- that the grape must to be enriched contains the required minimum potential alcoholic strength;
- that the enrichment does not exceed the prescribed limits regarding the increase in alcoholic strength and volume;
- that no forbidden means of enrichment are applied;
- that the application of concentrated grape must whether or not rectified, subsidized by the Community, is carried out in compliance with the regulations.

In Chapters 2 and 3 it will be discussed whether the control data required by the responsible inspecting authorities in the Member States and at Community level can be obtained, and by what control instruments. On the basis of this inventory, the effectiveness of the control system with regard to the present functioning of the control of enrichment of wine is analyzed in Chapter 4. The possible consequences of a ban on the use of sucrose as a means to control enrichment are outlined in Chapter 5. In the last chapter the main conclusions are given with respect to the control aspects of wine enrichment. Attention is also paid to considerations and recommendations of the study on the economic aspects of the enrichment of wine in the EC (Part II, Section 6).

2. ORGANIZATIONS OF CONTROL

2.0 Introduction

In principle, the power to control the EC wine market policy, to expose and take to court frauds committed at the expense of the communal budget, lies with the national administrations. They exercise control on behalf of the Community. The Commission specifically has to fulfill its overall responsibility to implement the communal budget, to check the quality of the national control and to try and guarantee that the way in which frauds are dealt with by the national authorities, will be fully in the interest of the Community.

The Member States, for example, have a duty to check if wine is enriched only in areas where this is allowed, and if, in defiance of communal regulations, the maximum extent of enrichment is not exceeded.

However, also the importance of control exerted by wine producers themselves should be stressed. In order to export wines to countries within or outside the EC sometimes such a 'self-control' on applied production techniques is required from the producer or the producers' organization.

In the report of the Commission Budgetary Control of the European Parliament on management problems in the vintage year 1983/84 and the production of artificial wine, including wine poisoned with methanol (Doc. A2-45/87), the following statements were made with regard to the control at national level:

- "the supranational character of many financial mechanisms of the Community has led to a supranational economic criminality which the decentralized control, investigation and prosecuting system cannot combat;
- the irregularities and frauds which cut into the Community's budget are for a large part concentrated in the Member States where the administrative structure is relatively weak and the jurisdiction less firm".

A breakthrough in unifying the control in the wine sector can be achieved by the implementation of Council Regulation 2048/89 of 19 June 1989 laying down general rules on control in the wine sector. This regulation is intended as the basis for the Community's control system (see also Section 2.4).

2.1 F.R.Germany

In the F.R.Germany the Bundes Ministerium für Jugend, Familien, Frauen und Gesundheit (Federal Ministry of Youth, Family, Women and Health) is in charge of the wine control. At Federal State level several Ministries are responsible for the implementation of the Wine Law and related questions of interpretation, and the co-ordination between the Federal States. The organization of the control of wine in the Federal State of Rheinland-Pfalz can illuminate the control system in the F.R.Germany (Hoffmann and Engel, 1989).

In Rheinland-Pfalz the Ministry of Environment and Health is responsible for the prementioned issues. All other aspects related to the control of wine are under the authority of the Bezirksregierungen (regional governments) and the Chemischen Untersuchungsämter (Chemical Research Institutes). They are responsible for the control of all foods. In order to assist these authorities the Ministry of Environment and Health established the so-called Zentralstelle für Weinüberwachung (Central co-ordination of wine control) on 1 May 1989. This organization regulates the stake or controllers and it collects data such as transport and harvest documents. In the F.R.Germany the supervision of all activities in the wine sector, from vineyard to consumer, is exercised by 50 controllers of whom 24 are active in Rheinland-Pfalz. At farm level they exert two forms of control:

- . Time-period control: all transactions of a farm in a certain period of time are controlled.
- . Production controls: a certain product or group of products are controlled with the help of the wine book keeping and by means of chemical analyses.

Samples from production firms, trade and food companies are at random collected by the wine controllers. They also check if the book keeping is in line with the law, and they are responsible for the analyses of the samples to be carried out by the Board of Investigations and wine-tasting. In this way all regulations of the Wine Law can be checked.

The controllers cooperate with the so-called amtlichen Prüfungsbehörden (official examination authorities) in combating fraud, with the official examination of quality wines. The official examination authorities come under the Ministry of Agriculture. The wines submitted to these authorities are chemically analyzed. To examine the enrichment of wine, analyses such as the Martin method (See Section 3.2) are carried out.

The accompanying application form provides information about the origin, specific gravity of the sugar content (° Oechsle), means of enrichment applied and extent of blending. The sugar content (measured in ° Oechsle) is the basis for the characterization of the harvested grapes in the different quality categories. This is then the basis for the final classification of wine. In Section 3.1 the registration of the cellar book keeping is further illuminated. During the harvest wine controllers check at random this cellar book keeping. The registered sugar content is compared with the natural sugar content and acidity of samples that are taken by the controllers themselves. In this way a reference system of the natural wine quality is established.

2.2 France

In France there are three main areas of enrichment control, namely checks on the vineyards, on the wine-making process and on transactions connected with the means of enrichment (Dubos and Montaigne, 1989).

The inspection of vine planting and the production of table wine from the grapes of these vines is the responsibility of the Office National Interprofessionnel des Vins (ONIVINS). In the case of vines for the production of VQPRD controls are undertaken by the Institut National des Appellations d'Origine des vins et eaux-de-vie (INAO). The Direction Général de la Concurrence, de la Consommation et de la Répression des Fraudes (DGCCRF) and the Direction Général des Impôts (DGI) have the task of controlling the production of wine. Some of the areas they control are: the use and storage of raw materials and means of enrichment, the oenological practices and the final product (the wine).

The control on transac-	1983/84	1984/85	1985/86	1986/87
tions (transport and stor-				
age) of means of enrich-				
ment, i.e. sucrose and				
(R)CM, falls under the				
responsibility of the DGI,				
which is also responsible				
for collecting a special				
tax (0.8 FF/kg) on the use				
in wine-making of sucrose.				
Every year the DGI publishes				
statistics concerning the number				
of inspections carried out and				
warrants made.				

Source: Dubos and Montaigne, 1989.

It is obvious from this scheme that the number of controls by the authorities has increased by approximately 17% in the period 1983 - 1987.

2.3 Italy

In Italy, checks to combat fraud in agricultural and food products are undertaken by a large number of organizations of which the Ministry of Agriculture and Forestry, the Amministrazione Sanitaria and the Ministry of Finance are the most important (Ventura and Millucci, 1989). The Ministry of Agriculture and Forestry concentrates on the protection of the genuineness and quality of agricultural and food products and on ensuring honest trading practices. The Amministrazione Sanitaria (local and regional health centres run by municipalities or the Ministry of Health) is mainly involved in hygiene and health aspects. The Ministry of Finance, of course, directs its efforts towards the reduction of fraud in the fiscal area.

In order to co-ordinate more efficiently the activities of the various organizations combating fraud at local, provincial and national level, a Committee was founded in 1965 in which all the authorities involved are represented (Presidential Decree no. 162/65). Under the stipulation of Act no. 462/86, a Central Inspectorate for Combating Fraud has been installed which has considerably more power than this coordinating Committee. The Inspectorate is part of the Ministry of Agriculture and Forestry and is responsible, among other things, for checking whether the regulations concerning the transport of sucrose are followed.

2.4 European Community

The implementation of control on EC regulations on behalf of the common organization of the wine market has always been in the hands of the Member States. The co-operation between the control authorities within one Member State and between those of different Member States is very laborious. Regulation 2048/89 will give control authorities the possibility to demand relevant information in other Member States. Such a request can be made directly to the responsible authority in that Member State or can be passed on to a similar organization in the other Member State via the appointed national coordinating organization. This coordinating organization passes the request on to the control authority concerned. Should this procedure fail, the request can then be passed on via the EC control authority, which has yet to be founded.

Under Article 3 of this regulation, Member States are required to take the necessary measures to improve the means of checking whether the rules in the wine sector are being obeyed, especially (for this report) those aspects listed below:

- harvest, production and stock declaration;
- the holding and marketing of wine-sector products which are not put up, including the establishment and use of the documents accompanying their transport, and the keeping of registers;
- the destination and use of concentrated grape musts, whether or not rectified, qualifying for aid;
- verification of the raw materials used for wine-making;
- oenological practices, including the holding and marketing of products used for the processing of wine-sector products;
- the enrichment of grapes, musts and wine and the holding and marketing of sucrose, concentrated grape must and rectified concentrated grape must;
- the preparation of concentrated grape must and rectified concentrated grape must including the production of the basic material employed.

3. INSTRUMENTS FOR CONTROL OF ENRICHMENT

3.0 Introduction

The instruments used to control the enrichment of wine have either an administrative or an analytical character. In combination these instruments should be sufficient to prevent fraud in wine enrichment. Administrative instruments are used to check cellar book-keeping and other documents such as those accompanying the transport of means of enrichment. The analytic control makes use of physical and/or chemical analyses and is, in most cases, applied to the final product (the wine). It is an instrument for control that offers the possibility to both wine producing countries and those (Member States and countries outside the EC) where no wine production takes place to state whether or not fraud has been committed in wine production.

3.1 Administrative control

The first thing that has to be investigated in the overall control of wine enrichment is whether the grape must to be enriched contains the required minimum potential alcoholic strength (see Section 1). This type of control is frequently carried out in the F.R. Germany. This is related to the way in which German wines are classified, namely on the basis of the natural sugar content of the grape. If this content is over a certain level, the so-called Q.b.A.m.P. wines can be produced. This wine is usually sold at higher prices than the Q.b.A. wine which is made of grapes with a lower sugar content. By definition, Q.b.A.m.P. wines may not be enriched, so, before the wine production starts, a decision has to be made regarding the type of wine one wants to make. The instruments to check this are the cellar book-keeping, called the so-called *Herbstbuch* in the F.R. Germany, and the sugar book-keeping. In the *Herbstbuch*, introduced in 1982, the wine-grower has to administer the following within 48 hours after wine production has begun: the volume of grapes harvested, the natural sugar level of the grapes, the sort of wine that is being made, applied quantities of sugar for enrichment, the storage place, etc. The sugar book-keeping must state the bought and applied quantities of sugar and the place of storage.

In the Federal State Rheinland-Pfalz, the control authorities have yet another instrument to check the Q.b.A.m.P. wines for illegal enrichment. Three days before the start of the production of Spätlese wines (a Q.b.A.m.P. wine), the wine-growers from that area are obliged to report their production plans to the public authority, i.e. the village or town municipality. This report is called the 'Drei-Tages Meldung' (Three days declaration).

To a certain extent, the wine-growing inspectors can see immediately from examining the books whether or not there have been any irregularities in the wine production. In many cases, the declared natural sugar content of the grape can simply be compared with that of other wine-growers in the neighbourhood. This can also be checked at a later stage with the aid of copies of the Herbstbuch that have to be handed in to the control authority concerned before a certain date.

In France and Italy the wine-growers are also obliged to undertake a cellar book-keeping that has to be handed in to the authorities at a certain time. In these two countries also, the start of the enrichment process has to be reported to the same authorities two days in advance. The declaration has to include the type and volume of the wine, the natural potential alcoholic strength, the quantity of sucrose or (R)CM applied, the time of the enrichment and the storage place. Apart from the cellar book-keeping, a sugar book has to be kept. Besides, the wine-grower is obliged to declare each year the acreage of the vineyard and the volume and type of wine produced. The second and third aspects that have to be examined in the control on enrichment of wine, are the extent of enrichment in terms of volume and alcohol strength, and the application of means of enrichment in wines and in areas where this is not allowed. Both aspects can be checked to a certain extent with the aid of the cellar and sugar book-keeping and the report of the intended enrichment or abstinence of enrichment.

An instrument of control that can be helpful in this respect is the document accompanying the transport and storage of sucrose and (R)CM. In Italy, quantities of sucrose larger than 10 kg must be accompanied by such documents. In France this quantity is fixed at 25 kg.

The accompanying documents for circulation of (R)CM and the obligation to report to the authorities 48 hours before its use, give the control authorities the possibility to conclude whether or not the (R)CM will be applied according to the rules laid down for the subsidy given.

3.2 Analytical control

A completely satisfactory analytical control of enrichment in wine should clearly indicate which means has been applied and to what extent. A number of methods are available by which the use of sugar to increase the alcohol strength of wine can be investigated. Some of these aim at the overall composition of wine. By adding sugar to must the alcohol/extract ratio changes compared with non-enriched wine. But the alcohol/extract ratio also varies according to how the grapes are processed into wine (pressing and maceration) so that this comparative method only yields limited evidence. The required data have been collected by the Service de Repression des Fraudes (D.G.C.C.R.F.) for the so-called Casier Vinicole. Methods based on the alcohol/extract ratio were frequently used at the beginning of this century, but these are gradually going out of date. At the end of the seventies, in the report of Murret-Labarthe addressed to the French Ministry of Agriculture (1978) it was proposed to establish a so-called Casier Mustimétrique in order to collect data on the natural sugar level of grapes from the wine growing areas in France. With this the alcoholic strength found in the wine and the natural sugar level could be compared via a data bank. For a thorough study on the background of Murret-Labarthe's report about the enrichment of wine and the reactions of all parties concerned in the French wine-growing sector, reference should be made to the report by Dubos and Montaigne on the economic aspects of the enrichment of wine.

The methods current at the moment are based on isotope analysis of the alcohol in wine. The presence of various isotopes in wine and their mutual relationships can indicate the origin of the wine and whether enrichment has taken place with sugar or alcohol. Some examples of such a method are the well-known technique developed by the French professor Martin and the method recently published by Rossmann and Schmidt (1989). In this report only the so-called Martin method will be discussed.

This method, based upon Site-Specific Natural Isotope Fractionating and Nuclear Magnetic Resonance (S.N.I.F./N.M.R.), uses a comparative analysis of the resonance value and ratio of deuterium and hydrogen in alcohol obtained by fermentation of sugars such as grape sugar, beet and cane sugar. When the D/H ratio of the wine under analyses is compared with the average D/H ratio of wines originating from the same region and being produced in the same vintage year the amount of sugar used for enrichment can be qualified (Martin et al. (1986 and 1988)). There is a significant difference between the way in which deuterium and hydrogen are divided over the

assimilating plants (maize and cane) and from plants such as beetroot and vine which follow a C3- or Calvin photosynthetic path. In the same way the distribution of the carbon and oxygen atoms and their isotopes (^{13}C and ^{18}O) over the ethanol molecule ($^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$) varies with the plants and places where they have been cultivated.

When only one type of sugar, e.g. cane or grape sugar, has been used for enrichment the D/H ratio in the Martin method is not fully conclusive. In those cases when it is suspected that a mixture of sugars has been used for enrichment the Martin method can be combined with a $^{13}\text{C}/^{12}\text{C}$ analysis, although the quantification of the level of enrichment is then less precise. At present, it is impossible to detect the use of (R)CM for enrichment by means of the Martin method.

Another disadvantage of the Martin method is the necessity of keeping a comprehensive documentation of previous analyses and of an analysis of non-enriched wines from the same place of origin and vintage year. Such a data base has to be established to be able to interpret the analyses. Uptill now the private company EUROFINS in Nantes (France) is the exclusive owner of a data base in the EC.

As far as the detection of the extent of enrichment is concerned, it has to be stated that, unfortunately, the Martin method (like other methods) still allows the existence of a relatively large range of uncertainty. This imperfection weakens the control if it has to be proved that there has been a fraud in applying (subsidized) concentrated grape must, whether it has been rectified or not. As a matter of fact, such a quantitative determination is also indispensable in checking wine that is handed in for distillation, for, if the wine has been enriched, the distillation price should be lowered.

A relatively important quality control is also needed on the manufacturing of (R)CM. By adding sucrose to (R)CM, the producer can make considerable profits. Three methods to uncover this fraud are available in this case. The first is a separating technique based on liquid and thin layer chromatography. A limitation of this method is that controls should be carried out before the sucrose has been inverted.

Another method makes use of the meso-inositol level of rectified concentrated grape must. The level of this compound in RCM should amount to 80 mg per 100 grammes of sugar, according to Versini et al. (1984). When the meso-inositol level is lower, it can be assumed that sucrose has been added. The third method is the Martin method described above. In this case the (R)CM solution has first to be fermented into alcohol.

4. CURRENT PROBLEMS OF CONTROL

The present-day problems concerning the control on enrichment of wine are not new. Ever since the use of sucrose in wine-making was legalized in the different countries of the present EC, it has been very difficult to control whether all conditions concerning enrichment, namely the natural sugar level, the means of enrichment applied and the extent of enrichment have been fulfilled.

In view of the possibilities and limitations of the analytical methods of control described in Section 3, it has to be concluded that the extent to which the demands mentioned above can be controlled by means of present-day, modern techniques (especially by the Martin method) is insufficient. This was confirmed by various control experts from different Member States during a meeting of the Committee of Management of the Wine Market, held on 17 October 1989 in Brussels. The administrative control on enrichment would then have to compensate for the shortcomings of the analytical control techniques in order to have a full proof control system at their disposal. The instruments for this are the cellar and sugar book-keeping of the wine-growing firm, the obligation to report enrichment, the documents accompanying the circulation of sucrose and (R)CM, and the report of sugar sales to the wine sector made by the sugar industry. The intensity and frequency with which all these documents are controlled determines, in the end, the effectiveness of the administrative control system.

The estimate of the illegal use of sugar in the wine sector can give an indication of the actual effectiveness of the control system. The estimates mentioned in Part II, Section 5.1 of the illegal use of sucrose for enrichment purposes in the F.R.Germany, France and Italy are deplorable.

One may as well come to the conclusion that the administrative controls are insufficiently effective to turn the fraudulent use of sucrose into a risky activity. The report by the Audit Office on the budget year 1987 (C 338/88), in which research into the control on the application of subsidized (R)CM in enrichment of wine was included, is hardly more positive. The Office finds that "the services responsible for the control of the measures concerning enrichment of wine and the preparation of grape juice, were seldom able to perform physical checks, although the regulations of the Community stipulate that the authorities have to be informed prior to the commencing date of the subsidized activities. This was especially the case in France and Italy, where most of the Community expenses

in connection with these measures are incurred". The Office continues with "in some cases, it was found that the registers did not follow the standard model and were badly kept up. Essential data, such as the origin of the concentrated must, were not given in some cases. In other cases, the procedures by which the authorities were informed prior to the commencement of activities, were unsatisfactory".

5. IMPLICATIONS OF A BAN ON ENRICHMENT BY SUCROSE

As an illustration of the importance of the control on the use of sugar in wine-making, in respect of a possible ban on the use of sucrose, the report of the Commission for Budgeting Control of the European Parliament (A2-45/87) is quoted: "The most important problem of abolishing the use of sucrose is the control: it is difficult to define whether sucrose or (R)CM is used in wine-making. This is one of the reasons why the Council did not accept the proposals of the Commission which favoured a ban on the use of sucrose and the abolishment of the aid measure of Art. 14. With the new Martin method it can be exactly determined which means of enrichment is applied, and, with this, one of the objections of the Council has disappeared".

In Section 4 it has been concluded, however, that the control system and the implemented methods of control are insufficient at this moment to ascertain fraudulent activities in the enrichment with sucrose. Furthermore, it turns out to be impossible to detect enrichment with RCM via analytical methods such as the Martin method.

For this reason, things being as they are, a ban on chaptalization will not ease the problems concerning the controllability of enrichment activities. On the one hand, such a ban makes the control of the observance of the conditions with respect to enrichment with subsidized (R)CM unnecessary, assuming that the subsidy is abolished. On the other hand, intensifying the national control on fraud with sucrose will then become even more necessary, for with the abolition of subsidies on (R)CM, the profitability of the use of sucrose will increase enormously.

So, in case of a ban on chaptalization, the number of controls on enrichment of wine will have to increase strongly. This will increase the financial demands on the Member States in the form of: increasing the number of inspectors, acquiring new control equipment, appointing analysts, enlarging the administrative civil servant apparatus that has to deal with the results of the controls. Second, the control will then have to be aimed more at the natural sugar level of the grape. As was shown in Section 4, the extent of the use of (R)CM cannot be checked in a physical and/or chemical way. The degree of enrichment can only be found if the natural potential alcoholic strength (e.g. measured in ° Brix or ° Oechsle) of the grape is compared with the final alcoholic strength of the wine. The proposal by the Frenchman Murret-Labarthe, made in 1978, to

found a data bank with information on the local and regional natural sugar levels of grape varieties in each vintage year is worth examining again within this framework.

If the control on the enrichment of wine is to have some chance of succeeding, a strict control on the manufacturing and circulation of (R)CM is an absolute necessity.

6. CONCLUSIONS AND RECOMMENDATIONS

The control system has been evaluated on the inspection of the extent to which the following aspects have been observed: the natural sugar level of the grape, the means of enrichment applied, the extent of enrichment and, finally, subsidies granted on the use of (R)CM in the enrichment of wine. The administrative and physical/chemical instruments of control (including the Martin method) have turned out to be insufficiently effective to make fraud in enriching wine a risky activity.

A ban on chaptalization will considerably aggravate the demands made on an effective system of control. There are two reasons for that. In the first place, the illegal use of sucrose will become very attractive if a ban on chaptalization coincides with an abolition of the subsidies on (R)CM. In the second place, as enrichment with RCM cannot be proved analytically, the control would have to be completely administrative.

To adapt the present control system to these higher demands, large national and communal financial contributions will have to be made in order to extend not only the administrative control system but also the physical/chemical analyzing equipment.

This recommendation can be extended to the economic study (See Part II, Section 6). In the conclusions and recommendations of this study the introduction of stricter limitations on enrichment as to the minimum alcoholic strength, the increase in alcoholic strength by enrichment and the maximum alcoholic strength is recommended. The effectiveness of such limitations highly depends on the control system.

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PART IV

MAIN CONCLUSIONS OF THE STUDIES

MAIN CONCLUSIONS OF THE STUDIES

1. Enrichment of wine by adding sugars to the must is an authorized technique frequently used by wine-growers in the European Community.* It is one of the oenological practices to align the quality, and in the case of concentrating must also the quantity of the wine being produced with the legal requirements and the demands of the market.
2. By means of enrichment, wine-growers are able to compensate for a deficient natural sugar content caused by incidentally and structurally unfavourable growing circumstances.
3. In the past decades enrichment activities within the EC seem to have gradually increased. In many wine-growing areas of the Community, enrichment is an indispensable oenological practice. In other regions it is often an economically attractive practice. In large areas of the EC, in fact, the authorization for enrichment has become the rule rather than the exception.
4. From a technical point of view, rectified concentrated must (RCM) as a means of enrichment is an almost perfect substitute for sucrose. With respect to the chemical composition of the enriched wines and the taste of that wine, RCM and sucrose turn out to be fully interchangeable. Wine producers who have never used RCM before will have some problems as far as the implementation of the oenological practice of enrichment by RCM is concerned. In the longer run, those problems can be overcome.
5. The possibility to supplement the natural sugar content has the effect that more attention is given to increasing the yield per hectare, when considering plant variety and cultivation improvements, than to the percentage of sugar in the grapes. The various measures that directly or indirectly make enrichment attractive, have the effect, therefore, of increasing the surplus problem in the wine sector.
6. Chaptalization (enrichment by sucrose) is certainly not the only enrichment method that has a negative influence on the market balance. Enrichment in general, regardless of the means used (sucrose, CM or RMC), is of more decisive importance

* except Italy, Greece and Spain

in the long run because of its effect on the technological developments in wine cultivation.

7. A ban on the use of sucrose will decrease the surplus of table wine in the short run, because a part of the must will have to be used for the production of (R)CM. However, the savings on distillation costs will be negated by the costs of subsidies on the (R)CM used to replace sucrose. Moreover, within a couple of years, this initial production-reducing effect will be overtaken by the ongoing trend for higher yields.
8. By abolishing the subsidies on (R)CM in combination with a ban on chaptalization, the profitability of enrichment will be considerably reduced. This will have painful negative consequences on income levels which will be spread unevenly within the Community. It is doubtful whether the Community is in an authoritative enough position to enforce this type of policy, especially in those regions where chaptalization is a long standing and authorized practice.
9. A ban on chaptalization will aggravate the demands made on an effective system of control. There are two reasons for that. First, the illegal use of sucrose will become very attractive if subsidies on (R)CM are abolished. Second, as enrichment by RCM can not be proved analytically, the control will have to be completely administrative.
10. The above considerations make it obvious that banning sucrose is not a recommendable policy to curtail surpluses of table wines. It is more advisable to design measures that either reduce the necessity to enrich wine or that make enrichment economically less attractive, irrespective of the means of enrichment used.
11. By making enrichment economically less attractive, wine-growers will be stimulated to pay more attention to the natural quality of their wines. Quality is, however, not only determined by the natural sugar content but also by other components such as the acid content and the aroma.
12. The need for enrichment should be reduced by tightening up the restrictions with respect to the minimum alcohol levels and to the maximum extent of enrichment.
13. The present control system is insufficiently effective to make fraud in enriching wine a risky activity. Large national and communal financial contributions have to be made in order to improve and extend both the administrative control system and the

physical/chemical analyzing equipment. This holds even more so if enrichment, as recommended, is further restricted.

14. It is desirable to regulate the compulsory distillation in such a way that it will no longer be profitable to enrich wine by home-produced concentrated must. Producers would then be unable to avoid the full penalty on high yields, and the aim of the measure to link distillation to the level of yields would be fulfilled.
15. An in-depth research is recommended into the perceptions and the preferences of consumers with respect to the alcoholic grade of wines, the enrichment of wine and the means of enrichment used. Such a study provides a basis for discussing the idea to have non-enriched wines distinguished from enriched wines all over the Community and for printing on the label of the bottle the addition of sugars.
16. It is very much to be regretted that it has been impossible to introduce the viticultures in Greece, Spain and Portugal as being integral parts of the common wine producing sector into this study and its conclusions.

European Communities — Commission

EUR 13239 — Agrimed research programme
The enrichment of wine in the European Community

Edited by: *J. De Hoogh, G. Klein Essink and P. Dupuy*

Luxembourg: Office for Official Publications of the European Communities

1991 — X, 151 pp. — 16.2 × 22.9 cm

Agriculture series

ISBN 92-826-2000-X

Catalogue number: CD-NA-13239-EN-C

Price (excluding VAT) in Luxembourg: ECU 12.50

According to Article 20, paragraph 1 of Regulation 822/87 the European Commission was commissioned to undertake a thorough study of the possibilities of using concentrated grape must, whether or not rectified, and sucrose for enrichment. This study should in particular cover the oenological aspects of the various permitted methods, the economic aspects of the use of sucrose or concentrated grape must, whether or not rectified, and the methods for monitoring this use.

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