MODERN APPROACH TO THE RED GRAPE QUALITY MANAGEMENT

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Summary
The recent years were marked by a significant development in the laboratory analytical methods for the analysis of the polyphenols in the red grapes. However, for the measurement at the receiving or in the vineyard the developments were rather limited.
The present work reports the practical results of a modern approach to the evaluation and management of the quality of the red grapes.
Thanks to the development of a new system for the polyphenol measurement right in the vineyard, it is possible to measure in real time the phenolic capacity of single vineyards, the effects of growing methods and the ripeness curves.
If this system makes possible a quality based assessment, in order to determine the quantity, it is still necessary to rely on extraction methods: a lab procedure has therefore been optimized to extract polyphenols through the use of microwaves, greatly assisting in the samples management and consequently increasing the laboratory analytical capacity.
On completion of this system, the aid of a quick measurement of the polyphenols quality at the receiving point allows the selection of all grapes in relation to their polyphenols quality, ahead of vinification.
The evaluations right in the vineyards, together with the quick responses in both laboratory and receiving point, enables the selection of the grapes and the vineyards; this allows to determine an actual value to the red grapes, in turn essential for the vineyards selection and to optimize the oenological techniques.
The information gathered will than enable to intervene in the vineyard to maximize the potential of the various areas, furthermore, on the market, it is possible to separate the fresh grapes from the dry, in order to determine the price.

INTRODUCTION

As a rule, the degree of technologic ripeness of the grapes is traditionally rated through the trend of the ration sugar contents over acidity. In addition, for the red grapes, there is the evaluation of the phenolic ripeness. This is the moment of maxim concentration of anthocyanins and is related to the total content of polyphenols. The phenolic compounds, found in the grape skin and seeds, affect the final quality of the wine adding to the taste development, colour, aromas and structure. Knowing the phenolic maturity enables also to correctly choose the maceration condition in order to optimize the process in relation to the characteristics of the raw material.
The assessment of the content of anthocyanins and tannins in the grapes during the ripening, enables us to follow the evolution of this compounds and to classify both the vineyards and the plots, according to the phenolic features. The phenolic ripeness matches the simultaneous achievement of an important potential in grape pigments and their diffusion ability in the wine.
To determine the total phenolic content there are various methods which pinpoint the phenolic ripeness and therefore the harvest date, when the strengths of the phenolic compounds is at the maximum level, in the hypothesis that the extraction is carried out always in the same conditions.
Various researchers have developed methods of analysis applicable in the laboratory environment, while others developed the use of spectroscopy parameters in the UV, VIS and IR spectra. Based on the experience obtained in wines, the ICV has drafted a sensory analysis method of the grapes, easy to learn, quick, and especially helpful in the final ripening stages when the sugar build up slows down and the aromatic and phenolic content rapidly evolves. The various laboratory

methods to establish the phenolic stage are precise, but they require a good deal of effort and are not quick enough to allow the use of the results in real time. Furthermore, during the sample preparation process, there is numerous variables difficult to standardize, like the blending, the separation of seeds, pulp and skin, the solvent used for the extraction and the sample storage. It is also possible to have analytical artefacts.
In recent years, for the analysis of polyphenols in red grapes, we have had a good development of laboratory analytical methods, but very little research has been dedicated to fast methods and innovative applications.

OBJECTIVES

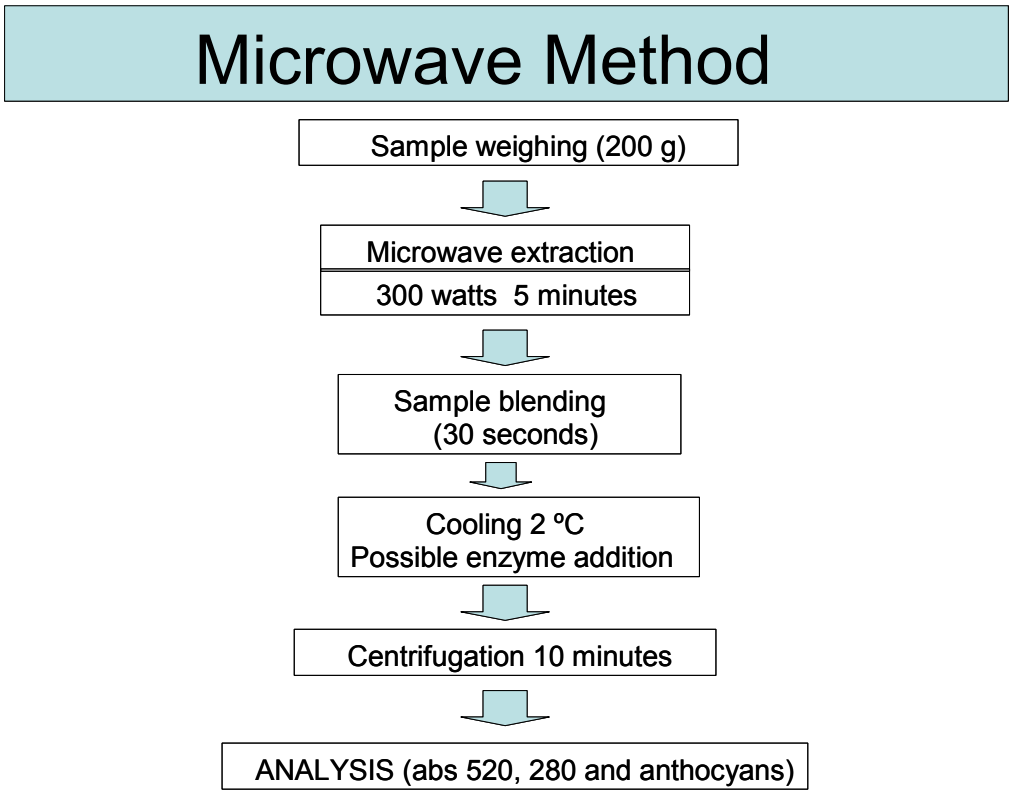
The present work shows the more significant results of a multi-year research that has taken place at the University of Udine with the close cooperation of the production sector. Particularly, to better understand the quality of the grape phenolic content and optimize its management, targeted interventions in the vineyard, at the delivery point in the winery, and in laboratory, have been devised.
The objective is to refine the knowledge and to manage the phenolic potential in the red grapes, through the careful integration of the different investigative methods, particularly the application of new procedures able to perform accurate analysis in a short period of time.

EXPERIENCES IN THE WINERY LABORATORY.

A method has been optimized which is fast, reliable and easy to use, so that it is possible to monitor the levels of anthocyanins, polyphenols (absorbance unity at 280nm) and the colours intensity (absorbance unity at 520nm of the extracts), on a greater number of samples compared to the traditional methods.
Keeping the analysis methods and the instruments unchanged, so as to compare with the traditional methods, the procedure of extraction was modified by implementing the microwaves in order to achieve a fast extraction.
For the experiments, a simple microwave oven has been used; the effect is related to the electromagnetic phenomena which the microwaves induce in the water content of the plant tissues. The microwaves radiation on the grapes induces all the water's molecules to a rotating motion. This in turn produces friction and therefore heat. The heat causes the explosion of the cells, because of the pressure of the water changing in to steam, making easy for the phenolic matter to be released in short time.
The trials were conducted on the Valpolicella varieties of Corvina, Corvinone, Rondinella, Molinara, and the international varieties of Merlot and Cabernet.
An important aspect is the choice of the container to be used when working on the berry without the stem. After studying the performance of various containers used (ceramic, plastic, polypropylene) and observing other types of polypropylene containers of different shape, we concluded that the best characteristics (thermal resistance, limited deformability, airtight qualities, diameter and perimeter which allow the positioning of the grapes on a single level) are given by a square polypropylene container.

Sample of grapes before (left) and after (right) the microwave treatment

The sample of grapes is made of about 400 g of berries without stems.
The sample is divided in two equal parts. On one the traditional reference analysis for the polyphenolic substances (anthocyanins and total polyphenols) are conducted; on the other the extraction is made via microwaves.
Once established the standard trial container, it was time to find the right power (watts) over time, avoiding the evaporation caused by heating.
The conclusion, after processing the data, is that the critical point, in the radiation of microwaves, is always a power of 300watts over 5 minutes.
Once the microwave extraction procedure was established, the comparison of this method with the traditional one, using solutions at pH1, pH 3.2 and methanol acid, has been performed..



First the grapes are separated and cleared of the stems.
The berries are then placed in a polypropylene container making sure they are well spread at the bottom of it. This is necessary because an overlapping of the grapes would result in a different rate of extraction, obtaining non homogeneous data.
The extraction is made at 300 watts over 5 minutes always with a lid on.
Following the “extraction” phase, the mass is first placed in a blender for 30 seconds and after in to a test tube or similar container. The sample is then cooled at room temperature, left for 15 minutes, then centrifuged at 3000rpm over 5 minutes. Only if the sample is not clear, the procedure can be modified, with the addiction, before blending, of a high standardized dose of pectolictic enzyme in order to quickly obtain a clear sample. The sample is then analyzed for anthocyanins, total polyphenols (Abs 280nm) and Abs 520nm.

Real examples on Merlot

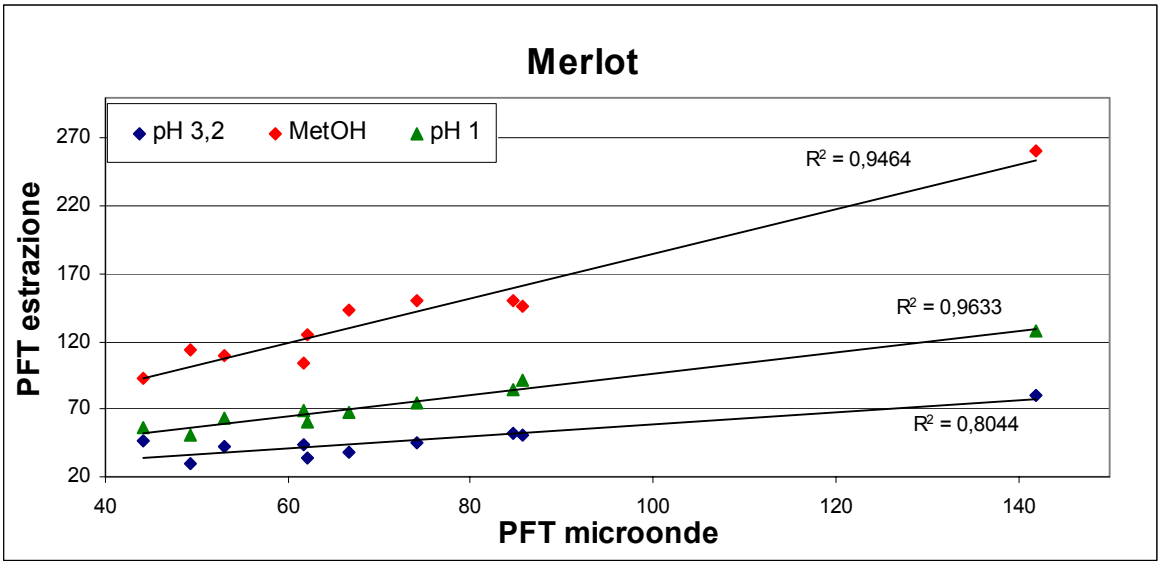


Figure 1 Polyphenols extracted: microwave (x) vs. solvent (y) extraction

Figure 1 shows the evaluation of total polyphenols through direct measurement of the absorbance at 280nm on a sample obtained with extraction with solvents and with microwaves. The data underline the significant connection between the two methods with regard to the total polyphenols content. Similarly the analysis of the anthocianins (Figure 2) shows significant relations between the new proposed methods and the traditional one, with highly significant correlations factors.

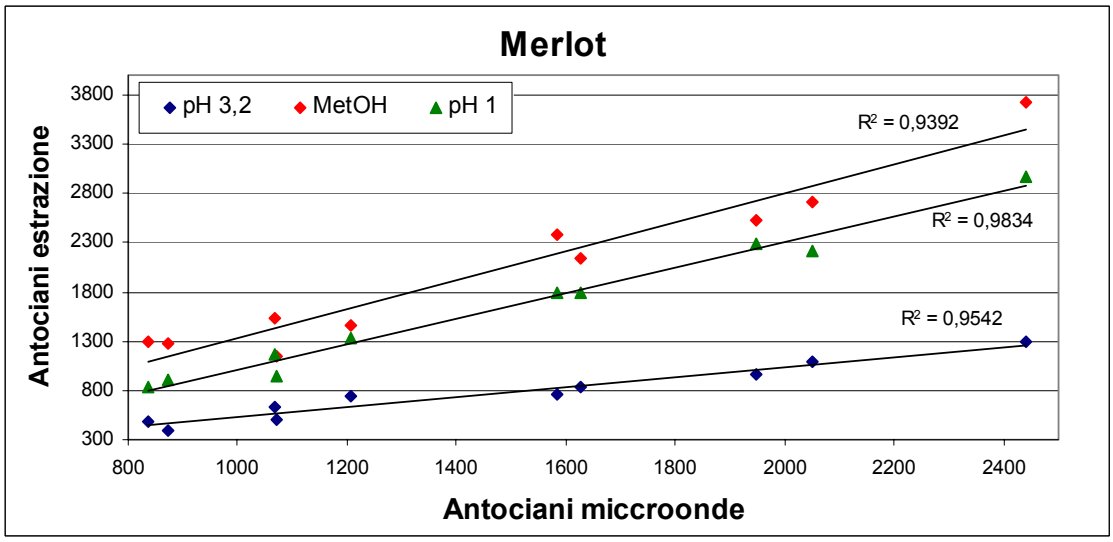


Figure 2 Anthocianins extracted via microwaves (x) and through solvents (y)

Finally the relation between the direct measurement of the absorbance at 520nm and the anthocyanins, for both extraction methods (Figure 3), confirms the effectiveness of the extraction via microwaves and the significant correlation between the absorbance measure and the anthocyanins contents.

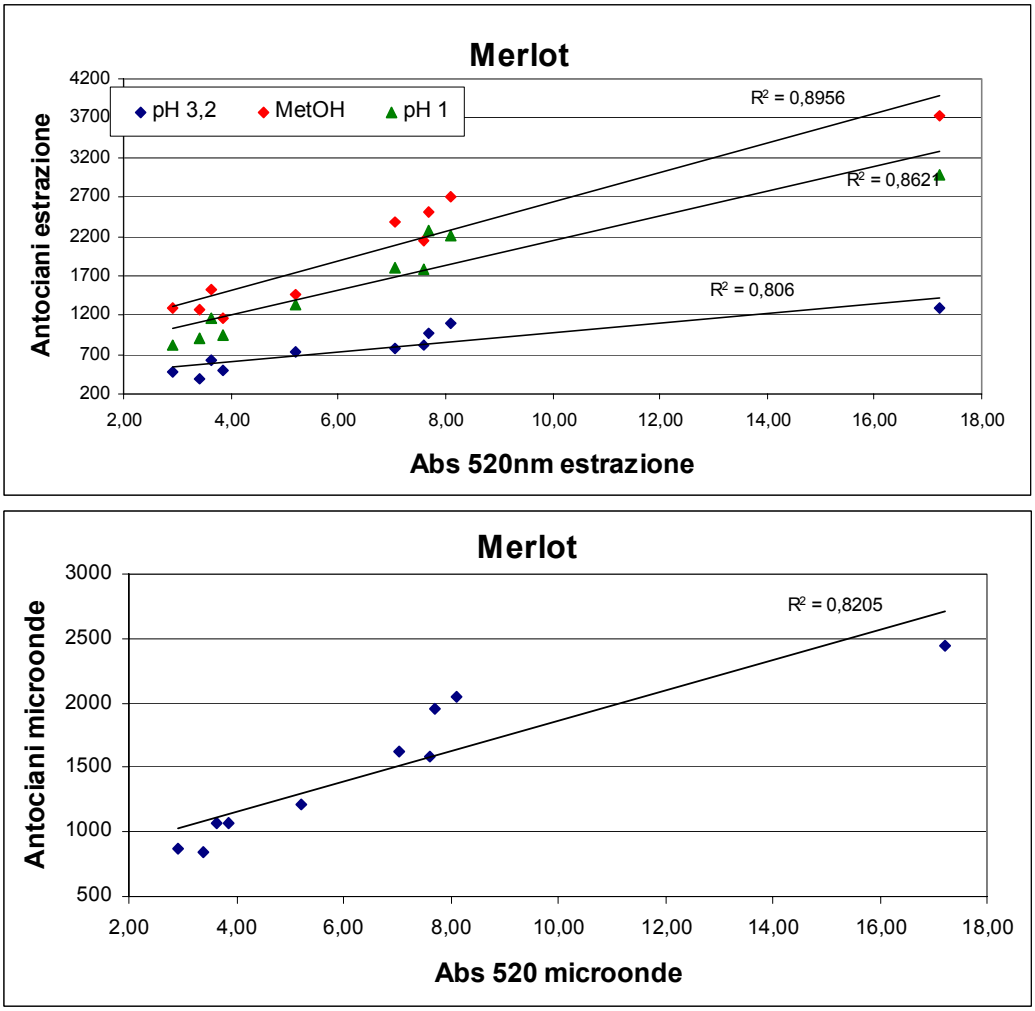


Figure3 relation between direct measure of Abs 520nm and the Anthocyanins.

It is therefore confirmed the validity of the extraction with microwaves as an additional method to simplify the analysis in the laboratory harvest.

Possible applications of the microwaves extraction method

- Elimination of time involved in extracting with solvents
- High number of samples processable per day
- Chance to check many vineyards
- Easier management of the maturity curves
- Availability of quantity index of the analyzed polyphenols
- Possibility of replacing the analysis of the anthocyanins with only the measure of Abs 520nm

A second phase of the work regarded the development of a system able to give in laboratory a global phenolic index to estimate the ripening curves of the grapes, on mashed grapes through the direct and immediate evaluation of the reflectance.

The procedure includes the acquisition of a reflectance signal exclusively in the visible spectrum. The measurement were conducted, contrary to all the other methods used until now, directly on the mashed grapes, and the combined colorimetric information was analyzed by a photodiode, weighted and calibrated until the same information which would be achieved from a typical extraction curve of polyphenols with traditional methods are obtained. To homogenize the product a normal kitchen blender was used in a standardized operating mode.

About 35 g of blended product have been used for the analysis with the reflectance equipment. The cuvette for the sample has a lid to avoid external light interference. Everything is then connected to a processor. Immediately after the preparation the blended grape sample is placed in the cuvette and the reflectance measurement is carried out. The time between the blending and the reading is less than a minute and the reading itself takes a few seconds. The data obtained from the validation of the method on different red grapes cultivars, made it possible to elaborate an index of global phenolic maturity called MT (Maturity Trend), which significantly reflects the maturity curve of phenols of the red grapes.

Cultivar	Coefficienti di determinazione (R2) tra l'indice MT e i polifenoli				media	SD	CV %
Merlot	0.9554	0.9920	0.9703	0.8682	0.9465	0.0470	4.97
Cabernet Franc	0.7976	0.9239	0.8120	0.7768	0.8276	0.0570	6.89
Cabernet Sauvignon	0.9102	0.8438	0.9170	0.8750	0.8865	0.0294	3.31
Pinot Noir	0.9852	0.9791	0.9775	0.9878	0.9824	0.0042	0.43
Rondinella	0.8980	0.8920	0.9849	0.9279	0.9257	0.0368	3.97
Corvina	0.9485	0.9186	0.8694	0.8791	0.9039	0.0317	3.50
Corvinone	0.8980	0.8920	0.9849	0.9279	0.9257	0.0368	3.97
Montepulciano	0.9875	0.9397	0.8982	0.9489	0.9436	0.0317	3.36
Sangiovese	0.9817	0.9676	0.9603	0.9689	0.9696	0.0077	0.79

Table 1 Relation between the MT index (grape mix reflectance) and the total polyphenols (extracted with solvents)

The trend of the phenolic maturity retraceable using the MT index is shown to be significantly interrelated with the total polyphenols and anthocyanins determined via the traditional extraction methods. The use of maturity gradients in laboratory allowed a significant calibration of the method for the practical application of the MT index.

The MT index, being significantly correlated with the polyphenols quantity (chart 1), shows to be a good compromise between anthocyanins and tannins and is therefore an ideal marker to express the evolution of the polyphenolic potential of the red grapes during ripening.

The proposed MT index, although does not give any indication about the quantity of the polyphenols concentration, allows to qualitatively define the trend of the phenolic maturity in very short time. After blending, the measurement, memorization and elaboration of the index takes a few seconds. All this together with the ease of use and the quickness of procedure, allow to avoid the use of traditional analysis techniques.

The possible applications, therefore, can be targeted to define the quality of the phenolic maturity trend, to establish the best time of harvest, to compare the vineyards with the same varieties, to the create databases helpful for the management of the vineyards, to improve the delivery process in big size wineries and to allow, considering the lack of laborious analysis, the process of far more samples also increasing the number of monitored vineyards. The Figure 4 shows two examples of ripening curves on Pinot Noir: highlighted are one case in continuous increase, and a second case with a final decrease in polyphenols.

The possible quantification of the polyphenols with traditional methods in laboratory can be therefore reduced to a sample near the harvest date, which will be decided with the only use of maturity trend.

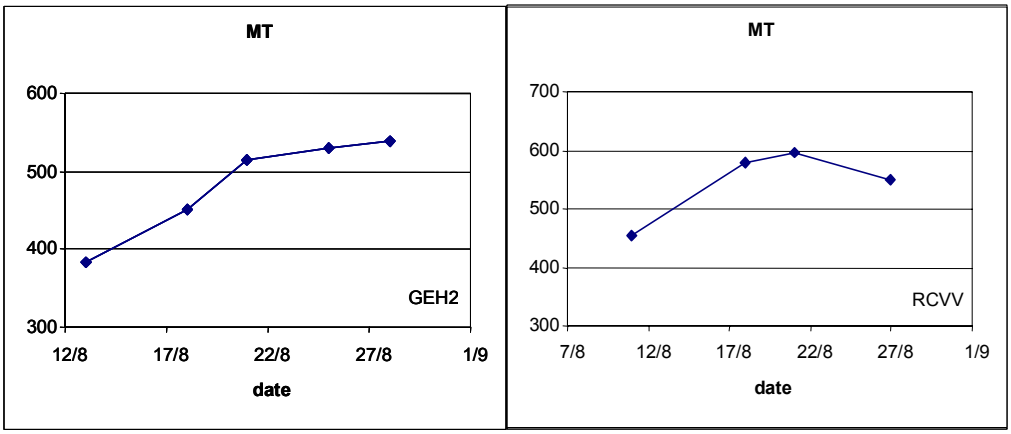


Figure 4: Examples of phenolic maturity curves elaborated with the MT index on two Pinot Noir vineyards in Bourgogne

Possible actual application of the reflectance laboratory method

- The end of time consuming extraction in laboratory
- High number of samples analyzed in any day
- The chance to check on many vineyards
- Quick redaction of maturity curves
- The only preparation needed is the grape blending, followed by the reflectance measurement (few seconds)
- Only one quality index is obtained (MT – maturity trend)
- Index function of variety

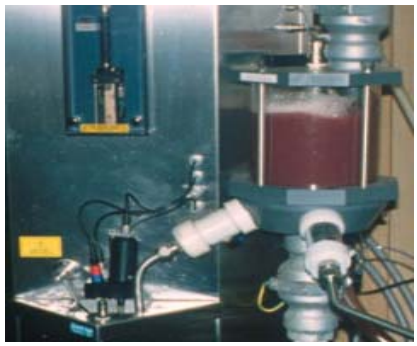
On the light of the countless analytical possibilities available for the laboratory, it is important to ponder over some factors, before choosing the analysis method/s; is important to consider in particular the following aspects:

What we need to determine
Choice of method
Costs evaluation
Consider the number of samples manageable in one day
Sampling procedure and timing in the vineyard
Sample Preparation
Prompt results
Accuracy of the data
What the information is needed for (vineyard-winery)

Even though the information obtained in laboratory can be exhaustive, there is the necessity to determine in real time the phenolic quality, right at the delivery point in the cellar.

EXPERIENCES AT THE RECEIVING POINT IN THE WINERY

To satisfy the need of the productive world, a new system able to measure the phenolic potential of the healthy grapes at the receiving point by testing a colorimetric parameter of reflectance on the sampled must and used to evaluate the sugar content, has been fabricated. (International patent, Universita' degli Studi di Udine).



QF measurement on the must sampled from the red cart of red grape

The analysis procedure is based on the light analysis. By processing the colorimetric parameter a number indicated as QF is obtained, which magnitude is between 90 and 200 without expansion limits for value below 90 and above 200. Inside this range are all the varieties with differentials from 10 to 50, big enough to discriminate between phenolic qualities.
For the QF measurement is used the same cloudy must used for the sugar content measurement, generally obtained by probing directly from the transport container.

The developing of the system has shown the existence of a significant correlation between some colorimetric parameters of the cloudy must, obtained by probing, and the polyphenols in the skins of the same grape from which the must was extracted (Fig 5). The correlation are significant even with analysis made by extraction at very low pH, therefore we can say that the QF parameter is not influenced by the degree of cells maturity.

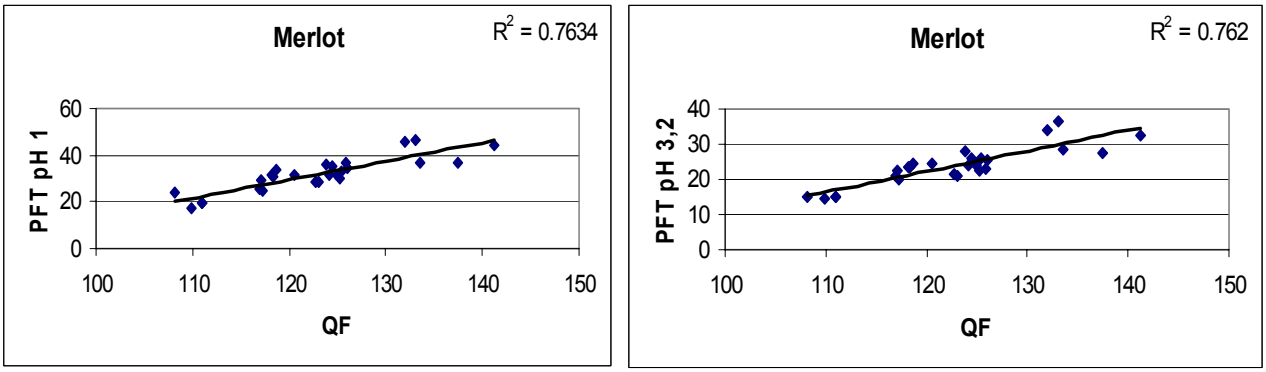


Figure 5 Correlation between QF (on must) and total polyphenols analysis with solvent extraction.

Thanks to this correlation it is possible to classify the grapes on the bases of their phenolic potential already at the receiving point, with a real time analysis, which allows the oenologist to optimize the vinification process according to the measured quality class. It is also possible to use the information at end of harvest to improve the pricing of the grapes and to improve the vineyard management; the application has been tried also on grapes mechanically harvested.

For every variety the differential of the QF is wide allowing the correct classification of the grapes at the delivery in the winery.

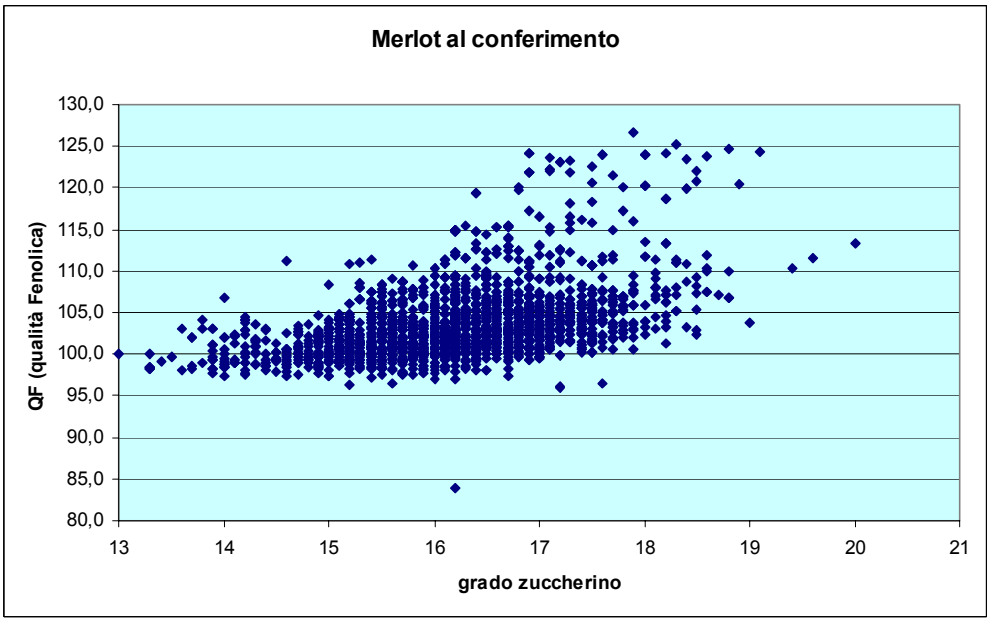


Figure 6. Sugar content and QF at co-op delivery point.

Among the data gathered it is interesting to note the connection between the value of the phenolic quality and the other parameters measured at the point of delivery.
In particular, no significant relation was found with the must acidity and furthermore no interesting relation emerged with the sugar content value determined by refractometry on the must (Fig. 6).

This last notion is very important because highlights the lack of connection between polyphenols and sugars, as one would possibly expect at least on very ripe grape. As a matter of fact, even in viticulture environments where is generally witnessed a strong building up of sugar (Sicily, Australia, etc) the lack of connection between sugars and polyphenols is evident at harvest time.
As an example, the table shows the data monitored in a big winery in which is confirmed the lack of correlations between sugar and phenolic quality. This result is the most interesting because it shows that it is indispensable to evaluate the polyphenols degree as well as the sugar content, to be able to determine with better precision the quality of the grapes.

In this situation is obvious that the pricing system need to be revised according to the phenolic content, in particular the growers delivering grapes rich in polyphenols but not so much in sugar, are greatly penalized.
The study of the agronomic and microclimatic factors characterizing the better cases (high QF and high sugar), can be used to pin point interventions in areas where, on the contrary, insufficient phenolic and sugar maturity is shown.
There are various solutions ranging from productivity checks to ad hoc pruning intervention to, in extreme cases, the cultivar replacement.

Not being an absolute measurement, but a differential one in the range of every single variety, it is obvious that the oenologist will have a working tolerance when using the QF parameter in the wine making, pricing, vineyard intervention, as well as using this classification system for the different harvest conditions, including the mechanical one, as already verified in some Italian and foreign experiences.
The parameter has to be used not as a single data but is based on the differences between data: this is of great advantage because one can apply the system to every situation.

The QF parameter is not easy to verify by the oenologist, generally for the lack of trained personnel, so various experiences were performed to localize the relation between the QF value and the colour intensity of the wine.

Cabernet Sauvignon	
QF at the receiving point	IC of the wine
100	3.8
110	8.1
120	12.5
130	16.9
140	21.3
150	25.6
160	30.0

Table 2 Example of correlation between phenolic quality of the grapes and the colour intensity of the wine obtained with a fixed vinification technique.

The table shows, as an example, the correlation between the phenolic quality and the probable colour intensity of the wine. Obviously the data refers to grapes vinified with the same technique in order to have comparable results. It is obvious that changing the maceration technique can change the results, however it has been verified that against a significant difference of QF there are

corresponding differences in the IC of the wine, in a more or less wide proportion according to the maceration technique (Table 2).

From the collected data is established that the QF evaluation gives the chance to separately vinify the better grapes to highlight their quality potential, which otherwise would be dispersed and diluted with poorer quality grapes.
Interesting in the figure below, are also the results related to large scale vinifications in 2006 harvest. Together with the significant response on the colour of the wine, in the Valpolicella it was proved a response proportional to the QF also in relation to the organoleptic preferences (Figure 7). Even though the correlation it not direct, it is a factor to be taken in account to by the oenologist, in separating the grapes according to the final quality of the wine.

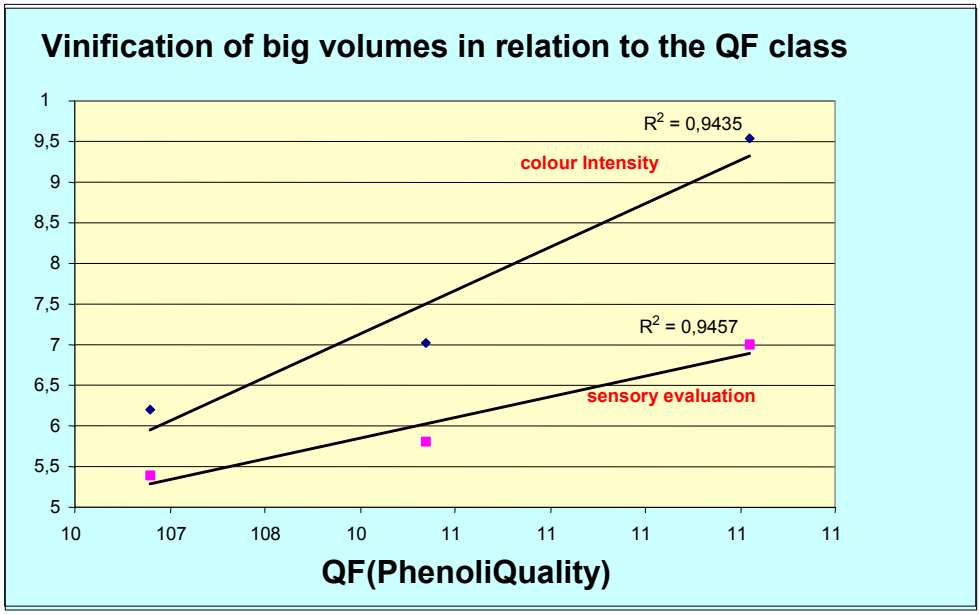


Figure 7 Experiences on vinifications of high volume split according to QF and wine quality (IC and sensory evaluation).

Possible applications of the QF system

- Objective monitoring of all the grapes
- Optimization of the oenological techniques
- Different vinifications according to the polyphenols
- Opportunity to control the grape price
- Data to be later used for the management of the vineyard
- Territorial map in relation to the phenolic maturity
- Zone mapping implementation

The weak stage however is the quality of the vineyard, which needs to be better and more rapidly evaluated.

THE IDEA FOR THE VINEYARD AND RELATED APPLICATIONS

With the present research an innovative spectroscopic method has been designed to directly check in the vineyard the potential phenolic content in the red grapes. The objective is to present the professionals with an instrument able to provide valuable information which can then be used for the maintenance of the vineyard, in view of optimize the maceration technique and the plant care. The goal of this work is also to find a fast and cheap qualitative parameter which will enable to forecast the total phenolic potential, without having to rely to long, laborious analysis almost only available in a laboratory.
The instrument manufactured (International Patent Pending, Caleano SrL/Verona/Italy) is made of a clamp with a light source in the VISIBLE which light the skin up, and a photodiode placed on the

opposite side, which attracts the light which goes through the skin. The data obtained, duly processed, gives an index proportional to the polyphenolic content in the skin. For this study, red grapes from representative wine areas in the world were used, sampled in North Italy, Chile and in Bourgogne (France). The tests were made in the harvests of 2004, 2005 and 2006.

In the picture: clamp for the measurement, shin ready to be analysed and testing operation in the vineyard.

The first step of the work was to verify the validity of the clamp system compared to the traditional methods of extraction and analysis.

Of every sampled variety, many berries were analyzed. Every berry was squashed between thumb and index finger, making sure not to tear the skin tissues. The skin was then used for the analysis. Later the skin of every berry is open and, using a cork borer, a circular incision with a diameter of 0.88 cm is made, resulting in a small disk of an area of 0.61 cm2. This procedure is needed to get samples with the same area and be able to compare the results on the extracts. The skin section with a known area is analyzed with the clamp to establish the quantity of light that can get through it, later the same skin is sent to the extraction and the traditional analysis.

The Table 3 shows the coefficient of determination between the value obtained with the clamp and the content of poyphenols, antocyanins and the Abs 520nm analyzed after skin extraction. The picture 8 shows the details of a comparative example between the measurement in the vineyard and the analysis performed in laboratory, with extraction.
The data are significant and it is possible to define a new index of phenolic maturity usable right in the vineyard to know the phenolic potential of the grape. The figure is a global index of polyphenols, its correlation with the total antocyanins and polyphenols makes it a tool both for the grower and the oenologist.
After many tests it was shown that the new index can be determined on the double skin, straight after having squeezed the pulp out.

Variety/test	clump vs anthocyans	clump vs Abs 520nm	clump vs IPT
Barbera	0.8199	0.7094	0.8230
Corvina ZVP21	0.8929	0.8779	0.9223
Corvina ZVP23	0.8099	0.8486	0.9257
Corvina ZVP1	0.8932	0.8968	0.9069
Corvina ZVP6	0.8904	0.9032	0.8959
Montepulciano	0.8304	0.8694	0.8369
Merlot	0.6363	0.4950	0.7840
Oseleta	0.8634	0.8691	0.9068
Rondinella ZVP1	0.7682	0.7860	0.8345

Table 3 Connections between direct measurement with clamp and the polyphenols obtained by extraction.

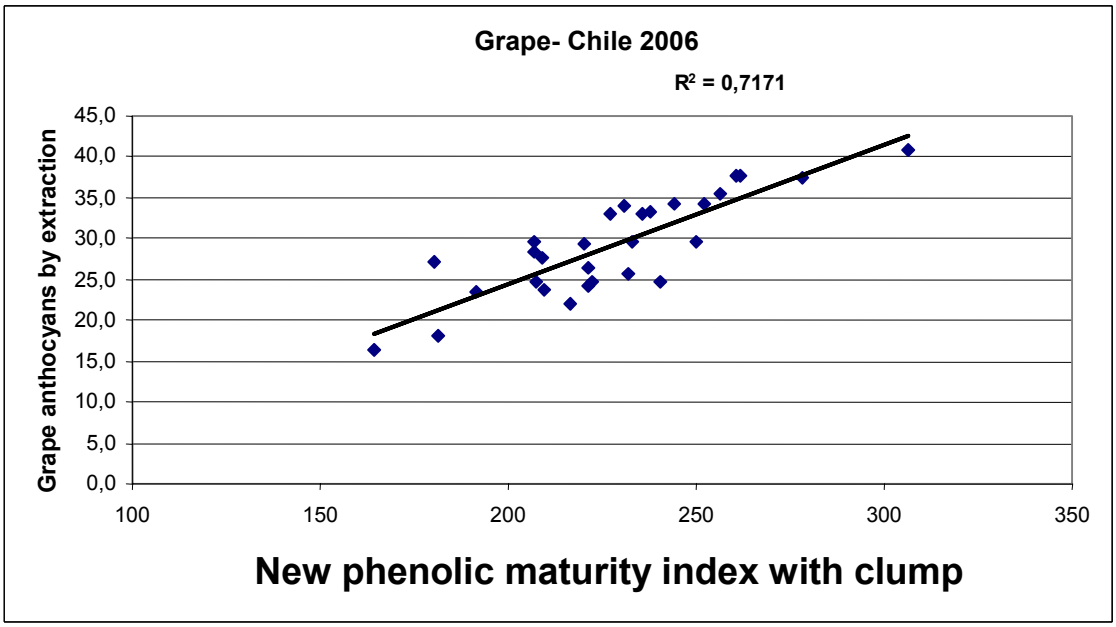


Figure 8 Example of correlation between the direct measurement with the clamp and the anthocyanins extracted.

We checked many maturity curves in several Companies. Figure 9 shows the maturity curves in a few varieties monitored by using the clamp. It is interesting to highlight that the results are similar to those obtained in the laboratory, except that direct analysis in made right in the vineyard, with no lab intervention whatsoever.

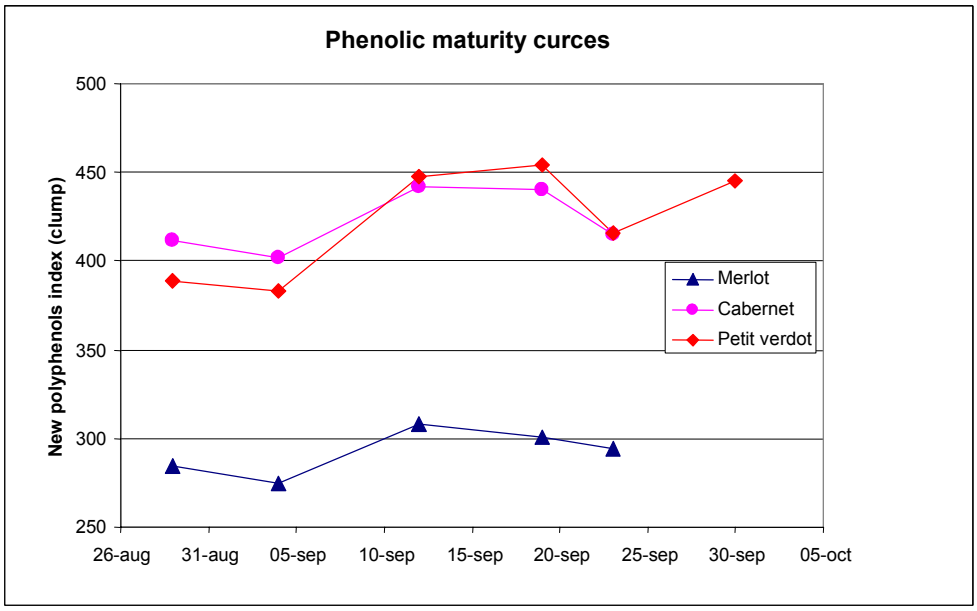


Figure 9 Evaluation of maturity curves with the clamp.

The variability of the measurement of different berries is related to the grape varieties and to the different ripeness of the berries in any bunch of grapes. The average time of measurement in a vineyard is 15 to 30 minutes according to its dimension; for every sample average results will be used. In any day is possible to process many measurement, with no need for the laboratory; in this way the end of sampling (the same needed for the analysis in laboratory) coincide with the end of the analysis.

On top of that the work on the 2006 harvest allowed the monitoring of different vineyards of the same grape variety on the same dates but different clones, as shown on table 4.

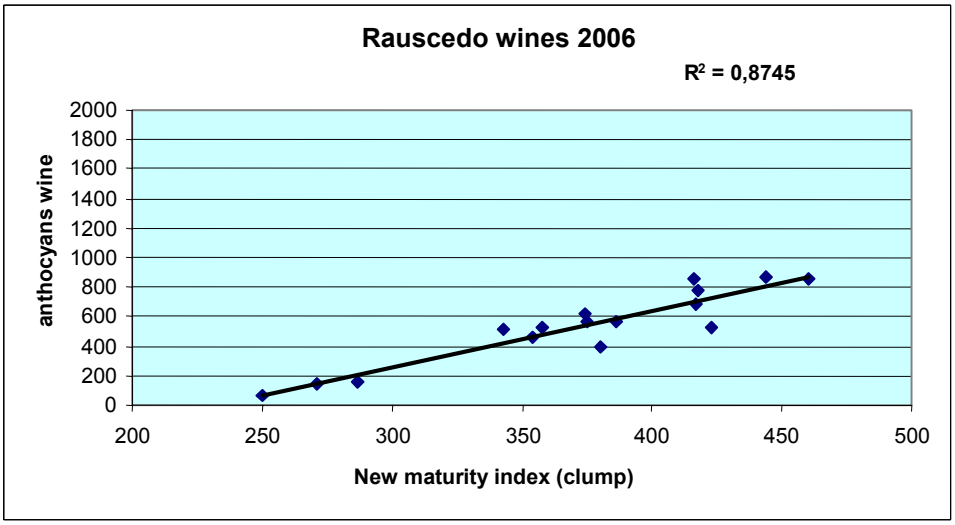
Pinot Noir	clump index
clone VCR 20	**303**
clone VCR 18	**326**
clone SMA 185	**305**

Pinot Noir	clump index
Vigneto Cailleret	**309**
Vigneto Pommard	**286**
Vigneto Clos des Ducs	**303**

Tab 4: direct comparison between clones among vineyards, with the clamp instrument.

Other tests show the effect of the grapes exposition, with an increase in polyphenols in the grapes exposed toward east compared to the side facing west.

This opportunity is therefore helpful to check right on the vineyards the effect of cultural practices, like the presence of grass between vine rows, watering, thinning and others on the increased of the polyphenols. On a practical level it is possible to monitor a vineyard in short time, obtaining an average on the total berries; also, to follow the maturity curves, the sampling of a berry always from the same side of the bunch accelerate the analysis timing, decreasing the number of sampled berries.
The data can be used straight away to determine the harvest period and to set the maceration techniques on selected grapes.
In the 2006 harvest, a series of micro-vinifications of red grapes were also made, the results were processed using the index measurement of the polyphenols directly in the vineyard with the clamp (Figure 10). The data shows the significance of the parameter and therefore the application of it, since the close relation between the quality of the grape in the vineyard and the quality of the finished wine.



Figuer 10 relation between the index obtained by claws in the vineyard and the anthocyanins in the wines.

Practically the measurement in the vineyards is made following this procedure:

- Instrument calibration (only once before measurements are taken)
- Take the grape berry and squeeze out the pulp with the fingers
- Put the skin in the space provided in the clamp
- Read the parameter of phenolic maturity (few seconds)
- Repeat the measurement for a representative number of berries and use the average data

- In about 15-20 minutes a vineyard or other entity (vine row, plot) is sampled
- Wash with water only once at the end
- To quicken the procedure and avoid the variability inside the cluster, is better to chose the berries always from the same location (ex from the tip of the cluster)

With this research it was possible to prepare an instrument enabling the evaluation right in the vineyard of the phenolic potential of the red grapes. With the simple measurement of the quantity of light going through the skin, is possible to quickly analyze and obtain spectroscopic information significantly correlated with the polyphenols in the skin. The analysis is immediate, it only needs the use of the skin to be placed in the clamp like instrument, which reads in few seconds the quantity of light. The average data is then used to make up the phenolic potential of the area or the row.

The analysis, for every variety, can be repeated and a maturity curve can be followed, in order to decide the best harvest time, all this without the need of laboratory analysis. The possible analysis of the polyphenols quantity will be done only once, near the harvest. It is furthermore possible to compare the different vineyards near harvest time, to select the ripest and schedule accordingly the harvest dates. It is also possible to check the effect of cultural intervention on single vineyard. With this system is therefore possible the fast monitoring on a large scale of the phenolic potential of different grapes allowing a thorough approach on mapping and will help the oenologist with the grape selection. It will then be possible to schedule the arrival of grapes and choose the best techniques.

The portable clamp system can easily be combined with precision systems (satellite readings and GPS) to limit the analytical necessity during the harvest periods.

Herewith are detailed some of the results and direct experiences on the vineyard, combined to satellite data and laboratory measurement of the vigour in the Valpolicella vineyard (Figure 11). The development of the analysis in the vineyard will improve the monitoring of ripeness in short time, on a large viticultural area. The combination with vigour parameters (Figure 12) will perfect in short time the study of the vineyard so as to manage the harvest days and enhance the cellars techniques according to the wine to be produced.

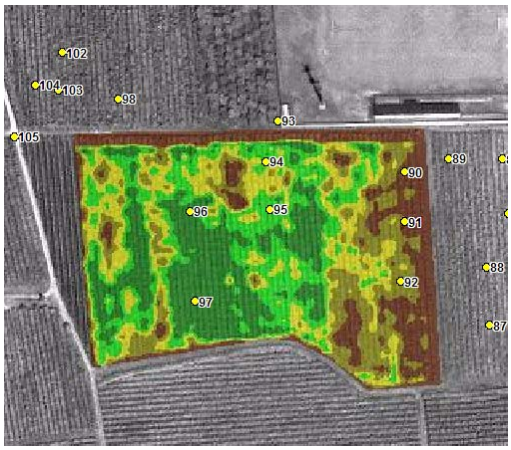


Figure 11 Satellite reading of a vineyard and processing of the spectra information in vigour indexes.

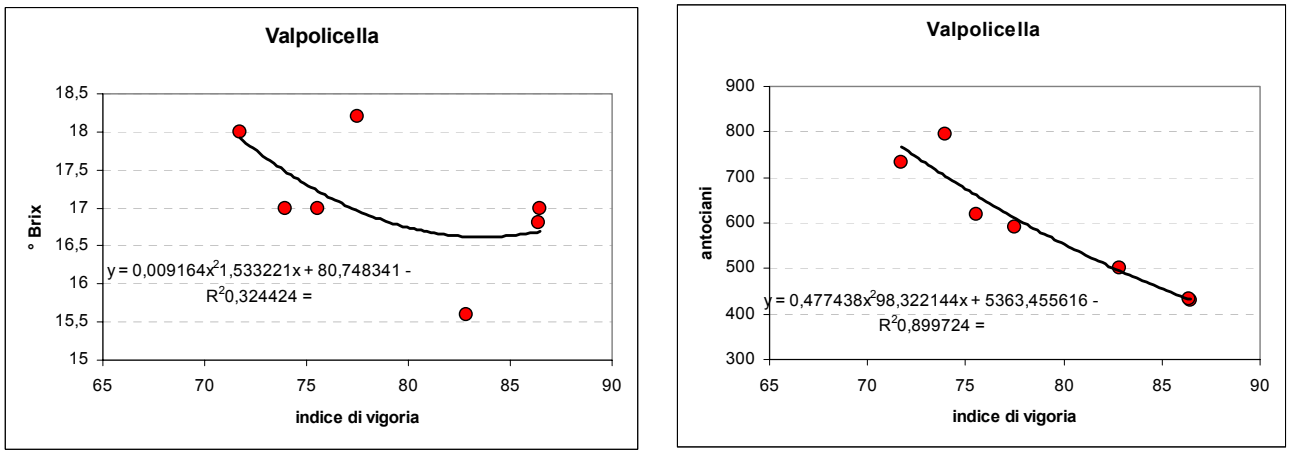


Figure 12. Correlations between the the vigour index from satellite reading and some quality parameters in the Valpolicella region.

Possible applications of the clamp for the polyphenols.

- Direct measurement of phenolic maturity index in the vineyard
- Immediate comparison amongst vineyards
- Immediate comparison amongst vine rows , plots in relation to cultural variables (watering, exposure, feeding, etc)
- Preparation of maturity curves straight in the vineyards
- Easy integration with sugar contents data and satellite reading for the study of the region and the management of the harvest dates
- Elimination of a great amount of laboratory analysis
- Application of mapping projects
- Conjunct use of the satellite reading for sampling according to vigour ranges (precision viticulture)
- Connection with the refractometric measurement

GENERAL CONCLUSIONS OF THE ESSAY AND PROSPECTS

A modern viticulture and oenology must integrate different methods, but especially enhance the direct checks in the vineyards to obtain the following quality aspects:

- Harvest schedule in the different vineyards
- Choice of vinification techniques according to the polyphenolic levels

Briefly, the results obtained over the years of activity in close co-operation with the professionals can be thus recapped:

- Better management of the viticultural mapping
- Maturity checks possible even for small Companies
- Better check in the vineyard and choice of the right harvest date
- The chance to manage many samples
- Reduction of laboratory activity (personnel, reactive agents, etc)
- Rational evaluation of grapes being delivered
- Best use of vinification techniques
- Better intervention on the grape price
- Better quality checks on drying grapes
- Planning grapes and wine

The direct evaluation in the vineyard (instrument with clamp), together with the fast procedure in laboratory and at the grape reception, will make possible the selection of vineyards and grapes, to rationally estimate the price of red grapes and to optimize the oenologic technique.

The total of the information allows the intervention in the vineyard to maximize the quality potential of the single areas of production and is also possible to distinguish on the market the fresh grapes from the dried, in order to correctly price them.

It will be possible to integrate the quality parameters, vigour and climatic information; in the next years, a great management of the ripening process will help the forecast, during the summer, of the quality and quantity of the grapes in a vineyard.

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