Comparison of the skin resistance of several grape varieties in relation to their physico-chemical properties

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Abstract:

Context and purpose of the study :

The purpose of this study is to compare the skin resistance (SR) of the grapes with physico-chemical propertiess using a stong dataset and multidimentional statistical analysis .

A recent study has shown the role skin resistance plays against pest invasion but skin resistance could be a useful agronomic parameter, for example in the choice of the type of winemaking, by influencing the quantity of juice during crushing and maceration.

Material and methods :

In this study we have used a hundred samples belonging to different vineyards of south of France (Aude) totaling twelve different grape varieties: Cinsault, Petite Arvine, Bourboulenc, Syrah, Carignan, Viognier, Cabernet Franc, Mauzac, Mourvedre , Merlot, Grenache N and Marselan. Each sample consists of fifty berries. For each berry of a sample, a skin resistance test was carried out (Penelaup Robot). For each sample twenty four physico-chimical variables were measured with traditional methods (Dubernet Laboratories): citric acid, gluconic acid, malic acid, tartric acid, total acidity, volatile acidity IRTF, amino nitrogen , ammoniacal nitrogen IRTF, assimilable nitrogen IRTF, calcium, copper, delta C13 IRTF, iron, glucose + fructose IRTF, glycerol IRTF, magnesium, manganese, volumic mass IRTF, phosphorus, potassium, sodium, % Vol IRTF, zinc and pH IRTF.

Results :

Thanks to our strong dataset, the results of this work demonstrate firstly a significant difference of the skin resistance depending on the grape variety and secondly that the skin resistance is a single parameter which cannot be directly explained by other physico-chemical variables.

We plan to complement the dataset with sensory analysis of the corresponding wines for each sample.

Keywords: skin resistance, variety, chemical properties, Penelaup, Laboratoire Dubernet.

1. Introduction

The objective is to develop a new measurement tool and a process that has not been used until now, to try to deliver new knowledge not included in the current state of the art.

This process consists of measuring the skin resistance (SR) of different varieties of grapes from various agronomic origins in order to quantify this measurement for each situation tested and to correlate SR with other physico-chemical analyzes, or with any other parameter of the grapes, or with any other known elements of the vine.

2. Material and methods

The Dubernet Laboratories provided the plant material among 96 different situations as well as the associated traceability. The grapes came from vineyards or chateaux located in the south of France (Aude).

These samples belong to the following grape varieties:

Cinsault, Petite Arvine, Bourboulenc, Syrah, Carignan, Viognier, Cabernet Franc, Mauzac, Mourvedre, Merlot, Grenache and Marselan.

For each sample, the following variables were measured with traditional methods :

citric acid, gluconic acid, malic acid, tartric acid, total acidity, volatile acidity IRTF, amino nitrogen , ammoniacal nitrogen IRTF, assimilable nitrogen IRTF, calcium, copper, delta C13 IRTF, iron, glucose + fructose IRTF, glycerol IRTF, magnesium, manganese, volumic mass IRTF, phosphorus, potassium, sodium, % Vol IRTF, zinc and pH IRTF.

The Serisud company has developed with INRAE the PENELAUP™ Robot (ABBAL and PLANTON, 1990). This robot was used to study the firmness of the berries (ABBAL et al, 1992 ; ABBAL et al, 1997). More recently a new version of Penelaup Robot was developped by INRAE to study SR and special indices were defined (ABBAL et al, 2020). Finally, in 2022 several engineers of Serisud company studied and modeled a new tool dedicated to SR allowing to work with a whole berry rather than on the pre-cut berry skin. A new software including new precision sensors and high speed micro processors were set up.

The measured variables were AF3 (ABBAL index, micro joules) and Fmax (maximum strength, newtons).

3. Results and discussion

First of all, due to the great number of physico-chemical variables provided by the Dubernet Laboratories, we tried to explain the 2 parameters of SR (AF3 and Fmax) by means of the physico chemical variables. For this purpose, we performed a multidimensional statistical test (Principal components analysis, PCA).

Looking at the PCA graph (figure 1) we noticed that the two main axis explain only 38% of the total statistical inertia, which is very low. We couldl just see some trends.

The two parameters of SR are close to the factorial axis number 2, as well as total TAV, Glucose fructose and density variables. If the inertias brought by these two axis were greater, the 3 variables TAV, Glucose fructose and density could have been considered as explanatory for AF3 and Fmax.

Then we analyzed the dataset using only the variables closest to AF3 and Fmax in the first PCA.

In this case, the explained inertia became significant. Nevertheless, the variables were located almost orthogonally to AF3 and Fmax (figure 2). So they could not explain neither AF3 nor Fmax so can we deduce that SR is a new and singular parameter of the grapes.

In a second step, we tried to analyze the data by grouping them by variety to see if SR depends on the variety .

The scores obtained using the ABBAL index (AF3) clearly show that SR strongly depends on the variety.

These original results were never before obtained and have never been published (Table 1) .

4.Conclusion

In this study, using an important dataset , we have measured a great number of physico chemical variables to try to explain the origin of the berry skin resistance.

This results clearly show that SR is a singular variable which cannot be deduced from any other physico-chemical variable.

Our results show important differences of SR ranging from 1 to 4 between the varieties of our dataset.

With that in mind, this study opens a wide field for future investigations to better understand the origin and the role SR plays in the quality of the grape and of the wine.

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Variety	AF3 (µ Joules)	Ranking
CinsaultM	1 751,76	
Petite ArvineM	1 871,21	
BourboulencM	2 437,50	
SyrahM	2 943,06	
CarignanM	3 142,11	
ViognierM	3 718,00	
Cabernet FrancM	3 786,67	
MauzacM	3 989,50	
MourvedreM	3 741,07	
MerlotM	3 842,00	
GrenacheM	4 440,43	
MarselanM	6 812,25	

Table 1 : classification of varieties according to the ABBAL index AF3.

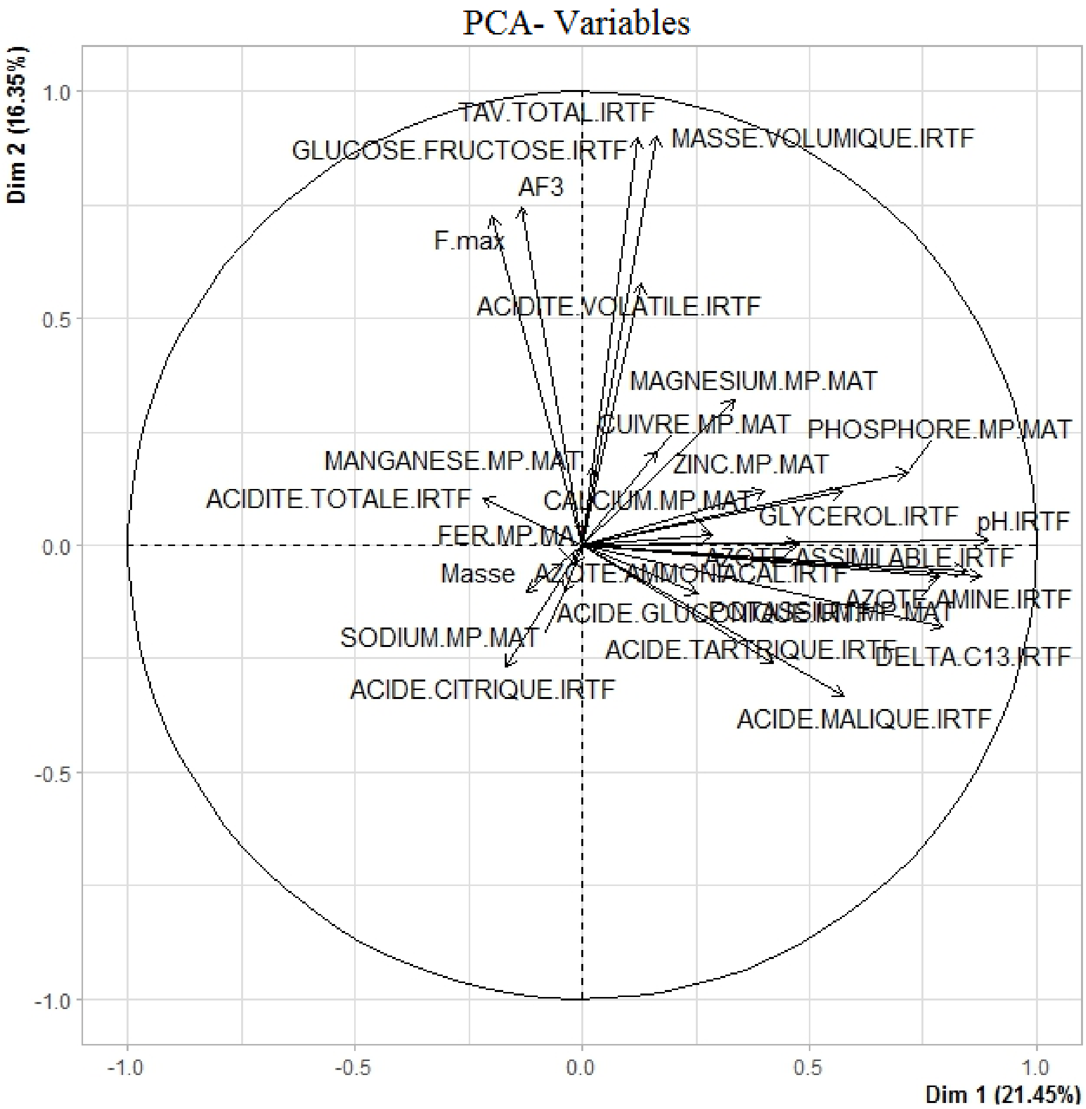

Figure 1 : multidimensional analysis (PCA). The first two principal axes explain only 38% of the total inertia.

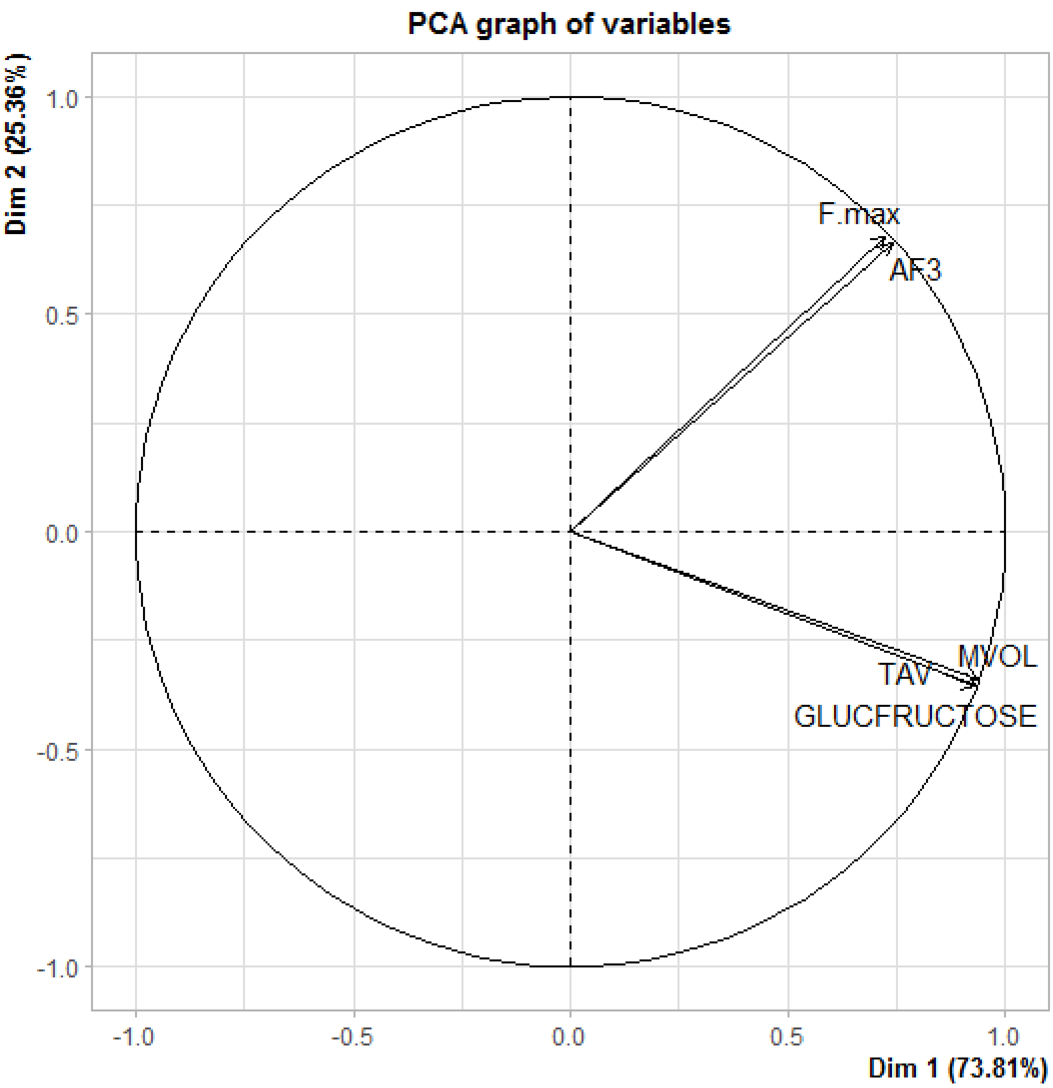

Figure 2 : New PCA with a dataset using only the variables closest to AF3 and Fmax. The explained inertia is good but the variables TAV , MVOL and GLUCOSE FRUCTOSE are positioned almost orthogonally to AF3 and Fmax . They cannot account neither for AF3 nor for Fmax.