Modern Enology: *Quo vadis*?

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SUMMARY

Enology, the science of wine, enters the atmosphere of technological explosion of the third millennium. In order to achieve higher quality products enology is expected to implant to the utmost the latest scientific knowledge into wine technology. Enology will satisfy these demands, but will the consumer be satisfied too?

It will not be possible to produce modern and attractive wines without "considerate" methods of pressing, intact prefermentation must processing and realisation of regulated fermentation process. Regulation of fermentation will be carried out even more consistently in biological (pure yeast cultures, immobilised cells, genetically manipulated microorganisms), physically-chemical and bioengineering (shape of the containers, continual fermentation) ways. Will wine be produced in strictly reduction regimes; will purely physical methods be enough in the process of wine stabilisation? Won't the resources of must chemical consistency (acids, polyphenols, proteins, other native antioxidants) be more widely used for this reason?

The beauty wine of the third millennium should develop from the refined range of today's varieties. However, application of the latest methods of chemical analysis (GC, HPLC, MS, SNIF – NMR) will allow a more precise determination of the origin, purity and authenticity of wine in the near future. It will help define the originality (both chemical and sensory) of a wide range of wines from different parts of the world which have to be preserved for the generations of our descendants.

KEY WORDS

enology, vinification, wine, yeasts

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Received: December 20, 2000

INTRODUCTION

Wine has accompanied human generations for many thousand years. In the Antiquity and Middle Ages nations admired and honoured wine, bud they did not know the essentials about its origin. The way to knowledge was long and complicated. It was connected with the development of knowledge of the mankind. Only by the end of the 17th century A. van Leeuwenhoek described yeasts in grape juice, but he establish no relationship between yeasts and fermentation. In 1836 Cagnard-Latour pointed on the function of yeasts which cause biochemical transformations in wine. In 1866 Louis Pasteur published his celebrated work „Étude sur le vin", in which he analyzed the spoilage of wine and prescribed appropriate treatment. This was truly the origin of scientific enology, which has continued to progress from that point on.

Taxonomic and systematic studies on the microorganisms of grape juices and wines at the beginning of the century, as well as the progress in chemical and biochemical technique in the middle of this century revealed the „image" of the wine. The development of bioengineering contributes to a better understanding of the fermentation mechanism. Winemaking thus becomes a modern science - enology in the sense of Ribéreau-Gayon and Peynaud („Traite d'Oenologie" 1960). „Enology is more than speciality. It is central interest around which one can create and coordinate comprehensive program of fundamental research which is authentic and of general interest" (Lafon-Lafourcade 1983).

Enology, the science of wine, enters the atmosphere of technological explosion of the third millennium. In order to achieve higher quality of products enology is expected to implant the latest scientific knowledge into the wine technology.

MODERN VINIFICATION, MODERN WINE

Progressive vinification gives birth to modern wine. There is no doubt that modern means good, too. This may not be otherwise, as it is born by procedures respecting scientific knowledge of exact sciences in viticulture and winemaking. Good wine may be produced solely from good grapes... and produced only in good vineyards. Vineyards have to be protected from retarding stress - climatic and agrotechnical factors. The vineyards should be secured by sufficient amount of humidity and nutrients. It is possible to regulate fertility (the viticulturist must not be avaricious and has to respect legislation), the vineyard ought to be protected against parasites and diseases. The only problem of Slovak geographic zone is insufficient sunshine. However, the nature has been generous to us few last years (1997, 1999, 2000). If excellent grapes have been harvested, outstanding wines should be produced from them.

Well, what are these excellent wines at the present time? Their colour is less intensive, more modest, attractive vegetable and fruity odours mark their bouquet, their taste is harmonious, persistent, rounded... In addition, such product is deprived of exogenous heterogeneous substances and chemical stabilization. Moreover, detailed chemical analysis signalizes sufficient antioxidant concentration (mainly polyphenols) that make wine healthier and a more hygienic beverage.

It will not be possible to produce modern and attractive wines without „considerate" methods of pressing, intact prefermentation processing and realization of regulated fermentation process. Modernised winemaking refuses unsuitable pressing systems, favours pneumatic pressing and refuses too long white pomace fermentation of aromatic vine varieties. It is advised to use pectolytic enzymes (not cocktails of undefined enzymatic preparations). One is more or less cautious with application of heat and carbon dioxide in red pomace fermentation and extraction. The resulting grape juice of white cultivars requires an intact settling method that does not affect its aromatic microstructure. Extraordinarily important is that modern enology refuses systems of uncontrolled fermentations.

Regulation of fermentation will even more consistently be carried out in biological (pure yeasts cultures, immobilised cells, genetically manipulated microorganisms?) physico-chemical (temperature, osmotic pressure, inner surface of fermenting grape juice, fermentation activators and inhibitors) and bioengineering (shape of the bioreactors, continuous fermentation?) ways (Malík 1997).

The most progressive form of pure yeasts cultures are active dry wine yeasts preparations. Nowadays, these are the most pregnant phenomenon of existing enology. They contribute to many advances but they are also part of some technological risks. The present third generation of those yeasts starters is responsible for specific activities enabling to change the chemical composition of grape juice and wine to certain extent (Degré 1993). It concerns first of all genetically manipulated wine yeasts strains. Their future in enology of the third millennium is disputable. For centuries there is a preserved conservatism on the one hand, and on the other hand there are advantages that would benefit the wine by introducing these techniques. Firstly, a reliable control of the fermentation process course in wine might be guaranteed, and secondly, purity of sensory and hygienic value of the wine could be preserved (Barre et al. 1993). May the efforts asserting principles of enological modernity of the 21st century turn out no matter now, we are sure that genetic manipulations of wine yeasts will be a grateful theme of basic enological research in the next decades.

Enological research and practical winemaking also consider the application of immobilized wine yeasts. In many cases the fermentation process becomes more efficient if such yeasts are used. By wine yeasts immobilization, a change of by-product concentration of alcoholic fermentation occurs, higher glycerol and higher alcohol concentrations are produced, though less acetaldehyde is formed (this is the most probably caused by the fact, that the immobilized cell is able to assimilate amino acids of grape juice and wine to a greater extent). The development of immobilized systems of winemaking is restrained by unsolved technological, bioengineering, hygienic and also by economic aspects. The selection of the carrier of immobilized cells plays an important role. The carrier accepted by winery practice has to be unexceptionably of hygienically nature and chemically inactive (it must not influence sensory wine composition). In addition, the carrier must not show inhibitory affect on wine yeasts and thus it should not enormously increase production costs (Malík 1997).

The attraction of wine in the next years will depend on the control of biochemical processes in the course of winemaking. In justified cases the course of spontaneous malolactic fermentation may be promoted by the application of malolactic starter cultures. The inoculation of wines with a large number of viable bacteria prevents the necessary growth before malolactic fermentation is carried out. With a suitably prepared starter culture, a wine can be inoculated with a cell density of 10^6-10^7 viable bacteria/ml. This represents a stationary culture at maximum cell density in wine, and little or no further growth is necessary for complete conversion of the malic acid. Strains of lactic acid bacteria selected for induction of malolactic fermentation may comprise those of *Leuconostoc oenos, Lactobacillus brevis, Lactobacillus plantarum, Lactobacillus hilgardii* and *Lactobacillus casei.* Strains of *Leuconostoc oenos* are most preferred because of their tolerance to low pH and high alcohol concentration, and because of flavours and palate they produce. Other options for reducing the content of malic acid in wine by using the yeasts *Schizosaccharomyces pombe* or *Schizosaccharomyces malidevorans* have not given satisfactory wine quality. Malolactic fermentation is important for the wine not only from the point of view of organic acids adjustment but also because of adjustment of sensory properties. Much information has been published on the production of flavour-active compounds during malolactic fermentation in wine. Two important characteristics of wine, namely body and length of after-taste, are most reliably recognized in white and red wines as being increased with malolactic fermentation (Malík 1998).

The wine of the third millennium will still fight some more technological battles. Will wine be produced in strict reduction regime? Will purely physical methods be enough in the process of wine stabilisation? And there are additional questions... Will not the resources of juice chemical consistency (acids, polyphenols, proteins, other native antioxidants) be more widely used for this reason?

CONCLUSION

The beauty of wine of the third millennium should be developed from the refined range of today's varieties. However, application of the latest methods of chemical analysis (GC, HPLC, MS, SNIF - NMR) will allow a more precise determination of origin, purity and authenticity of wine in the near future. It will help the definition of originality (both chemical and sensory) of a wide range of wines from different parts of the world which have to be preserved for the generations of our descendants.

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