TENDENCIES REGARDING AUTOMATION AND MONITORING OF TECHNOLOGY IN WINEMAKING PROCESS

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Abstract. *To obtain high quality wines, large winery complexes are using automated machinery and equipment beginning from the crushing and pressing the grains grapes and before must fermentation and wines blending. The paper listed parameters monitored and controlled during winemaking and are given benefits of automation technology to the classic wine making technology.*

Key words: *wine, Monitoring process.*

INTRODUCTION

Winemaking predates recorded history, and writings thousand of years old suggest that appreciation of wine is as ancient as civilization. The enjoyment of wine has been one of the recurring high points in human experience.

The winemaking process can most easily be understood if it is divided into phases. First is the biological phase, during which grapes (or other raw materials) grow and ripen. At this time the basic quality of the wine is set; while winemakers can preserve this quality they can rarely improve it.

Next is the microbiological/enzymatic phase, called fermentation, when microorganisms (yeasts and bacteria) do most of their work.

These microorganisms produce enzymes: yeast enzymes that convert grape sugars into alcohol and carbon dioxide; and bacterial enzymes that sometimes convert malic acid into the milder lactic acid. It is during this phase that the winemaker determines the basic style of the wine. One can, for example, make a low-alcohol, very fruity, semi-sweet white wine by conducting the fermentation at low temperatures and stopping it before it is finished. Or one can take the same grapes and make a higher-alcohol, complex, dry whit wine with a touch of oak flavor by fermenting to dryness at higher temperatures in barrels.

The third phase is the physical or clarification stage, during which small particles in the wine settle by gravity force. At this time tartaric acid (a natural grape acid) combines with potassium (a mineral element found in grapes) and precipitates as potassium bitartrate (cream of tartar). It is at this stage that the appearance and the stability of the wine are largely determined.

The forth phase is the chemical or aging phase, during which the various components of wine combined whit oxygen forming new substances. If the wine is stored in wooden barrels, some soluble extractives from the wood dissolve, adding odor and flavor. This is the time when the ultimate quality of many wines is realized.

These four phases occur in the given order, but there is often some overlap. During grape ripening and prior to fermentation some enzymatic action takes place. During fermentation some settling of grape particles, yeast cells, and tartrates occurs. Aging begins sometimes unwanted yeast or bacterial activity takes place. While a winemaker cannot control all happenings in each phase, he or she should be aware of them and direct them toward the type of wine desired.

If these phases are not monitored an controlled thus they could develop to optimal parameters could appear some problems of wine stability; a wine badly stabilized doesn't present any kind of risks for the consumer's health, but its commercial aspect is badly modified, we are talking about an aspect strictly related to quality in general. A good control of the technological process of grapes processing (figure1), removes a lot of the risks of diseases appearance and of wine damaging.

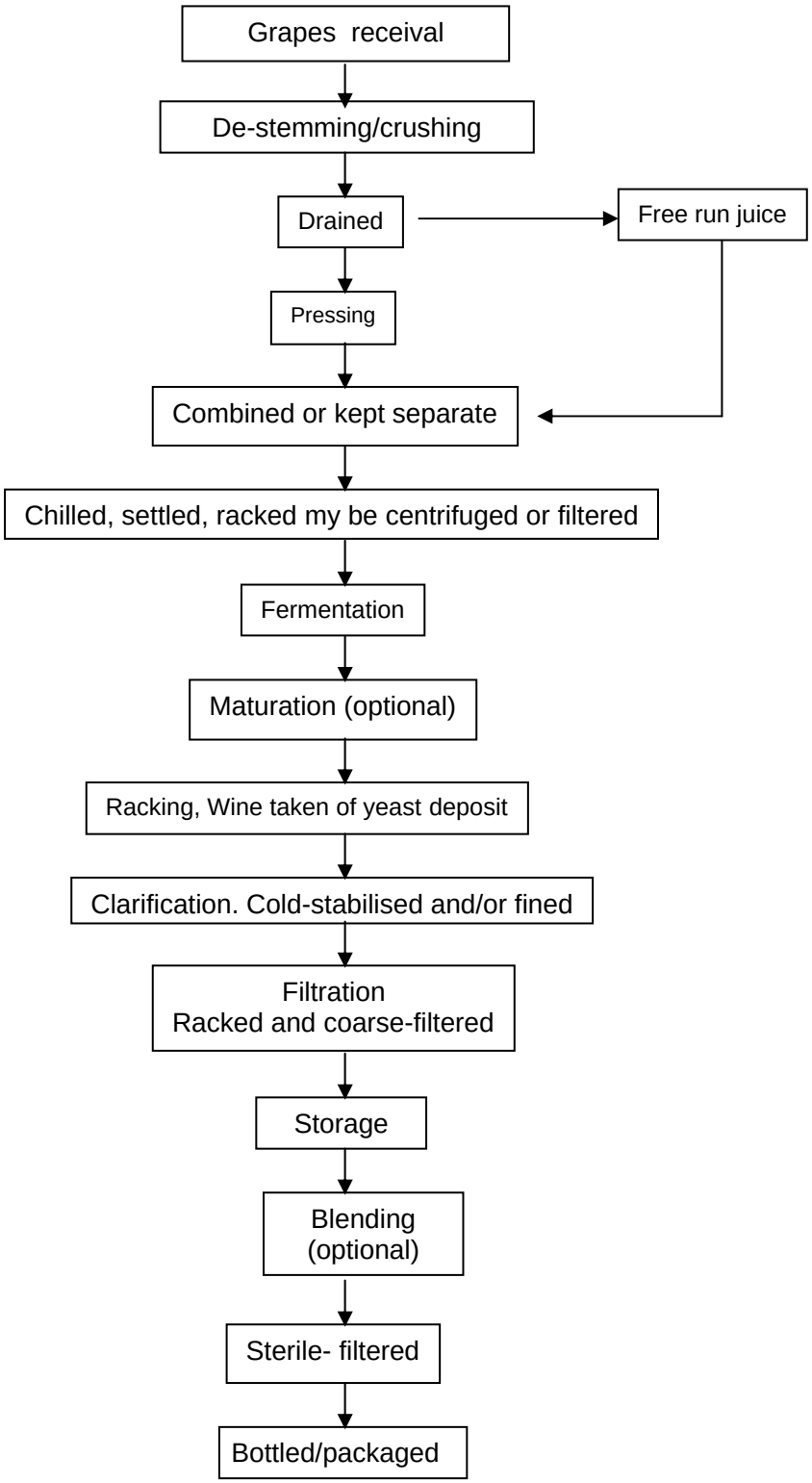

Fig.1. The scheme of the technological process of grapes processing for producing white wines.

THE MONITORING AND CONTROL OF WINEMAKING PROCESS

The modern winemaking installations are equipped with automated systems of control and of monitoring of the technological process, having as purpose the obtaining of wine of good quality and to reduce the production costs.

The components parts of a monitoring and control system has the following elements: sensors and transducers putted in different points of wine making installations; block of acquisition (interface) and a server (computer) equipped with a monitoring and control soft and of setting some parameters.

The monitoring system controls easily and affordably interface to any winery

Fig.2 The functions of a monitoring system and of control of the technological process of wine making.

component. This allows the winemaker to view and/or control all aspects of the operation from any location via one interface. This includes pump-over, stirrer, crusher pad automation, humidity, CO2, water usage, must lines, plant rooms, production Database etc.

At the middle of the system are the modules with each input capable of reading each tank at any process: temperature, humidity, pressure, liquid flow, resistance, CO2 emission from wine cellar (environment): sound, gas detection, gas flow, motion.

Modules allow manual changeover from heating to cooling or fully automatic heat and cool.

Tank Temperature Control: Temperature control is very much the heart of the module system. It has earned a reputation for outstanding reliability and accuracy while offering the winemaker temperature features far beyond basic “on/off” control.

The system permits the control (management) of the winery from any internet enabled device wherever you may be (the system has been scaled for use on PDA's etc), with no limit to the number of tanks.

The soft facilities

Increment to Setpoint" allows you to move towards a setpoint over a specified time period for a gentler temperature change (and be alerted via SMS alarm if this rate of change is not being achieved).

- when a temperature or time period is reached, a soft function can be used to trigger a subsequent action, *e.g. when temperature reaches 30C, send me an SMS text message and then increment to a new setpoint of 28C over a 6 hour period".* In this instance, a winemaker can get a ferment going and then slow it down without having to be on site.
- can be set with as many automated steps as required for a ferment and then allocated to any tank or group of tanks (eliminates mistakes and saves time).
- enables a temperature range that does no heating or cooling - e.g. a tank is set to 25C with a deadband of 8C means the tank will be warmed to 21C and then the ferment will take over up to 29C at which point the cooling comes back on.
- **Power Saving** features incorporate tank priority settings which are driven by the wine status to facilitate actions such as night cooling. A wider range of new initiatives include peak load management, coolant setpoint control, coolant pump control, must chilling control, cold stabilization mode etc.
- **3 Dimensional Views** of the winery display flashing lights on tanks in alarm mode and allow the user to drill directly down to the tank setting screen. The 3D screen range also includes tank control status and tank wine status.
- **Whiteboard Replacement** - A large wall mounted LCD display essentially eliminates the need for the traditional whiteboard with the ability to enter data onto the circles from your own computer and print. As things are happening out in the tank farm such as temperature changes, these are dynamically updated in front of you. The same applies to data being imported from your winery production system.
- **Production Database Integration**
- **Reports** - full reporting features (ullage, tank status, tank volume, status, station report).
- **Tank Lists** according to group, status, tanks turned on/off and empty tanks (all data can be easily exported to Excel).
- **Graphs** - superior graphing functionality.
- **Data Storage** - data stored in the database allows trend analysis helping you repeat past procedures and repeat successes.
- **Comprehensive Tank and Plant Alarms** can be sent as text messages to as many mobile phones or email accounts. Alarms can easily be configured in the form of flashing lights, sirens or dialers to the home phone.

Some producers put on a proof stick so that they can control the process of wine ferment. The fermentation probe measures the conversion of sugar to alcohol (fermentation rate) and delivers the information to a computer. Real-time data is presented in the familiar graphical ferment curve format. It can be used solely for online monitoring or can be integrated in adjustment soft of temperature control for automated temperature changes to match the winemaker's ferment expectation. Proactive control provides labor savings, repeatability, more efficient use of refrigeration and insurance against out of control fermentations.

The proof stick of ferment can be used to track fermentation much more precisely than periodic Brix measurements. More importantly, the data can be used to control cooling, mixing and pump-overs via the control software.

The modern units of wine making are equipped with laboratory equipment for making some quick and precise. With such a machine which can quickly measure glucose/fructose, pH, malic acid, total acidity and ethanol all in about two minutes and without any special sample preparation. The advantage of these machines consists in the fact that it can calibrates itself using the CO_2 in the atmosphere. This is supposed to make the analyzer essentially maintenance-free. When combined with a two-minute

analysis time, it's hard to see why a winery wouldn't at least take one of these analyzers for a test drive.

CONCLUSIONS

In order to obtain a qualitative wine, beginning from the crushing and pressing of grapes and up to the must fermentation and of wine blending, everything must be done automatized.

With the help of a special soft is monitored, controlled and adjusted the technological process of winemaking and of blending in each evolution stage of the process.

REFERENCES

[1]. Cebotarescu, I.D., et al. 1997. Utilaj Tehnologic pentru Vinificatie. *Editura Tehnica Bucuresti.*

[2]. Jackson, R.S. Wine Science, Third Edition (Food Science and Technology), Academic Press Elseivier

[3]. Pomohaci, N. 1990. Oenologie. *Editura Didactica si Pedagogica, Bucuresti.*

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