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Opinion Article

Authentication of ATR-MIR Spectroscopy for Wine Alcohol Fermentation Technology

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DESCRIPTION

The biochemical process known as "alcoholic fermentation" which underlies the conversion of sugars (glucose and fructose) into ethanol and carbon dioxide by yeast, often of the species Saccharomyces, is the basis for the creation of wine. It is a complicated process since a variety of yeast metabolites that are connected to the physicochemical and organoleptic qualities of the finished product are released at very variable amounts. Therefore, the management of these by products has a significant influence on the wine's final quality. However, other from the daily visual inspection of the tanks, the only variables that are regularly and historically measured in the basement to track the alcoholic fermentation is just the temperature, the density, and the pH. Although several direct tools that can measure and forecast certain oenological characteristics are currently available on the market, they are not often employed. This is due to the fact that, much like with determining these parameters using other analytical techniques, there is a delay between getting the results and taking remedial action. Delays in implementing corrective actions therefore have a detrimental impact on quality, which ultimately results in financial losses, when issues like deviations, stopped fermentations, or slow fermentations are discovered. Because of this, there is a growing interest in creating a real-time, effective monitoring plan. According to the US Food and Drug Administration, Process Analytical Technologies (PAT) is mechanisms to design assess and control manufacturing pharmaceutical processes through the measurement of Critical Process Parameters which affect Critical Quality Attributes. This mind-set may help any other industry where quality control is important, such as the food industry. It is important to keep in mind that food samples are typically complex chemical mixtures that are easy to alter. Since only the final product may be evaluated to determine a food product's quality, in-line or online measurements must be employed to track the product's progress throughout manufacturing process.

The Process Analytical Technologies has previously been used in several food industry sectors due to its viability and usefulness industry with good results and references therein). As can be seen, in all circumstances, in the food process analytical technologies method it is necessary to completely understand the process and comprehend all the causes of variability to produce accurate findings. Variability in wine alcoholic fermentation can be attributed to both the starting materials (grape variety, grape sanitation, ripening, and vintage) and the fermentation itself (species and strain of microorganisms, sudden temperature changes, excess or lack of oxygenation, amount of assimilable nitrogen, or spoilages, among other factors). Numerous parameters should be measured in order to identify possible issues in biochemical processes because the reasons of variation might be numerous and quite diverse. Typically, these parameters should be determined in several batches at various production sites. Fortunately, using current multi-analyzers makes these decisions much simpler, albeit managing the vast quantity of data they produce is sometimes challenging. Therefore, these data should be analysed using appropriate statistical and chemometric methods in order to extract important information. Process Analytical Technologies (PAT) method frequently uses multivariate analysis to cope with the largest quantity of data and improve process control. Through the examination of the produced data, multivariate analysis enables both qualitative (classification or pattern identification) and quantitative outcomes (parameter prediction). The use of spectroscopy-based analyzers for food process monitoring is becoming more important among the several instrumental approaches now in use. Spectroscopy is a perfect tool for Process Analytical Technologies (PAT) methods because to its quick data gathering, lack of sample preparation or little sample pretreatment, and mobility.

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