Sorting out top-class wines

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The good berries land unharmed in a container. Insects, leaves, unripe grapes and other foreign objects are removed by the optical equipment. Credit: Fraunhofer IOSB

No vintners want their wine to have a bitter note to it. Now, new sorting equipment with optical recognition can guarantee this is never the case. The machine sorts the harvest into quality grades – sparing winemakers laborious manual work.

The tasters are overjoyed: of over 100 wines that were submitted, this rosé is of exceptional quality. "Fresh, dry, pleasant – a real summer wine," says one; "incredibly well rounded," says another; "delicate," says a third. They also praise its harmony and the balance between sugar and acidity. If a wine is to win jurors over so unanimously, not only must there be no hitches in the processes it goes through at the winery, but all weather-related factors need to stack up, too. For a vintage to be good, the weather has to have encouraged the growth of the grapes at the right time and offered a proper balance of sun and rain over the course of the year. But in Germany, the weather can often quite literally ruin the harvest for winemakers. A novel piece of optical sorting equipment is set to help make the most out of grapes' quality. Researchers from the Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB in Karlsruhe are working to develop the equipment together with Armbruster Kelterei-Technologie GmbH, Ingenieurbüro Waidelich and Geisenheim University in the GrapeSort project, which is funded by Germany's Federal Ministry of Economics and Technology BMWi.

Sorting the good from the bad

Once the vats of grapes have been delivered, their contents pass through a feeding unit into the destemmer provided by Armbruster, which separates the berries from their stems. Next, the grapes are individually placed on a conveyor belt by a newly developed conveying system. "What's important is to get the berries onto the belt without damaging them," says Dr. Kai-Uwe Vieth, a scientist at the IOSB. The grapes are then carried along by the conveyor belt past the IOSB's sorting module at a speed of 3 meters per second. At the heart of the module is a high-speed line scan camera that records the material flow, taking photos of the fruit as it rushes past – 18,000 times a second. IOSB analysis software evaluates each image in milliseconds and controls compressed air jets that blow foreign objects such as insects, vine shoots, stones or

twigs out of the material flow. Bad or undesirable berries are also removed by the Waidelich air ejection unit. The "good" berries fall into a container. "Our sorting module is designed to exceed the capabilities of current machines. Not only does it remove foreign objects, it also sorts the berries into various quality grades. That lets you create exactly the wine you want," says Vieth. The camera is trained in advance what to deem "bad". Mold, earwigs, leaves and the wrong degree of ripeness are typical rejection criteria. Sorting is done based on analyses of shape and color.

The researchers are already able to use their equipment to recognize various degrees of berry ripeness based on nuances of color. In future, they also want to be able to tell the ripeness by investigating how much sugar there is in the fruit. "Winemakers measure sugar content using an optical device called a refractometer, which allows them to read out on a scale the degree to which sugar molecules in the must influence the angle of refraction of incoming light. The higher the sugar content, the more the light is refracted. The line scan camera can also measure reflected light, as it is a light-sensitive line," Vieth explains. This integrated line sensor is sensitive to both visible and invisible light. For the laboratory analyses that run while the measurements are taken, Vieth and his colleagues use imaging sensors for the wavelength range of 240 to 2500 nanometers. The sensors generate spectra for each pixel.

Several tons of grapes pass through the sorting facility every hour. Grapes of the Trollinger, Riesling, Weißburgunder and Lemberger varieties have been successfully sorted in preliminary testing, with project partners unanimously declaring the results of the sorting to be good. An optimized functioning prototype that will serve as a basis for a production-ready facility is set to be tested for the first time in October 2013. All the components undergoing constant development and optimization – the feeding unit, the camera box and the air ejection unit – will be connected up and tested in time for the grape harvest. And the

entire project will be put to the sensory test at another premiere in June 2014: the tasting of the resulting wine by the Geisenheim University viticulture experts who are providing their expertise to the project. Vieth and his project partners are convinced that their wines will be a great success: "The sorting system helps to improve quality and separate the harvest into various quality levels. This will allow winemakers to expand their premium output."

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