Session 2

Ripening detection in grapevine: development of a handheld NIR sensor

Lucie Gebauer[1], Julius Krause[2], Xiaorong Zheng[1], Felix Kronenwett[2], Robin Gruna[2], Reinhard Töpfer[1] and Anna Kicherer[1]

[1]Julius Kühn Institut (JKI) – Federal Research Centre for Cultivated Plants, Institute for Grapevine Breeding Geilweilerhof, Siebeldingen

[2]Fraunhofer IOSB Institute of Optronics, System Technologies and Image Exploitation, Visual Inspection Systems, Karlsruhe

E-mail of corresponding author: lucie.gebauer@julius-kuehn.de

The quality of wine is influenced by various factors e.g. cultivar, vineyard site, nutrition of plants, health status, and weather conditions. Sugar and acidity belong to the metabolic compounds, which are indicators for ripeness and harvesting grapes. The quality level is highly depending on the sugar converted into alcohol or remains as residual sugar determining the wine´s sweetness. In order to obtain a balanced and tasty wine a certain amount of acids is required besides of aromatic compounds. While the sugar content increases steadily, acids decline as the berries start to ripen. Based on that, the winemaker is facing the challenge to determine the optimal harvest date.

To this aim a random sample of one hundred berries is taken in viticulture practice to measure sugar and acids in a squeezed sample, for example by using Fourier-Transform Infrared (FTIR) Spectroscopy. This sampling method is costly and time intensive and could be improved by implementing a non-destructive sensor measurement using Near-Infrared Reflectance (NIR) Spectroscopy (NIRS). This technique has previously been shown to be successful for many agricultural applications such as ingredient determination of oils, proteins and starch.

A small handheld device measuring diffuse reflection of the berries between 1350 nm and 2500 nm with a resolution of 16 nm was used (Si-Ware, USA). Sixteen individual berries of Riesling (*Vitis vinifera* L.) were sampled per vineyard and week over the whole ripening period, starting with Véraison (beginning of berry softening) until one week after harvest, to ensure a broad range of ingredient concentration. Physiological differences in ripening were taken into account by sampling berries from different fruit as well as cluster zones, and from shaded and unshaded bunches. Corresponding reference sugar (fructose, glucose) and acid (malic and tartaric acid) content were determined with high performance liquid chromatography (HPLC) coupled with refraction index and diode array detectors.

With this approach, in a first study we systematically investigated ripening progress of a whole vineyard, to develop a simple and time effective handheld sensor for viticulture practice. The sugars glucose and fructose could be individually predicted with an 87 % accuracy for each ($RMSE_P$: ±7.59 g/l and ±6.57 g/l, respectively). Simultaneously tartaric and malic acid could be predicted independently, with 89 % and 78 % accuracy ($RMSE_P$ of ±0.52 g/l and ±1.89 g/l, respectively), with a better forecast for tartaric acid, which is predominant during harvest.