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# Chemometric validation of an enzymatic method to detect glucose and fructose in wines

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## INTRODUCTION & AIM

Grapes contain 150–300 g/L of sugars—mostly glucose and fructose. These levels are essential to wine quality, harvest timing, fermentation, and classification under EU rules:

- Dry (≤4 g/L)
- Semi-dry (>4–12 g/L)
- Semi-sweet (>12–45 g/L)
- Sweet (>45 g/L)

Both sugars have the same chemical formula ($C_6H_{12}O_6$) and occur equally, but fermentation favors glucose. Fructose, being sweeter and slower to ferment, can linger in dry wines, risking spoilage and excess sweetness.

This study aims to validate an automated device for OIV-MA-AS311-02 analysis, improving efficiency in food labs and reducing human errors. The open analyzer for sugar measurement operates at low costs, minimizes environmental impact by using fewer reagents and samples, and requires little maintenance.

## METHOD

Four commercial Italian wine samples were analyzed.

The sum of glucose and fructose levels was performed according to the OIV-MAAS311-02 both manually and into the automated sequential analyzer Y15 Biosystems (Sinatech, Grottazzolina (FM), Italy).

The yest was validated in terms of linearity, LOD (limits of detection) and LOQ (limit of quantification), accuracy, and precision, according to ISO/IEC (2005).

## RESULTS & DISCUSSION

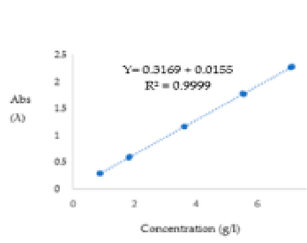
In this work, an automated apparatus was validated to perform the OIV-MA-AS311-02 method.

The validation plan verified the compliance of the automated apparatus's results with those obtained by the specialized operators (reference method).

The coefficient of determination (R2 = 0.9992) and the normal residual distribution in the ANOVA test confirmed the linearity of the calibration curve (Figure 1 and Figure 2). The range in which the concentrations and spectrophotometric measurements were proportional was obtained by evaluating the calibration curve's determination coefficient (R2) and the residues' distributions.

| Sample | Concentration | Abs |
|---|---|---|
| 1 | 0.86 | 0.2926 |
| 1 | 0.87 | 0.289 |
| 1 | 0.88 | 0.2918 |
| 2 | 1.83 | 0.5972 |
| 2 | 1.82 | 0.5859 |
| 2 | 1.82 | 0.5917 |
| 3 | 3.62 | 1.1582 |
| 3 | 3.61 | 1.1651 |
| 3 | 3.62 | 1.1649 |
| 4 | 5.51 | 1.7753 |
| 4 | 5.55 | 1.7655 |
| 4 | 5.52 | 1.7705 |
| 5 | 7.11 | 2.2711 |
| 5 | 7.1 | 2.2517 |
| 5 | 7.07 | 2.2587 |

Figure 1. Calibration curve.



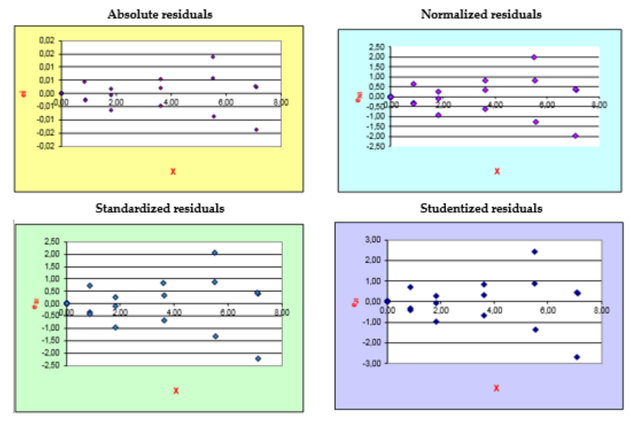




Figure 2. Residual distribution evaluated via ANOVA test. gi = absolute residuals; gNi = normalized residuals); gSi = studentized residuals; gji = standardized residuals.

The method sensitivity was evaluated via LOD, LOQ, and measuring range.

LOD = 0.05 g/L LOQ = 0.08 g/L Decision limit: Ydc = 0.01 Xdc = 0.02

Intra-assay precision was measured by performing ten analyses' replicates of each reference wine on the same day; inter-assay precision was measured by replicating ten analyses of each reference wine on diverse days of a week

The method's selectivity was evaluated by estimating the uncertainty related to potential interferences with the target analyte.

## CONCLUSION

The tested apparatus to be used for legally analyzing fermentable sugar levels in wines. These technologies reduce costs by requiring less specialized personnel and enabling more daily analyses than traditional methods, lower the risk of operator error, and promote environmentally sustainable practices by optimizing solvent use.

## REFERENCES

Dini, I.; Tuccillo, D.; Coppola, D.; De Biasi, M.-G.; Morelli, E.; Mancusi, A. Validation of an Eco-Friendly Automated Method for the Determination of Glucose and Fructose in Wines. *Molecules* **2023**, *28*, 5585. https://doi.org/10.3390/molecules28145585