

# Relationship between precipitation and wine tritium concentrations, Tokaj, Hungary

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## 1. Introduction –

The relationship between the elemental composition and quality of wine and geographical and climatic conditions is a well-known fact, which also significantly determines the international recognition of wines. The isotopic composition of Tokaj wines provides important information about changes in the environment and provides basic information for determining the authenticity of wines. Isotope analysis studies have previously shown that the isotopic composition of wines contains tritium from natural and artificial sources (tritium is a triple mass isotope of hydrogen with a half-life of  $4500 \pm 8$  days). Much of the tritium of artificial origin was generated primarily by hydrogen bomb tests in the mid-20th century, while natural tritium is generated primarily by nitrogen in the upper atmosphere from cosmic radiation. The concentration of tritium in the current rainwater varies between 7 and 16 TU at medium latitude (TU: tritium unit, where 1 TU corresponds to  $10^{-18}$   $^3\text{H}/^1\text{H}$ , 0.119 Bq/kg for water), which is uptaken by grapevines through their root system. It may reflect the isotope composition of rainfall during the growing season. Therefore, bottled wine can retain long-term changes in the tritium concentration modulated by solar activity.<sup>1, 2</sup>

**2. Experimental** – Wine and precipitation samples have been analysed using the  $^3\text{He}$  ingrowth method.<sup>3</sup> The main principle of this method is based on the mass spectrometric measurement of the accumulation of  $^3\text{He}$ , because the daughter product of tritium is  $^3\text{He}$ . When analysing the samples, isotope dilution technique was applied, where an ultrapure  $^4\text{He}$  spike was added to the sample to eliminate systematic errors. This method is the most sensitive one that can be used to detect low-level tritium concentrations in environmental waters. The uncertainty of the  $^3\text{He}$  ingrowth method is about 0.1–0.4 TU in the range of 5–20 TU.

**3. Results and Discussion** – The pattern induced by solar activity is well reflected in precipitation tritium concentrations, so the research sought to answer whether this natural variability can be detected in the isotope composition of wine samples as well. To explore this, we used a Tokaj wine stock covering a longer period (1999–2019). We have confirmed that the pattern observed in the precipitation is related to the tritium concentration values of the Tokaj wine samples, the correlation between them is significant (correlation coefficient: 0.66). In addition, we determined the isotopic composition (radiocarbon, strontium) characteristics of each vintage, which helps to determine the originality of valuable Tokaj wines specialties such as aszu.

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## 5. References

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