GEOGRAPHICAL ORIGIN OF HOPS - DETERMINATION BY ISOTOPE RATIO MASS SPECTROMETRY (IRMS)

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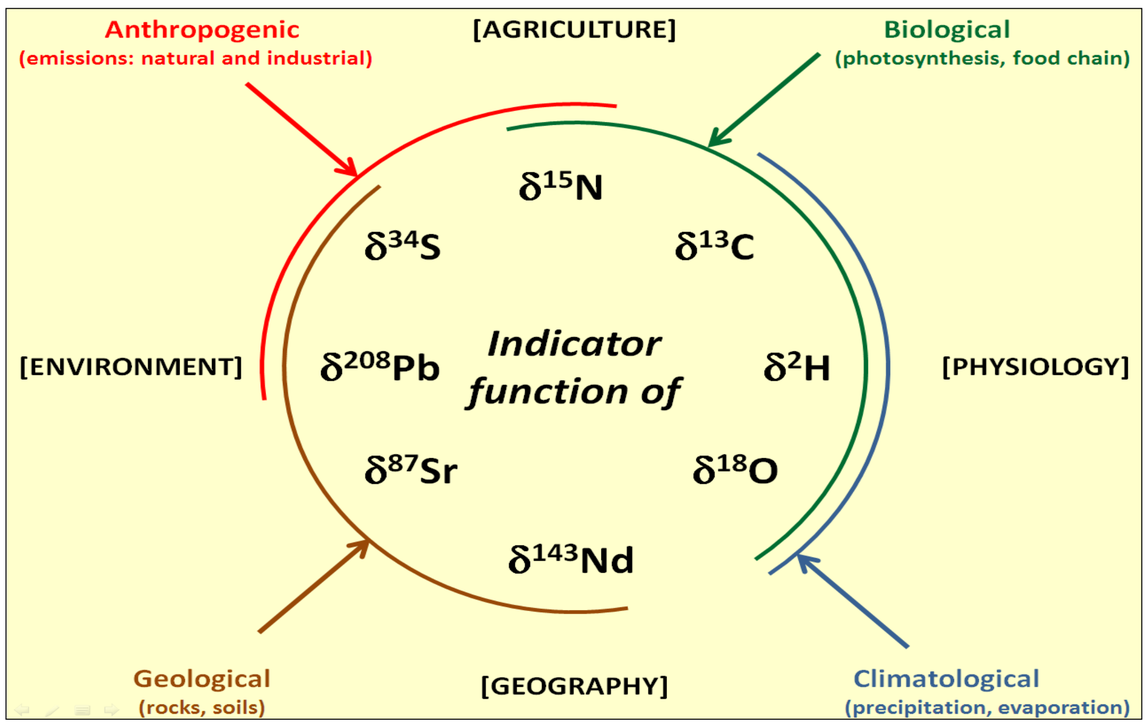
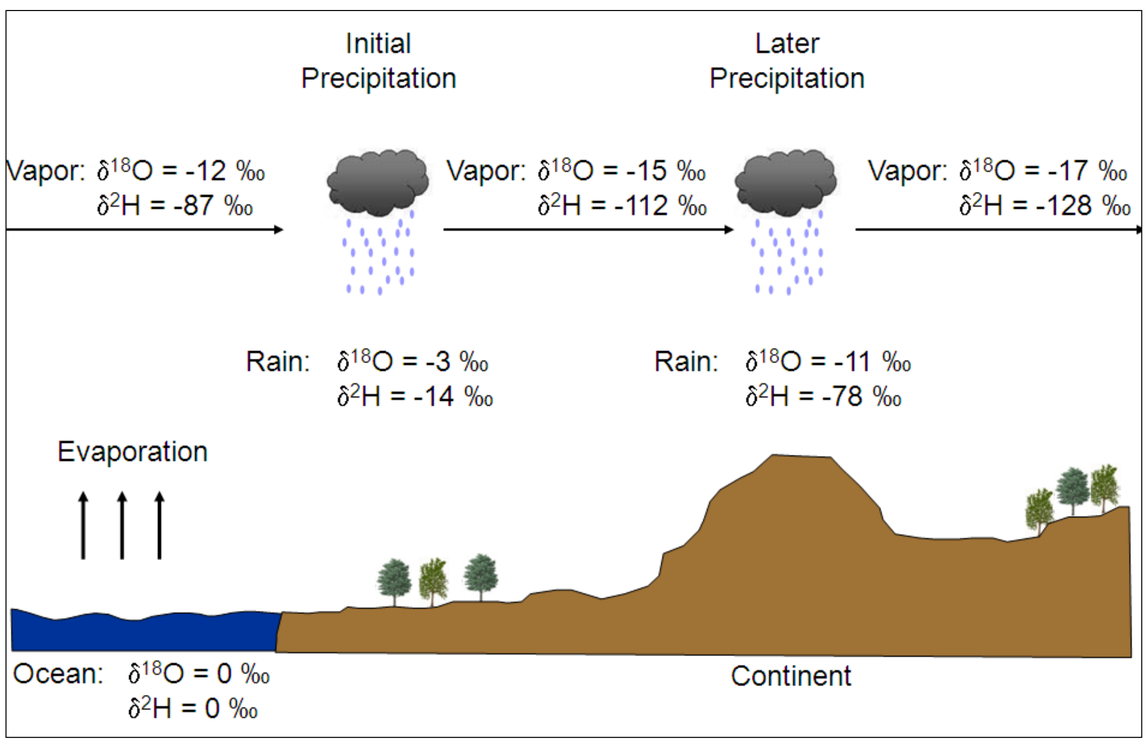
Introduction

The isotope ratio mass spectrometry (IRMS) is a suitable method to determine the geographical origin and authenticity of agricultural products, foods and beverages (1). Well known examples for the application of this technique are asparagus, fruit juice, wine and ham.

For the production of their biomass during the vegetation period plants incorporate chemical elements and their stable isotopes into the synthesized molecules (e.g. ^{13}C, ^{18}O, ^{2}H or ^{15}N instead of ^{12}C, ^{16}O, ^{1}H or ^{14}N). The following figure indicates the factors which influence stable isotope ratios in natural compounds (2):



Not all waters are the same! The isotopic composition of rain (and groundwater) is influenced by climate impact (e.g. temperature) and depends amongst others on the distance from the ocean (see figure below).



Materials and methods

For the analysis the samples have to be defatted using the Soxhlet extraction. After combustion of the plant material and adsorptive separation of all gases the isotope ratios are determined by means of mass spectrometry. The multi element method is described in detail in the literature (2).

The results are calculated by the equation (e.g. for $^{13}C/^{12}C$):

$$\delta^{13}C=[^{13}C/^{12}C_{\ sample}/\ ^{13}C/^{12}C_{\ standard})-1]*10^3$$

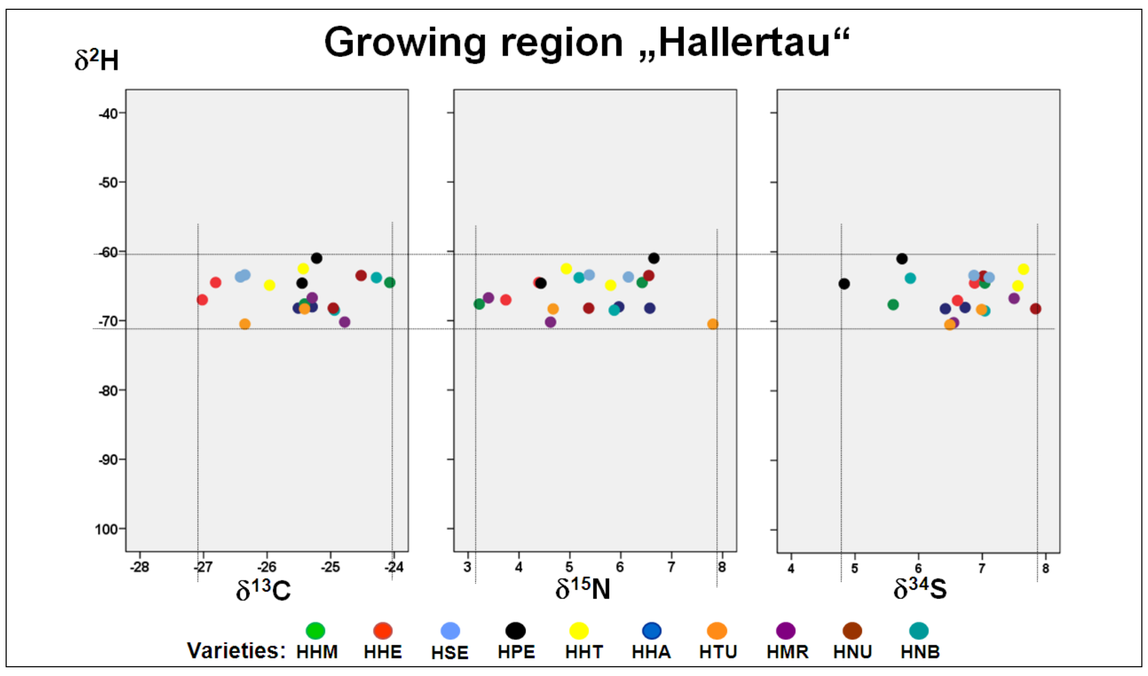
They are expressed in ‰ versus respective international standards (e.g. V-PDB for carbon).

Results and discussion

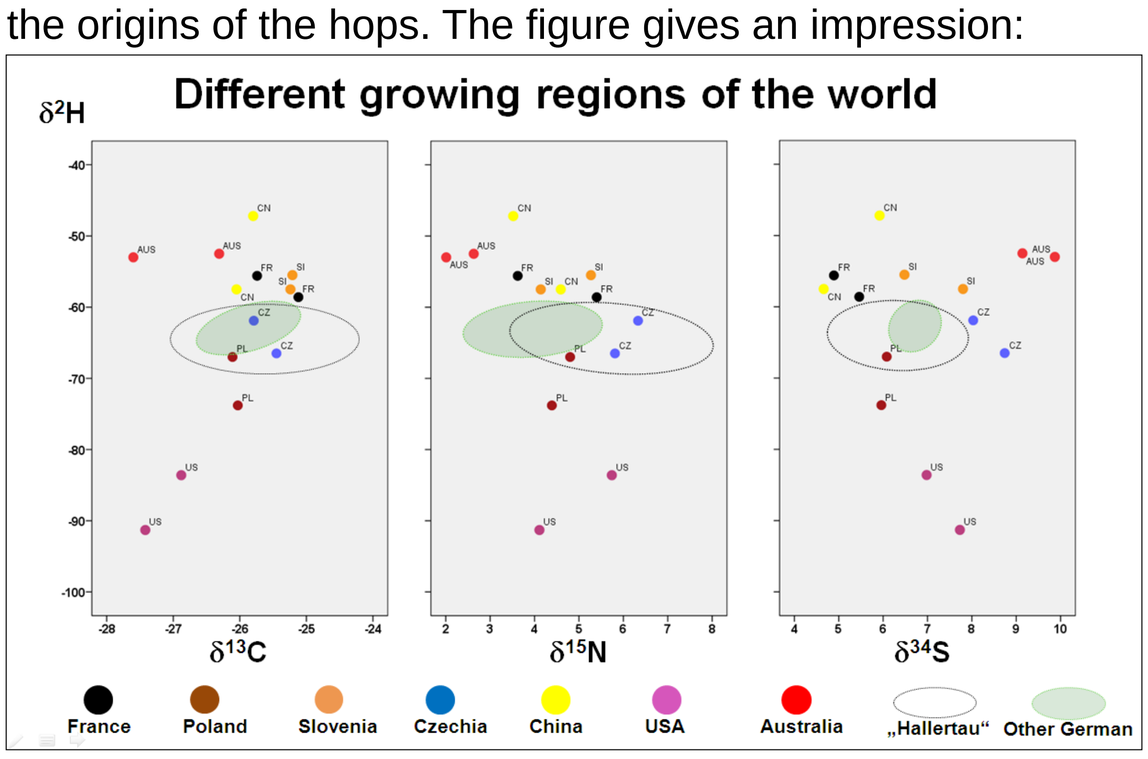
Testing material was selected to check possible parameters: regional influence, variety and crop year. The “Hallertau” region was examined intensively. Hops from all over the world were represented by random samples.

The following figure shows the findings for the “Hallertau”. Variety and crop year have a small effect on the results.

The dominant parameter to distinguish the samples is the influence of the growing region: Definite differences in all four isotope ratios are found.



Regarding the worldwide results the differences between the growing regions increase and show big variations with δ^2H, $\delta^{15}N$ and $\delta^{34}S$. The isotope fingerprints of the growing regions all over the world are characteristic. The isotope ratio δ^2H seems to be the most important criterion to distinguish the origins of the hops. The figure gives an impression:



Conclusions

The origin of hops can be distinguished by means of isotope ratio mass spectrometry using a multi element method. To evaluate series of results the discriminant analysis should be applied to draw conclusions. A database of results for authentic reference samples is required. Growing regions can be discriminated and so the determination of the geographical origin is possible. The more detailed the information in the database the more an exact statement about the origin of a sample is valid. For a definite determination of an origin an identical reference material is necessary.

Literature

1. Schmidt H.-L., Rossmann A., Stöckigt D., Christoph N.: 39, Chemie in unserer Zeit, 90-99, 2005
2. Rossmann A.: Rundgespräche der Kommision für Ökologie, Bd. 30 “Auf den Spuren der Natur”, S. 153-164, 2005