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EA-IRMS: Characterizing Himalayan rice of different origin by oxygen and hydrogen isotope fingerprints

Authors: Oliver Kracht, Christopher Brodie
Thermo Fisher Scientific, Bremen, Germany

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Goal

Illustrate how isotope fingerprints support further investigation on mislabeling and food fraud, by providing a framework for study of provenance of rice using oxygen and hydrogen isotopes.

Introduction

Rice, a cereal grain, is the seed of the grass species *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice). It is considered staple food for a large part of the world's human population, especially in Asia.

Basmati rice is a variety of long, slender-grained aromatic rice which is traditionally from the Indian subcontinent and it is unique for its natural smell provided by the aroma compound 2-acetyl-1-pyrroline. Legally, the term basmati rice can be only used for perfumed rice grown in specific regions of India and Pakistan, which limits its availability on the market.

This uniqueness has contributed to make basmati rice the center of food fraud activities by means of mislabeling or contamination with inferior long-grain rice. Consequently, mislabeled rice enters the food market affecting producers and consumers' trust.

Distinguishing authentic products by geographical origin is one of the challenges in food industry. Since origin is often associated with quality and price, products with high commercial values are a target of criminal activity.

Testing the accuracy of product label claims is one of the key ways of monitoring and enforcing legislation on food product labelling (EC Reg. No. 1169/2011 and FDA-2012-N-1210)[1]. The identification of mislabeled products subsequently protects consumer confidence, brand market reputation and related revenue-generating capabilities.

This application brief reports oxygen and hydrogen analysis of 69 rice samples. The samples are from two growing regions of different altitude, demonstrating the capability of isotope analysis to provide a framework for differentiation and determination of origin of samples.

Oxygen and hydrogen isotope fingerprints of rice

Rice samples carry oxygen and hydrogen isotope fingerprints which can be used to identify the geographical origin of rice. Oxygen and Hydrogen isotope fingerprints in plants are related to local-regional rainfall and groundwater. Light isotopes of O and H evaporate faster causing the rainfall at higher latitudes to be more depleted in the heavy O and H isotopes. This provides a spatial tool that can help track the origin of a material across the world based on the differences in the isotope fingerprints of water[1].

Analytical configuration

Analyses were undertaken with the Thermo Scientific™ EA IsoLink™ IRMS System using around 2 mg of rice sample (ground and dried over night at 80 °C to account for the hygroscopic nature of the material). Samples were weighed into silver capsules and introduced into the combustion reactor from the Thermo Scientific™ MAS Plus Autosampler. The CO and H_2 gas produced was then analyzed by the Thermo Scientific™ DELTA V™ Isotope Ratio Mass Spectrometer. Analytical time per sample is 450 seconds.

Results

The two-dimensional plot XY shows the two subsets of rice from the two different growing regions. Subset 2 (average δ^2H: -67‰, average δ^{18}O: 27.1‰) unveils lower isotope values than Subset 1 (average δ^2H: -62‰, average δ^{18}O: 28.7‰) which may indicate that the growing region of Subset 2 is at a higher altitude than Subset 1. A comparison with the Global Meteoric Water Line (GMWL) implies that local climatic conditions and irrigation practices must be taken into consideration when performing investigations on samples from unique growing regions.

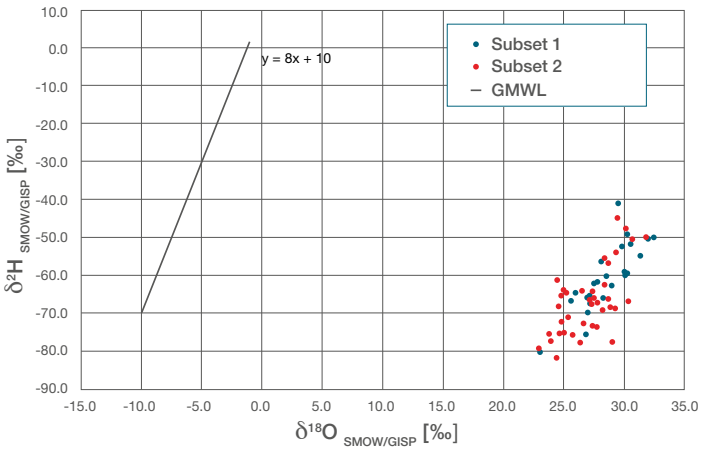

Figure 1. 2-dimensional plot of stable isotope ratios of oxygen and hydrogen from 69 rice samples. Two subsets are indicated by color, each from a growing region at different altitude.

Conclusion

The correct labeling of rice affects producer and consumer value. Laboratories need an analytical technique providing conclusive answers on origin and authenticity of primary ingredients. Analyzing oxygen and hydrogen isotope fingerprints of rice allows the differentiation of samples from two growing regions, supporting further investigations to determine mislabeling of rice. Further studies on rice involving stable isotope analysis are given below in the References section[2,3]. This helps protect producer reputation and consumer confidence by detecting fraudulent activity.

With the EA IsoLink IRMS System, laboratories gain an effective analytical solution which provides fast and reliable analysis with full automation.

References

1. Kelly, S., Baxter, M., Chapman, S., Rhodes, C., Dennis, J. and Brereton, P. (2002): The application of isotopic and elemental analysis to determine the geographical origin of premium long grain rice. *European Food Research and Technology, 214 (1), pp. 72-78.*
2. Suzuki, Y., Chikaraishi, Y., Ogawa, N., Ohkouchi, N. and Korenaga, T. (2008): Geographical origin of polished rice based on multiple element and stable isotope analyses. *Food Chemistry, 109 (2), pp. 470-475.*
3. Chung, IM., Kim, JK., Prabakaran, M., Yang, JH., Kim, SH. (2016): Authenticity of rice (Oryza sativa L.) geographical origin based on analysis of C, N, O and S stable isotope ratios: a preliminary case report in Korea, China and Philippine. *Journal of Sci. of Food and Agriculture, 96(7), pp. 2433-2439.*

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