Geographical provenancing of palm oil

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Introduction

The global production of palm oil has risen steeply over the past few decades and the rapid expansion has raised concerns about the environmental and social sustainability of palm oil cultivation in certain areas. As a result, several initiatives for sustainable palm oil cultivation have recently emerged.

The concept of sustainable production however is entirely dependent on proper certification. Complementary to certification, objective methods are required to validate the authenticity of sustainable palm oil.

As sustainable oil palms are cultivated only in a limited number of regions, validation of the geographical origin is an important aspect in the authentication of sustainable palm oil.

Aim

This study is part of a larger framework in which an integral approach is developed for authentication of sustainable palm oil. The present study investigates the application of stable isotopes for geographical provenancing of palm oil and their relationship with climatic factors.

Materials and methods

For this study, 44 crude palm oil samples were collected from 7 countries (Figure 1) and analyzed for bulk δ^2H and bulk $\delta^{13}C$ using a EA-IRMS. Precision (2SD) of the δ^2H and $\delta^{13}C$ analysis was generally better than 3.5 ‰ and 0.08 ‰ respectively.

Discussion of results

Results show that δ^2H and $\delta^{13}C$ values of bulk palm oil from southeast Asia and Brazil are systematically more depleted compared to palm oils from west Africa (Figure 2).

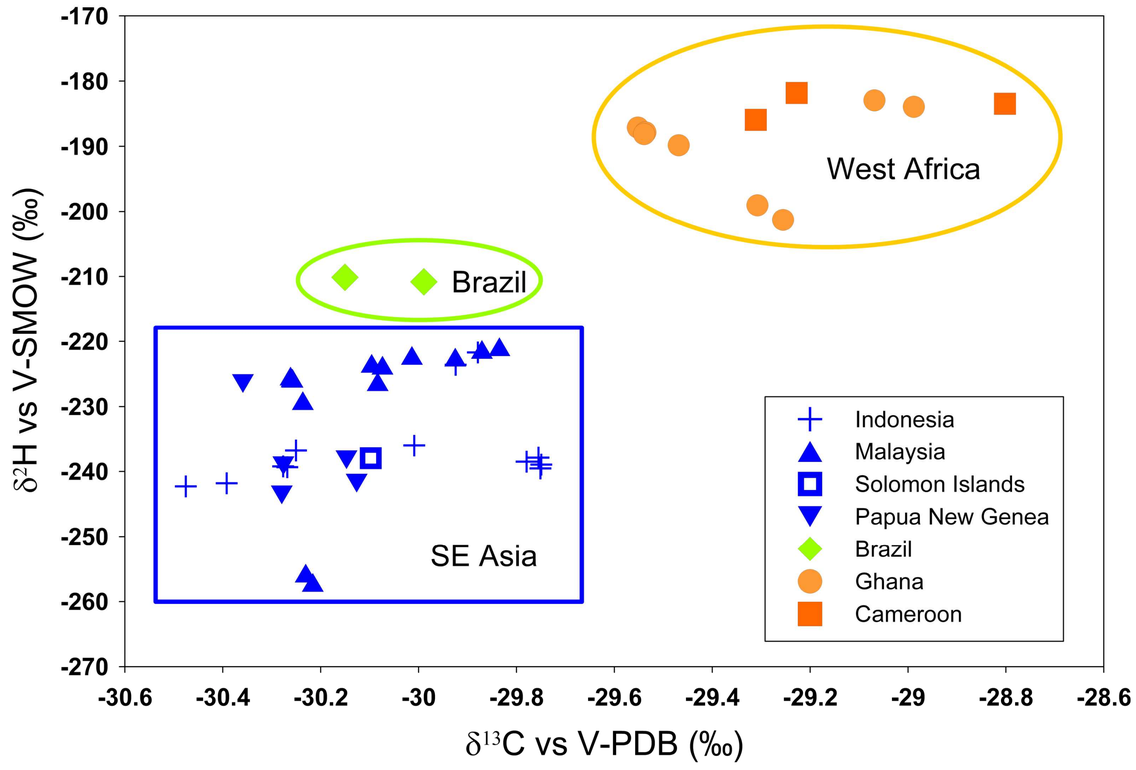

Figure 2 – $\delta^{13}C$ vs. δ^2H ratios of crude palm oils from various countries (N = 44 samples).

The isotopic composition of plants is affected by several factors such as relative humidity, temperature, the amount of precipitation and water stress. The observed differences in the isotopic composition of palm oil is most likely a reflection of the drier climate in the west African countries compared to southeast Asia and central Brazil (see Figure 1).

δ^2H variations of up to 30 ‰ in palm oils from Malaysia and Papua New Guinea may indicate some palm oils are harvested from both sustainable (farmed) and non-sustainable (native forest) sources. Farmed oil palms will receive mainly local precipitation and irrigation water, while native forests will be more dependent on groundwater sources.

These climate induced isotopic differences provide a means to distinguish between palm oils originating from different geographical origins.

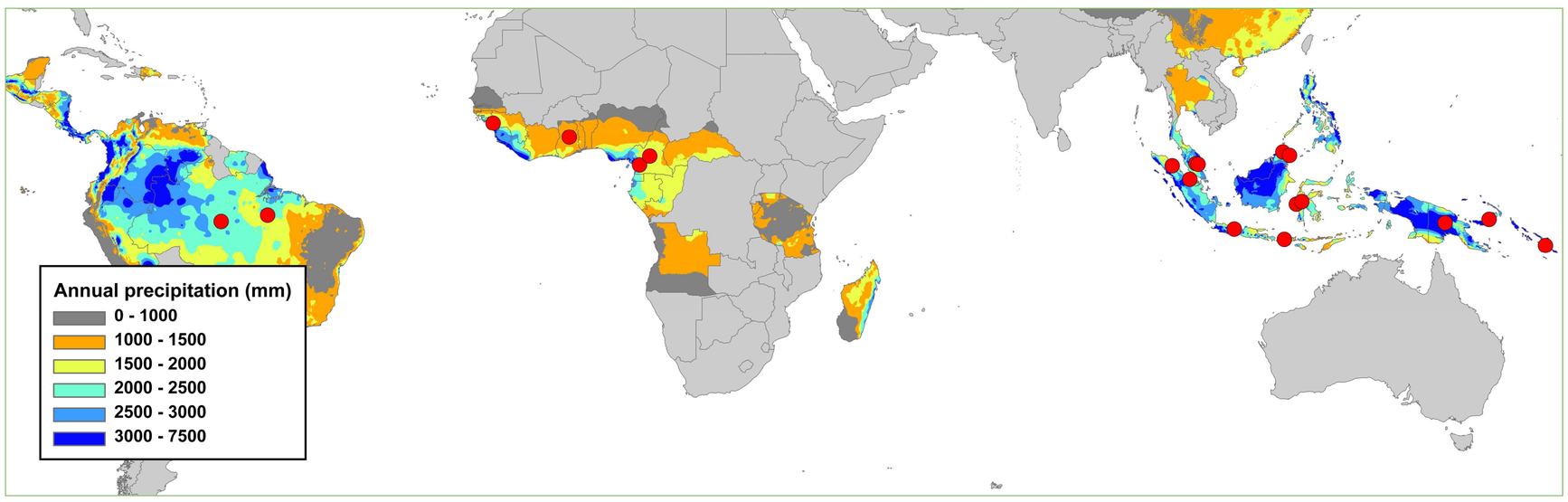

Figure 1 – Overview of palm oil sample locations and the mean annual amount of precipitation (mm) in the palm oil producing countries (coloured areas have precipitation > 1000 mm).

Conclusions

The present study shows that deuterium and carbon isotopes of palm oil are useful tracers of the geographical origin, allowing palm oils from climatically different regions to be distinguished.

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