

Project Review

“Robustness of Stable Isotope Analytical Techniques in Doping Control”

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The analysis of $^{13}\text{C}/^{12}\text{C}$ is a well proven and powerful method to detect abuse of endogenous steroids. However, the method is rather complicated as compared to more classical analytical techniques. Successful application requires skilled and experienced technicians and scientists.

However some possible problems appear to be exaggerated. This has led partly to the impression that only measurements obtained under absolutely perfect conditions can be trusted. Self evidently this has been exploited to dishonestly charge the method.

The project aims to find out to which degree $^{13}\text{C}/^{12}\text{C}$ analyses are impaired when the conditions are not ideal.

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Results and Conclusions

- Chromatographic resolution in GC-C-IRMS is significantly impaired by ineffective combustion.
- Lack of oxygen and the state of the furnace themselves are more significant than e. g. combustion temperatures in this respect.
- By contrast, the effects of dead volumes, cold spots etc. seem to be less important.
- Observed peak overlap which is induced by cold spots (and possibly also by dead volumes) does not necessarily result in invalid data.
- This even applies when the (true) $\delta^{13}\text{C}$ -values of incompletely resolved signals differ largely.
- Nonetheless, poor peak shapes and insufficient resolutions require careful investigation of the corresponding causes.
- In order to still benefit from analyses obtained from poorly resolved chromatograms, incomplete combustion must definitely be excluded.
- The peak shapes of highly oxidized compounds are a sensitive indicator for the effectiveness of combustion, increasing peak tailing corresponding inefficient combustion. This however might confound with the effects of higher retention times.
- The $\delta^{13}\text{C}$ -values of lowly oxidized compounds are more sensitive to incomplete combustion than those of highly oxidized compounds. However, these conclusions must be confined to steroids currently.