

Hair analysis for THCA-A, THC and CBN after handling cannabis plant material

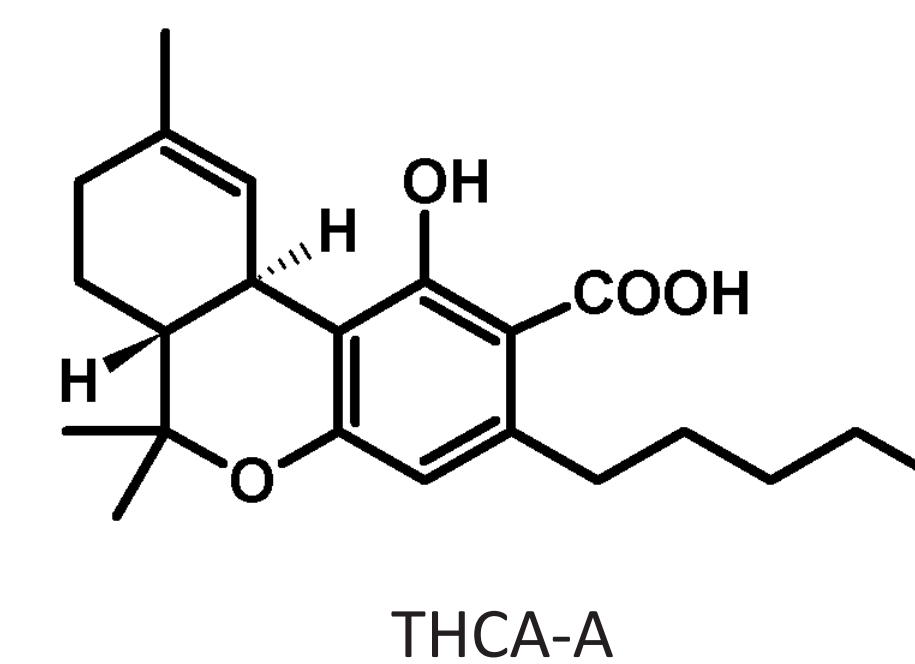
B. Moosmann, N. Roth and V. Auwärter

Institute of Forensic Medicine, University Medical Center Freiburg, Freiburg, Germany

**IRM Institute of Forensic Medicine
Forensic Toxicology**

Introduction

A previous study has shown that Δ^9 -tetrahydrocannabinolic acid A (THCA-A), the non psychoactive precursor of Δ^9 -tetrahydrocannabinol (THC) in the cannabis plant does not get incorporated into the hair through the bloodstream after repeated oral intake (applied limit of detection: 50 pg/mg) [1]. However, THCA-A can be measured in forensic hair samples in concentrations often exceeding the detected THC concentrations and may therefore act as a marker for an external contamination. Recently, another study demonstrated that a contamination through sidestream marijuana smoke can be ruled out as the source for high THCA-A concentrations in hair [2] and proposed that transfer through contaminated fingers may be an explanation for the findings in forensic hair samples. As a consequence, a study was carried out to analyze whether the handling of cannabis plant material prior to consumption is a contributing factor for THC positive hair results and to evaluate if THCA-A can act as a marker for such a contamination.

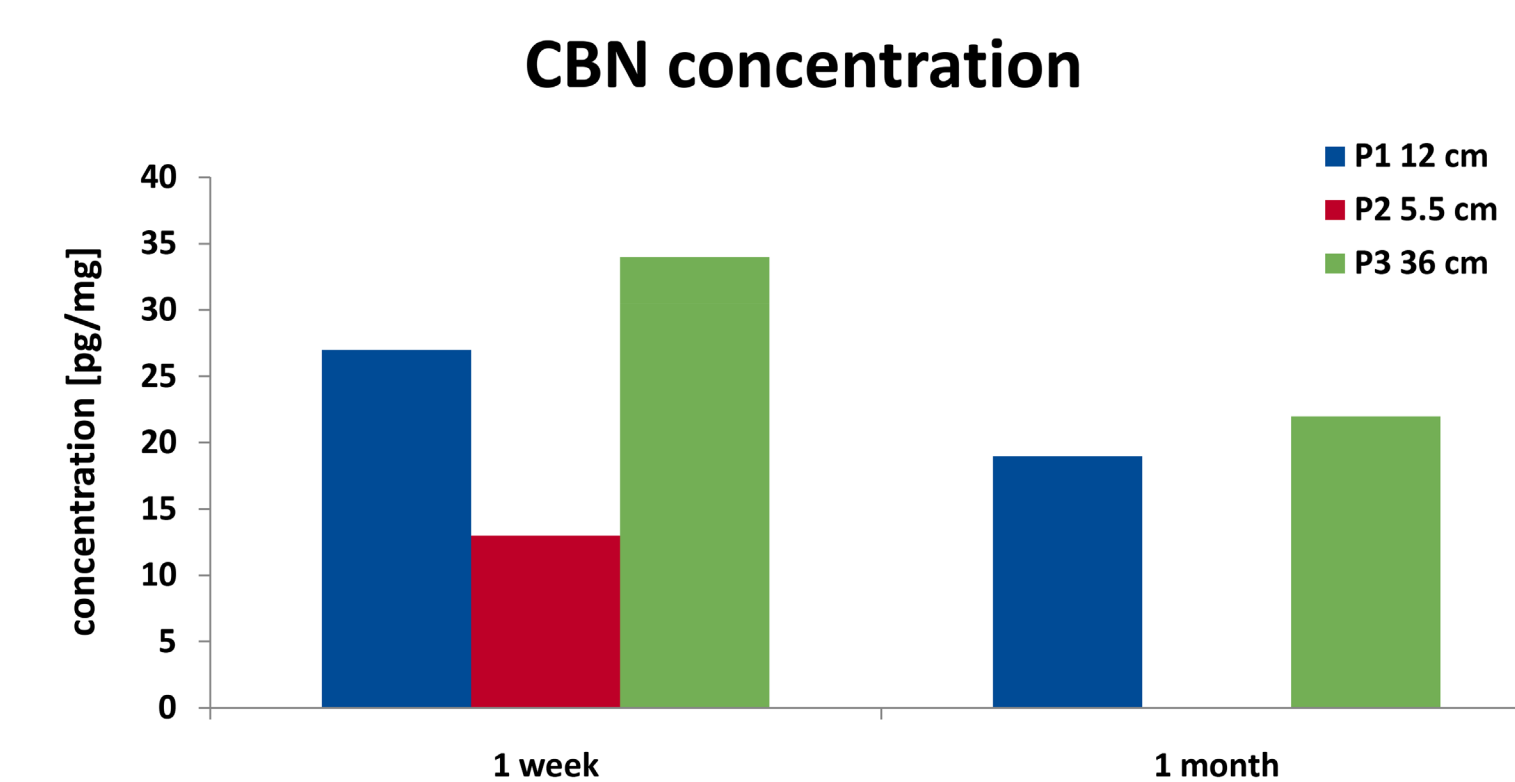
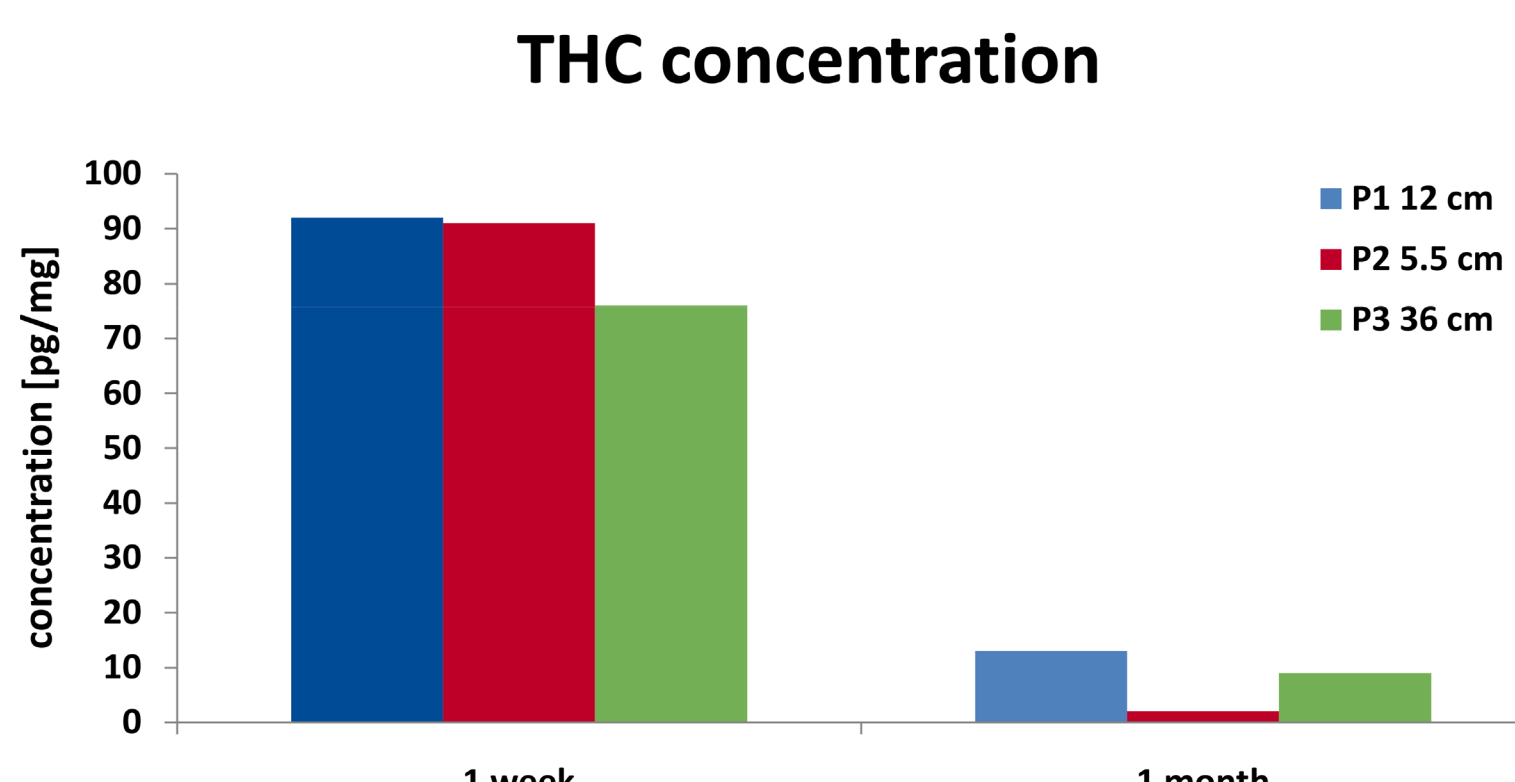
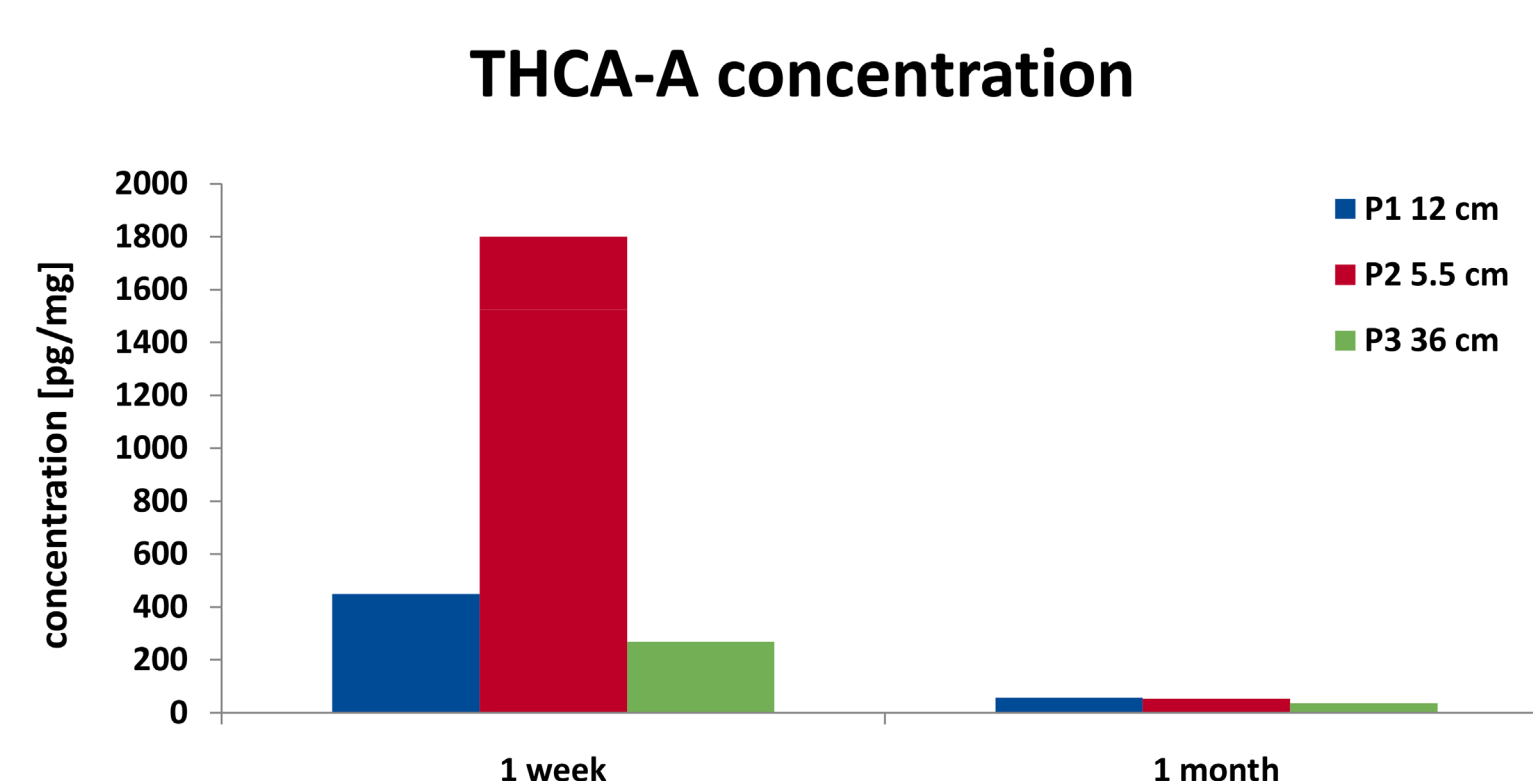


Materials and methods

Three subjects rolled a marijuana joint containing 500 mg marijuana flowers (8.9% THCA-A & 1.3% THC) as well as 500 mg tobacco on five consecutive days. Afterwards the participants were not allowed to wash their hands for at least three hours. Three hairs samples of each participant were obtained. One prior to the study, one at the end of the five day period and one sample one month after the first exposure. In addition to the hair samples urine samples were obtained to exclude any cannabis consumption prior to or during the study period. The concentrations of THC, THCA-A and cannabinol (CBN) were measured in the segmented hair after methanolic extraction using a validated LC-MS/MS method with a lower limit of quantification of 2.5 pg/mg for THCA-A and 20 pg/mg for THC and CBN [3].

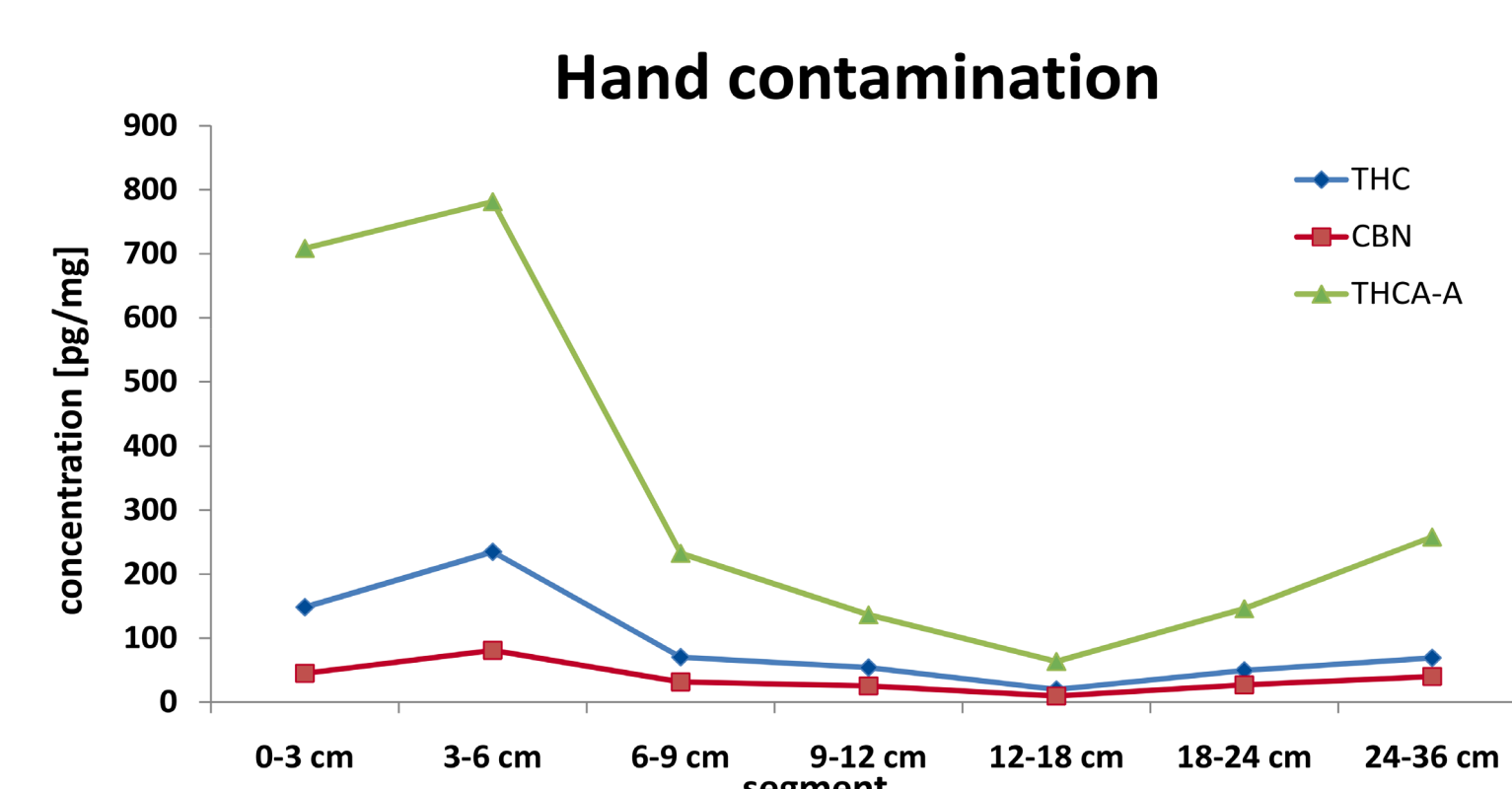
Results and discussion

Concentrations

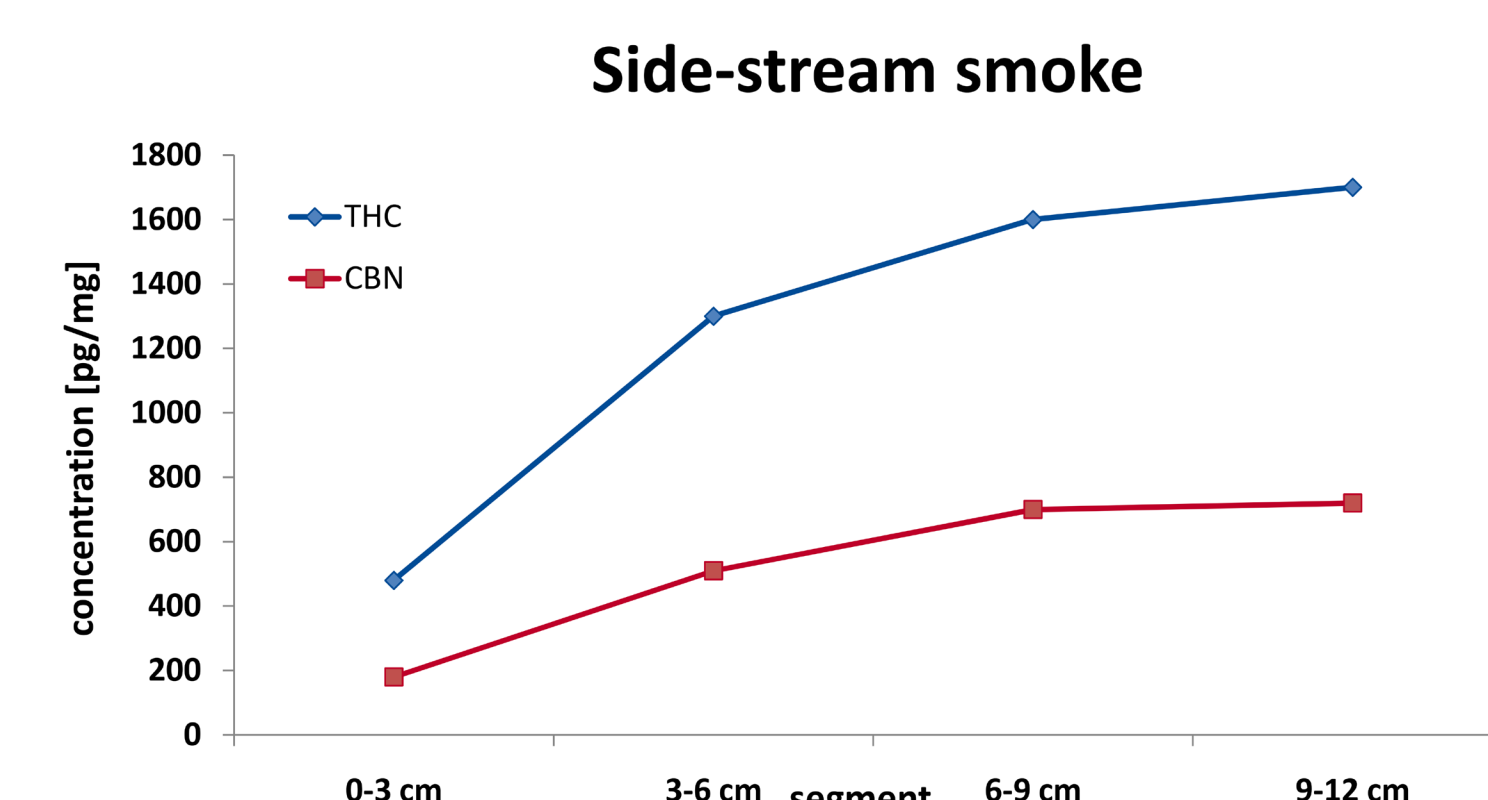


The participants 1 and 3 with longer hair (12 and 36 cm) show a similar degree of contamination for all three analytes. Participant 2 with the shortest hair (5.5 cm) shows the highest degree of contamination at the end of the exposure period for THCA-A and similar concentrations of THC and CBN as participant 1 & 3. However, with shorter hair the analytes seem to be washed out more easily and as a consequence participant 2 shows the largest decline of the cannabinoid concentrations at the end of the study. One month after the exposure, THCA-A as well as THC could still be detected in all the obtained samples. However, the concentrations of THC in these samples were below the cut-off applied in Germany for driving license issues (20 pg/mg).

Distribution



In contrast to an external contamination caused by sidestream marijuana smoke [2], the highest concentrations were found in proximal segments and the lowest in segments obtained from the middle of the hair shaft. A possible explanation for this finding may be that the major part of the transfer is caused by e.g. head scratching (proximal). The high proximal concentrations are particularly critical as it may be misinterpreted as a heavy recent consumption.



Comparison to forensic samples

Comparing the detected ratio of THCA-A to THC of 3.5 : 1 to 27.5 : 1 in the study samples with the ratios found in forensic samples which ranged from 1.1 : 1 to 6.1 : 1, the findings suggest that transfer through contaminated fingers may be the main reason for the high concentrations of THCA-A detected in routine samples.

Conclusion

It can be concluded that at least parts of the THC and CBN as well as the major part of THCA A found in routine hair analysis derive from external contamination caused by direct transfer through contaminated fingers. The three tested cannabinoids with their high lipophilicity can be transferred onto the hair and incorporated into it. Taking the THC and CBN contamination caused by sidestream smoke [2] and by transfer through contaminated fingers into account, interpretation of consumption habits / frequency based on the measured THC concentration has to be strongly questioned. Additionally, the above findings may be an explanation for cases where high THC/CBN concentrations are measured in hair without a detectable presence of 11-nor-9-carboxy-THC. This finding is of particular interest in interpreting THC positive hair results of children or partners of cannabis users, as the presence of THCA-A can be a valuable information for the evaluation of a possible incorporation of cannabinoids into the hair by external transfer.

References

- [1] Auwärter et. al. Hair analysis for Δ^9 -tetrahydrocannabinolic acid A – new insights into the mechanism of drug incorporation of cannabinoids into hair. *Forensic Sci Int* 196: 10-13, 2010
- [2] Moosmann et. al. Hair analysis for THCA-A, THC and CBN after passive in vivo exposure to marijuana smoke. *Drug Test Anal* DOI: 10.1002/dta.1474
- [3] Roth et. al. Development and validation of an LC-MS/MS method for quantification of Δ^9 -tetrahydrocannabinolic acid A (THCA-A), THC, CBN and CBD in hair. *J Mass Spectrom* 48: 227-233, 2013

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Contact

Bjoern Moosmann
Institute of Forensic Medicine
Forensic Toxicology
Albertstraße 9
79104 Freiburg, Germany
bjoern.moosmann@uniklinik-freiburg.de