PROJECT REVIEW

“Study on the detection of dope testosterone manipulated with 13C labelled standards”

Pr. J. Wang, Pr. Xu, Pr. Liu (China Anti-Doping Agency)

Testosterone, an endogenous steroid banned by the World Anti-Doping Agency, is still one of the most widely used performance-enhancing drugs in the athletic community. Isotope ratio mass spectrometry (IRMS) is a commendatory technology used to detect urinary endogenous steroids by determination of the carbon isotope ratio (13C value). Recent investigation revealed that 13C labeled testosterone standard could be used to regulate the 13C value of testosterone products and lead to the false negative results in doping test. With increasing availability of the manipulated testosterone, significant efforts are needed by anti-doping authorities to develop methods to detect its abuse.

The aim of this study is to establish method for the detection of testosterone manipulated with 13C labeled standards. The key difference in structure between manipulated testosterone and non-manipulated testosterone is that certain amount of C-3 or/and C-4 are labeled by 13C in manipulated product which makes significant positive contribution to 13C value. In this study, chemical reactions will be explored to remove C-3 or C-4. For the manipulated testosterone, the 13C value of resultant of the reaction would be more negative than that of the reactant. By comparing the 13C values of reactant and resultant, the manipulated T could be detected.
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Results and Conclusions

13C labeled standards can be used to control the $\delta^{13}C$ value and produce manipulated testosterone (T) which cannot be detected by the current isotope ratio mass spectrometry (IRMS) method. The aim of this study is to establish a method for the detection of T manipulated with 13C labeled standards. A method was explored to remove the $^{13}$C labeled atom at C-3 in androsterone (Andro), the metabolite of T in urine, to produce the resultant (A-nor-5α-androstane-2,17-dione, ANAD). The difference in $\delta^{13}C$ values between Andro and ANAD ($\Delta \delta^{13}C_{\text{Andro-ANAD}}$, ‰) would change significantly in case manipulated T is abused. After administration of T manipulated with $^{13}$C labeled standards, urine samples were collected from volunteers and analyzed with the established method. Based on the population reference, the cut-off value of $\Delta \delta^{13}C_{\text{Andro-ANAD}}$ for positive result was assessed. The developed method could be used to detect T manipulated with 3-$^{13}$C labeled standards. The study results have been published in Analytica Chimica Acta (DOI: 10.1016/j.aca.2014.09.007).