

## PROJECT REVIEW

### *“Carbon Isotope Ratio Determination of Seized Nandrolone, Boldenone and Testosterone”*

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Determining the origin of anabolic steroids that are also produced endogenously in the human body, is a major issue in doping control. Increasing amounts of anabolic steroid preparations of nandrolone, boldenone and testosterone preparations, both in a ready-to-use form and as bulk material, have been confiscated by the Norwegian Custom Authorities and the Norwegian Police.

In rare circumstances, nandrolone and boldenone metabolites may be produced naturally in humans and animals. Hence, the measurement of the  $^{13}\text{C}\text{‰}$  value of nandrolone, boldenone and testosterone of synthetic origin is important for their comparison with the nandrolone and boldenone metabolites, and testosterone endogeneously produced. As a result of this, IRMS is required for a definitive assignments of the origin of nandrolone, boldenone and testosterone found in urine.

The aim of the project is to determine the  $^{13}\text{C}/^{12}\text{C}$  ratios of nandrolone, boldenone and testosterone available on the Scandinavian black market. The success of the established doping test is depending on a significant difference in  $^{13}\text{C}\text{‰}$  values between the administered product and the endogenously produced steroids. A comprehensive knowledge of these data with a global perspective is essential for doping analysis of certain anabolic-androgenic steroids.

In addition, the confiscated testosterone preparations will also be investigated for the content of other possible masking agents like epitestosterone.

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**Results and Conclusion**

There have been a substantial number of seized doping preparations, including preparations of nandrolone, boldenone and testosterone, in Norway lately. Determining the origin of anabolic androgenic steroids (AAS) that are also produced endogenously in the human body, is a major issue in doping control. The aim of this study was to use GC-C-IRMS to determine the  $\delta^{13}\text{C}\text{‰}$  values of nandrolone, boldenone and testosterone in seized preparations, and to what extent these products have been designed to mimic the endogenous  $\delta^{13}\text{C}\text{‰}$  values, and hence prevent positive GC-C-IRMS findings. Out of 55 products, one nandrolone and five testosterone products (11%) were found to display  $\delta\text{C}\text{‰}$  values between -24‰ and -26‰. In addition one nandrolone and eight testosterone products (16%) displayed  $\delta\text{C}\text{‰}$  values of -27‰, which is close to the upper reference range (-26‰) reported for urinary reference metabolites. None of the investigated products contained epitestosterone. This study shows that there are AAS available with  $\delta\text{C}\text{‰}$  values near and within the endogenous urinary reference range in Norway.