Daniel Stork

8/18/2020

CHE 811 Proposal

“Spectroscopic and Chromatographic Studies on Some Regioisomeric Aromatase Inhibitors”

Athletes are required to follow strict rules when it comes to substances that are allowed for their sport. Athletes are always looking for ways to improve their performance by either finding a new protein shake, mixing electrolytes to improve hydration, and even consuming performance enhancing drugs. These performance enhancing drugs cause issues within the competition, as they create an unfair playing level for participating athletes. Athletes had been using substances to enhance their performance and there was a need to stop this. In February of 1999, the International Olympic Committee decided to host a World Conference in reference to doping in sports. After this two-day conference the agency compiled the Lausanne Declaration on Doping in Sports. This declaration formed a new order in modern sports prohibiting substances that cause performance enhancement.

The World Anti-Doping Agency (WADA) is now in charge of listing what substances are prohibited due to their use and effects. WADA acts as an impartial party in the sports industry to ensure that all members, from coaches to players, are following the specific code of anti-doping. Common doping drugs used by athletes are anabolic androgenic steroids. WADA lists anabolic agents as prohibited in and out of competition. Anabolic steroids occur either naturally or synthetically, but ultimately, they are derived from testosterone that is found in higher concentrations in the male testes and in lower concentrations of female ovaries. Testosterone is responsible for muscle growth, muscle strength, and all other developmental features. Athletes who use these drugs for performance enhancing purposes claim to see results in strength, losing body fat, and overall injury recovery time. Since testosterone is a naturally occurring hormone, it is very hard to test for steroids, due to the fact they are derived from testosterone and will metabolize in a similar manner. During metabolization, the drug breaks down due to our body processing it and only leaving pieces like a puzzle for scientist to put back together. A problem arrises when the pieces of the puzzle are designed to mimic testosterone, which the human body naturally produces and breaks down.

This causes issues in analytical testing because testosterone levels vary so much between different people and that these designer steroids mimic the natural occurring hormones. The designer drugs are regioisomeric, where the main carbon skeleton is kept the same, but the substituents are moved along the carbon chain. These drugs typically have the same formula and the same exact and nominal mass. These drugs are designed to mimic properties of the original structure making it difficult to differentiate. Scientist typically use High Performance Liquid Chromatography (HPLC) or Gas Chromatography (GC) to separate the components of the mixture. An issue arises with the separation techniques, due to the fact that designer drugs have similar properties, so this causes elution times to be fairly similar. Next Scientist use a Mass Spectrometer (MS) to obtain the nominal mass followed by a spectra of fragments from the parent ion. Another problem arises because these designer drugs have the same exact and nominal masses. Scientist also use Fourier Transform Infrared Spectroscopy (FT-IR) to differentiate the functional groups present of the drugs. More research is required to help find reliable methods to properly identify and discriminate among these isomeric drugs of abuse.

The broad objective of this research is to improve the specificity, selectivity and reliability of the analytical methods used to identify three regioisomeric aromatase inhibitors; 5-alpha-Androstan-17-one, 5-alpha-Androst-16-en-3α-ol and 17-beta-Hydroxy-5-alpha-androst-2-ene. A combination of chromatographic and spectroscopic techniques namely, HPLC, GC-MS, and FT-IR, will be used to generate the analytical profiles of the three regioisomeric drugs in addition to discriminating among them. In addition, this project is aiming to improve chromatographic resolution between the three studies compounds to provide additional layer of discrimination when the mass spectra are nearly identical.

References.

Berthold, E. (2019, September 19). What are anabolic androgenic steroids? Retrieved August 19, 2020, from https://www.science.org.au/curious/people-medicine/what-are-anabolic-androgenic-steroids

Sutton, B. (n.d.).Â *SPECTROSCOPIC AND CHROMATOGRAPHIC STUDIES ON SOME REGIOISOMERIC AROMATASE INHIBITORS*Â (Rep.). Masters of Science Thesis. Eastern Kentucky University. May 2020.

Vlad, R., Hancu, G., Popescu, G., & Lungu, I. (2018, November). Doping in Sports, a Never-Ending Story? Retrieved August 19, 2020, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6311632/

What is Prohibited. (n.d.). Retrieved August 19, 2020, from <https://www.wada-ama.org/en/content/what-is-prohibited/prohibited-at-all-times/anabolic-agents>

Prohibited List. (2020). Retrieved from World Anti-Doping: <https://www.wada> ama.org/sites/default/files/wada\_2020\_english\_prohibited\_list\_0.pdf