Diabetes is a disease in which the body does not produce or properly use insulin. Insulin is a hormone that is needed to convert sugar, starches, and other foods into energy needed for daily life. Vanadium compounds are of particular interest in the treatment of diabetes because they have insulin mimetic properties. Vanadium is a Group 5 transition metal with oxidation states ranging from -3 to +5. Under physiological conditions the +3, +4, and +5 oxidation states are thermodynamically and kinetically accessible. In particular, it was found that V⁴⁺ is the most likely form of vanadium mimicking or enhancing insulin action by interacting with the glucose transporters.

There are three general classes of vanadium compounds that have insulin mimetic properties: 1) inorganic vanadium salts containing vanadate [VO₄]³⁻ or vanadyl [VO]²⁺; 2) complexes formed from V⁵⁺ and H₂O₂; and 3) chelated vanadium complexes. Much of the current research has focused on chelated vanadium complexes because they are more readily absorbed by animals and are inherently less toxic than the inorganic vanadium salts. This seminar will focus on the structural and chemical properties of three chelated organic vanadium (IV) complexes that have shown significant insulin mimetic properties. VO(ma)₂, prepared from mixing maltol and vanadyl sulfate in a 2:1 ratio, was the first chelated vanadium complex that was shown to have activity. Aqueous solutions of VO(ma)₂ at 1.58 mM concentration normalized glucose and lipid values and restored food and fluid intake levels. In 1999, Orvig et al. reported the preparation of VO(pa)₂·H₂O in a similar fashion, and this complex was found to lower plasma glucose levels in 50% of the test animals at a concentration of 2.28 mM. Also in 1999, Sakurai and coworkers reported the preparation of VO(X)·H₂O (where X = a bis(amino acid)ethylenediamine ligand) and determined that these complexes displayed IC₅₀ values well below 1 mM concentration.
References


