



Denver

CHEMISTRY

Spring 2024

Seminar Series



11am-12pm

Jan 26th

NC1130

Department of Chemistry
Colorado State University

<https://cranslab.colostate.edu/>

"Medicinal Applications of Vanadium: Combinatorial therapy prevents loss of pancreatic β cell mass and function while ameliorating insulin resistance"

As one of the 10 first row transition metals vanadium is not essential for humans like the five other five first row transition metals (manganese, cobalt, iron, copper and zinc). However vanadium has many desirable biological activities. As a result it has been considered for treatment of various disease include diabetes. To enhance insulin sensitivity through rescuing the loss of insulin-secreting β cells in type 2 diabetes mellitus (T2DM), a novel vanadium-oestrogen combinatorial therapy was developed using the membrane permeable graphene quantum dots (GQDs) as delivery platform. Vanadyl acetylacetonate (VAC) and estradiol (E2) are integrated stably on the surface of GQDs ($\phi \sim 2.5\text{nm}$) in desired amounts to form GQD-E2-VAC complexes. On db/db transgenic type 2 diabetic mice, GQD-E2-VAC complexes ($10 \mu\text{mol/kg/day}$ for vanadium; 250nmol/kg/day for E2) exhibited anti-diabetic effects including fully control of hyperglycemia (normalizing fasting blood glucose, feed blood glucose, and urine glucose) and dyslipidemia, improvement of insulin sensitivity, correction of hyperinsulinemia, and restore of β -cell mass. Further analysis on tissue samples using a NIT-1 pancreatic cell model revealed that co-regulation of TXNIP activation by vanadium and oestrogen would contribute to the enhanced anti-diabetic effects of the combinational therapy. Moreover, dietary supplement of a potent mitochondrial protective antioxidant, coniferaldehyde (0.2mmol/kg/day), can significantly potentiate the protective effects of GQD-E2-VAC complexes, supporting the significance of correction of redox state in diabetes. Collectively, the present work provided a vanadium-oestrogen combinatorial approach that achieved simultaneously protection of β -cells and insulin enhancement using very low dose of vanadium close to the upper safety limit of daily intake of vanadium as an essential element. Our work may encourage further new multi-modal therapies towards the cure of type 2 diabetes.

For more information see: <https://clas.ucdenver.edu/chemistry/seminars-and-events>