

# XAS and XFM in Speciation and Biodistribution of Vanadium: From Drugs to Microfossils

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**Background:** There is considerable debate as to whether vanadium is an essential trace element for humans. Recently, there is mounting evidence that it may have an essential role in glucose metabolism and other functions to maintain human health. Vanadium complexes have also been explored extensively for their potential as anti-diabetic and anti-cancer drugs. In addition, there is considerable controversy as to appropriate criteria to identify ancient microfossils from carbonaceous deposits that are similar in appearance to genuine microfossils. We have identified the use of vanadium as a biomarker to make this distinction.

**Methods.** In this talk, we will discuss the information obtained from X-ray fluorescence microscopy, X-ray absorption spectroscopy and synchrotron radiation FTIR microscopy on understanding vanadium biochemistry associated with these functions.

**Results.** XAS has been used to identify speciation that occurs within biological fluids and treated and untreated cells, which is important in understanding their modes of action. For instance, many vanadium drugs undergo decomposition in cell medium and the released ligands are important in the in-vitro activities of many V anti-cancer drugs. Similar time-dependent intracellular vanadium speciation occurs for most vanadium anti-diabetic and anti-cancer cells, with the main role of the ligands to deliver V either into the cell, or to biomolecules such as transferrin and serum albumin that interact with the cell. XFM combined with micro-XANES has been used to determine the distribution of V in both treated and untreated adipocytes (fat cells). The results indicate such cells naturally accumulate vanadium and together with other results on glucose metabolism, cell signaling, etc., vanadium may have an essential role. XFM was also used to determine that vanadium could be detected in genuine microfossils in the cytosolic space.

**Conclusions:** XAS and XFM are extremely useful tools to provide important information about the modes of action of vanadium drugs, the essentiality of vanadium and its application as a biomarker in identifying ancient microfossils.

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## References

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