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The Potentiality of Vanadium Complexes as Antibacterial Agents

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INTRODUCTION & AIM

- Vanadium is an important transition element. Previously it has been reported that the vanadium complexes have a wide range of potential medicinal and diagnostic application with low toxicity.
- Researchers have been inspired to develop vanadium-based drugs due to its diverse biological applications [1].
- The aim of this study is to focus on the biological applications of vanadium complexes as antibacterial agents.

METHOD

The literature for review was examined and taken from prominent indexing databases over the past decade to explore the biological application of vanadium complexes as antibacterial agents.

VANADIUM AS AN ENZYME SWITCH

- The ability of vanadium to activate enzymes is primarily due to its complexation with the ligand, such as the anionic form of vanadium $(VO_4)^{-3}$ stimulates glucose-6-phosphate dehydrogenase in the cells of mammalian.
- Furthermore, vanadate compounds stimulate the tyrosine kinases $p59^{fyn}$ and $p56^{Ick}$.
- They also activate protein kinase B (PKB), or Akt, and extracellular-signal-regulated kinases (ERKs). On the other hand, vanadium can inhibit several enzymes, such as acid phosphatase, and alkaline phosphatase both involved in the mineralization of bone and glucose-6-phosphatase (G6P) (Fig. 1) [2].
- These findings indicate that vanadium complexes regulate a variety of biological processes.

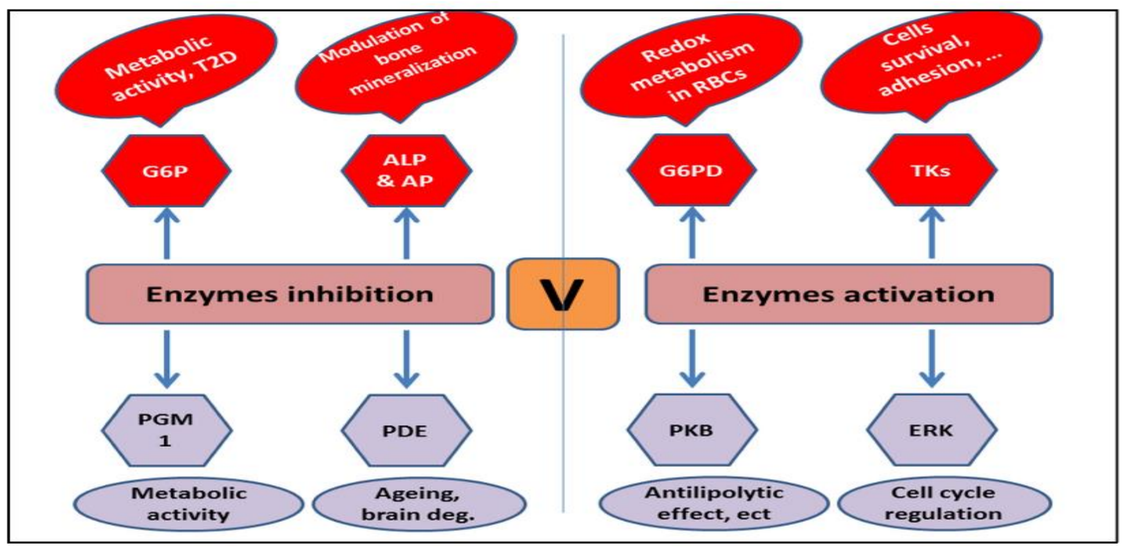

Fig. 1. The main enzyme targets of vanadium complexes

ANTIBACTERIAL ACTIVITY OF VANADIUM COMPLEXES

❖ Vanadium (+4) complexes of 1,2,4-triazole Schiff base (Fig. 1(a-b)) exhibited *in vitro* antibacterial activity against *B. subtilis*, *S. aureus*, *E. coli*, *P. aureginosa*, *S. flexenari* and *S. typhi* respectively [3].

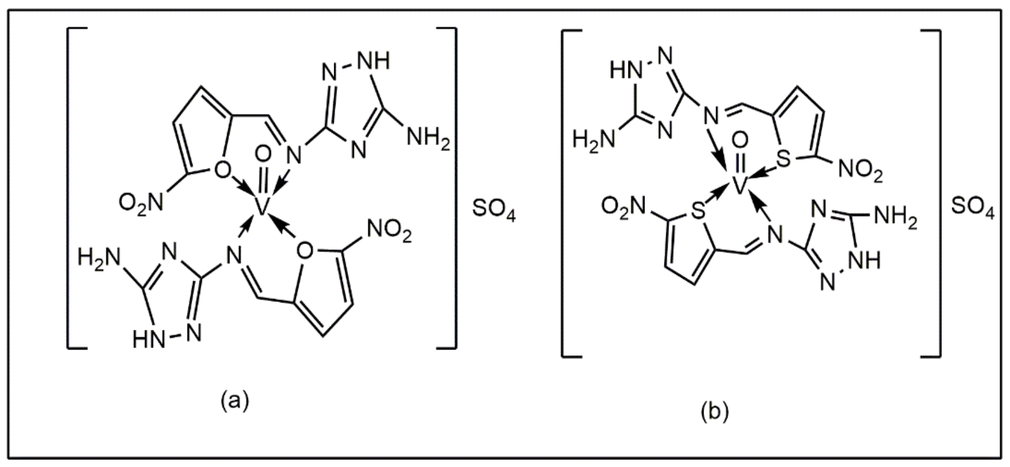

Fig. 2. Vanadium complexes with 1,2,4-triazole derived Schiff bases

❖ Vanadium (+5) complexes with dimalonitrial-based Schiff base (Fig. 2(a-b)) have been reported to exhibit antibacterial activity against *E. faecalis*, *L. monocytogenes*, *K. pneumonia*, *P. aeruginosa*, and *E. coli* [4].

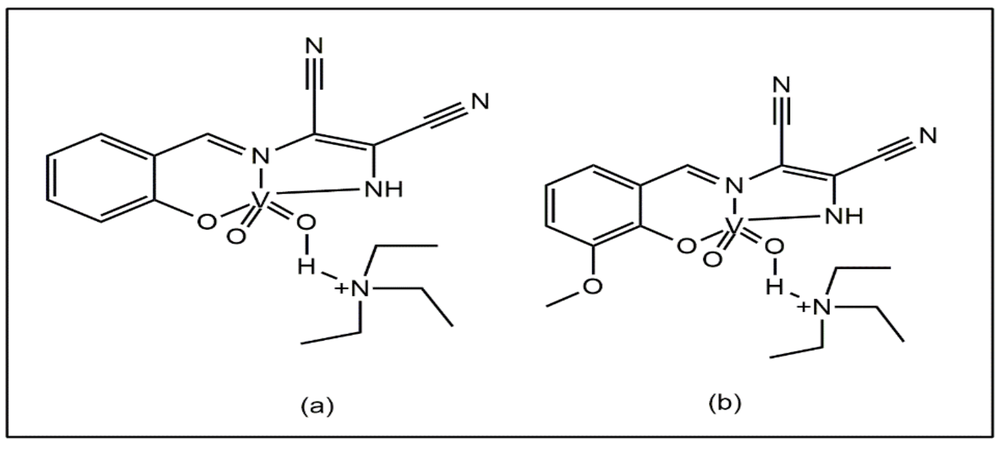

Fig. 3. Vanadium complexes with dimalonitrial-based Schiff base

CONCLUSION

Research on antimicrobial metallodrugs is crucial to combat antibiotic resistance, but mechanisms of toxicity remain uncertain, and limited *in-vivo* data hinders further development due to limited bacterial targets. Future multidisciplinary research on vanadium complexes as antibacterial potential offers opportunities to explore biochemistry, design novel, and improve solubility, bioavailability, and toxicity and focus on developing novel strategies for targeting toxic metals and developing nanostructured antimicrobials for better understanding metal complex behaviour in living organisms.

FUTURE WORK / REFERENCES

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3. Chohan, et al. **2010,** *J. Coord. Chem.* 63, 3981–3998, https://doi.org/10.1080/00958972.2010.523783.
4. Ebrahimipour, et al. **2016,** *Inorganica Chim. Acta* 442 (2016) 151–157, https://doi.org/10.1016/j.ica.2015.11.026.