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# The biosynthesis, biochemistry and physiology of coenzyme 3PG-F420

Coenzymes promote productive enzymatic activities assisting in almost all major metabolic pathways. Coenzyme  $F_{420}$  is a deazaflavin that acts as a hydride carrier in diverse redox reactions and has been indicated in a range of both bacteria and archaea. 3PG  $-F_{420}$  is a novel hydroxylated derivative of coenzyme  $F_{420}$ , found in the Gram-negative, endofungal bacterium *Paraburkholderia rhizoxinica*, a symbiont of phytopathogenic fungi *Rhizopus microsporus*.

The availability of the exotic cofactor  $F_{420}$  is not generous and the biosynthetic pathway of  $F_{420}$  has remained elusive regarding the starting precursor and substrate specificity of key enzymes involved. 2-phospho-L-lactate guanylyltransferase (CofC in Archaea and also known as FbiD in Bacteria) is a key enzyme in the biosynthesis of coenzyme  $F_{420}$ . Within the field of research, both 2-phospho-L-lactate (2-PL) and phosphoenolpyruvate (PEP) have been recognized as the accepted substrates by CofC/FbiD of Archaea and Mycobacteria respectively. In contrast, CofC of *P. rhizoxinica* accepts 3-D-phosphoglyceric acid (3-PG) as a substrate thus leading to the formation of a novel derivative termed coenzyme 3PG-F420. Both 3-PG and PEP are intermediate of glycolysis while availability, source and function of 2-PL are yet to be determined.

The main goals of the thesis are to complete our model of  $3PG-F_{420}$  biosynthesis, to discover more  $3PG-F_{420}$  producing organisms and to study the biochemical and physiological roles of  $3PG-F_{420}$  in these organisms.

## Publications

Hasan M, Schulze S, Berndt L, Palm GJ, Braga D, Richter I, Last D, Lammers M, Lackner G (2022) Diversification by CofC and Control by CofD Govern Biosynthesis and Evolution of Coenzyme F420 and Its Derivative 3PG-F420. *mBio* , e0350121. <u>Details PubMed</u>

Braga D, Hasan H, Kröber T, Last D, Lackner G (2020) Redox Coenzyme F 420 Biosynthesis in Thermomicrobia Involves Reduction by Stand-Alone Nitroreductase Superfamily Enzymes *Appl Environ Microbiol* 86(12), e00457-20. <u>Details PubMed</u>

Braga D, Last D, Hasan M, Guo H, Leichnitz D, Uzum Z, Richter I, Schalk F, Beemelmanns C, Hertweck C, Lackner G (2019) Metabolic Pathway Rerouting in *Paraburkholderia rhizoxinica* Evolved Long-Overlooked Derivatives of Coenzyme F420. *ACS Chem Biol* 14(9), 2088-2094. <u>Details PubMed</u>

#### Supervisor

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#### Start of PhD

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