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Review of the dissertation thesis of Mgr. Millan Boublik

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Continuing the development of high-quality separation science at one of its premier centers in Central Europe is a most valuable undertaking. Mgr. Milan Boublik's thesis is an appropriate proof of the depth – and breadth – of this laudable tradition. The topics covered in the chapters of his thesis and the appended published papers range from liquid chromatography to capillary electrophoresis, from problems in the daily practice of separation science (how to improve detection limits, how to improve retention control) to problems in the theory of separation science (how to determine thermodynamically meaningful pK_a and limiting mobility values for ampholytic and non-ampholytic weak electrolytes). The common, unifying theoretical thread through these wide-ranging topics is a demonstrated thorough understanding of the effects of the ionic constituents of the systems studied: how they alter dissociation, solvation, partitioning, the formation and properties of reactive boundaries. All of these were achieved by properly identifying existing needs, making theory-based predictions, numerically simulating their manifestation and corroborating them by carefully completed experiments.

Closest to my heart is the paper and the corresponding chapter that turn sour lemons (system peaks hated with a vengeance by all of us in the field) into enjoyable lemonades (into exquisitely controlled transient pH changes that trap and concentrate dilute analytes and lead to improved detection limits). I value that in addition to demonstrating the correctness of the predictions, a broad analysis of all possible cases was carried out, and that a field-proofed decision flow chart was produced that the practicing separation scientist could confidently apply to tackle a new problem, even in the absence of a literature reference to rely on.

I am intrigued by the selection of guanosine 5'-monophosphate (GMP) as the vehicle to demonstrate the capabilities of the new method – and associated software, Anglerfish – in Chapter 3.2 and Paper III. In their landmark paper, Prof. Sigel and coworkers from University of Basel (*J. Am. Chem. Soc.* **1994**, 116, 2958-2971), list critical (though not thermodynamic) pK_a values at $I=0.1$ M for the dissociation of five protons from $H_3(GMP)^+$ as follows: 0.3 (N-7H⁺); 2.48 (O=P(OH)₂O⁻); 6.25 (O=P(OH)O⁻O⁻); 9.49 (N-1H) and >12 (2'-OH) that were obtained potentiometrically. I would be interested in the candidate's opinion whether these could be corrected by Anglerfish, and if so, learn how these would compare with the values Mgr. Boublik obtained by CE. Also, would the candidate consider Anglerfish suitable for obtaining

thermodynamic GMP-metal complexation values ($\log K_{\text{MGMP}}^{\text{M}}$) from Sigel's published data (which I consider "conditional" complexation constants)? If yes, this would not only extend the field of use for Anglerfish to the large and very important field of modern biological chemistry, but also liberate their "conditional" constants and turn them into "free" thermodynamic constants for all to use. It may also turn CE (with the metal ion in the BGE and GMP as the analyte) into a favorite, fast tool of biological chemists.

The five publications that describe Mgr. Boublik's work (and already appeared in well regarded separation science journals) corroborate my assessment that the thesis is suitable for the defense and fulfills the criteria necessary for obtaining the PhD degree.



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