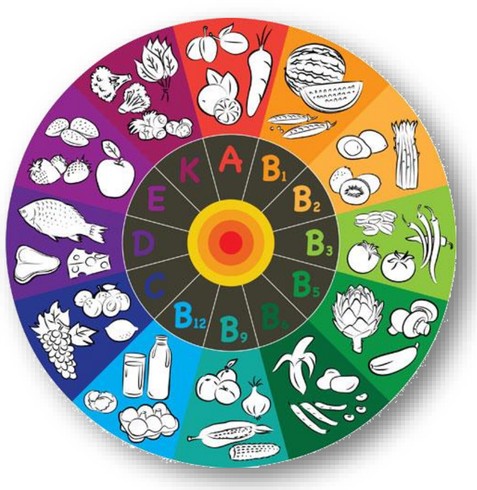
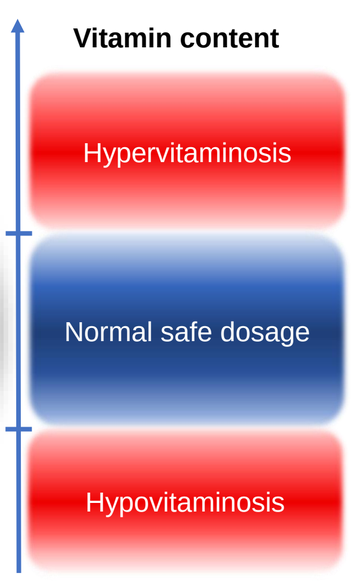
9TH INTERNATIONAL WORKSHOP ON SURFACE ENGINEERING
5TH INTERNATIONAL WORKSHOP ON APPLIED AND SUSTAINABLE ENGINEERING
20.06. - 26.06.2021, Koszalin University of Technology

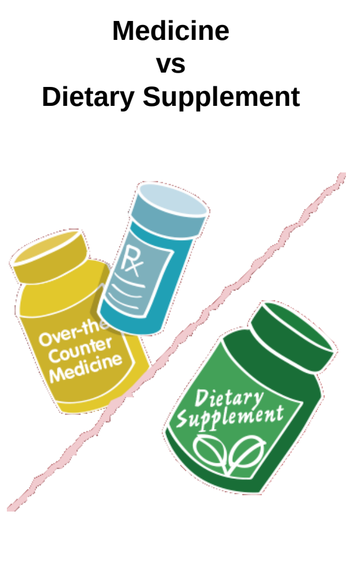
Voltammetric analysis of dietary supplements

Radosław Porada
AGH University of Science and Technology
Faculty of Material Science and Ceramics
al. Mickiewicza 30, 30-059 Kraków, rporada@agh.edu.pl

INTRODUCTION





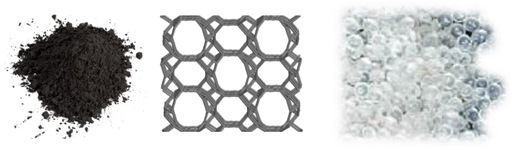


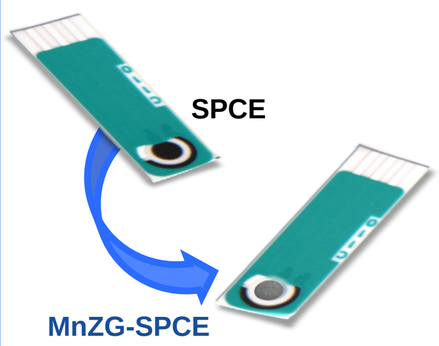
EXPERIMENTAL

- **Electrochemical analyzer**: M161E *mtm anko* Poland
- **Electrode stand**: M164 *mtm anko* Kraków
- **Electrolytic cell**:
  - Working electrodes – CGMDE, MnZG-SPCE
  - Reference electrode – Ag | AgCl | 3 M KCl
  - Auxiliary electrode – Pt-wire
- **Reagents**
  - Supporting electrolytes: McIlvaine buffer, acetate buffer
  - Standard solutions of vitamins
- **Techniques**
  - Differential Pulse Voltammetry (DPV) with CGMDE (VB1, VB3)
  - Differential Pulse Adsorptive Stripping Voltammetry (DP AdSV) with MnZG-SPCE (VB9)

VITAMIN B9

ELECTRODE PREPARATION





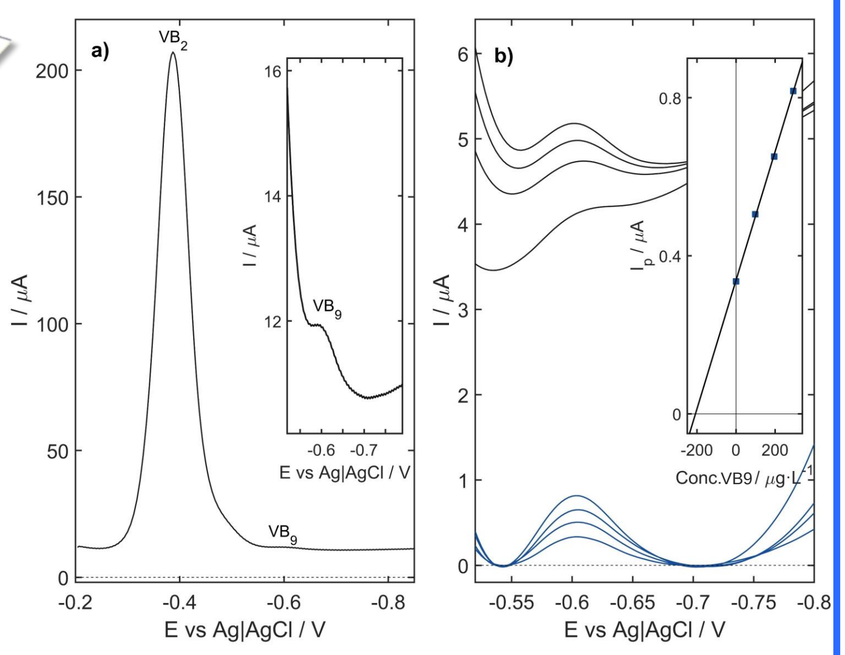
TESTED SAMPLES

VB9 pharmaceuticals

Multivitamin supplements

VB9 content in pharmaceutical formulations (n = 3)

Sample	VB9 content / µg per tablet		Recovery / %
	declared	found	
Ballans	200	225.2 ± 5.2	**112.6**
Bellis	200	200.9 ± 4.3	**100.5**
Folian	400	420 ± 13	**105.0**
Folik	400	368 ± 11	**96.5**

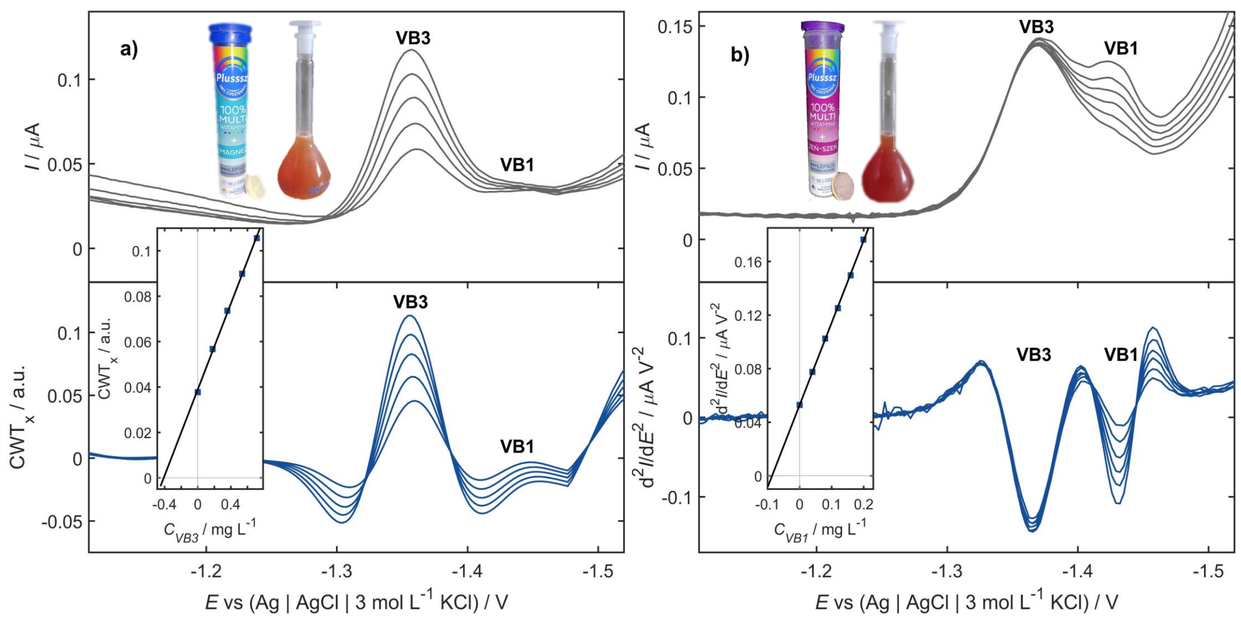


a) DP stripping voltammogram recorded for multivitamin formulation Bellis. Inset: magnification of the voltammogram in the range from -0.5 to -0.8 V. **b)** Determination of VB9 in Bellis dietary supplements using the standard additions method.

VITAMIN B1 AND B3

VB1 and VB3 content in effervescent dietary supplements. decl. – declared content; CWT, diff. – content calculated based on the CWT and derivative voltammograms, respectively

Vit.		Content / mg per tablet		Recovery / %	
		Plusssz Mg	Plusssz Ginseng	Plusssz Mg	Plusssz Ginseng
VB1	decl.	1.1	1.1	-	-
	CWT	1.09 ± 0.02	1.15 ± 0.05	**98.7**	**104.3**
	diff.	1.06 ± 0.02	1.08 ± 0.05	**96.4**	**97.8**
VB3	decl.	16	16	-	-
	CWT	16.4 ± 0.6	17.2 ± 0.5	**102.2**	**107.4**
	diff.	15.7 ± 0.7	16.9 ± 0.6	**98.3**	**105.6**



(a) DP voltammograms recorded for the *Plusssz Mg* and for additions of VB3 standard solution (top) with the curves obtained by means of CWT with Ψ_V mother wavelet (bottom). **(b)** Second derivatives (bottom) of the DP voltammograms registered for the *Plusssz Ginseng* and for additions of VB1 standard solution (top). Inset: corresponding calibration plots.

CONCLUSIONS

- → **Differential Pulse Voltammetry** with **preceding accumulation** of the analyte allows determining nanomolar concentration of vitamins.
- → The application of **Continuous Wavelet Transform** and **differentiation** enables separation of the overlapped voltammetric peaks.
- → The developed methods are **robust** to the present of the matrix components of tested samples.

REFERENCES

1. P.J. Stover, *Nutr. Rev.* 62 (2004) 3–12.
2. M. Lucock, *Mol. Genet. Metab.* 71 (2000) 121–138.
3. Combs GF The Vitamins Fundamental Aspect in Nutrition, Third. Elsevier Academic Press, Amsterdam (2008).
4. B. Brunetti, Electroanalysis 28 (2016) 1930–1942.
5. M. Jakubowska, Electroanalysis 23 (2011) 553–572.

RP has been partly supported by the EU Project POWR.03.02.00-00-I004/16
European Union
European Social Fund
European Funds
Knowledge Education Development