



**Student Scientific Research Group
“Electrophoresis in Drug Research and Analysis (ECDrug)”
Academic year 2024/2025**

Members:

Gabriel Hancu, PhD, professor (coordinator)

Kelemen Hajnal, PhD, professor

Aura Rusu, PhD, professor

Székely Szentmiklósi Blanka, PhD, lecturer

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Research topics:

1. Development of capillary electrophoresis methods for the determination of pharmaceutical substances from pharmaceutical preparations

1.1. Development of capillary electrophoresis methods for the simultaneous determination of pharmaceutical substances with similar structural and physico-chemical characteristics



1.2. Development of capillary electrophoresis methods for the simultaneous determination of pharmaceutical substances from fixed dose combinations

1.3. Development of capillary electrophoresis methods for the determination of the presence of illicit substances in adulterated dietary supplements

2. Applications of capillary electrophoresis in the analysis of chiral pharmaceutical substances

2.1. Cyclodextrins as chiral selectors in the enantioseparation of pharmaceutical substances by capillary electrophoresis

2.2. Neutral cyclodextrins vs. ionized cyclodextrins in the chiral separation of pharmaceutical substances by capillary electrophoresis

2.3. Method development and optimization for the separation and determination of enantiomers in pharmaceutical preparations by capillary electrophoresis

2.4. Application of experimental design in the development of chiral separation methods for pharmaceuticals by capillary electrophoresis

2.5. Verification of chiral impurities and enantiomer ratio of pharmaceuticals by capillary electrophoresis

2.6. High performance liquid chromatography vs. Capillary electrophoresis in modern chiral analysis

3. Applications of capillary electrophoresis in the analysis of biological samples

3.1. Development of capillary electrophoresis methods for determination of pharmaceutical substances from biological samples (urine, plasma).

4. Application of capillary electrophoresis in the analysis of food

4.1. Development of capillary electrophoresis methods for the determination of honey composition

4.2. Development of capillary electrophoresis methods for the determination of xenobiotics presence in honey

Relevant techniques:

Capillary electrophoresis (CE)

High performance liquid chromatography (HPLC)

Relevant *in extenso* ISI and BDI articles of the student scientific research team (student/PhD student name is highlighted):

ISI articles:

1. **Modroiu A.** Marzullo L. Orlandini S. Gotti R. Hancu G. Furlanetto S. *Analytical quality by design-based development of a capillary electrophoresis method for omeprazole impurity profiling*, Journal of Pharmaceutical and Biomedical Analysis. 2024, 248, 116295, doi: 10.1016/j.jpba.2024.116295, FI: 3,10 (Q2)



Contents lists available at [ScienceDirect](#)

Journal of Pharmaceutical and Biomedical Analysis

journal homepage: www.journals.elsevier.com/journal-of-pharmaceutical-and-biomedical-analysis



Analytical quality by design-based development of a capillary electrophoresis method for Omeprazole impurity profiling



Adriana Modroiu^{a,b}, Luca Marzullo^b, Serena Orlandini^{b,*}, Roberto Gotti^c, Gabriel Hancu^a, Sandra Furlanetto^b

2. **Modroiu A.** Sulaiman K. Hancu G. Scriba G. *Quality by design-guided development of a capillary electrophoresis method for the chiral purity determination of silodosin*, Journal of Pharmaceutical and Biomedical Analysis, 2023, 222, 115117, doi: 10.1016/j.jpba.2022.115117, FI: 3,10 (Q2)

Journal of Pharmaceutical and Biomedical Analysis 222 (2023) 115117



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Journal of Pharmaceutical and Biomedical Analysis

journal homepage: www.journals.elsevier.com/journal-of-pharmaceutical-and-biomedical-analysis



Quality by design-guided development of a capillary electrophoresis method for the chiral purity determination of silodosin



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3. **Modroiu A.** Sulaiman K. Hancu G. Scriba G. *Quality by design-guided development of a capillary electrophoresis method for the simultaneous chiral purity determination and impurity profiling of tamsulosin*, Journal of Separation Science, 2023; doi: 10.1002/jssc.202300604; FI: 3,10 (Q2).

DOI: 10.1002/jssc.202300604

RESEARCH ARTICLE

SEPARATION SCIENCE

Quality by design-guided development of a capillary electrophoresis method for the simultaneous chiral purity determination and impurity profiling of tamsulosin

Adriana Modroiu^{1,2} | Sulaiman Krait¹ | Gabriel Hancu² | Gerhard K. E. Scriba¹

4. **Cârcu-Dobrin M.** Hancu G. Papp L.A. Fülöp I. *Chiral discrimination of mexiletine enantiomers by capillary electrophoresis using cyclodextrins as chiral selectors and experimental design method optimization*, Molecules, 2022, 27(17), 5603, doi: 10.3390/molecules27175603, FI: 4,60 (Q2).



Article

Chiral Discrimination of Mexiletine Enantiomers by Capillary Electrophoresis Using Cyclodextrins as Chiral Selectors and Experimental Design Method Optimization

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5. Orlandini S Hancu G. Szabó Z.I. **Modroiu A.** Papp L.A. Gotti R. Furlanetto S. *New trends in the quality control of enantiomeric drugs: Quality by Design-compliant development of chiral capillary electrophoresis methods*, Molecules, 2022, 27 (20), 7058, doi: 10.3390/molecules27207058, FI: FI: 4,60 (Q2)



Review

New Trends in the Quality Control of Enantiomeric Drugs: Quality by Design-Compliant Development of Chiral Capillary Electrophoresis Methods

Serena Orlandini ^{1,†}, Gabriel Hancu ^{2,*}, Zoltán-István Szabó ³, Adriana Modroiu ², Lajos-Attila Papp ², Roberto Gotti ⁴ and Sandra Furlanetto ¹

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6. Hancu G. Orlandini S. Papp L.A. **Modroiu A.** Gotti R. Furlanetto S. *Application of experimental design methodologies in the enantioseparation of pharmaceuticals by capillary electrophoresis: a review*, Molecules, 2021, 26(15), 4681, doi: 10.3390/molecules26154681, FI: 4,60 (Q2).



Review

Application of Experimental Design Methodologies in the Enantioseparation of Pharmaceuticals by Capillary Electrophoresis: A Review

Gabriel Hancu ^{1,†}, Serena Orlandini ^{2,†}, Lajos Attila Papp ^{1,*}, Adriana Modroiu ¹, Roberto Gotti ³ and Sandra Furlanetto ²

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7. Papp L.A. **Krizbai S.** Dobó M. Hancu G. Szabó Z.I. Tóth G. *Determination of chiral impurity of naproxen in different pharmaceutical formulations using polysaccharide-based stationary phases in reversed-phased mode*, Molecules, 2022, 27 (11), 2986, doi: doi.org/10.3390/molecules27092986, FI: 4,60 (Q2).



Article

Determination of Chiral Impurity of Naproxen in Different Pharmaceutical Formulations Using Polysaccharide-Based Stationary Phases in Reversed-Phased Mode

Lajos-Attila Papp¹, Sarolta Krizbai¹, Máté Dobó², Gabriel Hancu¹, Zoltán-István Szabó^{3,*}
and Gergő Tóth²

8. **Cârcu-Dobrin M.** Hancu G. Papp L.A. Fülöp I. Kelemen H. *Development of a chiral capillary electrophoresis method for the enantioseparation of verapamil using cyclodextrins as chiral selectors and experimental design optimization*, Symmetry, 2021, 13, 2186, doi: 10.3390/sym13112186; FI: 2,940 (Q2)



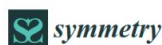
Article

Development of a Chiral Capillary Electrophoresis Method for the Enantioseparation of Verapamil Using Cyclodextrins as Chiral Selectors and Experimental Design Optimization

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9. **Milan A.** Hancu G. Lupu D. **Budău M.** Garaj V. Kelemen H. *Venlafaxine chiral separation by capillary electrophoresis using cyclodextrin derivatives as chiral selector and experimental design method optimization*. Symmetry, 2020, 12(5):849, FI: 2,645 (Q2).



Article

Venlafaxine Chiral Separation by Capillary Electrophoresis Using Cyclodextrin Derivatives as Chiral Selector and Experimental Design Method Optimization

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10. **Budău M.** Hancu G. Muntean D.L. Papp L.A. Cârje A. Garaj V. *Enantioseparation of citalopram enantiomers by capillary electrophoresis: method development through experimental design and computational modelling*. Chirality, 2020, 32(8): 1119-1128; doi: 10.1002/chir.23255, FI: 2,437 (Q2)

REGULAR ARTICLE

WILEY

Enantioseparation of citalopram enantiomers by capillary electrophoresis: Method development through experimental design and computational modeling

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11. **Papp L.A.** Foroughbakhshfasaei M. Fiser B. Horváth P. Kiss E. Sekkoum K. Gyéresi Á. Hancu G. Noszál B. Szabó Z.I. Tóth G. *Reversed-phase HPLC enantioseparation of pantoprazole using a teicoplanin aglycone stationary phase – Determination of the enantiomer elution order using HPLC-CD analyses*. Chirality, 2020, 32(2): 158-167; doi: 10.1002/chir.23146, FI: 2,437 (Q2)
12. **Cârcu-Dobrin M. Sabău A.** Hancu G. Gyéresi Á. Rusu A. Kelemen H. Papp LA. Cârje A. *Chiral discrimination of amlodipine from pharmaceutical products using capillary electrophoresis*. Brazilian Journal of Pharmaceutical Sciences, 2020, 56:e18259, FI: 0,814.
13. **Papp L.A.** Hancu G. Gyéresi Á. Kelemen H. Szabó Z.I. Noszál B. Dubský P. Tóth G. *Chiral separation of lansoprazole and rabeprazole by capillary electrophoresis using dual cyclodextrin systems*. Electrophoresis, 2019, 40: 2799-2805; doi: 10.1002/elps.201900107, FI: 3,081 (Q2)

Electrophoresis 2019, 00, 1–7

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Research Article

Chiral separation of lansoprazole and rabeprazole by capillary electrophoresis using dual cyclodextrin systems

14. **Sarkany A.** Hancu G. Cârje A. **Drăguț C.** Papp LA. *Chiral separation of tramadol enantiomers by capillary electrophoresis using cyclodextrins as chiral selectors and experimental design method optimization*. Chemical Papers, 2019, 73, 2363-2370, FI: 1,246.

Chemical Papers (2019) 73:2363–2370
<https://doi.org/10.1007/s11696-019-00789-8>

ORIGINAL PAPER



Chiral separation of tramadol enantiomers by capillary electrophoresis using cyclodextrins as chiral selectors and experimental design method optimization

Anita Sarkany¹ · Gabriel Hancu¹ · Anca Cârje² · Claudiu Drăguț¹ · Lajos Attila Papp¹

15. **Papp L.A.** Gyéresi Á. Hancu G. Mircia E. Kelemen H. *Development of a generic method for the determination of proton-pump inhibitors by capillary zone electrophoresis*. Brazilian Journal of Pharmaceutical Sciences, 2019, 55: e17786; doi: 10.1590/s2175-97902019000117786, ISSN 1984-8250, eISSN 2175-9790, FI: 0,814.
16. Hancu G. **Toncean A.** Podar D. **Sarkany A. Drăguț C.** Barabás E. *Simultaneous determination of anthelmintic drugs by capillary electrophoresis using cyclodextrins as buffer additives*. SN Applied Sciences, 2019, 1:478.
17. **Cârcu-Dobrin M. Budău M.** Hancu G. Gagyí L. Rusu A. Kelemen H. *Enantioselective analysis of fluoxetine in pharmaceutical formulations by capillary zone electrophoresis*. Saudi Pharmaceutical Journal, 2017, 25, 397-403, FI: 3,11 (Q2).
18. **Budău M.** Hancu G. Szabó ZI. Kelemen H. Rusu A. Muntean DL. Cârje AG. *Captisol® as chiral selector in capillary electrophoresis of non-acidic drugs*. Journal of the Chilean Chemical Society, 2017, 62(3):3566-3571, FI: 0,463.



ORIGINAL ARTICLE

Enantioselective analysis of fluoxetine in pharmaceutical formulations by capillary zone electrophoresis



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19. Stăcescu Ș. Hancu G. Gagyi L. Soare R.M. Kelemen H. *Simultaneous determination of hydrochlorthiazide and telmisartan from pharmaceutical preparations using capillary electrophoresis*. Studia Chimica UBB, 2017, LXII, 2, 189-198, FI: 0,305.
20. Mircia E. Hancu G. Nițu O. Kelemen H. Cârțu-Dobrin M. Gâz ȘA. Balaci T. *Simultaneous determination of fibrates by micellar electrokinetic capillary chromatography*. Farmacia, 2017, 65(1), 109-113, FI: 1,507.
21. Hancu G. Neacșu A. Papp LA. Ciurba A. *Simultaneous determination of amoxicillin and clavulanic acid in pharmaceutical preparations by capillary electrophoresis*. Brazilian Journal of Pharmaceutical Sciences, 2016, 52(2): 281-286, FI: 0,474.
22. Hancu G. Hilochie A. Vlad RA. Cârje A. Tero-Vescan A., *Enantiomeric separation of sibutramine by capillary zone electrophoresis*. Journal of the Brazilian Chemical Society, 2016, 26(7): 1116-1120, FI: 1,198.
23. Modroiu A. Hancu G. Vlad RA. Stăcescu Ș. Soare R. Kelemen H. *Simultaneous determination of amlodipine and telmisartan from pharmaceutical products by capillary electrophoresis*, Current Issues in Pharmacy and Medical Sciences. 2016. 29(1): 42-45.
24. Szabó Z.I. Tóth C. Hancu G. Muntean DL., *Simultaneous chiral separation of four H1-antihistamines by capillary zone electrophoresis using a dual cyclodextrin system*, Chromatographia, 2015, 78(21): 1377-1384, doi: 10.1007/s10337-015-2967-y, FI: 1,332.
25. Hancu G. Papp L.A. Rusu A., *Chiral separation of the enantiomers of omeprazole and pantoprazole by capillary electrophoresis*. Chromatographia, 2015, 78: 279-284, FI: 1,332.
26. Hancu G. Cârje A. Iuga I. Fülöp I. Szabó Z.I. *Cyclodextrine screening for the chiral separation of carvedilol by capillary electrophoresis*. Iranian Journal of Pharmaceutical Research, 2015, 14(2): 425-433, FI: 1,352.
27. Hancu G. Sasebeși A. Rusu A. Kelemen H. Ciurba A. *Study of the electrophoretic behavior of cephalosporins by capillary zone electrophoresis*. Advanced Pharmaceutical Bulletin, 2015, 5(2): 223-229.
28. Hancu G. Budău M. Kántor L.K. Cârje A. *Cyclodextrine screening for the chiral separation of amlodipine enantiomers by capillary electrophoresis*. Advanced Pharmaceutical Bulletin, 2015, 5(1): 35-40.



29. Hancu G. **Sămărghițan C.** Rusu A. Mircia E. *Sotalol chiral separation by capillary electrophoresis*. Journal of Chilean Chemical Society 2014, 59(3): 2559-2562, FI: 0.469.
30. Ciurba A. Hancu G. **Cojoclea L.** Sipos E. Todoran N. *Development of new formulation and its evaluation by capillary electrophoresis of tablets containing tramadol hydrochloride and paracetamol*. Pharmaceutical Development and Technology 2014, 19(7): 833-838, FI: 1.335.
31. Hancu G. Rusu A. Simon B. **Boia G.** Gyéresi Á. *Simultaneous separation of ciprofloxacin, norfloxacin and ofloxacin by micellar electrokinetic chromatography*. Journal of Brazilian Chemical Society 2012, 23(10): 1889-1894, FI: 1.283.

Papers presented at scientific meetings by students member of the scientific research group (student's name is highlighted):

1. **Milan A.** Hancu G. Venlafaxine enantioseparation by capillary electrophoresis using cyclodextrins as chiral selectors and experimental design method optimization, Marisiensis, 25-29 martie 2020, Acta Medica Marisiensis, 66(3); 77.



2. **Sarkany A.** Drăguț C., Hancu G. Method development through experimental design for the separation of tramadol enantiomers by cyclodextrin mediated capillary electrophoresis, Marisiensis, 27-31 Martie, 2019, Acta Medica Marisiensis, 65(1), 57 – **cea mai bună lucrare experimentală**



National Congress of
Pharmacy in Romania
17th edition, 2018

3. **Sarkany A.** Drăguț C. Toncean A. Gagyı L. Hancu G. Determinarea unor substanțe antihelmintice prin electroforeză capilară, Congresul Național de Farmacie, ediția a XVII-a, 26-29 septembrie, 2018, București, Book of abstracts, ID 68



4. **Cârcu-Dobrin M.** Budău M. Hancu G. Kelemen H. Rusu A. Separarea chirală a fluoxetinei prin electroforeză capilară utilizând ciclodextrine ca și selectori chirali (Chiral discrimination of fluoxetine enantiomers by capillary electrophoresis using cyclodextrins as chiral selectors),



Congresul Național de Farmacie București, 28 septembrie – 1 octombrie 2016, volum de rezumate, ID 45

5. **Stăcescu Ș.** Hancu G. Soare R. Rusu A. Szekey-Szentmiklosi B. Gagy L. Determinarea simultană a hidroclortiazidei și a telmisartanului din forme farmaceutice prin electroforeză capilară (Simultaneous determination of hydrochlorthiazide and telmisartan from pharmaceutical products by capillary electrophoresis), Congresul Național de Farmacie București, 28 septembrie – 1 octombrie 2016, volum de rezumate, ID 51.

6. Budău M. **Uilăcan A.** Papp LA. Hancu G. Kelemen H. Muntean DL. Separarea chirală a venlafaxinei prin electroforeză capilară utilizând un sistem dual de ciclodextrine (Venlafaxine chiral separation by capillary electrophoresis using a dual cyclodextrine system), Congresul Național de Farmacie București, 28 septembrie – 1 octombrie 2016, volum de rezumate, ID 52 – **cel mai bun poster al secțiunii.**



7. **Uilăcan A.** Moldovan A. Hancu G. Budău M. Venlafaxine chiral separation by capillary electrophoresis using a dual cyclodextrin system, International Congress for Students, Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 30 martie – 3 aprilie, 2016, Acta Medica Marisiensis, 62(4): 86.

8. **Stăcescu Ș.** Hancu G. Simultaneous determination of telmisartan and hydrochlorothiazide by capillary electrophoresis, International Congress for Students, Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 30 martie – 3 aprilie, 2016, Acta Medica Marisiensis, 62(4): 87.

9. **Cârcu-Dobrin M.** Hancu G. Budău M. Chiral determination of cetirizine enantiomers from pharmaceutical products by capillary electrophoresis, International Congress for Students, Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 30 martie – 3 aprilie, 2016, Acta Medica Marisiensis, 62(4): 88 – **premiul II**

10. **Iriminescu DN.** Hancu G. Simultaneous equation and first-derivative UV spectrophotometric methods for the simultaneous determination of rifampicin and isoniazid, International Congress for Students, Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 30 martie – 3 aprilie, 2016, Acta Medica Marisiensis, 62(4): 93

11. **Cârcu-Dobrin M.** Budău M. Rusu A. Mircia E. Hancu G. Chiral discrimination of fluoxetine enantiomers by capillary electrophoresis using cyclodextrins as chiral selectors, Sesiunea Științifică a Cadrelor Didactice, 11 Decembrie, 2015, Acta Medica Marisiensis, 61(8): 52.

12. **Modroiu A.** Székely Szentmiklósi B. Kelemen H. Soare R. Hancu G. Determination of amlodipine and telmisartan from fixed dose combinations by capillary electrophoresis, Sesiunea Științifică a Cadrelor Didactice, 11 Decembrie, 2015, Acta Medica Marisiensis, 61(8): 74.



13. Hancu G. **Cârcu-Dobrin M. Budău M.** Kelemen H. Rusu A. Szabó ZI. Gagy L. Enantioseparation of fluoxetine in pharmaceutical formulations by capillary electrophoresis, The 15th International Symposium and Summer School on Bioanalysis, Tîrgu Mureș, 13-18 Julie 2015, Acta Medica Marisiensis, 2015, 61(5): 28.
14. Kelemen H. **Papp L.A.** Hancu G. Rusu A. Cârje AG. Szentmiklósi-Székely B. Simultaneous determination of amoxicillin and clavulanic acid: UV-spectrometry versus capillary electrophoresis, The 15th International Symposium and Summer School on Bioanalysis, Tîrgu Mureș, 13-18 Julie 2015, Acta Medica Marisiensis, 2015, 61(5): 31.
15. Mircia E. **Soare R.** Hancu G. Gyéresi Á. Simultaneous determination of statins by capillary electrophoresis, The 15th International Symposium and Summer School on Bioanalysis, Tîrgu Mureș, 13-18 Julie 2015, Acta Medica Marisiensis, 2015, 61(5): 34.



16. **Butucea A.** Simion A. Vlad R.A. Hancu G. Study regarding the recreational use of benzodiazepines, The 19th International Scientific Congress for Students, Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 23-25 Aprilie, 2015, Acta Medica Marisiensis, 2015, 61(2): 85.
17. **Stăcescu S.** Călugăreanu I.G. Irimia-Constantin M.R. Hancu G. Phosphodiesterase-5 inhibitors: overview, present and perspectives, The 19th International Scientific Congress for Students, Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 23-25 Aprilie, 2015, Acta Medica Marisiensis, 2015, 61(2): 87.
18. **Cârcu-Dobrin M.** Rusu A. Hancu G. Chiral separation of fluoxetine by capillary electrophoresis using cyclodextrins as chiral selectors, The 19th International Scientific Congress for Students, Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 23-25 Aprilie, 2015, Acta Medica Marisiensis, 2015, 61(2): 88.
19. **Hilochie A.E.,** Hancu G. Tero-Vescan A. Cyclodextrins screening for the chiral separation of sibutramine by capillary electrophoresis, The 19th International Scientific Congress for Students,



Young Physicians and Pharmacists, Marisiensis, Tîrgu Mureș, 23-25 Aprilie, 2015, Acta Medica Marisiensis, 2015, 61(2): 88 – **premiul I.**



20. Hancu G. **Papp LA.** Rusu A. Kelemen H. Chiral separation of omeprazole enantiomers by capillary electrophoresis. University Scientific Session, 8-12 Decembrie, 2014, Acta Medica Marisiensis, Abstract volume, 117.