UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES

Ecole de Pharmacie
EPGL
Genève – Lausanne

Serge Rudaz
PhD, Associate Professor

Julie Schappler
PhD, Research Associate

The project in a nutshell

- **Low-cost analytical device based on capillary electrophoresis for counterfeits detection and sub-standard drug quality control**
- **Scientific and technical support with theoretical and practical training in emerging countries**

Context

The proportion of **counterfeit medicines** has dramatically increased in the last few years. According to numerous official sources, the proportion has reached **80%** in African countries. The fight against this calamity is complex and different levels of action are necessary. Among them, the **quality control** of batches imported into the different countries can be achieved, although this strategy is often difficult to apply due to a **lack of suitable analytical equipment in developing countries**. **Simple, reliable, and cost-efficient drug control approaches** are needed and the currently used methods entail numerous drawbacks such as (i) the availability of reference substances, (ii) the maintenance of analytical instruments, and (iii) the availability and costs of consumables.

In this context, the use of **capillary electrophoresis (CE)** appears of utmost interest since the separation is achieved in a capillary of **reduced dimension** (total volume of 1 µL), filled with an aqueous buffered solution of electrolytes. No organic solvent is needed and injection volumes are in the **nanoliter range**, which is perfectly adapted to the low availability of reference substances. Another CE feature is the equipment **simplicity**, with no mechanical constraint and simplified maintenance, only requiring a periodical control of the electrodes and detection performance during routine analyses. CE is now recognized by numerous **Pharmacopeia** and can therefore be used as a validated analytical procedure according to international guideline recommendations.

Serge Rudaz
PhD, Associate Professor

Julie Schappler
PhD, Research Associate

Prototype

The **University of Geneva** (Switzerland) collaborated with the **University of Applied Sciences of Fribourg** (Western Switzerland) and the **Geneva Pharmacy Hospitals** (Switzerland) to build a **low-cost CE** device and help transitional countries to fight against counterfeit medicines.

A first CE **prototype** was built during a 2-years period, in which the mechanical and electronic aspects were assessed, leading to an original detection device based on a diode technology.

After β-testing in several laboratories, some modifications were included to improve the system **robustness**, leading to a second prototype. Thanks to the financial support of **sponsors** and the creation of a **non-profit organization** (Pharmelp), eight final prototypes were built leading to several missions in emerging countries.

A New Capillary Electrophoresis Device with Deep UV Detector Based on LED Technology

Claude Rohrbasser[*a], Dominique Rhême[a], Sylvain Décastel[a], Samuel Roth[a], Maria de Lourdes Aja Montes[a], Jean-Luc Veuthey[b], and Serge Rudaz[b]

*Correspondence: Prof. Dr. C. Rohrbasser[a], Tel.: +41 26 429 67 01, Fax: + 41 26 429 66 00, E-mail: claude.rohrbasser@hefr.ch
[a]College of Engineering and Architecture of Fribourg, Department of Chemistry Boulevard de Pérolles 80, CH-1705 Fribourg
[b]School of Pharmaceutical Sciences, University of Geneva, University of Lausanne, 20, Boulevard d'Yvoy, CH-1211 Geneva

Abstract: During the last three years, the College of Engineering and Architecture of Fribourg has developed, in collaboration with the School of Pharmaceutical Sciences, University of Geneva - Lausanne, a low-cost analytical capillary electrophoresis (CE) device, equipped with a new deep UV detector based on LED technology. The aim is to use it for educational purposes and/or basic pharmaceutical-analytical services, including identification or quality control assays in developing countries.

Keywords: Capillary electrophoresis · Counterfeit drugs · LED

Journal of Pharmaceutical and Biomedical Analysis 53 (2010) 1278–1287

Contents lists available at ScienceDirect

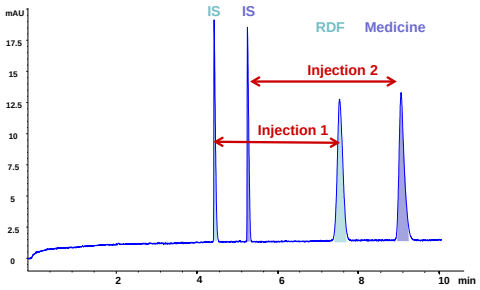
Journal of Pharmaceutical and Biomedical Analysis

journal homepage: www.elsevier.com/locate/jpba

Reliable low-cost capillary electrophoresis device for drug quality control and counterfeit medicines

R.D. Marini[a], E. Rozet[a,1], M.L.A. Montes[b], C. Rohrbasser[b], S. Roht[b], D. Rhême[b], P. Bonnabry[c], J. Schappler[d], J.-L. Veuthey[d], Ph. Hubert[a], S. Rudaz[d,*]

[a] Laboratory of Analytical Chemistry, Centre Interfacultaire de Recherche du Médicament, Institute of Pharmacy, University of Liège, CHU, B36, B-4000 Liège, Belgium
[b] Department of Chemistry, College of Engineering and Architecture of Fribourg, CH-1705 Fribourg, Switzerland
[c] Hôpitaux Universitaire de Genève - Pharmacie, Rue Gabrielle-Perret-Gentil 4, 1211 Genève 14, Switzerland
[d] School of Pharmaceutical Sciences - EPGL, University of Geneva, University of Lausanne, 20 Bd d'Yvoy, 1211 Geneva 4, Switzerland



Qualitative | **corrected migration times ratio**

Quantitative | **corrected area ratio**

Method

In order to analyze a high number of compounds and benefit from the device with basic chemistry knowledge, **simple and generic** methods were developed and validated. A strategy based on **multiple injections** is currently applied for the **simultaneous qualitative and quantitative** analysis of more than 80 drugs from the list of the 200 essential medicines defined by the **World Health Organisation**.

Serge Rudaz
PhD, Associate Professor

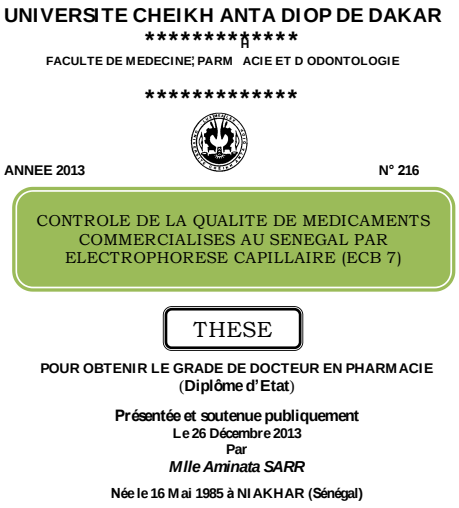
Julie Schappler
PhD, Research Associate

Missions

The **training** of laboratory operators was the main core of all missions so they could (i) use the device, (ii) implement the methods, and (iii) perform the quality control of **drug material** (active principal ingredient) and **drug products** (pharmaceutical formulations) according to the regulatory guidelines. Getting **feedback** regarding the instrument, the methods, and the field constraints was also part of the missions.

The first mission took place at the "Laboratoire National de la Santé" in Bamako (**Mali**) in 2009.

The second mission was achieved in 2011 at the "National Health Product Quality Control Centre" in Phnom Penh (**Cambodia**).



UNIVERSITE CHEIKH ANTA DIOP DE DAKAR
****
FACULTE DE MEDECINE, PARMACIE ET D ODONTOLOGIE
****

ANNEE 2013 N° 216

CONTROLE DE LA QUALITE DE MEDICAMENTS COMMERCIALISES AU SENEGAL PAR ELECTROPHORESE CAPILLAIRE (ECB 7)

THESE

POUR OBTENIR LE GRADE DE DOCTEUR EN PHARMACIE
(Diplôme d'Etat)

Présentée et soutenue publiquement
Le 26 Décembre 2013
Par
Mlle Aminata SARR
Née le 16 Mai 1985 à NIAKHAR (Sénégal)

In 2012, a mission involved the "Laboratory of Analytical Chemistry" of the "Bromatology, Medicine and Pharmacy Department" at the University of Cheikh Anta Diop in Dakar (**Senegal**), in close collaboration with the "National Health Laboratory of Senegal". A PhD thesis was achieved in collaboration with the University of Geneva.

In 2013, a mission was initiated with the University of Kinshasa (**Republic of Congo**), involving collaboration with the University of Liege (Belgium).

Two other projects are currently planned and will be implemented in 2015, with one prototype in **Rwanda** and one in **Burkina Faso**.

Convention

The last prototypes are involved in missions based on a convention signed between **Pharmelp**, the **University of Geneva**, and another non-profit organization, **Pharmaciens sans Frontières** (PSF). Drug products found in the areas covered by PSF are analyzed either locally by a low-cost CE provided by Pharmelp or by the University of Geneva from drugs collected and shipped by PSF. A first project was implemented in **Tanzania** at the Lugala Hospital in 2012 and another one was initiated in **Madagascar** with the University of Antananarivo in 2014.

Serge Rudaz
PhD, Associate Professor

Julie Schappler
PhD, Research Associate

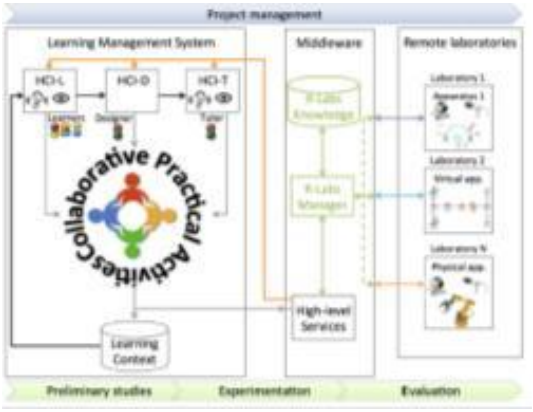
Conclusion

A **low-cost CE** was successfully built and implemented in **emerging countries**. Due to its short analysis time, simple instrumentation, low sample and solvent consumption as well as reduced operating costs, this device is perfectly adapted to (i) rapidly evaluate the **quality of drugs**, (ii) establish the **presence of the active principle(s)**, (iii) quantify the **amount of the active principle(s)**, and (iv) give evidence regarding the **presence of degradation impurities**. CE can thus be considered an appropriate tool to tackle the **counterfeits** problems.

Perspectives

In addition to continuous improvements of the methodological and technical aspects of the low-cost instrument, an **educational program** will be developed in the next few years related to the continuous education of scientists using CE in emerging countries.

The main objective is to increase the knowledge and the practical handling of the technique using **e-learning tools**. The program is based on three main sub-projects:



(i) development and implementation of an e-learning module related to the theoretical concepts of CE

(ii) development and implementation of a **hybrid course** based on practical work and computer–assisted simulations

(iii) participation to a **research project**, PracTICE (collaboration and tutoring supports for computer-supported collaborative practical learning)

Stakeholders

Prof. Serge Rudaz, Emilie Reginato, Dr Julie Schappler (**University of Geneva**)

Samuel Roth (**University of Applied sciences of Fribourg**)

Prof. Claude Rohrbasser (**Pharmelp**)

Prof. Pascal Bonnabry (**Geneva Pharmacy Hospitals**)

Sabina Sommaruga (**Pharmaciens sans Frontières**)