



Smartphone analysers for on-site testing of food quality and safety

Issue 3 – June 2018



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Welcome to the third FoodSmartphone e-Newsletter!

Dear reader and FoodSmartphone follower,

Some people say that being a coordinator of an EU project is tough and a hard life. For sure this is true, at least partly, but particularly in a Marie Curie European Training Network such as FoodSmartphone, my personal return on investment is absolutely fantastic. Following such an enthusiastic group of early stage researchers, shaping their own careers and personal daily lives in a foreign country is great! Their stories in the weekly blogs at www.foodsmartphone.blog are as exciting as their initial scientific results presented in open-access peer-reviewed papers and presented at leading conferences either as a poster or as an oral presentation. Their on-going complementary skills training courses range from presenting with impact to language courses. Additionally they were just trained by leading experts on all kinds of quality and validation aspects in our second network-wide summer school. Keep updated with their progress by signing up on our website and/or by following us on twitter (@FoodSmartphone) and tweet us using the hashtag #FoodSmartphone. Feel free to contact us at foodsmartphone@foodsmartphone.eu with any suggestions for improvement of this e-Newsletter, for future collaboration or dissemination opportunities, or just for a friendly chat. For now I wish you some great summer holidays, wherever you go!



Michel Nielen,
coordinator

FoodSmartphone progress versus research objectives

Key facts:

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January 2017

Duration: 48 months

Volume: 2.8 M€

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foodsmartphone.blog

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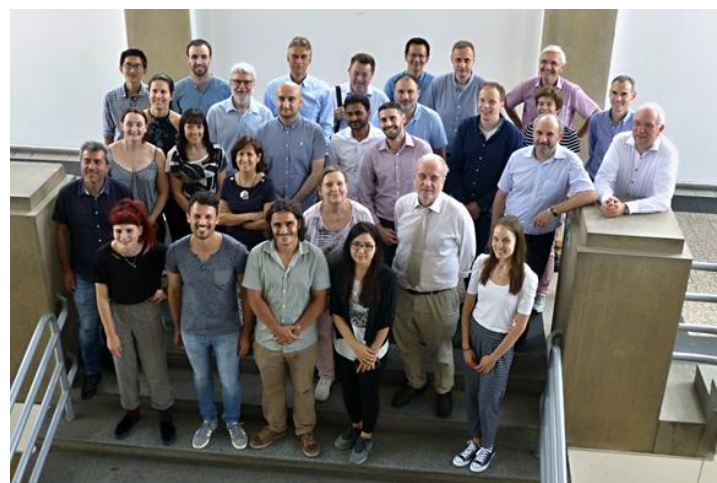
Facebook:

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YouTube:

[IXceX3TITzs](https://www.youtube.com/channel/UCeX3TITzs)

The major science and innovation gaps to be addressed by the FoodSmartphone project relate to high-speed and novel biorecognition of food contaminants, novel optical and electrochemical detection schemes in conjunction with smartphones, simplified microfluidic sample handling solutions that enable non-expert operation, advanced software architecture and the development of application demonstrators for food quality and safety issues of concern, viz. for antibiotics, pesticides, allergens, mycotoxins, food spoilage and marine toxins. Currently, most of



our early stage researchers (ESRs) have completed their first year of research and complementary skills training and all of them presented their progress, challenges and plans at the annual full consortium meeting in Prague on June 20th, 2018. Inevitably at this stage, most of them are still working with well-defined model systems without multiplexing or real-life application, but the progress into the right direction became very obvious from their exciting



WP1 leader

M.-Pilar Marco (CSIC)



WP2 leader

Monique Bremer (RIKILT)



WP3 leader

Daniel Filippini (LIU)



WP4 leader

Karen Rafferty (QUB)



WP5 leader

Jana Hajslova (UCT)



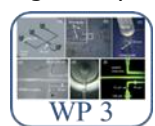
presentations. Very valuable suggestions and feedback was provided by experts from both the Supervisory Board as well as the Advisory Board of the FoodSmartphone project. Only a small part of the achieved results can be included in this newsletter:



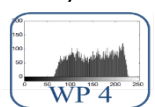
Biorecognition concepts. ESR Gina presented a Surface Plasmon Resonance (SPR) approach towards the rapid prototyping of dipstick immunoassays for hazelnut allergens. By selecting antibodies with the best association kinetics, visual allergen detection can be as fast as 30 seconds, and by using a smartphone readout probably even faster. ESR Safiye showed successful binding of aflatoxins by aptamers, as a potential alternative to antibody binders. Since aflatoxins require extremely low detection limits, the final choice of the biorecognition elements will be based on a critical comparison of the performance characteristics. DNA-directed immobilization (DDI) was shown by ESR Raheel for an inhibition immunoassay model system of the antibiotic tylosin in milk. Actually, the sensitivity of his approach was too good, allowing high dilution of the samples. ESR Aris successfully developed a rapid acetyl choline esterase (AChE) assay for the detection of AChE inhibitors such as carbafuran and organophosphorous pesticides.



Optical and electrochemical sensing. A lot of progress has been made in this area. With respect to less expensive immunoassay labelling reagents, ESR Gina showed initial results of carbon black nanoparticle labelled secondary antibodies for a better contrast in dipstick immunoassays. ESR Sahl showed an SPR-on-smartphone design which has an improved optical design and featuring position detection of the SPR-dip which is, at least theoretically, more accurate than light intensity measurement. ESRs Javier and Jordi showed beautiful nanostars and nanorods for plasmonic signal enhancement in ligand binding assays for food spoilage organisms such as campylobacter and marine biotoxins such as domoic acid, respectively. Interestingly, these particles show catalytic properties as well thus allowing very rapid colorimetric detection schemes for a variety of applications. ESRs Klaudia and Safiye showed a lot of progress in electrochemical transducers for aflatoxin and atrazine biorecognition respectively, using graphene, carbon and gold screen-printed electrodes. ESR Vincent left the project and a new ESR is to be recruited in order to interface the ligand binding assays of the project with mass spectrometry for lab-based confirmatory analysis, as required for applications in regulatory control settings.



Integrated sample preparation devices. Rapid and easy-to-use assays require (i) that the binding partners can reach each other without long incubation times due to mass transport limitations and (ii) that the sample handling is fully integrated. ESR Andriy showed a silicon nitride microsieve approach as a biorecognition and sample handling platform without diffusion limitations. He successfully developed tailored polymer brush layers covalently bound to these microsieves, showing excellent stability and antifouling characteristics, and functional anchors for covalent coupling of biorecognition elements. ESR Sahl showed initial results in the production of low-cost microfluidic lab-on-chip (LoC) unibody devices. Typical ELISA-like workflows can be simplified and operated by simple 'finger pumps' in such a low-cost disposable device. ESR Aris performed initial experiments for immobilisation of his WP1 enzymes onto microfluidic paper-based analytical devices (μ PADs) in order to transfer his current well-based design into a more simplified and handy format.



Data handling and software tools. ESR Yunfeng (Jack) presented his scoping exercise of all the software needs at the individual ESR projects for image recognition and handling of data from the WP2 optical and electrochemical readout systems. Furthermore, he designed, demonstrated and validated a 3D-printed prototype smartphone attachment for the reliable reading of dipstick immunoassays. In addition, by using machine learning techniques, he developed algorithms for colorimetric smartphone detection and validated his methodology by smartphone reading of pH colour strips, while critically comparing RGB and LAB approaches and benchmarking against conventional pH electrode measurements. In addition to the agreed activities in the FoodSmartphone project, ESRs Jordi, Javier, Jack and Aris developed by their own initiative an extensive literature database, acronym BEST, which stands for the Bio End user Sensor Tree. You simply answer a few questions, such as which compound do you want to detect? Do you have laboratory experience? Do you need a portable sensor? Following this you will obtain an open source e-document where your options from literature are summarized. Needless to say that this will be extremely useful to any current and future researcher and end-user in biosensing!



Demonstration of FoodSmartphone applicability and benchmarking.

This work package is actually to be started on January 1st, 2019. Nevertheless, some of the ESRs already demonstrated initial applicability of their assays during the full consortium meeting, as indicated above.

Feature: 2nd FoodSmartphone Summer School in Prague



The second summer school on Food Applications, QA/QC and Validation took place in Prague, Czech Republic, June 18-22, 2018. This summer school was mandatory for the FoodSmartphone ESRs but also open to others. In total, 13 students and researchers from 7 countries and 11 different nationalities participated in this course, including individuals from industry. The course was composed of lectures, literature discussion sessions and hands-on labwork. Prof. Vladimír Kocourek from UCT Prague opened the summer school by introducing the basic principles of QA/QC, ISO 17025 and the accreditation of testing laboratories. Apart from the multi-sectoral lecturers from within the FoodSmartphone consortium, three external visiting scientists were invited: Dr Petr Cuhra from the Czech Food Inspection Authority introduced specific requirements from a legislation point of view. Dr Jeroen Jansen from Radboud University Nijmegen who gave a very inspiring lecture about getting the most information out of your analytical data and your chemometric predictions. Last but not least, the topic of collaborative validation studies was discussed by Dr Katerina Mastovska from Covance, a leading private laboratory. The common scientific knowledge base was complemented with transferable skills training such as in critical reading and debating literature and in organizing their own ESR Council event in which a new ESR was elected to participate in the Supervisory Board meetings of the project. Adjacent to this summer school the ESR also presented and debated their own personalised research projects in the annual full consortium meeting.

Quotes from FoodSmartphone ESRs on www.FoodSmartphone.blog



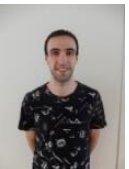
ESR1: Georgina Ross, RIKILT, Wageningen University & Research, The Netherlands:
I am constantly impressed with how much I have learnt, and how much I have grown as a scientist during this period. It is a fantastic gift to wake up each day and truly enjoy my work, I love that each day is different.



ESR2: Vincent O'Brien, RIKILT Wageningen University & Research, The Netherlands:
The chance to experience new cultures and countries is something many people my age would dream about. Not all are adapted to this new world of constantly changing scenery and faces however. Especially when you combine a changing environment with tackling a PhD! I'm not much for goodbyes but thank you for reading and I wish my colleagues in the FoodSmartphone consortium the best of luck!



ESR3: Jordi Nelis, Queens University, Belfast, United Kingdom:
Smartphones are really everywhere now: I saw them in the desert in the hands of a Bedouin woman sitting in the dunes, in the dashboard of a 40 year old taxi in the atlas mountains and even in the hands of a farmer transporting his goods to the market by donkey! Seeing this made me realise again the major opportunities of food and water testing with a smartphone based device and makes me hope even more that many affordable devices like that can be developed to help ensure safe food and water for everyone!



ESR4: Javier Lou Franco, Queen's University, Belfast, United Kingdom:
So as you can see it's been a proper end for our academic year, including a poster preparation, a talk given in front of our colleagues at Queen's and a group meeting with all our 4 supervisors here to decide how to start the 2nd year. After this we'll have some time to enjoy in Prague and we'll come back to Belfast to organize the IGFS barbeque.



ESR5: Yunfeng Zhao, Queens University, Belfast, United Kingdom:
Publication is one way of communication with the scientific community that almost all PhD students are expected to go through. However, the MSCA supported FoodSmartphone project provides unique opportunities to travel around, disseminate our projects and researches, and participate in tremendous amount of training activities.



ESR6: Aristeidis Tsagkaris, University of Chemistry and Technology, Prague, CZ:
Right now, I am writing you from Munich where the 12th European Pesticide Residue Workshop (EPRW2018) takes place... I am very happy being there and illustrate our progress with a poster presentation entitled "The potential of smartphones as portable detectors in AChE inhibitors screening. Additionally, I am proud to notice that our study

is the only investigating the analytical capabilities of smartphones for the pesticide residues screening.



ESR7: Raheel Ahmad, CSIC, Barcelona, Spain:

People concerned to various walks of life welcome New Year in their own hearty ways. It is a day which expresses joy and happiness all around. Genuine success comes only to those who are ready for it. So never step back and always have courage to accept new challenges.



ESR8: Klaudia Kopper, CSIC, Barcelona, Spain:

Getting lost in one little task of the project sometimes makes me forget about the final goal, so when I am starting to feel a little bit lost and overwhelmed I usually stop for a moment, take a few steps back and try to look at the bigger picture.



ESR9: Sahl Sadegi, Linköping University (LIU), Sweden:

From Istanbul to Amsterdam, I then finally arrived in Linköping's small and cozy airport, the 7th largest city in Sweden with over 150 thousand inhabitants, carved out onto a flat and smooth landscape.



ESR10: Andriy Kuzmyn, Aquamarijn, The Netherlands:

Every piece of technology around you, is the product of hard working stubborn people, who have chosen a challenging, exciting but also rather stressful job.



ESR11: Safiye Jafari, CSEM, Switzerland:

Personally, I believe the best way to develop these skills is learning by doing. I am completely aware of the amount of time and effort that it is going to take to improve my rather poor level of soft skills. I am ready to invest whatever needed and I am sure that the secondment and conferences opportunities within the FoodSmartphone will be of great help in this regard.

Forthcoming events / meetings



[Swiss Symposium in Point-of-Care-Diagnostics](#)

18 October 2018, Chur, Switzerland

[Rapid Methods Europe \(RME 2018\)](#)

5-7 November 2018, Amsterdam, The Netherlands

[Final FoodIntegrity Conference](#)

14-15 November 2018, Nantes, France

[FoodSmartphone Midterm Review Meeting](#)

March 2019, Brussels, Belgium

[3rd FoodSmartphone Summer School on Software Design and Exploitation](#)

June 2019, Belfast, United Kingdom

[Recent Advances in Food Analysis \(RAFA2019\)](#)

5-8 November 2019, Prague, Czech Republic

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