



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

Issue 6 – December 2019



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In this issue:

Welcome

FoodSmartphone progress versus research objectives

Feature:

FoodSmartphone orals and Open Days at RAFA2019

Farewell to Mr Wim Beek

Quotes from the FoodSmartphone ESR blogs

Forthcoming events / meetings

Contact us

Welcome to the sixth FoodSmartphone e-Newsletter!

Dear reader and FoodSmartphone follower,

As you know from our previous e-newsletters, or otherwise, FoodSmartphone is not just another European H2020 research project, but instead it is a training network for early stage researchers (ESRs) such as PhD students. One of the rather ambitious objectives described in the project proposal was "through high level training, to deliver a group of multidisciplinary scientists who can integrate (...) knowledge into a common supra-disciplinary goal (...) maintaining a healthy, safe and fair food supply". As a coordinator, I watched the nine oral presentations and demo sessions by FoodSmartphone ESRs at the 9th International Symposium on Recent Advances in Food Analysis (RAFA2019) and I felt really proud. Proud, of the exponential progress in the personal development of our ESRs since 2017, proud about everything they learned so far, on their collaborative attitude, on their opinions and views on future food quality and safety testing. I concluded with a smile that our most important project goal is indeed within reach: to deliver a very special new group of researchers by the end of the project in 2020.

Don't forget to read the ESR stories in their weekly blogs at www.foodsmartphone.blog and, of course, their latest open access research papers on the dissemination page of the FoodSmartphone website. Or simply stay tuned by following us on twitter (@FoodSmartphone) and tweet us using the hashtag #FoodSmartphone. Feel free to contact us with any suggestions at foodsmartphone@foodsmartphone.eu for improvement of this e-Newsletter, for future collaboration or dissemination opportunities, or just for a friendly chat.

For now I wish you great Christmas holidays, wherever you go, and an excellent start in 2020!



Michel Nielen,
coordinator

FoodSmartphone progress versus research objectives

Key facts:

Grant Agreement:

720325 –
FoodSmartphone –
H2020-MSCA-ITN

Start date:

January 2017

Duration: 48 months

Volume: 2.8 M€

Coordinator:

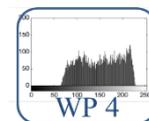
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Website:

www.foodsmartphone.eu

ESR Blogs:

foodsmartphone.blog



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. Several ESRs are currently making the turn from single food contaminant model systems towards the development of multiplex screening tools having smartphones with optical or electrochemical readouts: examples comprise multiple food allergens, multiple antibiotic residues and multiple pesticides detection in combined assay designs. Several 3D-printed prototypes have been designed and tested in order to facilitate user-friendly and simplified sample preparation and reagent delivery. A lot of progress has been made in



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IXceX3TITzs



WP1 leader

M.-Pilar Marco (CSIC)

WP2 leader

Gert Salentijn (WFSR)

WP3 leader

Daniel Filippini (LIU)

WP4 leader

Karen Rafferty (QUB)

WP5 leader

Jana Hajslova (UCT)

the reliable reading of colorimetric assay signals by smartphones with or without the use of cardboard boxes or 3D-printed attachments to control ambient light conditions.

So far, the scientific results of the project have been presented by the ESRs and/or their supervisors at numerous conferences. The following recent papers are on our [website](#):

- A large group of seven ESRs led by ESR6, Aris Tsagkaris, wrote a fantastic joint review paper entitled "Critical assessment of instrumental reference methods to confirm the analytical performance of sensor-based platforms for the detection of selected food contaminants and allergens" for the high impact journal *Trends Anal. Chem.* (<https://doi.org/10.1016/j.trac.2019.115688>).
- ESRs 3 and 5, Jordi Nelis and Yunfeng Zhao, wrote a research paper entitled "The Efficiency of Color Space Channels to Quantify Color and Color Intensity Change in Liquids, pH Strips, and Lateral Flow Assays with Smartphones", in the open access journal *Sensors* 19 (2019) 5104 (doi:10.3390/s19235104).

Several other papers are in the pipeline:

- ESR1, Gina Ross, wrote a research paper entitled "A Critical Comparison Between Flow-through and Lateral Flow Immunoassay Formats for Visual and Smartphone-based Multiplex Allergen Detection" which is currently under review at *Biosensors*.
- ESR 3, Jordi Nelis and ESR5, Yunfeng Zhao, wrote two joint research papers. The first one is entitled "Characterising the efficiency of various colour spaces to quantify colour and colour intensity change in commercial pH strips and lateral flow assays with smartphones" and the second one "A randomised combined channel approach for the quantification of colour and intensity based assays with smartphones."
- ESR6, Aris Tsagkaris, wrote two research papers, one entitled "Cholinesterase microplate assays: affordable and versatile tools in organophosphate and carbamate pesticides analysis" and a second one entitled "Hybrid lab-on-a-chip injector system for autonomous carbofuran screening", to be submitted soon.

Feature: FoodSmartphone Orals and Open Days at RAFA2019



RAFA is the leading biennial conference on Recent Advances in Food Analysis and the 9th edition, organised in Prague November 2019 (www.rafa2019.eu), attracted 860 scientists from 60 countries. During RAFA, the first European workshop on Portable Food Analysis and Citizen Science was organised jointly by FoodSmartphone and the local RAFA organisers. In this workshop, following a short general introduction, three highly complementary technical approaches

towards smartphone-based portable food analysis were presented, in the order of their current technology readiness levels: an optical scanner approach, the biorecognition smartphone approach and a portable mass spectrometry approach. Our colleagues from the H2020 Phasmafood project presented their results in the development and preliminary application of a prototype multimodal handheld scanner, comprising near infrared (NIR), UV-Vis, fluorescence and camera capabilities. They clearly showed the added value of data fusion of the individual sensors in order to improve the reliability of correct classification of different food qualities. Next, nine ESRs from FoodSmartphone presented their individual project and progress in biorecognition-based smartphone analyzers for on-site testing of allergens, antibiotics, biotoxins, food spoilage and pesticides. Special attention was also given to novel data handling concepts. All these ESRs did an excellent job for such a huge audience. Two of them were even given the opportunity to chair and moderate an entire session. The workshop ended with the first initial results obtained with a portable GC/MS analyzer. Adjacent to this workshop, an Open Days event was organised in a so-called Smart Lab area. Apart from short videos and PowerPoint presentations, conference attendees could meet our ESRs, watch live demos and video recordings from the ESR projects, get information on the FoodSmartphone objectives, and register as a stakeholder. The progress of the project versus the previous Open Days, two years earlier, was evident: the demo's comprised real-life 3D-printing of smartphone attachment prototypes for colorimetric measurements of assays,



a miniaturized imaging SPR prototype on a smartphone, application of a plug-in pH sensor featuring screen-printed electrodes and a miniature potentiostat, new concepts for confirmatory food analysis following large-scale food smartphone screening and, last but not least, different software modules for image data processing, including a prototype of a blockchain network software module that can be used to upload smartphone results to the cloud. Clearly, the FoodSmartphone project received a lot of enthusiasm and it was a pleasure to meet so many interested people. Apart from scientific oral, poster and demo presentations, FoodSmartphone also organised again a draw for conference participants who registered as a stakeholder. Tatiana Meschankina from Merzario was the lucky winner of a Lab2Go™ mobile allergen test system, kindly sponsored by our partner organisation Zeulab.

Farewell to Mr Wim Beek

Our FoodSmartphone project secretary, Mr. Wim Beek, will retire on February 1st, 2020. Wim has been active at the Wageningen Food Safety Research (WFSR) institute for more than 44 years. While originally being educated as a technician, over the years he gradually became a project and program secretary for a range of national research activities. Since FP6, he got heavily involved in EU project proposal writing and submission, supporting our project leaders in the proposal stage with all the tricky administrative and financial forms. Upon successful applications, he became project secretary for WFSR WP-leaders (for example in FP6 BioCop, coordinated by FoodSmartphone beneficiary QUB) and for our FP7 and H2020 program coordinators in projects such as CONFIDENCE, COLLAB4SAFETY, MARLON, NANOLYSE, NANODEFINE and of course for this Marie-Curie ITN FoodSmartphone. Wim is definitely by far the most experienced EU administrator of WFSR, taking care of the timely collection of draft reports, organizing and drafting of meeting agenda's and minutes, finalizing and uploading milestones and deliverables in the EU Portal, etcetera. What he has done is really impressive, but being such a modest person, he will probably not say that himself. Needless to say, Wim's expertise will be heavily missed within the project and the WFSR institute as a whole. I am sure I speak for the entire FoodSmartphone consortium when I say a BIG THANK YOU from all of us. We wish Wim a pleasant, happy retirement in good health.



Quotes from FoodSmartphone ESRs on www.FoodSmartphone.blog



ESR1: Georgina Ross , WFSR, Wageningen University & Research, The Netherlands:
It is often the simplest devices or systems that take the longest to design and develop; 3D-printing offers the chance to make multiple iterations of prototypes, with each design improving on features from the previous version. The secondment so far has given me an insight into the world of product design and a lot of what I have learned so far has helped me understand the consumer perspective more.



ESR(1)2: Ariadni Geballa Koukoula, WFSR, Wageningen University & Research, The Netherlands:
Being a scientist is not limited to results that show your greatness. As important is making people, without any scientific background, understand what you are doing within the walls of a lab. And essentially, make those people care about your work.



ESR3: Jordi Nelis, Queens University, Belfast, United Kingdom:
The biggest challenges to ensure food safety today and tomorrow is fighting the effects of climate change and reducing food waste.



ESR4: Javier Lou Franco, Queen's University, Belfast, United Kingdom:
Many people are involved in the food chain: farmers during production, operators during the processing, carriers during distribution, workers in restaurants and supermarkets, and of course, you, the final consumer. (...) So everyone in the chain has to do his part to ensure food safety. Something similar to herd immunity: if everyone collaborates, we might be protecting the final consumer that has decided not to test his food, but if the control tests are not run by a minimum number of people, the contaminated food might end up in your meal.



ESR5: Yunfeng Zhao, Queens University, Belfast, United Kingdom:
It is my pleasure to be in Prague and attend the RAFA conference again in the autumn of 2019! People came from all over the world, gathered together in the conference and exchanged their visions of the state of the art and future food analysis.



ESR6: Aristeidis Tsagkaris, University of Chemistry and Technology, Prague, CZ:
Although the peer-review process is complicated and stressful, it assures that the published paper is a clear input for the scientific community and, sometimes, has the potential of a commercial application.



ESR(1)7: Julian Guercetti, CSIC, Barcelona, Spain:
The extensive use of antibiotics in the veterinary field, could lead to the presence of these compounds on animal derivate products as milk, eggs or meat. For this purpose it is necessary to establish good regulations and controls, to monitor in a rapid way if the administration of these drugs is being done properly.



ESR8: Klaudia Kopper, CSIC, Barcelona, Spain:
It is definitely a challenge, but I am lucky enough to work in a project that is full of inspiring and motivating researchers, which also keeps me confident that we will be able to achieve our final goal.



ESR(1)9: Chi Xiao, Linköping University (LIU), Sweden:
Though I'm tired, it is a fruitful time and make me get in touch with many new knowledge, experiences and friendly people.



ESR10: Andriy Kuzmyn, Aquamarijn, The Netherlands:
My job as a researcher in the FoodSmartphone project is to create coatings on the surface of the biosensor that will allow us to see our Wally clearly, when I say Wally I mean pathogen, allergen or toxins in food.



ESR11: Safiye Jafari, CSEM, Switzerland:
In case of electrochemical biosensors, a smartphone is an interface and can be connected to a miniaturized electrochemical device by USB or Bluetooth. The App on smartphone can record and analyze the data, then show the result in a user-friendly format. An example is the traffic light format with red as alert and green indicating the safe sample. All this effort will result in our final prototype of FoodSmartphone device.

Forthcoming events / meetings



IoT4F 2020
 9-11 March 2019, Dublin, Ireland

EuroResidue IX
 18-20 May 2020, Egmond, The Netherlands

Biosensors 2020
 26-29 May 2020, Busan, Korea

FoodSmartphone final conference and open day 2020
 8-10 June 2020, Girona, Spain

Rapid Methods Europe 2020
 2-4 November 2020, Amsterdam, The Netherlands

EuroAnalysis 2021
 22-27 August 2021, Nijmegen, The Netherlands

Recent Advances in Food Analysis (RAFA2021)
 2-5 November 2021, Prague, Czech Republic

Contact us

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