Assuring the integrity of the food chain: Fighting food fraud

6-7 Aprii 2016 • Prague, Czech Republic

FOODINTEGRITY 2016

Workshop: Industrial Applications for Assuring Food Authenticity

OUTCOMES

1. ***…From the voice of the short-talk-pills speakers***

- ✓ Food Industry is in front of big challenges that are the result of global market connected with frauds increased risks, together with higher demanding and aware consumers. FoodIntegrity EU Project can be a concrete answer to these challenges because of the strict collaboration between industrial-academic-public/private research centres and competences.

- ✓ Food companies need constantly updated information and viceversa a lot of information is spread in different projects, old databases, etc. At the same time, reliability of databases is high demanding to be achieved/maintained. FoodIntegrity is going to release within 2016 a "searchable" comprehensive database.

- ✓ New portable analytical solutions placed on the market must demonstrate "measurable improvements" with respect to previous ones. Exploration capabilities without opening packaging, easy to use/cost-effectiveness are desired but they are in part in contrast with correspondent satisfying sensitivity.

- ✓ NMR solutions are a well established both rapid & confirmatory directions but there is still the need to make available adequate reference materials for really extend their range of applications.

- ✓ Significant percentage of raw materials that come to EU is still not constantly controlled. From "tree to the bottle", the legislation can change.

- ✓ Complexity of several food matrixes hinder concretely analytical reliable solutions

- ✓ There is a mainstream trend towards regional food. At the same time, we can say that "Nature ignores borders"!

- ✓ Sometimes it remains a real challenge to correctly interpret industry priorities to become a correspondent solutions provider

- ✓ Image protection is a key issue in companies. Third "super-parties" external partners that work in order to provide audits & official certifications can act "like a referee in a football match". In this field, the World is moving more and more into the direction of "no paper" solutions: smart devices, tablets, web platforms,…

- ✓ Reputation is at high risk due to frauds & adulteration issues for many different companies but industrial partnership along the chain still not enough strengthen.

2. *Interactive Team Working activity*

Participants have been firstly invited to reflect on assuring food integrity on the entire food chain:

In a first phase they worked alone, with the aim to define up to 7 (key)words/statements (seven words or short phrases related to gaps, status, challenges, issues that spring immediately to their mind) to cover the following 4 topics:
(i) Fragmentation of the food chains, variety,peculiarities of the different stakeholders
(ii) Effective rapid screening approaches already available or "wished"
(iii) Confirmatory analytical strategies already available or "wished"
(iv) Assessments & prevention models already in place/concrete in the near future

In a second phase the participants worked in pairs in order to share up to 7 (key)words/statements and up to 7 solutions referred to the 7 (key)words/statements.

In a third phase they were grouped in groups of 8-10 people (6 groups in total at the end) and they were asked to select, through an internal discussion and debate, only up to 7 (key)words/statements of all those that each pair of the group had previously written, identifying also a representative member for the subsequent phase. In a parallel way they were also asked to provide up to 7 shared solutions referred to the selected 7 (key)words/statements.

In the fourth final phase the representatives of each group had to defend the words/solutions identified, debating in front of the other representatives & audience:
the other participants were invited to comment and intervene during the discussion, in order to integrate a final framework that was reported at the end.

3. *Interactive Team Working final results - framework*

3.1 (Key)statements

- There is the need to develop a Global Food Control System (without borders…)
- A real difficulty is the effective way to obtain data integration/fusion/handling from different sources (not necessary analytical) and within different analytical strategies
- A relevant challenge is the integration/continuous update of supply chain mapping/assessment/management (highly fragmented situations in some cases)
- Another big challenge is the sustainability and quality of databases
- Complexity is present in terms of analytical methods on some food matrixes, validation of the methods is a key point in this sense
- There is the continuous search for cost effective solutions with particular focus/request on reliability of "in-line"/"on-site"/"on-field" technologies
- A lesson learning direction is the continuous improvement of audits effectiveness
- There is a lack of reliable predictive modelling solutions for making possible assumptions about future scenarios
- A stronger effort is stated as necessary in terms of industrial self-control strategies

3.2 (Key)solutions

- Develop an "International Umbrella Organization" devoted to standardize and harmonize protocols, audits, certifications, monitoring, data collection,…
- Stimulate the production of many more new reference standard materials/matrixes
- Enforce a stable network to set international "commodity based" methods & procedures
- Look for extrapolating the good aspects of successful previously developed databases
- Take responsibility for an overall integration of the food chains, "more" than the so-called "one step after/one step before" concept
- Set at least a basic legally obliged level of information sharing among the different stakeholders; define also the rules & timing on how progressively expand it
- Establish precise guidelines for international validation of methods and data collection/registration
- Promote the development of new confirmatory technologies (e.g. HRMS, NGS,…) specifically targeting complex food matrixes/issues
- Support the development of new chemometrics strategies
- Promote the development of new portable/screening solutions which demonstrate a sufficient quality of the produced results to meet the task they are devoted
- "Highlight" main raised scandals as driver for acting in the "zero tolerance" direction
- Activate constant non-announced audit actions (each step/stakeholder along the involved chain have to provide audit actions for the previous one)

- Speed up as much as possible the scale up of new analytical solutions
- Favour interlaboratory data & methods & performance criteria comparisons
- Combine screening & confirmatory approaches in each food chains prevention protocol

3.3 Besides: further remarks from participants after the workshop

- Look for citizen science/crowd sourcing solutions
- Think about "cloud based public money" database solutions
- Do not forget the aspect that very cheap tools means real difficulties for the customers in terms of true wide field of applications and for the instrument companies in terms of assuring a correct "after sales support" (like applications specialists)
- Food industries should consider to what is already in place in the pharmaceutical industries that have large expertise on some frauds aspects: they have their own fraud squad and plans - we should look at how they make it works

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AIMS, FORMAT & ABSTRACTS SHORT TALKS "PILLS"

WORKSHOPS — April 7, 2016

THURSDAY, April 7, 2016

8:00-9:00		Registration for the FOODINTEGRITY 2016 workshops
		SESSIONS 6 & 8, *in parallel*
9:00-10:30 Prague C&D hall		**SESSION 8: Workshop on Industrial perspective for strategies applied for assuring food authenticity (part I)** How to improve protection from food frauds and adulterations *Moderator: Michele Suman, Barilla, Parma, Italy*
9:00-9:10	L36	OVERVIEW OF CURRENT RESEARCH AND PRACTICAL OUTCOMES OF FOODINTEGRITY PROJECT ***Michele Suman**, Barilla SpA - Advanced Laboratory Research, Parma, Italy*
9:10-9:20	L37	USING THE FOODINTEGRITY NETWORK & THE FOOD INTEGRITY KNOWLEDGE BASE ***Michele Lees**, Eurofins Analytics France, Nantes, France*
9:20-9:30	L38	RAPID METHODS PERSPECTIVES (FOCUS ON THE SPIRIT DRINK SECTOR) ***Shona Glancy,** The Scotch Whisky Research Institute, Edinburgh, UK*
9:30-9:40	L39	Cancelled
9:40-9:50	L40	1H-NMR NON-TARGETED DETECTION OF ADULTERANTS IN VEGETABLE OIL ***James Donarski,** Fera Science Ltd, York, UK*
9:50-10:00	L41	SPECTROSCOPIC TECHNOLOGIES AND APPLICATIONS FOR AUTHENTICATION & ANTI-COUNTERFEITING ***Neville Davies,** Ocean Optics, Duiven, the Netherlands*
10:00-10:10	L42	INDUSTRIAL SELF-CONTROL IN THE FRUIT JUICE INDUSTRY: A MODEL FOR OTHER FOOD INDUSTRY SECTORS ***Aintzane Esturo,** SGF International, Nieder-Olm, Germany*
10:10-10:20	L43	HONEY IDENTITY: NEW APPROACHES TO THE BOTANICAL ORIGIN OF HONEY BY NEXT GENERATION SEQUENCING ***Maria Teresa Barreto Crespo,** iBET, Oeiras, Portugal*
10:20-10:30	L44	THE USE OF STABLE ISOTOPES FOR MONITORING OF PRODUCTS CLAIMING REGIONAL ORIGIN. A PROOF OF CONCEPT ***Markus Boner,** Agroisolab GmbH, Jülich, Germany*
10:30-11:00 Conference area		Coffee Break / Exhibition / Poster session

SESSIONS 7 & 9, *in parallel*

11:00-13:00 Prague C&D hall	**SESSION 9: Workshop on** **Industrial perspective for strategies applied for assuring food authenticity (part II)** How to improve protection from food frauds and adulterations *Moderator: Michele Suman, Barilla, Parma, Italy*
11:00-13:00	*An interactive team working exercise among the participants to address future scenarios related to:* *(i) Fragmentation of the chains,* *(ii) Effective rapid screening approaches,* *(iii) Confirmatory analytical strategies,* *(iv) Assessments and prevention models*
13:00-14:00 Hotel restaurant Loreta	**Lunch**

Workshop: Industrial Applications for Assuring Food Authenticity

(HOW TO IMPROVE PROTECTION FROM FOOD FRAUDS AND ADULTERATIONS)

Workshop Aims and Objectives

European food is of prime importance to the European Agri-food economy.

The authenticity of European food and the integrity of supply chains is under constant threat from fraudulent activities.

The topic of assuring the integrity of the food chain brings together producers, distributors, processors, retailers, regulators, researchers, enforcers and consumers.

The present workshop will be an opportunity for all these stakeholders to raise their awareness of food authenticity issues and get together in order to achieve the following objectives:

i. Share common relevant issues combined with best practices, enlarging the existing network and boosting exchange and collaboration

ii. Allow open and constructive discussions on how current research is expected to develop practical mitigation solutions for companies to use to protect themselves from food fraud

iii. Review all the relevant activities and tools that FoodIntegrity project has already made available and/or is developing for the industry (e.g. FI Network, FI Knowledge Base,...)

Workshop Format

The first part of the workshop will be devoted to have a series of short talks that will consider the 'state of the art' achieved from the FoodIntegrity project on the industrial side, together with stimulus and good practices provided directly from industrial player presenters from different points of the food chain.

At the end of each presentation, a moderator of the session will assist in identifying the knowledge gaps and stimulate discussion as to how these gaps might be addressed.

The second part of the workshop will be dedicated to an interactive team working exercise among the participants to address future scenarios related to: (i) fragmentation of the chains, (ii) effective rapid screening approaches, (iii) confirmatory analytical strategies, (iv) assessments and prevention models.

L36
OVERVIEW OF CURRENT RESEARCH AND PRACTICAL OUTCOMES OF FOODINTEGRITY PROJECT

Michele Suman[1*], Francesca Lambertini[2]

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European foods is under constant threat of frauds & adulterations and the consumer does expect to buy products of which safety, quality and authenticity are assured: these parallel aspects represent a big challenge for the industry. FoodIntegrity project (FI) key activities are to share data and knowledge, evaluate mislabeling, develop both rapid and confirmatory methods and systems for industry, develop early warning systems, understand consumer behavior for export. FI have the ambition to make a fundamental step in advance for assuring the added value of the integrity in the European food chain with a positive impact on EU citizens well-being, guaranteeing at the same time EU food reputation in front of NON EU countries. The industrial partnership and collaboration in the project permits to fully understand the opportunities that this multi-faceted project presents to food businesses, contributing also to compare the perspective of food chain vulnerabilities vs current analytical methods and technologies.

Keywords: food integrity, industry, rapid and confirmatory methods, food business, added value

Acknowledgement: The research has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 613688.

L37
USING THE FOODINTEGRITY NETWORK & THE FOODINTEGRITY KNOWLEDGE BASE

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The latest GFSI Guidance Document, due to be published in 2016, will include recommendations on how industry should tackle the problem of food fraud. The main food safety management schemes such as BRC (British Retail Consortium) and IFS (International Food Standard) are already one step ahead and have included specific food fraud requirements in their certification schemes. The two recommendations of the GFSI are (1) that companies should carry out a 'food fraud vulnerability assessment' in order to identify potential weaknesses in the supply chain and (2) that they then set up a 'food fraud mitigation plan' describing measures, including an analytical testing strategy, to target food fraud risk. This means that all food operators will have to put in place a documented procedure clearly indicating when, where and how the integrity of food products entering or leaving the factory is verified. They will need to show that they are aware of historical or developing food fraud risks and that their systems are protected by the most relevant and up-to-date scientific measures. The tools developed in the FoodIntegrity project, including the Expert Network and the Knowledge base will help food operators establish this information. Both are available through the FoodIntegrity website (www.foodintegrity.eu). The FI Stakeholder/Expert Database is a searchable tool to identify people/organisations with a particular skill set in the area of food integrity and can be searched by product type, analytical skill or location. The FI Knowledge base is Web-based tool providing information on various food fraud practices together with recommended analytical strategies. It is designed for use by industry and regulatory authorities to identify, easily and rapidly, potential threats to a given food product or ingredient and the existing solutions. Work is ongoing in the FoodIntegrity project to populate both databases and develop appropriate search engines to facilitate finding the information.

Keywords: food safety management schemes, food fraud, analytical tools, expert database

Acknowledgement: The research has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 613688.

L38
RAPID METHODS PERSPECTIVES (FOCUS ON THE SPIRIT DRINK SECTOR)

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In 2011 the European spirit drinks industry produced 37.5 million hectolitres of spirit drinks valued at over €23 billion, approximately two-thirds of which was exported. It is important to protect the reputation of such a large and valuable market from the harmful impact of illegally produced spirits. Counterfeit activities can not only be dangerous to health but extremely damaging to brand reputation. Laboratory methods to identify counterfeit spirit products are often complex and require sophisticated analytical instrumentation. However, some in-field technologies are currently in use and there are more in the development stage. In-field devices enable suspect counterfeit spirits to be identified rapidly at the point of sale or distribution by relatively unskilled personnel. Such a requirement for rapid analysis also extends back to the laboratory where quicker authoritative tests are desired. The Spirit Drinks Work Package of the EU FoodIntegrity Project has targeted the development of rapid analysis methods for spirit drink authentication as one of its primary aims. Initial feedback on such technologies from industry was provided at a FoodIntegrity Spirit Drinks Authentication Seminar held at The Scotch Whisky Research Institute in May 2015. This short presentation will introduce some of the rapid analytical methods evaluated by the FoodIntegrity Project, and perspectives of the spirit drinks industry on their associated benefits and challenges.

Keywords: authentication, counterfiet, spirit drinks, denaturants

Acknowledgement: The research has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 613688.

L40
^{1}H NMR SPECTROSCOPY FOR THE NON-TARGETED DETECTION OF ADULTERANTS IN VEGETABLE OIL

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The presentation will cover work carried out to develop non-targeted methods of detection of adulterants in vegetable oil using high field ^{1}H NMR spectroscopy and will include: Development of matrix-specific extraction strategies and NMR spectral acquisition-processing parameters; Generation of NMR spectroscopic data of representative vegetable oil; and testing of the database with adulterated vegetable oil.

Keywords: authenticity, non-targeted, vegetable oil

Acknowledgement: Nestlé Research Centre

L41
SPECTROSCOPIC TECHNOLOGIES AND APPLICATIONS FOR AUTHENTICATION & ANTI-COUNTERFEITING

Neville Davies[1*]

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This talk will give a brief overview of optical spectroscopy measurements across the food sector and how this technology is applied to authentication and anti-counterfeit applications, from an instrument providers perspective.

Keywords: optical spectroscopy, authentication

L42
INDUSTRIAL SELF-CONTROL IN THE FRUIT JUICE INDUSTRY: A MODEL FOR OTHER FOOD INDUSTRY SECTORS.

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SGF is a pioneer of industrial self-control that fights for safeguarding the compliance with legal and industrial quality and safety standards and for a safe and fair worldwide fruit juice market on behalf of members and consumers. Objectives of the association are to promote free and fair competition by increasing the safety and quality of the products, protecting the members against unfair competition as well as supporting members in averting unjust attempts. Since it was founded, in 1974, the task of the SGF has been to monitor the products of the fruit juice branch that are to be found on the market. SGF carries out market analysis and plant audits at the member production plants to monitor compliance with the food and labelling regulations. The aim is to ascertain irregularities, anomalies and adulterations of products already during the initial production phases of processing raw material and finished goods and not waiting until these are already on the market. Since 1986, the SGF's controls include the manufacturers of raw materials and semi-finished products from companies all around the world, with more than 600 members from about 60 countries. Nowadays more than 80% of the raw material coming to Europe is controlled. The control system that permits the traceability of a juice „from the tree to the bottle" is based on voluntary participants who open the doors of their semi- and finished goods facilities for the SGF auditors and allow samples to be taken of the semi- or finished goods from on-going production and from the warehouse for corresponding testing, together with hygiene audits of the plant facilities. The „complete control chain" from processing the fruit through to the finished product can provide verification of quality, even if natural changes resulting from origin, growth or variety characteristics cause deviations from normal expectations. At the same time it is easy to detect, localize and prove illicit product manipulation. Any infringements against the food regulations or against the rules of the system trigger corrective action by the SGF with corresponding follow-up inspections. The voluntary control system gives its participants greater security in purchasing semi-finished products and protects the sector from dishonest competitors. It also helps to safeguard the constantly growing quality expectations of retailers and consumers. As a result of the activity of SGF, in the last years adulteration is reduced to isolated cases, detected problems were solved before they became public and, luckily, fruit juice scandals up to now have been avoided. On top of the routine control activities, SGF contributes in implementing new analytical methods applied to fruit juices, such as the Proton – NMR-Spin Generated Fingerprint Profiling (SGF-Profiling TM) and developing projects that contribute to the improving of the quality and assuring the authenticity of the fruit juices.

Keywords: authenticity, quality, self-control, food chain

L43
HONEY IDENTITY: NEW APPROACHES TO THE BOTANICAL ORIGIN OF HONEY BY NEXT GENERATION SEQUENCING

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Food identity is very important for consumers due to their freedom of choice and also to their right to food authenticity and integrity. In turn, food integrity is also highly important to the authorities since traceability (the ability to follow the movement of a food through its production and processing) is mandatory in EU distribution (Regulations 178/2002 and 931/2011). Food can, nevertheless, be very diverse. Its complexity demands for new methodologies and analytical tools that can be used to trace their composition, origin, production, and transportation. Considering authenticity, the ideal sample analysis should present some important features: several targets detected in a single test, reliable results in complex and processed samples, high specificity, high sensitivity, and quick answers at fair price. Next generation sequencing (NGS) is probably the methodology that better fulfils these features, especially if applied to amplicon sequencing, as it ties the ability to produce a huge amount of data with high specificity, ability to detect a high number of organisms in one single analysis and sensitivity of PCR method. It can be applied to complex and processed food products targeting all species in a mixture. If using sample barcoding, it can also be applied to the analysis of several samples at the same time, becoming affordable for routine use. Honey is one of the EU TOP 10 targets most at-risk of food fraud and thus it was the selected matrix for this work. The origin of honey can be perceived by the geographical origin and/or by floral or vegetable origin. The honey matrix includes numerous pollen grains and honeydew elements that altogether provide a good fingerprint of the environment where the honey was produced. Pollen analysis has been therefore used to determine and control the geographical and botanical origin of honey. The objective of this work was to compare the current method of labelling botanical origin of honey, melissopalynology, (counting and morphologically identifying pollen under microscope) with DNA extraction, taxonomic discrimination and relative quantification by SGS. 50 different honey samples collected from different regions of Portugal and having different floral composition were classified by classical pollen analysis of honey. Simultaneously, an extensive DNA extraction optimization was performed as a pre-requisite to the subsequent steps of the analysis. Then, the DNA amplification of the extracted nucleic acids followed by NGS was performed using genomic regions suitable to produce a reliable plant species molecular identification. The primers used were tested for their universality. Finally, the high amount of results was analysed with dedicated software, designed to easily perform the correct identification of plant species. The profile of plant species associated with each honey sample was correlated with their origin and compared with the results obtained with the melissopalynology analysis.

Keywords: food fraud, honey, botanical origin, next generation sequencing

Acknowledgement: The financing of CATAA and iNOVA4Health Research Unit (LISBOA-01-0145-FEDER-007344), which is cofunded by Fundação para a Ciência e Tecnologia / Ministério da Ciência e do Ensino Superior, through national funds, and by FEDER under the PT2020 Partnership Agreement, is acknowledged.

L44
THE USE OF STABLE ISOTOPES FOR MONITORING OF PRODUCTS CLAIMING REGIONAL ORIGIN. A PROOF OF CONCEPT

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Products from a defined region are getting more and more popular in the European market. At the moment various certificates are available to ensure the origin. Nevertheless the demand of an independent analytical method is requested from the market and authorities as well. In the "watermark" project (funded by the Federal Office for Agriculture and Food) the stable isotope method was tested in the federal state of Hessen (Germany) in order to evaluate the origin of four agricultural products (wheat, potatoes, carrots and apples) and 4 animal products (pork, beef, eggs and milk). All eight products were firstly analysed on the stable isotopes of the water in the tissue water and the organic (D/H, $^{18}O/^{16}O$) and secondly on the further stable isotopes of the bio elements as carbon ($^{13}C/^{12}C$), nitrogen ($^{15}N/^{14}N$) and sulphur ($^{34}S/^{32}S$). To expand the possibilities various parts of the products were analysed separately as the fat (e.g. wheat, meat) or extracted proteins (e.g. potatoes). An essential part of the stable isotope method is always a reliable database. In the project more than 1298 reference samples from these eight products were sampled in the whole area of Hessen. Furthermore the field variation was checked as well. Therefore from 169 fields always four samples from different field location were sampled and analysed. The natural distribution of the field has finally an important relevance to build up an evaluation system to predict the origin of samples. Regarding the enormous data it was firstly possible to compare the stable isotopic signatures of the different products of a region. One result was the high similarity of the D/H ratios of apples (n=49) and potatoes (n=67) in their average value and standard deviation. The developed database was tested with 264 blind test samples to check the robustness of the stable isotope method to predict the origin of the country, regional and field level. A result was that the stable isotope method has a high performance, especially on the evaluation of the field level. Finally the conclusion of the project was integrated in an online database to make the stable isotope method accessible for the market as well.

Keywords: stable isotopes, origin check, regional products, online database, agricultural products

Acknowledgement: Project was funded from Federal Office for Agriculture and Food.