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METROFOOD-RI: Pilot services with physical, remote and virtual access

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ABSTRACT

METROFOOD-RI (www.metrofood.eu) is an ESFRI research infrastructure, funded upon the EU H2020 METROFOOD-PP project for its Preparatory Phase, aiming to establish a new distributed European Research Infrastructure (RI) to promote scientific excellence and increase efficiency in food quality and food safety. It strives to provide and coordinate high-level metrological services on a European scale for researchers, laboratories, food inspection agencies and policymakers.

As part of the preparatory phase towards the legal statute of ERIC (European Research Infrastructure Consortium), a service portfolio is being set up along with its provision diagram. As a test for this model of service provision, three use cases have been defined that are representative of the different types of access that will be provided by METROFOOD-RI:

1. *physical access to a food pilot plant* for demonstrating technical solutions and adaptations of food processing technology to minimize acrylamide in bakery products at the National Research & Development Institute for Food Bio-resources (IBA, Romania).
2. *remote access to the transmission electron microscope facility* for physicochemical characterization of nanoparticles in food (Sciensano, Belgium).
3. *virtual access to two e-services* for open data use, mainly addressed to researchers, laboratories, food inspection agencies and policy makers:

- a search engine and database for agrifood reference materials and official methods
- an application programming interface (API) for a risk evaluation tool

The use cases will help to evaluate the usability of the single access point of the research infrastructure and to fine-tune the access procedures and interfaces with users. This will support the elaboration of the final service chart of METROFOOD-RI including all the potential physical, electronical and integrated services that the infrastructure aims to provide to its users.

The paper will give an overview and first evaluation of the use case service provision and provide an overview of the potential METROFOOD-RI service portfolio.

1. METROFOOD-RI service portfolio

The objective of METROFOOD-RI is to create a unique platform providing access to a worldwide distributed network of scientific facilities and state-of-the-art services, data, information and metrological tools for the measurement and assessment of food quality and safety, covering the entire food chain from agrifood primary production up to final consumption. At present, the METROFOOD consortium includes numerous facilities distributed in 18 European countries that will provide scientific services in an integrated and collaborative manner.

The RI includes a physical (P-RI) and electronic component (e-RI) (<https://www.metrofood.eu/about-us/infrastructure.html>). The **Physical-RI** (Fig. 1) will enable to carry out different research activities supporting data collection and measurement reliability, quality & safety and traceability of food production, as well as basic and frontier research in food and nutrition. The main components of the physical RI are on

one side the **analytical labs** providing methods and tools for food safety, quality, authenticity, nutritional value, agro-ecosystem characterization and plants for the development, production, characterization and certification of **reference materials (RM)** both for food and feed matrices, as well as primary RM (METRO-side). This also comprises tools for method and performance evaluation, standardization and harmonization; along with provision of Proficiency Testing schemes and inter-laboratory testing. The FOOD-side of the P-RI on the other hand, covers not only services and facilities to improve **primary food production** and consumption, such as experimental fields and greenhouses, but also **food processing and kitchen pilot plants** to develop and test new production technologies and demonstrate best practices for food preparation, storage and packaging including strategies for the reduction of food losses and new sensors and tools for food traceability.

The Electronic-RI (Fig. 2) will provide a new access platform to share and integrate knowledge and data on metrological tools for food

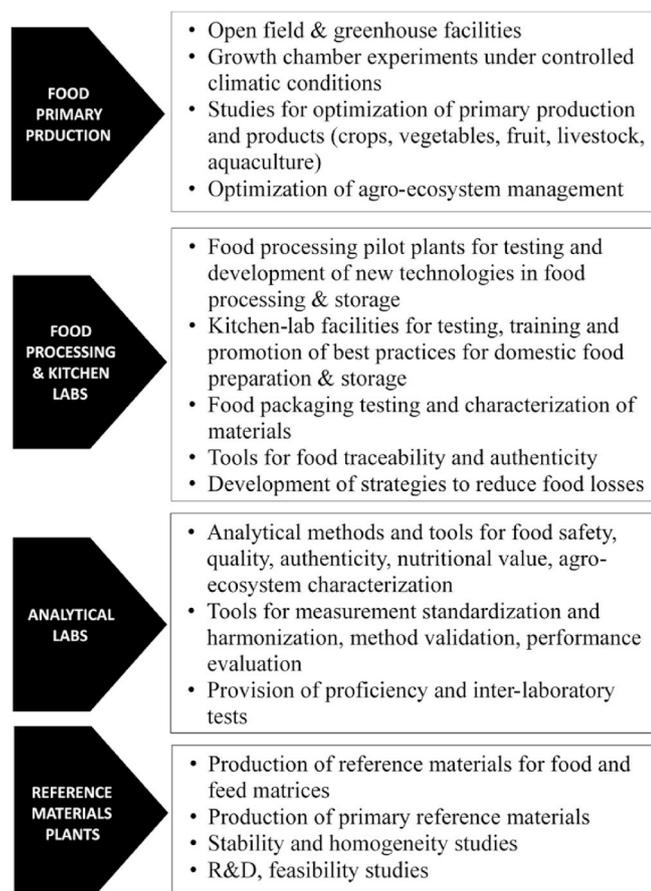


Fig. 1. Physical facilities and services of METROFOOD-RI.

analysis. It will include tools for the integration of existing database on food, focusing on emerging needs and collection of data on food composition, nutritional contents, markers and food contamination levels related to environmental and health impact.

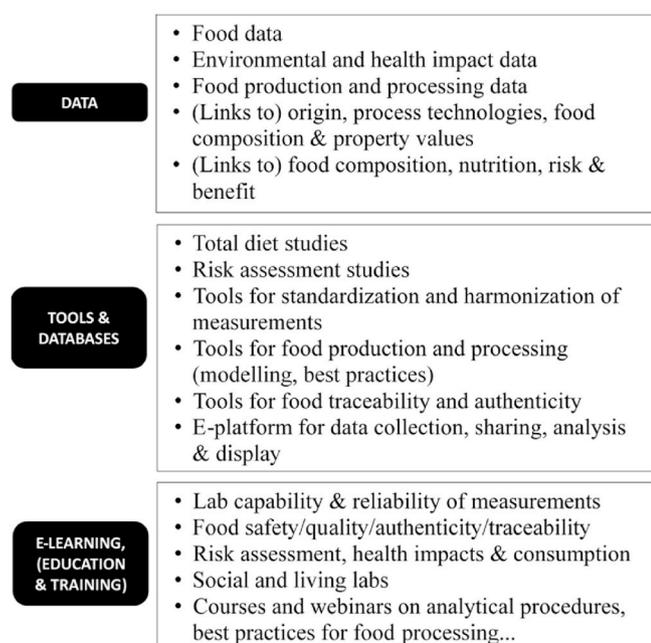


Fig. 2. E-services of METROFOOD-RI

2. METROFOOD-PP use cases

Three use cases have been defined, planned and initiated to represent the different access types and to cover the entire users' community that will be addressed by the METROFOOD-RI service portfolio. The purpose is to test and refine the provision and organisation of services, to identify on how to improve user-provider interaction and to evaluate the socio-economic impact. The service flow of these case studies was monitored and registered following the procedures to be implemented within the future ERIC. Apart from the wide access for the e-services, physical and remote access relates to excellence-driven (free-of-charge) access. Open calls for the physical and remote access have been launched in July 2020 on the METROFOOD-RI website and other communication channels (<https://www.metrofood.eu/access/open-call.html>). Applications had to be submitted before the end of September by means of a uniform registration form on the website. Access was granted based on merit (excellence) and specific eligibility criteria set up by each use case operator.

2.1. Physical access to a food pilot demonstrator - how to minimize acrylamide in bakery products

The purpose of this use case is to transfer scientific knowledge and demonstrate technical solutions to food business operators (with specific reference to small and medium enterprises) on how to adapt/improve food processing technology to inhibit or to minimize process contaminants, specifically acrylamide, in bakery products. Such on-site demonstration will improve the production of healthier foods through the implementation of appropriate process technologies, and supports the food safety agencies in their advices to food business operators.

This service is provided at the pilot plant of the national R&D Institute for Food Bioresources (IBA) in Bucharest (RO) (Fig. 3). It includes experimental demonstration of different baking conditions for biscuits and breads with several flour types and ingredients, chemical analysis of acrylamide and sensorial evaluation of the obtained products. Four applications were registered and accepted. However, due to the COVID-19 restrictions, physical access was not possible; therefore the demonstration was recorded and made available, together with an interpretation of the results.

2.2. Remote access to a transmission electron microscope facility for physicochemical characterization of nanoparticles in food

This use case was designed to provide services to external users in need of analyses for the physicochemical characterization of nano-materials in food offering access to a high-end analytical transmission electron microscope (TEM) at Sciensano (Belgium) (Fig. 4).

This highly specialized technology is available at three levels:

- I. Samples supplied by external users are analysed by in-house operators. The users obtain a full report and discussion of the results.
- II. Sciensano operators provide on-site training in the analytical techniques and equipment to external candidates. As a result the trainee will be able to execute his/her own analyses and take home the essential knowledge and skills to perform these analyses independently and in accordance with certified protocols.
- III. As a proof of concept, remote control and operation of the TEM is set up for the external user. This provides the opportunity for other facilities or research teams to have remote access to the TEM during a defined amount of time to monitor their own analyses.

Two proposals were evaluated and accepted based on well-defined criteria such as the applicant's previous experience in nano-related analytical techniques, the specific type of samples and services



Fig. 3. Food pilot plant at IBA (Romania).



Fig. 4. Transmission electron microscope facility at Sciensano (Belgium).

requested, the project's objective and its relevance for food safety. Also the suitability of the project timing was taken into consideration. After notification of approval, further user-provider contacts were established to discuss and agree upon the best analytical method and sample preparation protocol and the time schedule for service provision and reporting. The first experiments are planned for summer 2021 and will mainly involve the first step (see above). Afterwards on-site training of applicants is foreseen.

2.3. Virtual access to e-services

The use case dedicated to the wide virtual access is developed by Premotec (Switzerland), in collaboration with ENEA (Italy) and includes access to two different tools:

2.3.1. A search engine for agrifood reference materials (RMs) and official methods

Partly due to the multidisciplinary approach and multidimensionality, the food and nutrition research sector suffers from a high data fragmentation and dispersion. The information on metrological tools (reference materials, reference and official methods, proficiency testing provision) is still too fragmented into a large variety of organizations and datasets spread around the world. This implies that, whether public and private, research and control laboratories are daily involved in time consuming, sometimes duplicated, researches into scientific literature and too broad and general databases. The use case/service will enable

the identification of all the available RMs for a given matrix/analyte combination through a single access point. The users will be able to search the database of available RMs provided by ENEA, categorized by country, producer name, category, matrix information, parameter information, etc. The search includes "basic search" and "advanced search" modules; the search results provide a table including the most relevant information on the identified RM items, with a link that redirects the user to the producer's website/offer. Any user will be able to use the application upon registration.

2.3.2. A tool to integrate total diet study (TDS) sample data with Monte Carlo risk assessment (MRCA)

This tool will facilitate researchers, food inspection agencies, control agencies and policymakers to perform risk assessments based on analytical data obtained from total diet studies (TDS). Researchers performing TDS studies tend to collect their data in separate systems (for example, a dedicated software or/and excel file) and often this software is not compatible with certain data quality systems. Consequently, researchers may face problems to transfer these data for risk analysis into MRCA (for example by exporting to excel and then importing to MRCA). For the needs of this use case, an application programming interface (API) has been developed, enabling seamless TDA data transfer to MRCA from FOODCASE or other compatible databases. The web app has been build using a Wordpress plugin, where the user can select a concentration dataset stored in FOODCASE and a consumption dataset stored in MRCA. Both datasets are then automatically analysed in MRCA and the

results are displayed. In order to use the Wordpress plugin, the user registration and log in are required. The necessary API documentation is provided to allow also other apps to upload their datasets for analysis in MRCA.

The implementation and internal testing of both cases will be shortly finalized, after which the user testing and evaluation will be initiated.

3. Conclusions

Food quality and safety, authenticity and health benefits have become a focus for public concern and consumer's requirements all over the world. However, there is still a significant fragmentation with regard to food control, analysis, data and research in Europe and worldwide. The establishment of METROFOOD-RI aims to address the need for researchers, policymakers, control agencies, food business operators and consumers to have a one-stop-shop with access to a worldwide distributed network of high quality scientific services in the domain of food. During the preparatory phase, three use cases have been initiated to cover the different modes of service access (physical, remote and virtual) and several applicants have been admitted to these test cases. The follow-up on the service access and user-provider-operator interactions will enable the future RI to optimise its final organisation and procedures.

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