NETWORKING TOOLS FOR STANDARDIZATION

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Abstract – In order to systematize and networking data and information useful in measurements for food and nutrition, ENEA is developing a web application based on open source cloud technologies. This application will permit to inventory the available resources on Reference Materials, Proficiency Testing schemes and Reference Methods for food analysis, collecting in a single web-site all the available information for standardizing and harmonizing food analysis.

Keywords: database, food analyses, networking, reference materials an methods, standardization

1. INTRODUCTION

Partly due to the multidisciplinary approach and multidimensionality, the food and nutrition research sector suffers from a high data fragmentation and dispersion. Chemical and biological measurements lack evidence of a proven metrological link and are still open to improvements in analytical reliability by applying metrological principles. The information is still too fragmented into a large variety of Organizations in the World. That implies that either Public and Private, Research and Control Laboratories are daily involved in time consuming activities, such as researches into scientific literature for methods and into too broad and general databases. Currently some databases on the RM worldwide production are available on line, such as COMAR, IAEA, *Japanese RMs search*, VIRM, but they are of general interest (not specific for the food sector) and designed for including any kind of RM. Only for other application fields there are available specific RM databases, such as GeoReM, for RMs of geological and environmental interest, and the EVISA dB, for RMs to be used in speciation analyses). As a consequence, searching of RMs for a specific application field - and especially for the food sector - is often difficult and distracting. In addition, the access to official methods of analysis in many cases is not free (i.e. CEN or ISO methods, AOAC and ASTM methods) and it is often difficult to collect all the necessary information, due to the many different sources to be consulted.

Considering the above mentioned difficulties, on 2000 ENEA realized a new database on the worldwide production of RMs specific for the agrofood sector [1,2] which is periodically updated directly consulting the catalogues of the individual producers (e.g.: IRMM[1], LGC[1], NIST[2], IAEA[3], MUVA[4], NRC-CNRC[5], RomerLabs®-Biopure[6], NMI-NARL[7], FAPAS®[8]), as well as seeking in the general databases available online. In particular, for some specific analytical applications, in depth examinations are available (e.g.: RMs for mycotoxin analysis [3], RMs for food flavour analysis [4], RM for food traceability [5,6]). In addition during the last years ENEA is inventorying all the reference methods available for some classes of foodstuff (such as: cereals and derivatives, milk and dairy products).

In recent years ENEA is working in the development and set up of a web application aimed to concentrate and interlink all the information on food measurements into a single free access web platform. It will permit to integrate and network all the available information on the worldwide availability of metrological tools, food composition and consumption, food markers, etc., obtaining all the information starting from the matrix/analyte combination.

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[1] LGC – Laboratory of the Gorvernment Chemist (UK) - www.lgc.co.uk/
[2] NIST – National Institute of Standards and Technology (USA) - www.nist.gov
[3] IAEA – International Atomic Energy Agency (Austria) - www.iaea.org/
[4] MUVA Kempten (Germany) - www.muva.de
[5] NRC-CNRC – National Research Council Canada - www.nrc-cnrc.gc.ca
[6] RomerLabs®-Biopure (Austria) – www.romerlabs.com
[7] NMI-NARL – Australian National Measurement Institute - www.measurement.gov.au
[8] FAPAS® (UK) – The food and environment research agency -– www.fapas.com

2. DEVELOPMENT OF A NEW INTEGRATED MODULAR DATABASE

In the framework of a National funded programme, ENEA has been promoting the development of a web application based on open source cloud technologies, consisting in: a relational database modular expandable; a server application in PHP5 language installed on a dedicated Linux Server; a statistical engine based on language R; a Graphycal User Interface (GUI) based on HTML5, CSS3 and jQuery.

The main features are: stability, security, performance, expandability, and portability. The relational database is able to handle large amounts of data (order of millions of records per table) with quick response (order of units of seconds) and ensure data integrity, allowing complex queries of cross-data. The server application is the set of the operative modules implementing the *business rules* and managing the interaction of the user with the functionalities and the database. It represents the heart of the system and, being centralized, can reside on scalable servers that grow in performance in direct proportion to the demand of use. The statistical engine permits to realize statistical analyses and technical graphs, directly interfacing with the databases and the server application. The GUI is realized with web technologies and therefore don't require the installation and is always updated. It can be used by any operating system and from any kind of device, with any browser; the only requirement is to be on-line.

Different categories of users are provided for. Each category will have different rights (e.g.: only read, or read & write) and - where necessary - different graphical interfaces. In fact, the features offered by the system will vary depending on the category of users, based on different specifications. Among these categories, users with an active role in creating and managing the database and users logging in only for consultation are provided for. In all cases, the system assists the user in the operation by providing *wizards* for guided research - alongside the free research, and intelligent controls in the data entry.

The system is multilingual. In fact, at the moment, the application works both in English or in Italian and it is possible to select the language. In addition, as further development, the possibility to enlarge the languages of use has been foreseen. The full compatibility with excel is guarantee for the easy import and export of the data.

The web application is characterized by a modular structure, able to be freely integrated and expanded in subsequent moments. At this first stage the database comprises four modules: Reference Materials (RMs), methods (AMs), Proficiency Testings (PTs) and Threshold Values (TVs). The system allows the research on each module and the cross-searching on two or more modules. The system allows also the creation of statistical reports and graphs. The software has been developed by GMSL S.r.l. (Milan, Italy) following the ENEA provisions.

Each module was modelled using consistent criteria to each other. Matrix classification was adopted in order to ensure future compatibility with other databases (e.g. food composition databases). In Tables 1, classes for ranking food matrixes are reported, while Table 2 lists the classes adopted for the parameters (measurable properties or analytes).

Table 1. Classes for ranking food matrixes.

Additives and integrators
Cereals and cereal products
Fruit and vegetables
Meats and poultry products
Fish products
Milk and dairy products
Olives, oils, vegetable and animal fats (excluding butter)
Sugar and sugar plants
Honey and bee products
Herbs, salt and spices
Cocoa, coffee, tea and derivatives
Feedstuffs
Prepared (ready to eat) food products and total diet
Beverages and vinegars
Substances for calibration
Agricultural "non-food" products
Other

Table 2. Classes for ranking parameters (measurable properties or analytes).

Constituents, nutritional and nutraceutical properties
Chemical contaminants (primary production)
Chemical contaminants (processing, conservation and consumption)
Elements, isotopes, metallorganics and inorganic ions
Organic contaminants
Mycotoxins and phycotoxins
Allergens and anti-nutritional substances
Pathogens and microbiological properties
Physical characteristic and rheological properties
Additives
Organoleptic properties;
Identity
GMOs
Other

RMs were classified using the following information: Country, producer, code of the producer, denomination, physical form, type, and for each parameter the following information are given: name, type (certified value, reference value or information value), value, uncertainty, unit of measurement, additional notes. As information sources considered both individual producers' catalogues and general RM dataBases available online were considered.

Reference Methods were classified using the following information: source, code, year, other sources, denomination, type (reference, official or standard method), analytical phase, and for each parameter the following information are given: name, method/technique, additional notes. In this first stage, only for selected food classes (cereals and milk and dairy products) all Reference Methods from CEN[9], ISO[10] and AOAC are included, other than official methods stated from current regulation and methods developed by other independent standardization bodies internationally recognized (e.g.: ICC[11] for cereals). The

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[9] CEN - European Committee for Standardization
[10] ISO - International Organization for Standardization
[11] ICC - International Association for Cereal Science and Technology

work is in progress both for other sources of Reference Methods and for the other food classes.

Information on providers of PT schemes were collected from the EPTIS web site [7], while TVs at this stage concern only limit values for contaminants in food and feed taken from EU Regulations and Directives.

The database search can be done either as guided search or as free research. In the case of guided research, by a drop-down menu the class / subclass / matrix of the product and/or the class / subclass of the parameter to be analysed can be selected. As an alternative, it is possible to perform a free search; namely the user will indicate the product and the parameter to determine which will be traced back to the classes / subclasses by means of pre-established associations (Fig. 1).
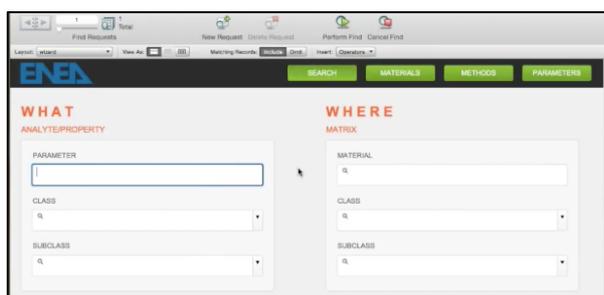

Fig. 1. Prototype of the database search form

By clicking on fixed boxes, it is possible to select the types of information (e.g.: name, manufacturer, parameters of interest) to be displayed. The search return different tables for RMs, AMs, PTs and TVs respectively, in which each line corresponds to a different RM (or analytical method, or PT, or TV), and report in the first column the ID and in the following columns the information previously selected (1 column for each type of information). From the obtained lists, it is possible to make manual selections (by clicking on the box) or automatic selections (by filtering data), with the possibly of reviewing the selection of the information to display included. By clicking on the ID of each record (RM, AM, PT or TV) a detail document is loaded. Also other fields have internal and external links: as an example, by clicking on the producer it is possible to access its website, or by clicking on the product class it is possible to obtain the list of all the RMs (or AMs, PTs, TVs) available for the respective class.

3. FURTHER DEVELOPMENTS

The web application is currently under development as concern sources and number of data. The modular design will allow the integration of the current module with successive integrations and additions of additional modules. Particular attention is being paid to the updating procedures and to enable full compatibility with the other databases, such as food composition databases, food consumption databases, COMAR; GEMS (WHO)/ Food Contaminants and EPTIS.

As further development, the present web application could be integrated with existing databases or implemented with data on food composition, food markers (of origin, quality, authenticity and process) and food consumption, in order to concentrate and interlink all the information into a single, free-access web platform. The web platform could also be subsequently integrated so as to use it as an instrument of networking for the development and validation of new analytical methods and further integration of the base of data.

REFERENCES

[1] M. G. Del Monte, L. Troisi, G. Zappa. Reference materials for agrofood. *ENEA Technical Report n.7/INN*, 2000

[2] R. Gatti, I. Lamberti, L. Mosiello, G. Zappa, C. Zoani. Reference Materials for mycotoxin determination and evaluation of fungal contamination of foodstuffs. III International Congress "Mycotoxins in Food Chain". ISS – Roma, 28-30/09/2009. ISSN 0393-5620 - *ISTISAN Report* 09/C6, 2009

[3] G. Zappa, P. Carconi, R. Gatti, C. Zoani. I materiali di riferimento per il settore agroalimentare: stato attuale e necessità. Proceedings of V Congresso "Metrologia & Qualità", Torino, 14-16 March 2007.

[4] R. Gatti, G. Zappa, C. Zoani. Reference Materials for Food Flavour Analysis. IMEKO TC-8, TC-23, TC-24 Three-day Conference *"Metrological traceability in the globalization age"* Paris, 6-8 April 2011

[5] G. Zappa, C. Zoani. Reference Materials for traceability of food products. IMEKO International TC8, TC23 and TC24 Symposium 2013 "*Recent Advances on Traceability of Chemical Food and Nutrition Measurements*" – Lisbon (Portugal), Sept. 22th-24th, 2013 (invited lecture)

[6] G. Zappa, C. Zoani. Reference Materials in support to food traceability. *"Frontiers in food science for feeding the World"* Pre-conference workshop of the 'Food technology 2015 conference' - University of Pisa, 15th June 2015. Submitted for publication to *Agrochimica* (Pisa University Press).

[7] EPTIS http://www.eptis.bam.de/en/index.htm