



## Research

### ACTEOLab-Salmonella : more than a database for the French Salmonella network, a tool for monitoring salmonellae of non-human origin.

Renaud Lailler<sup>1</sup> (renaud.lailler@ANSES.fr), Isabelle Berta-Vanrullen<sup>2</sup> (isabelle.bertha-vanrullen@ANSES.fr), Louis-Ziad Alexandre<sup>3</sup> (Louis-Ziad.Alexandre@ANSES.fr)

1. ANSES, Laboratoire de sécurité des aliments, Maisons-Alfort, France.
2. ANSES, Direction scientifique des laboratoires, Maisons-Alfort, France.
3. ANSES, Direction technique et informatique, Maisons-Alfort, France

Since 1997, the ANSES Laboratory for Food Safety has been coordinating and leading the French network for the epidemiological surveillance of *Salmonella* strains of non-human origin. This network currently comprises some 140 laboratories throughout France.

Work has begun on modernising the network's information system to extend the database's functional capabilities and storage capacities while tailoring it to EFSA standards (standard sample description available at [www.efsa.europa.eu/fr](http://www.efsa.europa.eu/fr)). ACTEOLab-Salmonella is a web application used to centralise and transfer data. Geared to the Salmonella network's operational epidemiology needs, it is designed to apply epidemiology tools to enhance the relevance and responsiveness of the surveillance system on *Salmonella* strains of non-human origin throughout France.

**Keywords:** data bank, non-human *Salmonella*, network

ANSES, the French Agency for Food, Environmental and Occupational Health & Safety, was entrusted with creating or contributing to the creation of scientific and technical databases within its fields of expertise by Ministerial Order No. 2010-719 of 28 June 2010, issued by the French Ministry of Food, Agriculture and Fisheries.

The Laboratory focuses on biological and chemical contaminants that may affect consumer health. It participates in all ANSES's missions within the area of food safety, from reference missions to research, vigilance, epidemiology or scientific and technical expert assessments. The laboratory therefore uses serological and molecular methods to characterise the bacteria responsible for collective or sporadic outbreaks of foodborne illness. This activity is crucial to investigating food contamination and tracking down its origin. The laboratory also monitors and detects emerging hazards such as resistance to antimicrobials or emerging bacterial clones. It holds several national and European reference mandates concerning bacteria identified as major foodborne human pathogens, including *Salmonella*. In conjunction with the ANSES Ploufragan-Plouzané National Reference Laboratory (NRL) for *Salmonella*, the LSAL conducts and coordinates characterisation activities for *Salmonella* strains of non-human origin. It coordinates the *Salmonella* network, a group of 140 public or private laboratories performing food and veterinarian analyses. These laboratories collect strains isolated in a variety of contexts, including in-house checks carried out by the food-processing industry, official monitoring and inspection plans, investigations or food alerts. At the same time, they collect epidemiological information relating to these isolates. The network reveals the diversity and spatiotemporal evolution of isolated serovars throughout the food chain (Lailler, 2012). It is a source of information on rare serovars or serovars not covered by regulations, and may alert health authorities when necessary (Danan, 2012).

#### ACTEOLab-Salmonella, the Salmonella network database

The microbiology analysis data produced within the network do not only provide scientific and technical support to partner

laboratories. Their full value is revealed when processed for epidemiological surveillance purposes. ACTEOLab-Salmonella originated from the need to update the information system used since 2001 to cope with increasing data volumes, coordinate the *Salmonella* network and produce health indicators for surveillance purposes. The project was initiated in 2012 and work continued throughout 2013.

ACTEOLab-Salmonella is an application designed to centralise and transfer data for operational epidemiological surveillance purposes. Run by the *Salmonella* network ([www.ANSESpro.fr/reseausalmonella](http://www.ANSESpro.fr/reseausalmonella)), it helps guide laboratory missions under the national salmonellae alert and surveillance system.

Once data have been centralised and processed, health indicators of particular use to risk managers may be generated. These could include trends in isolation or the emergence of strains critical to human health. ACTEOLab-Salmonella is therefore a key component in the French food-chain surveillance system. It complements the monitoring data on food from other sectors, such as data on chemical contamination from total diet studies.

Through this web application, the Laboratory aims to (i) develop, manage and maintain an information system compatible with ANSES requirements, (ii) remain in close contact with other laboratories in the network and its partners, (iii) combine the results from different teams of biologists typing strains, and (iv) communicate with users and partners.

Each laboratory keys into ACTEOLab-Salmonella the results of analyses and epidemiological data received in the post or produced within the laboratory. In the long term, ACTEOLab-Salmonella should be able to directly integrate data from network partners in electronic format. The application can be used to monitor the processing of analyses and perform multiple-criteria searches. It complies with the EFSA data standardisation classification (standard sample description, v.2) (EFSA, 2013).

#### Development of ACTEOLab-Salmonella

Initiated in 2012, the ACTEOLab-Salmonella project required scheduling various development phases. Each one was



## Research

characterised by detailed specifications based on the definition of specific needs, followed by a technical and functional acceptance test stage to check proficiency. Following implementation of each phase, there was a period for maintenance and corrective updates.

The 'Agile' development methodology applied to this project is an incremental method iterated over short periods. It led to a reduction in development costs, satisfied profession-oriented needs, constituted a library of reusable modules for future web applications and, significantly, removed the risk that detailed specifications phases represent in fixed-price methods. In-house human resources guided a service provider in producing a prototype application which revealed actual needs and enabled a shift in focus during the specifications phase.

Finally, ACTEOLab-*Salmonella* meets several objectives:

- Securing network data

The first ACTEOLab-*Salmonella* development step was completed in July 2013. All the data collected are currently hosted in a shared Oracle database offering the benefits of related technical environments at no extra cost. Older data currently centralised in two MS Access databases are being migrated to ensure their long-term accessibility.

- Modernising the web tool and interface

The ACTEOLab-*Salmonella* application was developed with full web technologies using free environments offering dynamic graphic interfaces. The migration of data stored in the previous database required transposing the existing reference system into EFSA's standard thesauruses. Analysis reports are processed through an ANSES cross-disciplinary document management tool.

- Rendering the tool generic

ACTEOLab-*Salmonella* was designed with generic service-oriented programming technologies for greater reusability. The project is therefore a foundation upon which future epidemiological surveillance projects may be built.

- Data processing for epidemiological surveillance needs

This future development stage is a natural corollary leading to the ultimate goal and value-added exploitation of the microbiology analysis data produced. Although at its current development stage ACTEOLab-*Salmonella* cannot yet offer surveillance tools, comparable surveillance information systems such as RESAPATH include features such as the automatic generation of health or performance indicators presented in the form of a dashboard which is both easy to use and interpret (Enki, 2013; Sorbe, 2011; Hulth, 2010; Weisent, 2010). This dashboard could be specifically geared to the challenges facing each particular user of the monitoring system.

### A tool to coordinate and direct the laboratory network

It is accepted that the key contributors driving the performance of a surveillance system are the coordination and regular assessment of network operation, harmonisation of the analytical methods and standards used for exchanging data, and the communication tools and resources used (Dufour & Hendrikx, 2011; Lailier, 2012).

Developed information systems obviously rise to such challenges. They help by providing a standardised approach to diagnostic values so that plug-in algorithms can check data quality and generate health and performance indicators. These IT systems are also used to key in, store and transmit

information by exchanging computer data. Through the web interface and solutions ensuring data confidentiality, ACTEOLab-*Salmonella* can also provide feedback to the multiple partners of the surveillance network. The ease with which information can be sent to network partners, in the form of dashboards for example, or the support provided for annual inventories of characterised *Salmonella* serovars are crucial for motivating players and boosting the performance of the whole epidemiological surveillance network.

### A tool for health and epidemiological surveillance rooted in a recognised network

According to the 'one health' approach described by Bousfield & Brown (2011), the health monitoring of salmonellae in France requires real-time access to an instant picture of circulating serovars and appropriate health indicators in the human population and the food supply chain, from the farm to the fork. It is also vital that this picture be monitored over time. Such an approach is needed to protect public health in France by quickly detecting an emerging pathogen so as to restrict its dissemination in the population, for instance. Finally, it is vital to collect information on serovars and the accuracy of the epidemiological values computed to study the risk factors associated with salmonellae.

However, the application of methodological actions needed for surveillance is currently inadequate. Repeated observations point to limits in surveillance protocols and insufficient sampling that must be improved to obtain more representative and robust data. There is also room for improvement in the processing of data produced by analysis and the computerised data management tools available. Finally, another finding was poor coordination in the area of epidemiological surveillance.

Centralising different kinds of data within the same IT system will enable newly emerging pathogens to be identified quickly and will provide support to investigations into outbreaks.

Even outside emergency situations, ANSES regularly produces synopses describing the data available in the *Salmonella* network database. Epidemiological data are collected for each strain and complemented by the results of analyses obtained once the different characterisation methods have been applied. The goal is to specify the context and origin of the microorganisms isolated and analysed. These data are very valuable for epidemiological surveillance and help risk managers facing an emergency or health alert. The data produced and collected by the ANSES LSAL relate to strains of non-human origin and originate from different stages of the food chain. They therefore round out the information available from the National Reference Centre and the French Institute for Public Health Surveillance.

### Looking ahead ...

ACTEOLab-*Salmonella* is currently being used in the LSAL by the team responsible for coordinating the *Salmonella* network. Its roll-out in summer 2013 secured the data collected by the network since 2001.

The application should shortly be opened up to network partners and integrate new modules and interfaces dedicated to the epidemiological surveillance of salmonellae of non-human origin.

The IT development strategy of ACTEOLab-*Salmonella* is such that it will be able to evolve in keeping with technological developments in the characterisation of foodborne microbial contaminants, such as whole genome sequencing. More



## Research

generally, the application's generic nature opens up prospects for its adaptation and use for other pathogens, other surveillance networks and other organisations.

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