SPECIAL COLLABORATION

THIRTY YEARS OF HEALTH SURVEILLANCE OF FOODS IN BARCELONA: THE "ICSA" FOOD QUALITY RESEARCH PROGRAM

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ABSTRACT

The Food Health Quality Research Program (Investigación de la Calidad Sanitaria de los Alimentos [ICSA]) of the Public Health Agency of Barcelona (Agencia de Salud Pública de Barcelona [ASPB]) was initiated in 1984 to carry out surveillance of certain chemical and microbiological parameters related to the sanitary and safety of foods sold in the city.

The present article analyzes the importance of health surveillance and provides details of the uses of the ICSA program. The main aim of this program is to evaluate whether marketed foods comply with the absence and/or established tolerance levels of specific parameters. Nevertheless, the program is able to incorporate or suppress parameters or foods that pose emerging dangers or interests not represented in current legislation. Besides, the program not only obtains a view of the parameters studied at a specific time period in each report, but also accumulates data over time, allowing risk assessment, calculation of dietary intake of contaminants, analysis of tendencies, and evaluation of the effectiveness of regulations to reduce contaminants. The program can also help in the planning of food control programs.

The information obtained is disseminated nationally and internationally and is included in dossiers of contaminants issued by national and European health agencies. This demonstrates that a locally-developed surveillance system can have a wider scope and broader objectives and can provide useful information for managers, administrations, economic operators and consumers.

Keywords: : Public health. Public health surveillance. Food safety. Food quality. Food contamination.

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RESUMEN

Programa de investigación de la calidad sanitaria de los alimentos (ICSA): 30 años de vigilancia sanitaria de los alimentos en Barcelona

La Agencia de Salud Pública de Barcelona (ASPB) dispone, desde 1984, del Programa de Investigación de la Calidad Sanitaria de los Alimentos (ICSA) como instrumento para la vigilancia de determinados parámetros químicos y microbiológicos relacionados con el estado sanitario de los alimentos comercializados en la ciudad.

Este trabajo analiza la importancia de la vigilancia en salud, particularizando con el análisis de la utilidad y beneficios del programa ICSA. El objetivo principal del programa es valorar si, una vez en el mercado, los alimentos cumplen con la ausencia y/o niveles de tolerancia establecidos para determinados parámetros. No obstante, su carácter abierto permite incorporar o suprimir parámetros o alimentos reflejando nuevos peligros emergentes o intereses más allá de lo legislado. Además, el programa no solo obtiene una visión puntual de los parámetros estudiados en cada edición sino que la acumulación de datos en el tiempo permite evaluar riesgos, realizar cálculos de ingestas de contaminantes a través de la dieta, analizar tendencias, valorar la efectividad de las normativas para la reducción de contaminantes o ayudar en la planificación de programas de control.

La información resultante se divulga local e internacionalmente, formando parte de los trabajos de recopilación de contaminantes de agencias de salud estatales y europeas, lo que muestra que es posible desarrollar un sistema de vigilancia a nivel local pero con alcance y objetivos globales y con información útil para gestores, administraciones, operadores económicos y consumidores.

Palabras clave: Salud pública. Vigilancia en salud pública. Inocuidad de los alimentos. Calidad de los Alimentos. Contaminación de alimentos.

INTRODUCTION

Current European Union policy related to food was promoted with the publication of the White Paper on Food Safety[1] and the subsequent Regulation 178/2002[2]. Among other strategic principles this legal framework establishes the process of "risk analysis" as the basis for the resulting policy and legislation. It also identifies commercial operators as the principal agents responsible for food safety. Therefore, the main function of the competent authorities is to ensure compliance with obligations deriving from the legislation, through the implantation of official systems of surveillance and control.

In Catalonia, various levels of public administration undertake a range of activities throughout the food chain which form part of the risk analysis approach (assessment, management and communication of risk). In Barcelona city, the ASPB (Barcelona Public Health Agency) exercises the management of health risks with respect to activities of food transformation and distribution by industry, central markets, retailers and catering[3]. Within its overall system of risk management, the ASPB operates the Research Program in Food Health Quality (ICSA) since 1984. This program is used as an instrument for the surveillance of additives and chemical or microbiological contaminants in food sold in the city[4]. The results obtained provide a general view of the levels of contaminants present in foods available to the consumer, as well as permitting the detection of anomalous situations, and assessment of trends based on the accumulated results.

The fundamental characteristic underlying the program is its open and dynamic nature, allowing for the incorporation or suppression of contaminants or foods to be investigated in each edition of the program. This flexibility permits coping with emerging dangers to food safety, arising as a consequence of continuous changes in lifestyles, attitudes of consumers and commercial operators with respect to food safety, technification of the industry or constant evolution of legislation and of analytical techniques.

The present paper presents the methodology of the program, its evolution over time and the utility of the data obtained to reflect the importance of public health surveillance, and particularities of a program which, although developed and implemented locally (period 1984-2014), has a much broader scope.

EVOLUTION OF THE PROGRAM: FROM THE MOST CONSUMED TO THE MOST SENSITIVE

Precedents of interventions to control meat sales in Barcelona date from the 14th century. At the beginning of the 20th century various state laws established a legal framework for the control and sampling of foods within municipalities[5]. Subsequently, the 1967 Spanish Food Code[6] established the minimal conditions to be met by foods, as well as hygienic conditions of its production, elaboration, manipulation, storage and distribution.

It was within this legislative context that the ICSA was initiated in 1984. The program aimed to change the existing system from simply pursuing specific anomalies to implementation of preventive surveillance that would permit obtaining a global view of the sanitary problems of foods. Since then, the objectives, methodology and coverage of the program have been updated at different times, giving rise to three distinct eras.

First era (1984-1990). Identification of anomalies in basic diet

With the intention of typifying the anomalies which basic foods may present, the program was set up to obtain representative results, of the city of Barcelona, for the foods most consumed. Sampling was performed weighting by per capita consumption of each type of food and its health hazard (established through analyses by the program itself). This method involved an enormous annual volume of samples and determinations (table 1) and

required a large technical team for purchasing foods, taking samples, data analysis and evaluation of the results (in dichotomic terms, "correct", "incorrect").

In addition to the presence of additives, abiotic and microbiological contaminants, during this era administrative, organoleptic and (most importantly) composition anomalies of foods were also evaluated (Figure 1).

Second era (1991-1998): Relatively few products, studied in-depth

Sampling during this period was no longer centred on the most heavily consumed foods, but rather certain specific products were given priority in order to obtain an overall view of their sanitary situation. For each food, a broad battery of parameters was analysed, so that the number of samples was reduced, but the high number of determinations per sample was maintained (table 1).

On the other hand, computerisation of the data handling and analysis of results made it possible to obtain different statistical descriptive parameters and a more in-depth analysis than simply correct/incorrect.

Third era (1999-2014): Control of parameters of interest

In this era the current model of the program was consolidated: the design is based on the analytical parameters that it is intended to study and, subsequently, foods susceptible to containing them are selected. It focuses on aspects linked to food safety and reduces the number of samples, and of determinations per sample.

This era is characterised by the evolution and specialisation of analytical techniques, the increase in their sensitivity, and the diversity of parameters available to investigate.

DESIGN AND CHARACTERISTICS OF THE CURRENT PROGRAM

The foods and parameters to be investigated in each edition of the program, whether annually or biannually, are mainly established based on the following information sources:

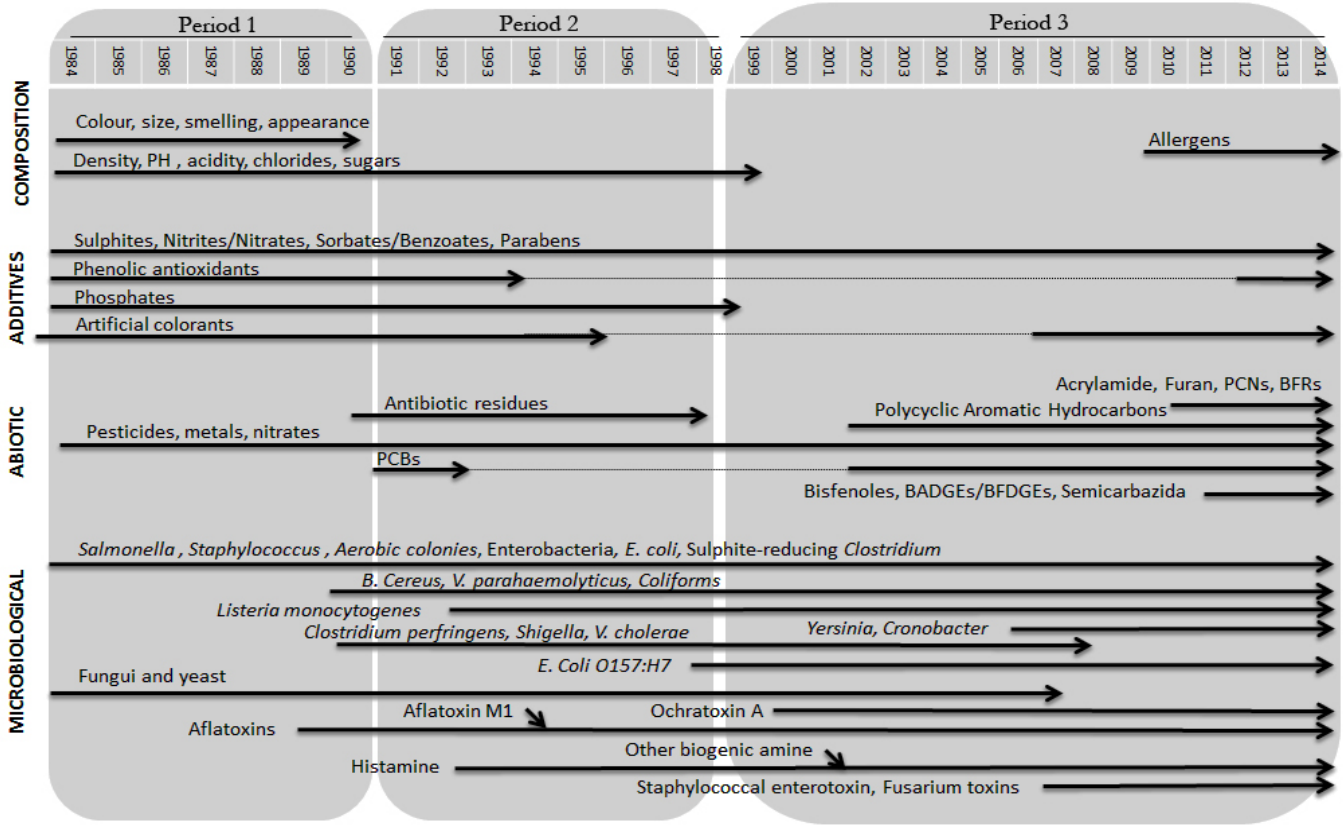
- Results from previous years of the ICSA program and suggestions or proposals made by food hygiene control services or the ASPB laboratory. Review of accumulated data, and the day-to-day work of technicians serve to define new needs and aspects of interest to be incorporated into the program, or indeed to suppress some parameter no longer considered to be a priority.

- Legislation or recommendations which fix obligatory or recommended legal limits for certain contaminants. With respect to the microbiological criteria applicable to food products, European regulations[7] establish safety criteria for a variety of foodborne pathogens (*Listeria monocytogenes*, *Salmonella, Enterobacter sakasakii*, etc.) and other microbiological criteria for hygiene of processes (*E. coli,* Enterobacteria, etc). These parame-

Table 1
Numbers of analytical parameters studied, samples analysed and analytical determinations per year, and mean number of analytical determinations per sample, in each period of the ICSA program. Barcelona, 1984-2014

	ICSA Program period		
	1984-1990	**1991-1998**	**1999-2014**
Parameters / year	210	186	77
Samples / year	3,376	1.153	605
Determinations / year	28,336	18,040	4,864
Mean determinations / sample	12	16	8

Figure 1
Main microbiological, chemical, additives, or compositional parameters analysed in the ICSA program in its different eras. Barcelona, 1984-2014



PCNs: Polychlorinated naphthalenes BFRs: Brominated flame retardants PCBs: polychlorinated biphenylsBADGEs/BFDGEs: Bisphenol “A” diglycidyl ether / Bisphenol “F” diglycidyl ether

ters are an example of criteria incorporated into the program which serve as a basis to evaluate the microbiological safety level of foods analysed.

- Food-related incidents (alerts and notifications consumer complaints, food borne disease outbreaks). The European and national networks of Food Safety Alerts (Rapid Alert System for Food & Feed, RASFF; and the Coordinated System of Fast Interchange of Information, Spanish acronym: SCIRI) facilitate the rapid interchange of information between administrations about any incidents which foods made available to the consumer may provoke. As an example, in 2008, the Spanish Food Safety Agency (AESAN) published an alert regarding baby milk preparations adulterated with melamina[8], a chemical used in materials with which foods may come in contact. As a result of this alarm, controls were set up to check for the presence of melamina in baby milks sold in Barcelona during a 3 year period; no positive samples were detected.

- Scientific information: debate over the possible use of certain Polychlorinated Biphenyls (PCBs) as indicators of the presence of dioxins in foods prompted the ASPB to collaborate with an external research institute with capacity to analyse for dioxins, and collection of samples in order to study this possible correlation[9]. The results showed that it was appropriate to maintain surveillance of PCBs in Barcelona, as sentinels for the presence of dioxins in foods.

Once the protocol to be applied has been designed, specifying the number and type of products and the determinations to be made, collection of samples begins. The criterion for non-packaged products is to use a diversity of establishments, evenly spread over the city districts. In contrast, for pre-packaged foods, a diverse range of brands is collected, regardless of origin. In this respect, if the aim is to have an overall view of the sanitary quality of everything consumed by the population, considering the free market in Europe and the increasingly international commercialisation of foods, exclusive monitoring of local products would not provide much information.

Currently, samples are collected in retail establishments and in a few industrial installations, and are sent to the ASPB laboratory for analysis.

PROGRAM RESULTS AND USES: OBJECTIVES OF SURVEILLANCE

As mentioned above, the main objective of the ICSA program is the prospective evaluation of the presence of certain contaminants in foods. In 30 years of operation the program has analysed over 42,000 food samples, yielding around 280,000 analytical determinations of parameters of composition, additives, and abiotic and biotic contaminants (Figure 1). Within an overall framework of health protection, these results contribute to a variety of functions, such as:

- Ensure food quality and safety for the consumer: evaluation of program results enables to assess whether foods available in the market, comply with absence and/or established tolerance levels of particular parameters. One example of this is the analysis for acrylamide which ICSA incorporated in 2009, based on a European Commission recommendation to control acrylamide levels in foods[10]. The results of this surveillance confirmed the low detection rate in the majority of foods (<3% of samples), with the exception of samples of potato chips.

- Monitor trends, perform calculations of food intake in order to assess exposure to low concentrations of accumulative contaminants or assess the effectiveness of new legislation. For some parameters, the investigation goes beyond checking for legal compliance with tolerance limits, to consider exposures and trends in the long term. In the case of certain environmental contaminants, resulting from emissions produced globally over decades, actions to reduce their presence are also global and continued over time. For these actions,

surveillance systems, both environmental and food-related, are particularly important to check their impact. For example, the Stockholm Convention on Persistent Organic Pollutants[11], laid the legal framework for progressive elimination at international level of the production and use of these compounds, as they are considered bioaccumulative and highly toxic. Surveillance of the main chlorinated organic pesticides from 1989 onwards found a progressive reduction in the number of samples in which these compounds were detectable, and in their concentration levels. This declining trend demonstrated the effectiveness of the implementation of agreements reached in the Convention[12].

- Respond to requests for data from national- or European-level programs. The results of the program not only circulate internally, but are communicated annually to the regional (Autonomous Community) administration, and from there to state and European administrations. Thus, ICSA results ultimately form part of a data set which these administrations use to elaborate various publications about pollutants. One example is Spain's participation, as a member state, in the common system of protective measures against certain zoonoses and zoonosis-producing agents which are transmitted from animals to humans via foods. The results on presence of pathogens in foods detected by the ASPB form part of various reports on the topic, such as "Trends and sources of zoonoses and zoonotic agents in humans, foodstuffs, animals and feedingstuffs", elaborated by the Spanish Ministry of Agriculture, Food and Environment[13].

- Management of "incorrect" parameters detected, and planning of the control programs. From the point of view of management of anomalous results, "incorrect" is understood as those results which exceed both current legal limits and the recommended limits. When such "incorrect" parameters are detected within the program, and are imputable to establishments in the city, health control mechanisms are initiated to correct them, via inspection, taking of reglamentary samples, or precautionary measures. When the imputation affects establishments outside the city, the competent authorities are informed through channels established for the communication of food hygiene actuations and controls (communication of irregularities). However, it should be noted that the percentage of "incorrect" samples in recent years has been relatively low (15.5 %). In terms of parameter types, "incorrect" parameters are microbiological in 72 % of cases (mainly indicator microorganisms or hygiene sentinels), additives in 16 %, abiotic parameters in 10 % and allergens in 2 % (Figure 2). Knowledge about "incorrect" results (parameter responsible, food sample, establishment type) is used as a basis for planning specific control programs.

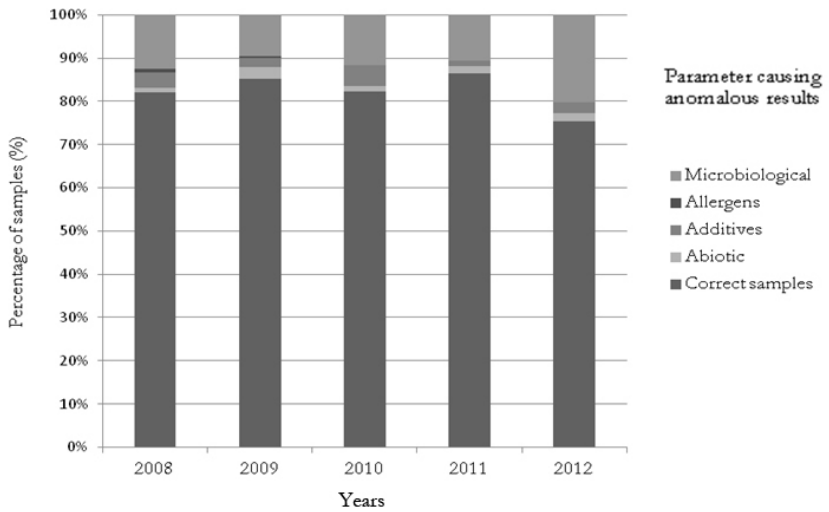
- Information for industry and consumers. Apart from communicating results to other administrations, the results are disseminated among public health professionals through workshops, congresses, articles in specialised journals, and systematic publication of final reports on the ASPB web site[14]. This transparency contributes to help the consumer base choices on scientific evidence and highlights the importance of self-controls and good practice in industry and catering, both of which directly affect the results obtained for many of the parameters investigated.

WHAT ASPECTS ARE CONTROLLED? EVOLUTION OF THE PARAMETERS INVESTIGATED

The last few years have seen a consolidation of various lines of surveillance of foods targeting the general public, as well as certain vulnerable groups such as babies and young children, which may be summarised as follows:

- Widely used additives such as sorbates, benzoates and sulphites, checking for their correct use and labelling.

Figure 2
Percentage of "incorrect" samples due to abiotic, microbiological, additives and allergen parameters. ICSA Program 2008-2012



- Abiotic contamination of foods: due to environmental or technological contaminants, or due to materials in contact with food. Pesticide residues and nitrates in vegetable products subjected to pest-control treatments in the primary production sector.

- Microbiological contamination: pathogens, hygiene sentinels and indicators, and toxins deriving from microbial activity.

These surveillance lines include the analysis of different parameters in a wide variety of food products. In some cases, attention focuses on a particular food, which is considered a risk. An example is the investigation of pathogens in prepared foods not subject to heat-treatment, or which contain non-heat-treated ingredients, from restaurants and the catering industry, ready to be consumed directly with no additional process to ensure the safety of the product (such as cooking or heating in microwave). Collection of samples of these products is done through the control of their storage conditions (under refrigeration or at room temperature) with the aim of assessing possible differences with respect to their safety in microbiological terms.

The majority of microbiological parameters have been maintained since the beginning of the program, allowing in some cases for analyses of trends over 20 or 30 years. Detection of *Salmonella*, for example, was started in meat products in 1984, with approximately 4 % of anomalies during the first few years. The variety of foods now being investigated is wide, but anomalies (around 1 %) are still mainly found in meat-based products. However, it should be noted that although the basic parameter is the same, the technique used has seen an important evolution, from the traditional cultures, to immunological or molecular techniques, so that we not only obtain a more detailed description of isolated strains, but also the information is obtained more rapidly.

In the case of abiotic parameters, technological innovations in production, storage and transport of foods, as well as the appearance of new environmental contaminants, mean

that new challenges and clear health hazards are constantly arising, something which is reflected in the interests of the program. In this sense, recent years have seen the incorporation of parameters such as flame retardants, additives used in plastification, or semicarbazide which may appear in preparations for babies through migration from sealing rings used in the lids.

As in the case of microbiological parameters, the laboratory capabilities and the specialization of its analytical techniques have been key in permitting the incorporation of new parameters or new foods. Not only the use of new technologies, but also the improvements in sensitivity of some techniques and the subsequent lowering of detection limits, have made it possible to analyse contaminants whose concentrations are typically of the order of ppb (µg/kg), such as in the case of PCBs.

FINAL REFLECTIONS

The exercise of evaluating 30 years of operation of the program should also lead to the detection of aspects to be improved in the future. In this sense, although the natural evolution of the program has tended to focusing ever more specifically on the food/parameter relationship, certain dangers may require an in-depth study in order to understand the factors or processes which affect their distribution across foods. In other words, a prior reflection on the planning of the program in order to clearly define the sampling variables and thus improve information obtained for parameters.

Secondly, as a public administration, we consider it important to disseminate our findings, not only to other health professionals but also to the public. As already remarked, the findings are disseminated via specialised channels, and a report of each edition of the program is published on the web site[14]. The published technical report is exhaustive, detailing results by parameter analysed and type of food, and is clearly useful for other professionals in the field. However, these data are not accompanied by anything to put them into context, nor assessment of hazards, something which would make the information more useful to the general public.

Despite this margin for improvement, the retrospective view of the program reveals its high usefulness, and also certain peculiarities of it. On one hand, the data accumulated over 30 years provides long time series, and hence a historic view of many hazards. Moreover, it highlights the innovative capacity of the program in the early investigation of hazards not contemplated by existing legislation. The close inter-departmental collaboration, specifically between control services and the ASPB laboratory is a strong stimulus for debate over prioritisation or innovation within the program.

Finally, we would like to stress that, while similar programs may be reasonably common at regional or country level, it is not so common to find programs at municipal level that are so ambitious and have such a broad coverage (regarding the number and variety of samples, types of parameters, etc).

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