

Title: The food safety control system: the Barcelona case study

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Highlights

- A single agency control system is in place in Barcelona city (Catalonia, Spain).
- The food safety control system is framed by the Catalan, Spanish and EU legal framework.
- Risk management is implemented through control, surveillance and audit programmes, as well as management of food-borne outbreaks, alerts, denunciations, complaints and irregularities, and sanitary authorisations, registries and certificates.
- Analytical services are provided by the municipal authority's official laboratory.
- Training activities for inspectors and auxiliaries, and communication and education activities for consumers and food business operators are performed.

Abstract:

Official food safety controls seek to ensure that food is safe through enforcing compliance with food regulations and thus protect consumers from suffering any damage caused by food hazards. This study attempted to describe the food safety control system of Barcelona city, where its municipal administration has official competences to implement risk management through the Barcelona Public Health Agency.

A single case study was performed through a qualitative content review of laws, regulations, internal protocols, reports or guidelines, among others, related to the food safety controls implemented by this administration. The research was directed by the five-element study model given by FAO and WHO, intended to describe, evaluate or analyse food control systems. Data of food control activities, personnel and food establishments from 2014 until 2019 were also added, exception given for 2020 data, which considering the peculiar COVID-19-lockdown in Barcelona, it could significantly mislead the study.

In Barcelona city, a single agency control system is in place in concordance with the autonomic and national multiagency system. Food controls are implemented and enforced for all food establishments located in this city based on ten action lines, which include sanitary programmes of control, surveillance and audit, as well as management of food-borne outbreaks, sanitary alerts, denunciations, complaints and irregularities, sanitary authorisations, registries and certificates. This administration owns its official laboratory, which supports all control and surveillance activities of risk management. Moreover, communication and information activities, and technical and refreshing training courses, are given addressed to food business operators and consumers, and food inspectors and auxiliaries, respectively.

It was perceived that the Barcelona food safety control system was successfully described by employing the proposed study model, which proved again to be useful for the subject of this inquiry. Since the Municipality of Barcelona has further official competences of control than all Catalan and most of the Spanish municipalities, the administration of this city is in a special position. This paper will enable a baseline for improvement of the Barcelona food safety control system and comparison between other municipalities' systems.

Keywords: Food control system, Food safety, Risk management, Barcelona, Catalonia, Spain

1 Introduction

Several food-borne crises linked to abiotic and biotic hazards have occurred in the EU, such as the recent listeriosis outbreak in Spain associated with the consumption of a ready-to-eat meat product (Boqvist, Söderqvist, & Vågsholm, 2018; CCAES, 2019). In 2019, 5,175 food-borne outbreaks were reported in EU causing 49,463 cases of illness in humans, 3,859 hospitalisations and 60 deaths (EFSA & ECDC, 2021). As flagged by several authors, these events have a negative impact on consumer trust, food and economic systems (Bánáti, 2011; Chammem, Issaoui, De Almeida, & Delgado, 2018; Giraud-héraud, Fontes, & Pinto, 2014; WHO, 2014; Savadori et al., 2010).

Food controls conducted by food safety Competent Authorities (CA) seek to protect public health by detecting and handling food safety problems along the food chain and ensuring compliance with food regulations (FAO/WHO, 2003). FAO and WHO define food control as the “mandatory regulatory activity of enforcement by national or local authorities to provide consumer protection and ensure that all foods during production, handling, storage, processing, and distribution are safe, wholesome and fit for human consumption, conform to safety and quality requirements, and are honestly and accurately labelled as prescribed by law” (FAO/WHO, 2003).

The Municipality of Barcelona has official competences to carry out activities of health protection and promotion, and epidemiological surveillance through its local health authority, ASPB, which is hence the authority to implement official food safety controls (controls) in Barcelona city (BCN). BCN is the capital of the Spanish Autonomous Community of Catalonia, located in the north-eastern coast of Spain. It was estimated that in 2019 this city had a population of 1,636,762 inhabitants with an extent of 101.35 km² (Statistical Institute of Catalonia, 2020). Barcelona Municipality and other 35 surrounding municipalities constitute the Barcelona Metropolitan Area, which in 2019 counted with a population of 3,291,654 inhabitants with a surface of 636 km² (Barcelona Metropolitan Area, 2020; City Council of Barcelona, 2020c).

The goal of this paper was to describe the Food Control System (FCS) of BCN, restricted to food safety control, with the intention, in a later stage, to assess and improve the Barcelona food safety control. For this reason, and with the purpose to obtain a baseline, this research aimed at answering the following research question: “How is the food safety control system in Barcelona city organised?”. Acronyms used in this manuscript are listed in **Table 1**.

Table 1

List of acronyms.

Acronyms	Full name
AC	Autonomous Community
ACC	Catalan Consumer Agency
ACSA	Catalan Food Safety Agency
AESAN	Spanish Agency for Food Safety and Nutrition
ASPB	Barcelona Public Health Agency
ASPCAT	Catalan Public Health Agency
CCAES	Spanish Coordination Centre for Health Alerts and Emergencies
DARP	Catalan Department of Agriculture, Livestock, Fisheries and Food
DISAL	ASPB Division of Food Safety
DG SANTE	Directorate-General for Health and Food Safety of the European Commission
DS	Catalan Department of Health
EC	European Commission
ECDC	European Centre for Diseases Control and Prevention
EFSA	European Food Safety Authority
ENAC	Spanish National Accreditation Entity
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
HACCP	Hazard Analysis and Critical Control Points
INFOSAN	International Food Safety Authorities Network
IQSA	<i>ASPB Research programme into the sanitary quality of foodstuff^a</i>
ISO	International Organization for Standardization
MAPA	Spanish Ministry of Agriculture, Fisheries and Food
MIC	Spanish Ministry of Consumer Affairs
MISAN	Spanish Ministry of Health
PNCOCA	<i>Spanish National plan for official control of the food chain</i>
PNIR	<i>Spanish National residues control plan</i>
RASFF	European Rapid Alert System for Food and Feeding Stuffs
REMAB	Barcelona Registry of Retail Establishments
RGSEAA	Spanish General Health Registration of Food and Food Establishments
RSIPAC	Catalan Sanitary Registry of Industries and Food Products
SCIRI	Spanish Coordinated Rapid Information Exchange System
SICAL	Barcelona Information System of Food Control
WHO	World Health Organization

^a *Programa d'investigació de la qualitat sanitària dels aliments.*

2 Materials and methods

A qualitative description of the BCN food safety control system was intended to be conducted through a single case study approach. This method is appropriate to answer questions like the one formulated for this paper, where the investigator has little or no influence over the case. The investigator performs an empirical inquiry which aims at describing, explaining or exploring a real-life phenomenon framed in a “social system” (the “case”), such as communities, organisations, institutions or nation-states (Swanborn, 2010; Yin, 2018). This approach has been typically applied in cases of the field of political sciences and public administration.

Information collection was based on a purposive sampling method, which consists in deliberately select sources rich on the research topic and “with a view to answering the research question” (Schreier, 2018; Velasco, 2012). For this reason, resources selected were intentionally restricted to the enforcement and implementation of risk management in BCN, and homogeneous on the characteristics of interest and content (Fritz & Morgan, 2012; Schreier, 2018). The availability of data depended on the number of resources related to the field of risk management where ASPB operates.

Qualitative data were studied through a content review of documents (laws, regulations, internal guidelines, reports, programmes, publications, manuals, procedures, etc.) that at the moment of the study were employed

to enforce and implement controls in BCN (FAO, 2006). In addition, resources retrieved from the official ASPB website and SICAL were also included.

Documents were reviewed by employing a directed content analysis based on the five-component framework of FCSs given by FAO and WHO: (1) *Food law and regulations*, (2) *Food management*, (3) *Inspection services*, (4) *Laboratory services* and (5) *Information, education, communication and training* (FAO/WHO, 2003; FAO, 2006; Hsieh & Shannon, 2005). A directed analysis is applied when existing theory or prior theoretical framework or research are utilised to guide and structure the data study and the discussion of the findings, and helps the researcher to identify the main aspects (key factors, concepts or variables) to be studied and the relationships among them (Hickey & Kipping, 1996; Miles & Huberman, 1994; Potter & Levine-Donnerstein, 1999). Besides, this fact enables other researchers to reproduce such a study.

Albeit FCSs priorities and elements will vary between systems, the conceptual model selected integrates the mandatory regulations together with the preventive programmes, as well as voluntary education and communication strategies: (1) *Food safety law and regulations* block refers to the mandatory laws and regulations that are enforced to ensure that controls are carried out by the designated CA; (2) *Food safety management* is intended to describe the operational co-ordination of all actions that aim to protect consumers health and therefore guarantee that produced and commercialised food is safe; (3) *Inspection services* element is meant to analyse all activities implemented to ensure that food is produced, handled, stored, and marketed according to the legislation; the fourth element, (4) *Laboratory services*, refers to the capabilities and activities of food analysis and its hazards; (5) *Information, education, communication and training* element has the purpose to describe how CAs improve knowledge and awareness on food safety of all stakeholders involved in the food chain (FAO/WHO, 2003; FAO, 2006).

This theoretical model was applied by other investigators when they described, analysed or evaluated other FCSs (Al-Busaidi & Jukes, 2015; Al-Kandari & Jukes, 2012; Alomirah et al., 2010; Pham & Dinh, 2020; Shukla, Singh, & Shankar, 2018). Although this model is intended to be employed for national systems, in this case, it was utilised to describe a municipal one (FAO/WHO, 2003; FAO, 2006).

Secondly, quantitative data concerning control activities, personnel and BCN food establishments, retrieved from the ASPB food control information system (the so-called SICAL) and City Council of Barcelona, were also added from 2014 until 2019: 2019 data were compared against average between 2014 and 2018, and standard deviation was calculated for each case. 2020 data were considered not be eligible due to the anomalous functioning that ASPB experienced because of the COVID-19 pandemic and the administrative measures adopted to tackle the situation (e.g., general lockdown, temporary closures of food establishments or schools, social restrictions, etc.), and this fact may have altered the present inquiry.

No attempt was made to assess ASPB's control effectiveness and consistency, and further research is required, as well as to evaluate the impact of the COVID-19 pandemic over its functioning.

Acknowledging the nature of single case studies, results cannot be easily transferred as a particular case is assessed instead of a general one. Yet, in this study, the investigators intended to demonstrate validity by an expert checking of the final results by senior ASPB control managers (Whittemore, Chase, & Mandle, 2001).

3 Theoretical background

3.1 Food safety control in Spain

With the intention to create an EU market and standards of controls to rely on, since 1989 EU Member States (MS) have been adopting a legal framework of regulations that enables them to enforce and implement food law at national level. For this reason and as any other EU MS, Spain has full competences to enforce food law within its territory throughout a system of official food controls covering all stages of the food chain (EC No 178/2002).

In Spain, MAPA and MISAN are the technical stewards for food safety and control issues, in co-ordination with other ministries with limited participation. The former is responsible for animal health, welfare and feeding stuffs, primary production of food of animal origin, plant health and food quality (primary phase). In contrast, the latter is tasked to protect consumer health in the successive stages of the food chain (DG SANTE, 2018; MAPA, 2020; Spanish Royal Decree 2/2020) (**Fig. 1**). Moreover, MISAN has the mandate to co-ordinate control at national level, as well as to perform risk evaluation and communication through AESAN, in co-operation with EFSA and DG SANTE (EC No 178/2002; Spanish Law 17/2011; Spanish Royal Decree 19/2014). As a result of the recent division of the former Ministry of Health, Consumer Affairs and Welfare into MISAN and MIC, AESAN is organically adhered to MIC but functionally linked to MISAN and MAPA (Spanish Royal Decree 495/2020).

Spain is administratively organised in 17 ACs and 2 Autonomous Cities (Spanish Constitution). In accordance to the 1978 Spanish Constitution (the most important national rule), the Statutes of Autonomy (equivalent to the Spanish Constitution but in an autonomic scale) of each AC and Autonomous City and the Spanish Organic Law 9/1992 (on transference of state powers to autonomic administrations), all of them have exclusive competences to implement controls, exception given for imported food, whereby MISAN and MAPA have reserved competences (Spanish Organic Law 9/1992; Spanish Royal Decree 1977/1999). Thus, each AC and Autonomous City are CAs to organise, co-ordinate and implement risk management in their territory. All ACs are divided into further provincial and municipal levels, and in certain cases, some functions and services of control are transferred to municipal authorities (DG SANTE, 2018).

Based on Regulation (EU) 882/2004 (repealed and replaced by Regulation (EU) 2017/625), since 2007 and according to DG SANTE indications and guidance, and autonomic authorities and competent ministries co-operation, AESAN elaborates the Spanish multi-annual national control plan, the so-called PNCOCA, which serves as the framework to implement controls at national level by all ACs (EC No 882/2004; European Commission, 2020; MAPA & MISAN, 2007). AESAN annually requests information and data of each AC's performance and results of official controls, so as to assess their compliance with and implementation of the PNCOCA and to elaborate the annual report, which is submitted to DG SANTE since 2011 (Spanish Law 17/2011).

3.2 Food safety control in Catalonia

Catalonia, as a Spanish AC and based on its Statute of Autonomy, has full competences to implement and enforce food controls along the food chain (Spanish Organic Law 6/2006) (**Fig. 1**). In accordance with the PNCOCA, Catalonia elaborates its own *Food safety plan*, which lays down its framework on this subject for all autonomic and municipal administrations of this territory (Catalan Law 18/2009).

As autonomic technical and responsible administrations there are DARP and DS. Whereas DARP is linked to the primary production, the latter is involved in the following phases of the food chain and has the mandate to organise and perform epidemiological monitoring and health protection and promotion (**Fig. 1**). DS tasks are executed through the Secretariat of Public Health, also known as ASPCAT (Government of Catalonia, 2016). Additionally, there is the ASPCAT's specialised area on food safety, ACSA, which carries out risk evaluation and communication, and strategically plans and coordinates all food safety interventions in Catalonia and elaborates the *Food safety plan for Catalonia* (Catalan Law 18/2009). Consumer protection during the consumption phase is carried out by ACC (Catalan Law 9/2004).

In Catalonia, municipal administrations are responsible to implement official controls for the commercial restaurants (e.g., restaurants, cafes, pubs, etc.) and retail establishments phase (Catalan Law 18/2009). Contrary, controls for the transformation and distribution phase (food industries, wholesale markets and slaughterhouses), as well as collective catering (e.g., canteens of schools, hospitals, nursing homes, etc.), are implemented by ASPCAT. However, in contrast with the rest of Catalan municipal administrations, the Barcelona Municipality has further control competences (**Fig. 1**).

4 Results and discussion

4.1 Food safety law and regulations

The Municipality of Barcelona, in compliance with the Catalan Law 22/1998, about the Municipal Charter of Barcelona, and the Catalan Law 18/2009 on public health, has full powers to implement controls along the processing and marketing phases of food that take place in BCN through ASPB (Catalan Law 18/2009; Catalan Law 22/1998).

This municipal administration has the same powers as any other Catalan municipality to implement food controls for the commercial restaurants and retail establishments phase, whilst at the same time have competences that in the rest of Catalonia correspond to ASPCAT: implementation of controls for the transformation and distribution phase and collective catering establishments (**Fig. 1**) (Catalan Law 18/2009; Catalan Law 22/1998). ASPB has no competences to implement controls at the household level. Although, through the *Information, education, communication and training* element this organism puts efforts on achieving improvements of food safety patterns on household food storage, manipulation, elaboration and consumption.

Madrid is another Spanish city that further competences were devolved from its autonomic government to the municipal administration, among other cities such as Malaga, Sevilla or Granada (Comunidad de Madrid, 2019; Junta de Andalucía, 2019). Within the EU framework, and acknowledging their domestic differences on control organisation, Finland and Cyprus are other two examples where certain risk management competences fall under the jurisdiction of municipal authorities (Finnish Food Act 23/2006; Hadjigeorgiou et al., 2013). On the other hand, other EU MSs shifted their control system administration moving from decentralised to centralised systems, so did Denmark since 2000, where control competences were transferred from 2 ministries and 275 municipalities to one single state authority (Nielsen, 2006).

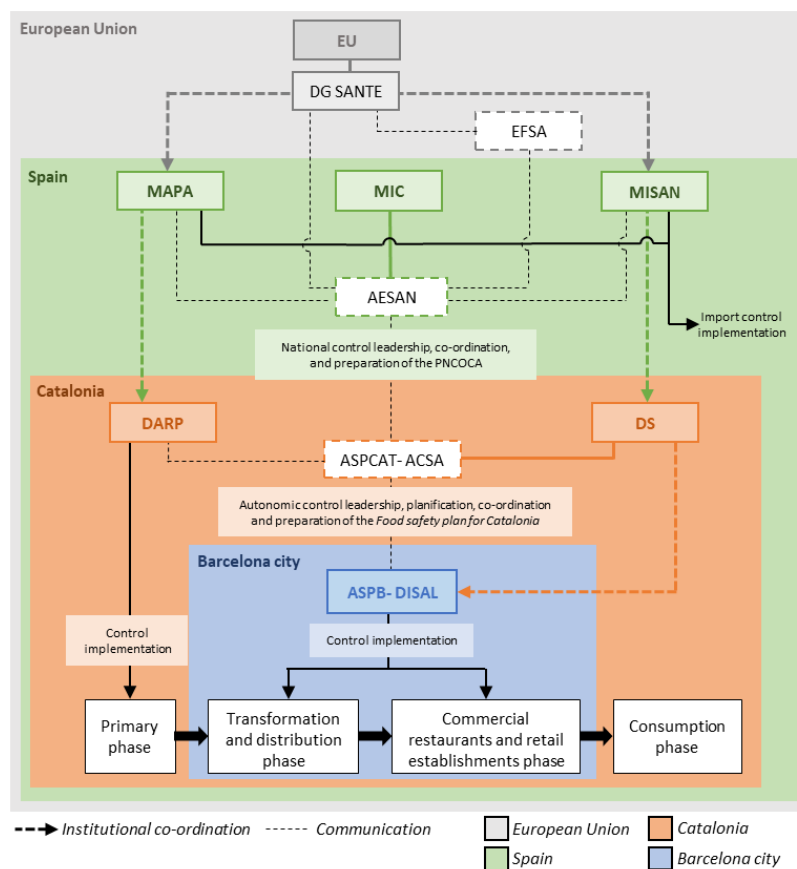


Fig. 1. Implementation of food safety control in BCN along the food chain (from EU, Spain, Catalonia to BCN level).

As an EU CA, the BCN administration conducts risk management according to the applicable EU, national, autonomic and municipal legal framework about food safety and controls, and when necessary, the Barcelona Municipality, like any other municipal administration, has legislative powers to draft municipal legislation, framed on its competences and applicable law.

4.2 Food safety management

In BCN, food safety laws and regulations are enforced through one single agency system, wherein ASPB is responsible (**Fig. 1**). According to FAO/WHO, this sort of system enables effective harmonisation and co-ordination of all control activities and avoids inconsistencies, gaps and duplication of tasks, in comparison with multi-agency or integrated systems (FAO/WHO, 2003).

In compliance with ASPB statutes, this agency is an autonomous organism with its own legal personality and independent patrimony, created by the Barcelona Health Consortium (*Consorci Sanitari de Barcelona*), and funded and governed by the Municipality of Barcelona and the Government of Catalonia (Government of Catalonia, 2002).

ASPB independently implements food controls in BCN through DISAL; notwithstanding, as earlier described, ASPB is part of the autonomic and national multi-agency system. In consequence, ASPB carries out its activity in co-operation and co-ordination with the rest of administrations and organisms involved in food safety throughout ASPCAT, which also acts as the ASPB's focal point with the rest of autonomic and national administrations (**Fig. 1**). The operative co-ordination between ASPB and ASPCAT is direct and articulated with communications, exchange of technical information, commissions and working groups, highlighting the ASPCAT health protection commission and the ACSA inter-departmental and inter-administrative co-ordination working group, which convenes all autonomic administrations involved on food safety control in Catalonia along the food chain (ACSA, 2020).

There is a further co-operation amongst the Municipality of Barcelona and other municipalities located in the province of Barcelona, which is through the Provincial Deputation of Barcelona (*Diputació Provincial de Barcelona*). This organism supplies technical, economic and technological support to all municipalities located in this province and since 2010 its public health service annually organises the Benchmarking Quality Circles for Local Public Services on food safety, where food safety control services of each municipality voluntary share and compare information about their performance and control results, and jointly propose actions for their straighten and improvement (Provincial Deputation of Barcelona, 2020).

4.3 Food safety inspection services

DISAL is responsible to implement official controls for foodstuff and establishments that elaborate and/or commercialise food in BCN. In compliance with Regulation (EU) 2017/625, methods and techniques used for control are on-site inspections, audits, sampling and testing of food samples or measurement verifications, among others (EU No 2017/625).

FBOs are expected and asked to ensure food safety along the food chain since by law they are defined as the primary legal responsible (EC No 178/2002). In front of non-compliance with or violations of food legislation, DISAL has the competences to take enforcement measures. **Table 2** shows the number of enforcement measures taken in 2019 and the average between 2014 and 2018. In most situations, in front of low-risk non-compliances, inspectors enforce legislation through written notices after an inspection, together with a time limit for correction. Nevertheless, penalty payments and other coercive measures, such as suspension of operation or food withdrawal, among others, are applied in cases of recurrent or grave violations (Catalan Law 18/2009).

4.3.1 Control implementation

Based on the ASPB criteria, food safety controls are implemented according to the following ten action lines (a list and numbers of activities performed by the DISAL inspection service linked to *Control implementation* can be gleaned in **Table 2**):

- **Action line no. 1- Sanitary control programmes for food industries and establishments.** This line comprehends all inspections that are annually planned and conducted in a risk-based manner with a preventive goal and without prior notice. According to the risk classification of each establishment and industry, a frequency of inspection is set, which varies between six months, for those establishments with high risk, to four years. These controls are performed by Official Inspectors (inspectors) and are addressed to all food industries, commercial restaurants, collective catering and retail establishments.

Industries can either have their factory (*industries with premises*) or offices (*industries without premises*) under the ASPB jurisdiction and both are object of control. Whilst the former are included in the on-site control programmes, documented controls are planned for the latter together with on-site inspections in case of non-compliances. Although, most on-site controls for industries without premises are motivated by unplanned reasons such as alerts or food-borne outbreaks.

The implementation of EU law about food controls in 2004 drove to a harmonisation of the risk management in the EU, where risk was the core element for prioritising and decision-making (EC No 882/2004). Hence, there was a shift moving from a “reactive” to a “preventive” approach based on risk (FAO, 2008).

This line is constituted by two types of controls: *generic* and *specific*. *Generic controls* are designed to check all sanitary requirements for food establishments: structure, equipment, food production processes, food handling, food products, traceability and the self-control systems together with their implementation. Conversely, *specific controls* are developed in order to control particular hazards, foodstuff, food handling practices or food establishments in a defined period. Those controls are formulated according to data and information retrieved from *generic controls* and all action lines. For example, in Spain, in 2017 there was an increase of food alerts because of histamine in tuna above regulatory limits and food-borne outbreaks linked to tuna products, for this reason DISAL implemented a specific control for this chemical hazard (AESAN, 2019).

Performance of scheduled inspections is subjected to unplanned activities that require immediate response like food alerts, denunciations, complaints or food-borne outbreaks. In front of such situations, programmed inspections for collective catering establishments and industries with premises are prioritised, being both considered high-risk businesses, above the rest of establishments. For this reason, as well as because of inspection frequency, planned controls performed can vary from year to year. When all planned inspections are not performed at the end of the year, establishments not inspected are reallocated to the control list for the following year.

- **Action line no. 2- Slaughterhouse control and surveillance programme.** This line is characterised by its own regulations and specificity (EC No 854/2004). Controls are daily conducted by inspectors and Official Auxiliaries of Inspection (auxiliaries) that are permanently based at the slaughterhouse. Controls carried out have the intention to verify that operators are fulfilling their responsibilities with regard to animal welfare, antemortem and post-mortem of slaughtered animals, as well as HACCP system implementation. A sampling of animal products is carried out for transmissible spongiform encephalopathy monitoring and control, mandatory by law, as well as other zoonosis and zoonotic agents, and chemical and veterinary residues, based on the PNIR (EC No 999/2001; Spanish Royal Decree 1749/1998).
- **Action line no. 3- Control programmes of central markets.** There are three wholesale markets in BCN: the Central Fruit and Vegetable Market (*Mercat Central de Fruïtes i Hortalisses*), the Central Fish Market (*Mercat Central del Peix*) and the Multipurpose Market (*Mercat Polivalent*). Those markets are a centre of food

industries and wholesalers, whereby general sanitary requisites of every business unit and the common installations of each market are controlled. There is a continuous service of inspectors and auxiliaries at the Central Fish Market since a high volume of fish and fishery products such as live bivalve molluscs, fresh tuna and other high-risk products are daily marketed.

- **Action line no. 4- Sanitary audit programmes.** Audits are undertaken to assess the effectiveness of the food safety management during the audited period (own-checking system, the HACCP-procedures and their implementation) in food industries and supermarket groups (chain-store groups). Audits are divided into two phases: there is an initial desk evaluation of the pre-requisite programmes and the HACCP-procedures, followed by an inspection that aims to examine their operationalisation and execution. Determined by the risks detected, audit results can be either *Favourable*, *Favourable with conditions* or *Unfavourable*. According to the results, FBOs are required to submit an action plan to offset the non-compliances detected in order to schedule a follow-up inspection.

Initially, audits were targeted only for food industries, although new food establishments were included in this programme. For instance, since 2017 DISAL audits supermarket groups as they are centrally managed and stores of the same group are included in the same food safety system. In this case, the second audit phase is carried out in different supermarket stores of the same group.

- **Action line no. 5- Food safety surveillance programmes.** This line refers to surveillance of chemical and microbiological hazards related to the sanitary and safety of foods commercialised in BCN.

Since 1984, DISAL elaborates the IQSA, which includes a planned food sampling with an extensive list of analytical parameters. The main aim of this program is to evaluate the compliance of food samples related to the absence and/or established tolerance levels of specific parameters. Besides, IQSA programme is characterised by its flexibility to incorporate or suppress parameters or foods based on new regulations or recommendations and serves to guide and prioritise risk management activities. Considering that ASPB is a municipal CA, Fontcuberta *et al.* stressed that such a comprehensive surveillance programme is not common for municipal CAs (Fontcuberta, Rodellar, Portaña, & Durán, 2015).

In relation to the 2019 IQSA edition, a total of 470 samples were processed (**Table 2**)(ASPB, 2019c). 85.00% of analysed samples were in compliance with regulations. Non-compliance results were mainly linked to abiotic parameters (sulphur dioxide in raw meat products, methylmercury in tuna, acrylamide in potato chips and pesticides in fresh vegetables)(EC No 1333/2008; EC No 1881/2006; EC No 396/2005; EU No 2017/2158). Based on recommendations for risks without legal standards, the most common discrepancies were related to detection of *Campylobacter* spp. and Shiga toxin-producing *Escherichia coli* in raw meat and meat products, and Norovirus in bivalve molluscs.

Number of determinations and analytes may vary yearly based on the nature of food and hazards analysed (**Table 2**). For example, when analysing food samples targeted to determine pesticide residues, number of determinations and analytes is much higher compared to the analysis of other hazards such as specific mycotoxins, metals or microbiological agents, which is much lower. This fact explains why the variance of IQSA determinations and analytes were high between 2014 and 2018.

Additionally, ASPB annually takes and analyses samples for the *Spanish national control programme for pesticide residues*, based on the EU coordinated multiannual control programme to assess the consumer exposure to pesticide residues (EC No 396/2005). Apportioned to the BCN population, ASPCAT indicates to ASPB the number of samples to be taken and the type of foodstuff. The volume of samples concerning this programme is very low, compared to the IQSA's one: 18 samples and 2,792 analytes were processed in 2019. Finally, results obtained are published in each IQSA edition as well as by AESAN, through a national report, compiling results from every AC.

- **Action line no. 6- Management and control of sanitary alerts.** Sanitary alerts of food safety can be originated at any stage of the food chain, either at municipal, national, EU or international level (from non-

EU countries). International and EU alerts are received by AESAN through INFOSAN and RASFF, respectively (EU No 16/2011; Spanish Royal Decree 19/2014). Then, this administration emits all sanitary alerts to CAs of each AC and Autonomous City through the Spanish information system SCIRI, among other contact points such as the Spanish Ministry of Defence or FBO's associations. When necessary and in case that an alert could affect BCN, following the official channel, ASPCAT emits it to ASPB (**Fig. 1**)(Spanish Law 17/2011).

SCIRI notifies information that either requires (or could require) an immediate reactive response like inspections, contains information of interest about food risks, border rejections, food withdrawal, recall of foodstuff or the so-called notices, non-contrasted information about food risks and food from informal sources.

- **Action line no. 7- Management and control of denunciations and complaints.** DISAL performs inspections derived from denunciations, complaints and notifications presented by citizens, FBOs and other public administrations, about presumed sanitary irregularities or law violations observed or detected in foodstuff or food establishments. Information collected is valuable to know and understand consumer's concerns and it is used to formulate or adjust control and surveillance programmes.
- **Action line no. 8- Investigation and control of food-borne outbreaks.** Information about food-borne outbreaks is transferred from the ASPB Epidemiology Service to DISAL. Thereafter, DISAL investigates the food establishments where the suspicious food was elaborated or commercialised through inspections. Those inspections seek to assess the hygienic conditions of the establishment, the elaboration processes and to collect food samples. This information and data help to understand the outbreak contributing factors and to confirm the implicated food. During and after the investigation DISAL may dictate either preventive or coercive measures in light to avoid further cases of the same food-borne outbreak.
- **Action line no. 9- Sanitary authorisations and registries.** By law, FBOs are asked to register their food businesses in a registry, submitting information about their identification, location and activities (Spanish Royal Decree 191/2011). In Spain, there is the RGSEAA (national scope), which includes information about all food industries that are located in each AC and it is managed by AESAN. Apart from this, there are further registries: in Catalonia, there is the RSIPAC (autonomic scope) with information about all industries and collective catering establishments located in its territory, and in BCN the REMAB (municipal scope), which includes information of all retail establishments and commercial restaurants of the city (ASPCAT, 2019).
- **Action line no. 10- Sanitary certificates for food and food establishments.** DISAL issues sanitary certificates for those FBOs that are willing to certify specific practices and foods, as well as their HACCP system. Most FBOs request sanitary certificates to be able to export food to non-EU countries. In comparison with previous years, the number of sanitary certificates for exportation increased in 2019 (**Table 2**). According to each type of certification, on-site inspections may be carried out.

Unplanned control activities such as management, investigation and derived inspections of alerts or food-borne outbreaks (**Table 2**) may vary from year to year depending on factors as greater exchange of information of food risks between FBOs and ASPB, intensification of border controls, implementation of new control measures, particular food control campaigns or law and regulations modifications.

Table 2

List and number of activities performed by the DISAL inspection service linked to *Control implementation's action lines* (in exception of those with continuous control service: *Action lines* no. 2 and 3) and enforcement measures taken, in 2019 and average between 2014 until 2018, and its standard deviation (SD).

Action line activities	Average 2014-18 (SD)	2019
Planned and unplanned inspections performed (<i>Action lines</i> no. 1, 6, 7, 8 and 10) ^a	5,781.20 (± 584,43)	4,994
Audits performed for food industries and supermarket groups (<i>Action lines</i> no. 4)	37.60 (± 5.08)	44
IQSA food samples processed (<i>Action line</i> no. 5)	454.00 (± 34.84)	470
IQSA analytical determinations (<i>Action line</i> no. 5)	2,807.60 (± 474,01)	2,729
IQSA analytes analysed (<i>Action line</i> no. 5)	25,025.40 (± 9,759.76)	15,951
Food alerts managed (<i>Action line</i> no. 6)	84.40 (± 12.40)	148
Complaints and sanitary irregularities managed (<i>Action line</i> no. 7)	490.40 (± 69.56)	462
Food-borne outbreaks investigated (<i>Action line</i> no. 8)	21.80 (± 9.52)	25
New RSIPAC registries issued (<i>Action line</i> no. 9)	649.20 (± 96.49)	627
Sanitary certificates of exportation issued (<i>Action line</i> no. 10)	456.60 (± 74.19)	636
Enforcement measures taken (coercive fines, requirements, sanctioning procedures and precautionary measures)	208.00 (± 21.33)	218

^a Inspections for industries with premises, commercial restaurants, collective catering and retail establishments.

Fig. 2 shows the number of planned and unplanned inspections performed in 2019 and average between 2014 and 2018. With commercial restaurants and industries with premises topping the list of establishments most inspected in 2019, when comparing 2019 data against previous years, those establishments were also the top-two categories most inspected, though number of inspections notably dropped off in 2019. Inspections for the rest of businesses remained similarly to the average.

In difference with industries, retail and collective catering establishments, between 2014 and 2018 commercial restaurants had a greater variance of inspections performed (**Fig. 2**). Although data showed contains planned and unplanned inspections, in line with what above-mentioned (*Action line* no. 1), this variance was associated to the fact that programmed inspections for commercial restaurants are more likely to be contingent upon unplanned activities, in respect to routine inspections for high-risk establishments. Whilst inspections for high-risk categories are also prioritised over retail establishments' scheduled inspections, its variance between 2014 and 2018 was small.

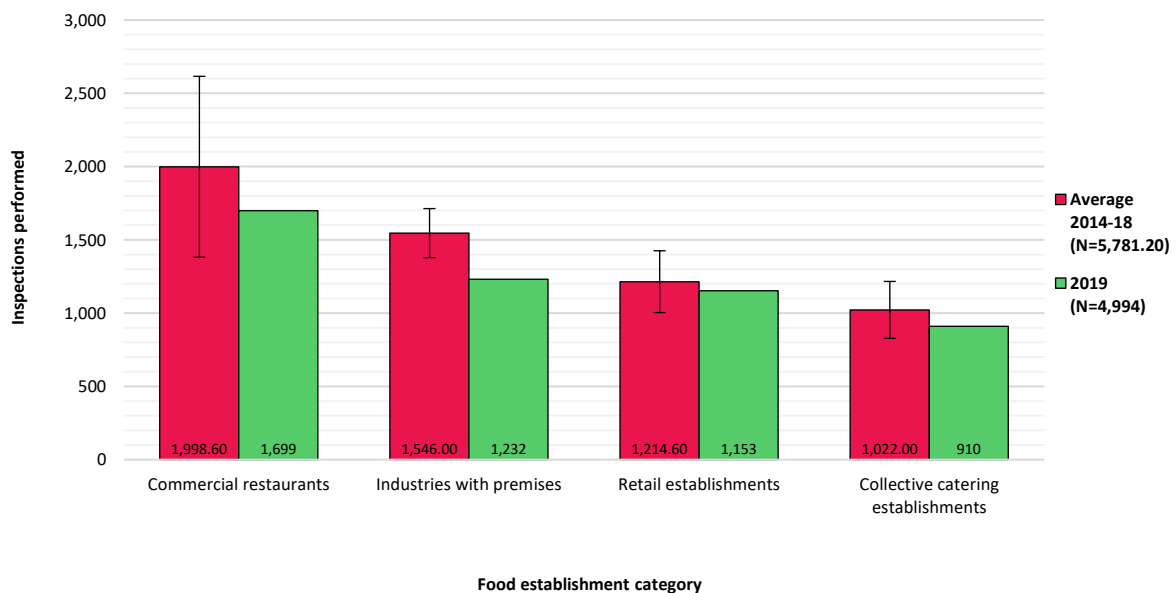


Fig. 2. Number of planned and unplanned inspections performed for commercial restaurants, retail and collective catering establishments, and industries with premises in 2019 and average between 2014 and 2018. Error bars represent standard deviation.

Immediately after each control and at the FBO's premises (never at the office), inspectors document inspections through written reports. Each report contains a description of the purpose of the inspection, the methods performed and the non-compliances observed (critical and non-critical violation), together with a plan of corrective actions of the non-compliances to be taken by the operators, proposed by each inspector. A hard copy of the reports is always given to FBOs after inspections. According to the risk of violations perceived by each inspector and based on their criteria, inspectors establish the time limit demanded to operators for correcting them. Finally, inspectors verify the correction of the non-compliances after the time limit through follow-up inspections, generating new reports.

Even though the current system allows individual evaluation of violations and selection of enforcement measures, this fact may influence the consistency and uniformity of controls (Kettunen, Nevas, & Lundén, 2017; Läikkö-Roto, Mäkelä, Lundén, Heikkilä, & Nevas, 2015; Lundén, Kosola, Kiuru, Kaskela, & Inkinen, 2021). In addition, it is important to highlight that no checklists are employed to conduct and guide inspections nor report templates are provided to document inspections. Hence, attention should be drawn to the fact that it is difficult to systematically analyse and monitor controls data and results since they are compiled through non-standardised checklists and reports. Despite of this, since 2017 the Central Fish Market inspectors and auxiliaries started documenting controls through electronic-based checklist forms. As flagged by other researches, the utilisation of standardised forms of reports "may lead to more systematic and risk-based inspection process", and decrease the inspector and unit factors during controls (Läikkö-Roto et al., 2015).

The unprecedented scenario of the current COVID-19-induced pandemic is disrupting urban food systems and triggering local administrations to prevent food systems from propagating the diseases, particularly for informal sectors as wet markets or street vending (FAO, 2020). Albeit there are none of these sectors in BCN, owing the COVID-19 pandemic, during the nationwide lockdown measures taken by the Spanish Government in March 2020 in light to mitigate the virus spread, all commercial restaurants (except for take-away food) and schools were ordered to pause their activity. Therefore, ASPB on-site routine inspections for those establishments were cancelled from March to June 2020, exception given for the slaughterhouse, wholesale markets, industries and retail establishments, which considered as essential services their activity persisted and inspections ceaselessly continued. The primary objective of those inspections was to avoid any food-borne outbreak that may make the current health crisis worse.

Since June 2020, with the reopening of most of the food establishments and public services, ASPB resumed its full inspection services. Nevertheless, due to the increase of COVID-19 cases and the intensification of social distancing measures, as of October 2020, a short-term commercial restaurants closure was ordered again, reopening again in November 2020 with persistent time restrictions of their activity and promotion of selling take away food.

4.3.2 DISAL personnel

The core DISAL workforce is constituted by inspectors and they are the ones responsible to carry out the ten *Action lines* of control in the front line, together with the support of auxiliaries. Inspectors can either be assigned to control activities for commercial restaurants, retail and collective establishments, industries, the slaughterhouse or wholesale markets (**Fig. 3**). It must be stated that auxiliaries are not empowered to take coercive decisions; however, they may give support to the slaughterhouse and central markets control under the supervision of inspectors when precise protocols are established (EU No 2017/625). All inspectors hold a bachelor's degree in veterinary sciences. Administrative staff supports the DISAL's performance by carrying out tasks of maintenance of the sanitary registers, inventory of equipment and material for sampling or consumers and FBOs public attention, among others. Finally, management staff are in charge of organising, managing and planning all controls and ensure co-ordination between all inspectors and auxiliaries, as well as with other APSB services and ASPCAT. Technical managers (DISAL's director and unit's heads) also hold a bachelor's degree in veterinary sciences and have previous experience in control activities as inspectors.

Fig. 3 shows the number and distribution of DISAL personnel according to their category in 2019 and average between 2014 and 2018. No remarkable variations were observed when comparing data between 2014 and 2018, though Inspectors was the category with the most variance detected. Unlike with wholesale markets inspectors and administrative staff (which decreased), the rest of personnel augmented in 2019, highlighting slaughterhouse inspectors and management staff.

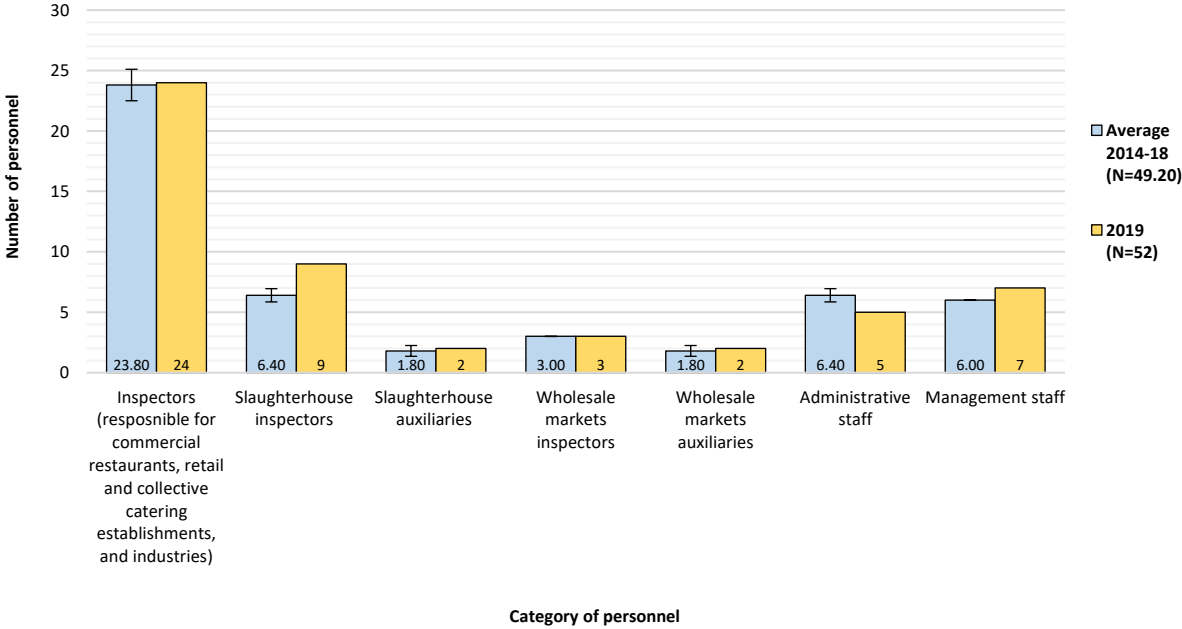


Fig. 3. Number and distribution of DISAL personnel in 2019 and average between 2014 and 2018. Error bars represent standard deviation.

It is noteworthy to mention that DISAL counts with the collaboration of the BCN Municipal Police to implement controls in certain aspects of food transportation and food street vending and events.

The incorporation of new personnel to the DISAL workforce with different curriculums related to other disciplines, such as food science and technology, public health or information technology, may contribute to the DISAL trans-disciplinary approach of food safety and control, and the “One Health” concept.

4.3.3 BCN food establishments

BCN is divided into 10 districts where the distribution of food establishments varies based on their category (City Council of Barcelona, 2020b). In difference, commercial restaurants, especially in those touristic areas, and retail establishments represent the major category of food businesses in the city, followed by industries with premises (Table 3). In 2019, 18.12% and 12.75% of all commercial establishments in BCN were commercial restaurants and retail establishments, respectively (City Council of Barcelona, 2020a). Retail establishments are principally constituted by small and medium-sized businesses; nonetheless, there is an increasing tendency for grouping retail establishments into supermarket groups. In addition, BCN counts with a municipal network of 39 covered food markets, which are distributed among every district of the city and each one of them represents a retail establishment nucleus (City Council of Barcelona, 2020d).

Although industries are present in all districts, they are particularly grouped in Mercabarna, one of the biggest southern European markets of fresh food (Mercabarna, 2020b). The Central Fruit and Vegetable Market, the Central Fish Market, the Multipurpose Market and the slaughterhouse are also located in Mercabarna.

It should be pointed out here that as of October 2020 the BCN slaughterhouse was permanently closed due to budgetary issues (Mercabarna, 2020a). The slaughterhouse production was reallocated among other slaughterhouses outside the ASPB jurisdiction. Consequently, slaughterhouse inspectors' and auxiliaries' tasks are currently being reassigned to other DISAL duties of control.

According to the averages between 2014 and 2018, and 2019 data of number of establishments, commercial restaurants, particularly, and retail establishments visibly increased. On the other hand, the number of collective catering establishments and industries with premises remained similarly, which together with commercial restaurants, variances between years were little (Table 3).

As the data in Table 3 shows, alongside with collective catering establishments, commercial restaurants were those categories with the highest number of establishments inspected in 2019 and between 2014 and 2018. Nonetheless, when comparing the number of businesses inspected against the total number of establishments in the city per category, 67.78% of collective catering establishments and 53.71% of industries with premises were inspected whilst, respectively, 8.39% and 9.32% of commercial restaurants and retail establishments were inspected (Fig. 4). As early discussed, in contrast with the former two, the presence in the city of the other two is remarkably larger (Table 3).

The number of inspected establishments (Table 3) is lower than the number of inspections (Fig. 2) because some establishments were inspected more than once within the same year due to follow-up inspections, alerts or food-borne outbreaks.

Concerning the variance of establishments inspected between 2014 and 2018, higher variance was found for commercial restaurants, attributed, once again, to the fact that routine inspections for this category are more likely to be postponed in front of unplanned activities than routine inspections for high-risk establishments (Table 3).

Most FBOs are currently facing a financial crisis fruit of the COVID-19 epidemic. This situation is leading to the closure of food establishments in BCN, especially commercial restaurants, considered those most affected. Given this scenario, number of food establishments in BCN will significantly vary between 2019, 2020 and 2021.

Table 3

Number of BCN food establishments according to their category and number of food establishment inspected, in 2019 and average between 2014 and 2018, and its standard deviation (SD), in accordance with to SICAL and City Council of Barcelona (City Council of Barcelona, 2015, 2017, 2020a).

Category of food establishments	Number of BCN food establishments		Number of food establishments inspected	
	Average 2014-18 (SD)	2019	Average 2014-18 (SD)	2019
Commercial restaurants	10,304.20 (± 47.65)	11,155	1,098.00 (± 332.68)	926
Retail establishments	7,552.80 (± 1,346.30)	7,851	750.00 (± 115.98)	732
Collective catering establishments	1,211.40 (± 5.73)	1,208	896.80 (± 149.17)	814
Industries with premises	840.20 (± 41.97)	875	513.40 (± 47.34)	470

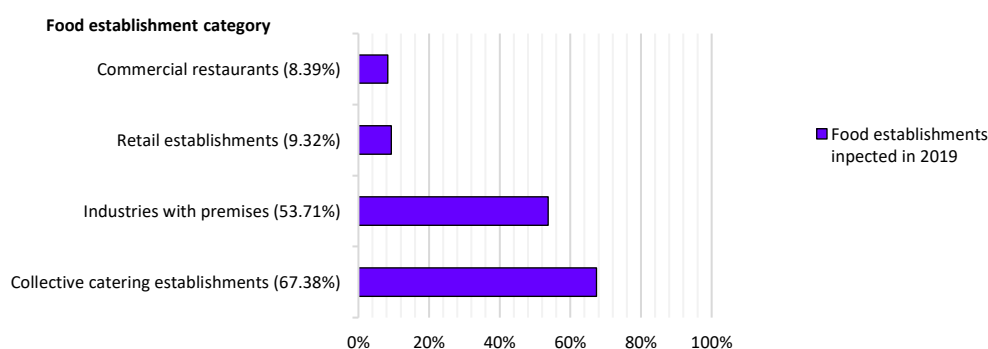


Fig. 4. Food establishments inspected in 2019 according to the category of establishment.

4.4 Laboratory services

ASPB has its own official laboratory, which gives support to all public health activities of this administration, and additionally to third parties, such as other administrations, as well as private businesses or individuals. ASPB laboratory is accredited according to standard EN ISO/IEC 17025 given by ENAC, requisite for any official laboratory in EU (EU No 2017/625). Furthermore, it is a member of the DS registry of food and environmental health laboratories. The degree of specialised laboratory equipment, facilities and techniques enables the incorporation of new analytical parameters in the DISAL's surveillance and control programmes (Fontcuberta et al., 2015).

The ASPB laboratory contributes to the DISAL control and surveillance programmes by providing analytical services of chemical and microbiological food hazards. The laboratory services are not managed by DISAL and for this reason, a differentiation of roles exists amongst DISAL and the laboratory personnel. DISAL inspectors are responsible to collect food samples, either for control or surveillance purposes during their on-site inspections. Those samples are analysed by the laboratory personnel, and results are transferred again to inspectors, who evaluate and interpret them.

4.5 Information, education, communication and training

DISAL divulgates material about food safety hazards and risks, elaboration and management of the HACCP and its pre-requisite programmes, and food handle practices. Promotion and education material can be either elaborated by DISAL or other administrations involved in food safety, such as ACSA, ASPCAT or AESAN. The ASPB Research, Training and Communication Area collaborates with DISAL during the design and launching phases of this material.

The content is based on control and surveillance results and the enforcement of new regulations. This is meant as a tool that supports and contributes to the rest of control activities. Recent publications were related to topics such as acrylamide, anisakis, histamine or food intolerances and allergies. In 2018 DISAL launched a series of music videos named "With food, safety is health" ("Amb els aliments, seguretat és salut"), distributed through YouTube (#BCNalimentssegurs), which promoted hygienic practices for commercial restaurants and retail establishments (ASPB, 2018a).

Since many food handlers in BCN are neither Spanish nor Catalan native speakers and this fact may represent a hurdle to effectively communicate and disseminate information, in this case, all videos were subtitled in English, Chinese, Urdu and Spanish.

Furthermore, DISAL promotes food safety topics through workshops and educating sessions addressed to citizens (children in particular) and FBOs, and collaborates with ASPB and ASPCAT health promotion programmes about healthy eating and food waste. Complementarily, a consultancy service through meetings, telephone calls and email correspondence is offered and addressed to all operators located in BCN, with the purpose to answer and give advice about food safety technical subjects (ASPB, 2020b, 2020a); a total of 140 consultancy meetings were scheduled in 2019.

This FCS element is applied to empower FBOs' technical skills on food safety and hygiene throughout strengthening and improving their knowledge of this field. In consequence, it is expected to achieve greater compliance with legislation, resulting in better control results. General public must be "armed against misinformation" on food safety through education, communication and training (Lelieveld, 2017).

Since 1984, ASPB annually publishes its health report by providing information about the health status of BCN inhabitants and its performance, in the light, among other reasons, to identify gaps (ASPB, 2015a, 2016, 2017a, 2018b, 2019a). Concerning health protection activities, DISAL performance and control results are also included in this report and food safety surveillance results are biannually published through each IQSA edition (ASPB, 2015b, 2017b, 2019b). Following the official path, IQSA results are shared with autonomic, national and EU CAs (Fontcuberta et al., 2015). Besides, information about DISAL's performance is included in the PNCOCA annual

report. According to the current concern about transparency, access to public information and well governance, DISAL publications contribute to align ASPB with the current demanding context of transparency. Furthermore, as of January 2020 and on a quarterly basis, ASPB publishes raw data about its food control performance (number of controls, their motives and results) on its official website (ASPB, 2020c).

Training of inspectors on technical areas is directly managed by the DISAL permanent training commission, constituted by inspectors and management staff, which after evaluating the inspector's needs and demands organises training and refresher courses on control methodologies and technical aspects. On the other hand, Barcelona Municipality organises training addressed to all personnel of this administration (including all DISAL personnel) and cover topics such as conflict solving, management techniques, writing or information technology skills. In 2019 DISAL personnel received 51 training sessions of technical and non-technical content.

As stated by EU applicable legislation, "training enables them (staff performing official controls) to undertake their duties competently and to perform official controls and other official activities in a consistent manner" (EU No 2017/625).

Complementary, ASPB annually organises, in collaboration with the J.H. Bloomberg School of Public Health and the Barcelona Pompeu Fabra University, the so-called Johns Hopkins Fall Institute, a series of short-term courses in a variety of public health subjects, addressed to ASPB employees and external individuals.

5 Limitations of this study

This study bears some limitations. First, no interviews were conducted with either inspectors or auxiliaries, who implement controls in the front line, or other agents involved in the BCN FCS. This exercise would have integrated information from other sources with the intention to seek for triangulation of data. Despite of this, results obtained were proactively checked by senior ASPB official control managers. Secondly, this description is comprised in a particular moment in time. We understand a system as an interconnecting network that changes over time. Therefore, components present in our description may be object of change, while new ones may appear based on emerging or unexpected needs and scenarios. Yet, the main five elements (*Food safety law and regulations, Food safety management, Inspection services, Laboratory services and Information, education, communication and training*) will remain identifiable.

6 Conclusions

This investigation represented the first attempt that hitherto described the BCN food safety control system. According to the results obtained, it was perceived that the study research question was successfully responded by employing the five-element study model given by FAO and WHO, which proved once again to be useful to conduct research on this topic and to qualitatively describe a municipal FCS.

Results of this study suggested that, based on the extended official competences of food safety control conferred to the Municipality of Barcelona, implemented through ASPB, it is worth noting that this fact situates this administration in a unique position in comparison with the rest of Catalan and most of the Spanish municipalities.

This paper established a baseline for future research on the current ASPB control organisation, either with the intention to perform a situation analysis of the current system or, as intended, to subsequently assess and strengthen the Barcelona FCS. Additionally, but not least, results here obtained can be object of comparison with information and data from other food control systems and administrations at urban level.

CRediT authorship contribution statement

Eduard Grau Noguer: Conceptualization, Methodology, Investigation, Writing- original draft, Writing- Review & Editing, Visualization, Funding acquisition. **Jordi Serratosa Vilageliu:** Conceptualization, Investigation, Writing- Review & Editing, Visualization, Supervision. **Maica Rodríguez-Sanz:** Writing- Review & Editing, Visualization. **Remo Suppi Boldrito:** Writing- Review & Editing, Visualization. **Núria Bertomeu Balagueró:** Resources, Data Curation. **Elena Jacas Egea:** Investigation, Visualization. **Santiago Rodellar Torras:** Writing- Review & Editing. **Samuel Portaña Tudela:** Conceptualization, Methodology, Investigation, Resources, Writing- Review & Editing, Visualization, Supervision, Project administration.

Disclaimer

The views expressed in this publication are those of the authors and do not necessarily reflect the views and policies of Agència de Salut Pública de Barcelona (Public Health Agency, Barcelona) nor the Municipality of Barcelona.

Declaration of interest

We declare no conflicts of interest.

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