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Performance assessment of food safety management systems in animal-based food companies in view of their context characteristics: A European study

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ABSTRACT

Recurrently the question arises if efforts in food safety management system (FSMS) have resulted in effective systems in animal-based food production systems. The aim of this study was to gain an insight in the performance of FSMS in European animal-based food production companies in view of their typical context characteristics. Hundred European companies (from Belgium, Spain, The Netherlands, Greece, Italy, and Hungary) varying in company size, and producing different types of fresh and processed animal-derived products (dairy, beef/lamb, poultry, and pork) were assed using a diagnostic instrument. Results indicated that most participating companies adapted adequately their food safety management systems to the riskiness of their context characteristics resulting in rather good safety output scores. Only a small group have overall basic systems and operate in a moderate or moderate-high risk context, which was reflected in lower safety output scores. Companies tend to invest first in the control strategies whereas assurance activities such as verification and validation seem to require more time and effort to achieve advanced levels. Our study demonstrated that also small and medium enterprises managed to have advanced systems, and achieve a good safety output. However, their typical organisational characteristics such as less resources (educated staff, laboratory facilities, time), more restricted formalisation (restricted use of procedures and formal meetings), limited information systems, but more stable workforce, might require more tailored support from government and/or branch organisations to develop towards advanced systems in the case of high-risk products and processes. More in-depth studies to successful SMEs could give insight in best practices to improve FSMS performance.

1. Introduction

Food safety is an issue of substantial concern for over 30 years in agri-businesses and the food industry. Hazard Analysis and Critical Point Analysis (HACCP) has become the worldwide-recognised method for food safety assurance, since the FAO/WHO Codex Alimentarius Commission adopted the application of the principles in1993. Nevertheless, in the last few decades, serious food safety scares have impaired public confidence in the ability of the food industry and public authorities to ensure safe food (Covaci et al., 2007; Gstraunthaler & Day, 2008; Holm & Halkier, 2009). Major foodborne pathogens have been frequently detected in animal-derived food products, such as beef and lamb, pork, poultry and to a lesser extent dairy products and, therefore, have been the focus of regulatory actions and surveillance programs, world-wide (Gill & Gill, 2010; Hussein & Bollinger, 2005; Kousta, Mataragas, Skandamis, & Drosinos, 2010; Muth, Fahimi, & Karns, 2009; Sumner et al., 2003).

In Europe, the White Paper on Food Safety (2000) has initiated substantial efforts in implementing prerequisite programs and HACCP principles in food safety management systems (FSMS) by-amongst others- animal-based food companies (Kok, 2009; Konecka-Matyjek, Turlejska, Pelmer, & Szponar, 2005; Mensah & Julien, 2011; Roberto, Brandao, & da Silva, 2006; Semos & Kontogeorgos, 2007). Studies also showed an increase in the adoption of additional quality assurance (QA) standards, like British Retail

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Table 1
Characteristics of companies of animal-derived products that participated in the FSMS assessment study.

Company size	Product group				Production process		QA guidelines & standards				
	Beef/lamb	Pork	Dairy	Poultry	Fresh	Processed	GMP + HACCP	BRC	IFS	ISO22000	Other[a]
Small/micro $N = 41$	14	14	8	5	11	30	41	17	6	11	16
Medium $N = 41$	7	15	9	10	16	25	41	22	17	3	28
Large $N = 18$	3	5	6	4	8	10	18	14	6	4	12
Total $N = 100$	**24**	**34**	**23**	**19**	**35**	**65**	**100**	**53**	**29**	**18**	**56**

[a] Other standards included ISO9001, Auto-control system Spain, and Auto-control system Belgium.

Consortium (BRC), International Featured Standards (IFS), and ISO22000, to upgrade the FSMS; especially when companies aim for export markets (Herzfeld, Drescher, & Grebitus, 2011; Kok, 2009; Varzakas, & Arvanitoyannis, 2008). Nevertheless, research indicated that micro, small, and medium enterprises face more difficulties than the larger food companies to establish their FSMS (e.g. Fielding, Ellis, Beveridge, & Peters, 2005; Walker, Pritchard, & Forsythe, 2003; Zanardi et al., 2007).

Recurrently the question arises if the efforts have resulted in effective FSMS in animal-based food production systems. Some studies found a decline in food borne outbreaks and pathogen contamination in these foods, based on published surveillance data over the last two decades, suggesting that FSMS are effective in improving food safety (Gormley et al., 2011; Hong, Todd, & Bahk; 2008; Nada, Ilija, Igor, Jelena, & Ruzica, 2012; Wilhelm, Rajic, Greig, Waddell, & Harris, 2011; Williams & Ebel, 2012). However, other studies indicated that the quality assurance standards and guidelines implemented did not necessarily result in the required food safety output (e.g. Bohaychuk, Checkley, Gensler, & Barrios, 2009; Luning, Jacxsens, et al., 2011; Muth et al., 2009; Sampers et al., 2010).

Each company has its own unique FSMS because it depends on which QA standards and guidelines they use and how they translate and adapt them to the company specific circumstances (Jacxsens, Kussaga, et al., 2011). Various authors discussed that the output of a system is not only dependent on the system performance itself but also depends on the characteristics of the context wherein it operates (Child, 2007; Van der Spiegel, Luning, de Boer, Ziggers, & Jongen, 2006). Food safety management systems should thus be adapted to its context characteristics to be able to achieve a good food safety output (Luning, Marcelis, et al., 2011).

The aim of this study was to gain an insight in the performance of food safety management systems in European animal-based food production companies in view of their typical context characteristics.

2. Materials and methods

2.1. Characteristics of participating companies

Acquisition of participants occurred via contacts of the academic and company partners in the European research consortium and via workshops organised in collaboration with branch organisations in respectively Belgium, Netherlands, Greece, Italy, and Spain. We aimed for small & micro, medium and large companies preparing fresh or processed dairy products, beef or lamb products (clustered as one group because both are red meat types derive from ruminants), poultry products, or pork products.

Respondents used a web-based or paper application of a ‘Food Safety Management System’ assessment tool (see Sections 2.2–2.4. for details) to fill in their company characteristics, define their most representative production unit, and indicate for this unit the most typical situation for their context characteristics, FSMS system activities, and food safety output. Micro and small companies completed the assessment at their own location with support of a researcher when they could not join the workshop (e.g. due to time constraints) and or could not complete the assessment alone. The QA responsible or QA manager(s) filled in the self-assessment, when more than one QA-person then they filled it in together. The assessment took circa 1 ½–2 h for the web-based application (as well individually done as during the workshops), and circa 2 ½–3 h for an on-site visit.

Hundred respondents completed the FSMS assessment in the period 2010–2012. Table 1 summarises the main characteristics of the respondents that participated in the study.

2.2. Performance assessment of food safety management system

The assessment tool addresses core control and assurance activities in an implemented safety management system, independent of the quality assurance standards and guidelines used for design of the system. The tool comprises sets of indicators to analyse the design of respectively preventive measures (8 indicators), intervention processes (3), and monitoring systems (7), and to analyse actual operation of these control strategies (7), i.e. the core control activities. It also includes indicators to analyse the core assurance activities, i.e. setting system requirements (2 indicators), validation (3), verification (2), and documentation & record keeping (2). Table 2 shows the complete list of indicators to analyse an implemented FSMS. Each indicator has a grid including four situational descriptions that correspond with respectively a low (score 0), basic (score 1), average (score 2), and advanced (score 3) performance level in order to enable a differentiated assessment (Luning, Bango, Kussaga, Rovira, & Marcelis, 2008; Luning, Jacxsens, et al., 2011). Score zero represents that an activity is not possible/applicable (e.g. when products are eaten raw an intervention process is not applicable), or is not applied/not done although it is possible (e.g. calibration of equipment), or is unknown (e.g. in case of lack of information on actual operation of control activities). The basic level (score 1) for control activities is typically characterised by aspects such as, use of own experience, use of general knowledge, ad-hoc analysis, incomplete methods or programmes, not standardised equipment, facilities, & methods, and in actual operation unstable equipment and unforeseeable people performance. For assurance activities, the basic level is typified by being problem driven, only checking and no analysis of collected data/information, lack of reporting, data/information are evaluated by own people, no independency. The average level (score 2), for control activities is characterised by use of expert (supplier) knowledge, (sector, governmental) guidelines, best practices, best available equipment,