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Public and private standards for dried culinary herbs and spices—Part II: Production and product standards for ensuring microbiological safety

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ABSTRACT

Dried culinary herbs and spices (DCHS) are minor food components with widespread use. Despite their low water activity, some microorganisms—including pathogenic and toxigenic ones—can survive in DCHS. The addition of microbial contaminated DCHS to ready-to-eat food in combination with improper food storage can pose a serious health risk for the consumer. In the past, several food-borne disease outbreaks were related to microbial contaminated spices. The aim of this study was to provide an overview on (i) spice/herb production standards important for promoting food safety by preventing microbial contaminations, (ii) public and private standards providing microbiological criteria to assess the microbiological safety of DCHS, and (iii) product testing performed by DCHS producing/processing businesses to comply with these standards.

For that, a literature search and a survey among herb/spice businesses were conducted. Several good practices and production guidelines specific for the primary production and/or processing of culinary herbs and spices were found. Microbiological criteria specific for DCHS are usually rare, but some national standards (mostly of non-EU member states) as well as recommendations by private bodies could be identified. By EU law, no mandatory microbiological criteria specific for DCHS are laid down. The survey indicated a frequent application of business-to-business agreements. The microbiological quality of DCHS was tested by the survey participants mainly in a routine manner by checking every lot or based on buyer–seller agreements. Risk-based testing was less common, which differed to chemical safety testing. Upon import into the EU, testing appeared to be performed predominantly in a routine manner for the pathogenic bacteria *Salmonella* spp., sulphite-reducing clostridia (including *Clostridium perfringens*), *Bacillus cereus*, and *Staphylococcus aureus*.

1. Introduction

Food safety is a challenge given our global food chains. For the spice and culinary herb chains, this is particularly true since these chains usually include many stages often with many actors per stage, e.g. at the primary production stage. Primary production of these commodities often takes place in less developed countries and production structures are very diverse; for example, they can include small-scale farming and wild collection (FAO, 2011). Moreover, the products themselves are highly diverse and comprise different parts of herbaceous and wooden plants. Furthermore, the products are offered in several processing grades ranging from fresh to frozen to dried and from whole to cut/broken/etc. to ground. Contaminations of spices and herbs can occur at any stage and actor in the food chain, including storage and transport.

Spices and culinary herbs in a dried form are minor ingredients that are added to many processed foods and most of our dishes. Thus, if a contamination of dried culinary herbs and spices (DCHS)

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takes place, it can have a far-reaching impact since a single batch has the potential to contaminate many food products. Besides potential chemical hazards, health concerns for the consumer can be particularly caused by microbiological agents (Moore, Spink, & Lipp, 2012; EFSA BIOHAZ, 2013; see also Schaarschmidt, 2016). Regarding microbiological food safety concerns in low-moisture foods, DCHS (including herbal tea) were ranked in the top three (FAO & WHO, 2014a). In the past, several food-borne disease outbreaks caused by *Salmonella*, *Bacillus* (*B.*) spp. or *Clostridium* (*C.*) *perfringens* were associated with microbiologically contaminated spices (EFSA BIOHAZ, 2013; FDA, 2013; Van Doren et al., 2013; FAO & WHO, 2014b).

If properly dried, culinary herbs and spices do not support microbial proliferation as a result of their low water activity. However, some microorganisms, including pathogens and toxin producers, are able to survive in low-moisture foods. Microbial contaminants of DCHS include fungi, such as yeasts and moulds, as well as bacteria (Banerjee & Sarkar, 2003; Kara, Gokmen, Akkaya, & Gok, 2015; Kong et al., 2014; Koohy-Kamaly-Dehkordy, Nikoopour, Siavoshi, Koushki, & Abadi, 2013; FAO & WHO, 2014b; McKee, 1995; Sagoo et al., 2009). The bacterial contaminants can cover next to spore-forming pathogens like *Bacillus* spp. and *Clostridium* spp. Gram-positive and Gram-negative non-spore formers. Among the non-spore formers, a special focus must be set on *Salmonella* spp.

In case of *Salmonella*, very few vital cells in DCHS might be sufficient to cause a salmonellosis (Lehmacher, Bockemühl, & Aleksic, 1995). Besides, problems with pathogenic/toxigenic microorganisms might particularly arise if a microbial contaminated spice or herb is added to a foodstuff with a higher water activity in combination with failure in food handling. If subsequent processing steps that inactivate microbial activity are lacking or insufficient, microbes can proliferate in the final product upon improper food storage. Moreover, some bacteria can survive a heat treatment as spores. If a high number of heat-stable spores of toxin-producers such as *B. cereus* or *C. perfringens* is present, improper storage of the final food can lead to toxin accumulation (EFSA BIOHAZ, 2005a; EFSA BIOHAZ, 2005b). Finally, these scenarios can, upon exposure of the consumer, result in a food-borne infection or food poisoning. Food poisoning can be also caused by mycotoxin-producing fungi (moulds). In addition, certain microorganisms such as yeasts can cause food spoilage.

Analysing outbreaks and performing scenario evaluations has drawn particular attention towards *Salmonella* spp. and *B. cereus* in DCHS (EFSA BIOHAZ, 2013; FDA, 2013; FAO & WHO, 2014b). Regarding the microbiological risk related to foods of non-animal origin in the EU, the Panel on Biological Hazards (BIOHAZ) of the European Food Safety Authority (EFSA) ranked spices and dry powdered herbs in combination with *Salmonella* spp. and *Bacillus* spp. within the top four food–pathogen combinations (EFSA BIOHAZ, 2013).

To limit potential contaminations of DCHS with pathogenic and toxigenic microorganisms and, consequently, the negative impact on consumer health, preventive measures are crucial. The basis for food safety management includes good hygienic practices (GHPs) and the principles of hazard analysis and critical control point (HACCP). Moreover, to enable private and public bodies to assess the microbiological safety of raw materials and end products, appropriate control measures together with product standards that specify microbiological criteria are important.

The objective of the study was to investigate current public and private standards that aim to promote the microbiological safety of DCHS. Here, the term “standard” covers regulations as well as recommendations, guidelines, codes of practice, and similar documents agreed upon by public or private bodies providing rules or guidelines for activities/practices or characteristics resulting from these. The study presents (i) examples of culinary herb/spice production standards important for preventing microbial contaminations, (ii) available product standards concerning microbiological criteria for DCHS, and (iii) information on product testing performed by producers and processors of DCHS to control food safety and compliance with standards. The work was performed from a European Union (EU) perspective.

2. Methodology

2.1. Literature/internet search

A literature study and internet search, including screening of EU (and some national) legislation, was performed to obtain an overview on culinary herb/spice production standards and microbiological standards specific for DCHS. For the latter, particularly the following keywords were used (individually or in different combinations) in English, German, Spanish, French, and Dutch language: “herb”, “spice”, “microbiological”, “microbial”, “criteria”, “standard”. The microbiological standards considered included facultative and mandatory standards of private and public bodies at the global, EU/multinational, and national level. The study does not claim to be exhaustive.

2.2. Online survey within the culinary herb/spice industry

An online survey was conducted in the spring of 2015 to obtain information from the culinary herb/spice industry, including primary producers, concerning *inter alia* the standards applied as well as the frequency and occasion of product testing performed. The survey addressed businesses and facilities located within or outside the EU-28 that produce, process, or trade culinary herbs or spices (referred to hereafter as “culinary herb/spice handling facilities”). The questionnaire was developed with support from the herb/spice industry. The online survey was established with the web-based software tool SoSci Survey (www.soscisurvey.de). The survey was distributed by the European Spice Association (ESA) (www.esa-spices.org/) among its members located within and outside the EU. In addition, 32 EU and non-EU herb/spice businesses, covering non-ESA members, were invited by the authors.

Survey data were compiled with SoSci Survey and were evaluated using MS Excel. The survey was entered by 20 facilities. Of those, 16 participated in the survey; 12 answered all questions (some questions were not answered because of filter questions within the survey). The questions of the present study are outlined in the Appendix B. From the 16 facilities that participated in the survey, 7 were located in the EU (Germany, Latvia, the Netherlands, and the United Kingdom) and 9 outside the EU (Egypt, India, Iran, Turkey, and Vietnam). Most survey participants were processors of culinary herbs and/or spices with large annual turnovers (>500 t of culinary herbs or >2500 t of spices). Moreover, 2 primary producers and 1 trader participated. In general, the EU participants mostly had a higher number of incoming culinary herbs (>10) and spices (>10) compared to the non-EU participants (Table A.1 in Appendix A). The sources of incoming products ranged from own farming, to contract growers, to other primary producers (direct sell), to traders; many participants had multiple sources. Contract growers (indicated by 3 participants as single source) and direct sell from other primary producers were the most common sources. 1 participant was a primary producer without any additional purchase of herbs/spices. All the others received at least a part of their culinary herbs/spices from sources located outside the EU (Table A.1).

To illustrate the distribution of specific characteristics among EU and non-EU participants, percent values are presented in the diagrams. However, it should be noted that the results of the survey