



## Evaluation of hygienic conditions of food contact surfaces in retail outlets: Six years of monitoring



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### ABSTRACT

A total of 68 food contact surfaces in five different retail outlets of the following food categories: raw meat (17 surfaces), fishery products (12), deli (11), pastry (18), and dairy products (10) were monitored for hygienic conditions during the years 2010–2015. Each retail outlet was visited three times per year, except for that of dairy products which was monitored once a year. The samples were collected by hygiene swabs used on the sanitized surfaces before coming in contact with any type of food and analyzed for total aerobic count and presence of *Salmonella* spp. and *Listeria monocytogenes*. On the basis of the results, the surfaces were classified according to compliance criteria with good hygienic conditions: compliant (from not detectable to 49 CFU/cm<sup>2</sup>), improvable (between 50 and 499 CFU/cm<sup>2</sup>) and not compliant (>500 CFU/cm<sup>2</sup>). The highest rates of improvable or not compliant data were found in the stores of raw meat (38 and 29%, respectively) and fishery products (23 and 31%), followed by deli (21 and 13%). As no regulatory limits have been established for food contact surfaces, the compliance criteria proposed in this study could be used to monitor the cleaning and sanitation procedures in the food distribution system.

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## 1. Introduction

Nowadays the consumer has become much more aware of food safety as a result of more information given by mass-media. Even if most of food borne diseases are due to the poor quality of raw material as well as to the manufacturing process in food production establishments, a significant proportion can be also the result of mishandling by food processors and retailers (Ismail et al., 2013). A high standard of hygiene in the working environment, in particular on food contact surfaces, equipment and facilities, is a fundamental requisite for the prevention of microbial contamination of food (Osimani, Garofalo, Clementi, Tavoletti, & Aquilanti, 2014). The inadequate cleaning and disinfection of food contact surfaces can result not only in the reduction of the shelf-life of food, but also in the possible presence of pathogens particularly those with a low minimum infective dose (Moore, Griffith, & Fielding, 2001). Moreover, several pathogens including *Staphylococcus aureus*,

*Listeria monocytogenes*, *Salmonella* spp. and enteropathogenic strains of *Escherichia coli* can survive on different surfaces for periods ranging from several hours to days, and even form biofilm (Martinon, Cronin, Quealy, Stapleton, & Wilkinson, 2012). Both in food production and distribution plants, the formation of biofilm generally starts when cleaning and sanitation procedures are not correctly performed, representing a potential reservoir for food contamination (Srey, Jahid, & Ha, 2013). This involves, in any food manufacturing operation, the provision for adequate microbiological methods of recovering microorganisms from the different food contact surfaces.

Unlike foodstuffs for which microbiological criteria have been established in the European Union by Regulation EC No 2073/2005 (EC, 2005) and subsequent amendments, there are no legal obligations to be met for surfaces and facilities used in the food industry, except for the responsibility of food business operators to identify, implement and monitor an appropriate cleaning and sanitation program according to Regulation EC No 852/2004 (EC, 2004). The general requirements include among others the adequate maintenance of a clean condition of all rooms intended to food production, and food contact surfaces must be easy to clean

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and disinfect by means of good hygienic operations. Then, food companies tend to establish technical specifications to add value to their products and limit contamination risks. Some studies reported a quantitative aerobic colony count  $<2.5$  CFU/cm<sup>2</sup> as post cleaning microbiological surface standards for both the food and healthcare sectors (Moore & Griffith, 2007). Traditional microbiological analyses (viable counting of total mesophilic aerobes, coliforms and *Escherichia coli*) are generally used to evaluate the effectiveness of sanitation operating procedures. The use of hygiene swabs remains an important mean of measuring the effectiveness of sanitation due to the ease with which they can be used for the sampling of food contact surfaces which are irregular or difficult to clean (Moore & Griffith, 2002).

There are few published data on microbial contamination of surfaces of equipment and facilities used in food stores. The aim of this study was the evaluation of the hygienic conditions of food contact surfaces after the cleaning and sanitation procedures, in five food retail outlets located in the Apulia region, Southern Italy. For each food retail outlet, different stores of the following food categories: raw meat, deli, pastry, fishery products and dairy products, were investigated. Hygiene swabs were used to sample a total of 68 different food contact surfaces and analyzed for total aerobic count as parameter of a good sanitation practice. Moreover, the presence of *Salmonella* spp. and *Listeria monocytogenes* was also evaluated, as these pathogens could survive and contaminate food during processing or storage.

## 2. Materials and methods

### 2.1. Collection of swab samples

Five food retail outlets (named A, B, C, D, E) were investigated throughout a 6-year monitoring period (years 2010–2015) in order to evaluate the good hygienic conditions of the most used food contact surfaces in stores of the following food categories: raw meat (17 surfaces), deli (11), pastry (18), fishery products (12) and dairy products (10). The food contact surfaces examined in each store were described in Table 1.

All stores were sampled three times per year, except for the store of dairy products which was visited just one time per year. During each visit, the selected food contact surfaces were sampled after the sanitation procedure and prior to the items coming in contact with any type of food, and analyzed for total aerobic count and presence of *Salmonella* spp. and *Listeria monocytogenes*. As improper cleaning measures would result in leaving food residues on surfaces that would induce microorganisms to proliferate, preliminary removal of coarse dirt with disposable paper towels and use of water at 50–60 °C were applied for all the examined food contact surfaces. Then, a detergent was spread evenly on the surfaces, left for 5–10 min and rinsed with hot water at 50 °C. Finally, a bactericidal disinfectant based on ammonium salts was diluted in cold water and left to work for other 10 min or even throughout the night. Removable parts or small equipment were directly immersed in the disinfectant solution.

However, in some stores the sampling was not possible for all the surfaces because some of them were not present at all or were unable to be sampled at the moment of the visit. Then, a total of about 1530 (raw meat), 990 (deli), 1620 (pastry), 1080 (fishery products) and 300 (dairy products) samples were collected as follows: a prepared plastic template was placed on the target surface and an area ranging from 20 to 100 cm<sup>2</sup>, according to the dimension of the surface to be sampled, was swabbed by sterile cotton wool swabs (Copan Italia Spa, Brescia, Italy) pre-moistened into a 10 mL sterile SRK solution (Copan Italia Spa, Brescia, Italy) immediately before use. The samples were put into the same diluent solution

**Table 1**  
Food contact surfaces examined in retail outlets of different food categories.

Food category	Food contact surfaces
Raw meat	
1	Knife container teflon
2	Teflon chopping block
3	Teflon worktop
4	Stainless steel worktop
5	Knife
6	Inner surface of hamburger machine
7	Underlying surface of hamburger machine
8	Cylinder meat grinder
9	Snail meat grinder
10	Pushbutton meat grinder
11	Bone saw blade
12	Slicing blade
13	Minced spill tray
14	Stainless steel tray
15	Boning glove
16	Handle cold room (red meat)
17	Stainless steel hooks
Deli	
18	Teflon salami cutting board
19	Salami slicing blade
20	Salami slicing denticles
21	Salami pliers
22	Teflon cheese cutting board
23	Cheese slicing blade
24	Cheese slicing denticles
25	Cheese pliers
26	Baking dish
27	Spoon
28	Knife
Pastry	
29	Stainless steel worktop
30	Preparation basin
31	Knife
32	Pliers
33	Spoon
34	Handle cold room
35	Container mixer
36	Arms mixer
37	Disposable cream filling machine
38	Stainless steel tip of cream filling machine
39	Icing sugar sieve
40	Bread container
41	Stainless steel baking dish for pizza
42	Container for ingredients of pizza
43	Refrigerated display case
44	Stainless steel tray
45	Pliers for pizza
46	Puff pastry machine
Fishery products	
47	Teflon cutting board
48	Shower faucet
49	Hole worktop for waste
50	Knife
51	Scissors
52	Peeler fish
53	Stainless steel
54	Container
55	Shovel for ice
56	Handle cold room
57	Knife container
58	Stainless steel worktop
Dairy products	
59	Curd cutter
60	Dipping tub
61	Stretching-forming machine
62	Forming roller
63	Cheese firming container
64	Faucet of cheese firming cart
65	Spinning basin
66	Facilities
67	Cheese container
68	Water chiller

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