



### *Reasons to Integrate Antimicrobials in Food Service Products & Equipment*

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#### **SUMMARY**

*By the nature of the food service environment, food-contact surfaces are readily contaminated by environmental microbes from human contact and food residues. Consumption patterns, re-use of items for multiple purposes, soil, food residues, moisture, human contact, and non-adherence to cleaning and sanitizing protocols exacerbate these conditions. While there are regulatory measures in place to control contamination, there are human, material, and equipment lapses that can render food-contact surfaces visually clean but susceptible to microbial survival and growth. Integration of **Microban antimicrobial technology** with current regulations and practices can enhance what is already being done right.*

Foodservice utensils, flatware, and equipment contact surfaces include exteriors that have the potential to directly interact with food intended for consumption. The importance of cleaning to reduce potential risks associated with the transfer of microbes from a surface, even a visually clean surface, to a ready-to-eat food, cannot be overemphasized. Food-contact surfaces are routinely subjected to biofouling due to a complex of various factors, such as types of food being handled, processes to which they are being subjected, and the environment in which the food is being processed (air, people, surface, material). These factors impact the composition of the organic soil, the nature of microbes as well as the microbial load that land, survive, and potentially grow

on food-contact surfaces. Microbes and organic soil mixture may be derived from a single soiling event, from several events separated by inadequate cleaning and sanitization processes, or, in rare instances, via biofilm formation.

Acknowledging that there are risks associated food handling and service, the United States Public Health Service (PHS) published the first *Food Code* in 1934 as the Restaurant Sanitation Regulations to regulate operations that provide food directly to the consumer. Since then, there have been 21 editions and the current *2013 Food Code* is the model intended to protect the public, ensure that food is unadulterated, and represents the United States Food and Drug Administration (FDA) best advice for a uniform system that addresses the safety and protection of food offered at retail and in food service (1).

### **What are the risks associated with food-contact surfaces?**

- 1. Food consumption patterns** have changed and more meals are prepared and eaten away from the home. In 1970, 25.9 % of all food spending was on food away from home; by 2012, that segment of the food budget increased to its highest level of 43.1 % (2). Since food service establishments are busier with higher traffic of patrons, food preparation and service items are being used more frequently and there is less time lapse in between uses. Also, while patrons are served in some restaurants, an increasing number of food service establishments have self-service stations for offerings therefore placing patrons in closer contact with more food service equipment and flatware. Given these shifts in consumption patterns, the microbial load on serving utensils is potentially higher because of higher rates of use (1).
- 2. Poor hygiene by humans handling food service equipment and flatware can contribute to microbial load on food-contact surfaces (3).** When food handlers fail to use proper handwashing practices, microbes can be inadvertently transferred to food-contact surfaces. All retail food preparation requires some level of human contact. Hands actively contact processing containers, money, raw food, food packaging, cleaning substances, disinfectants, body parts, door handles, sink faucets, and human wastes in any facility. Studies have shown that these types of

surfaces have high microbial loads. The Federal Food Code prohibits direct contact between hands and ready-to-eat foods and stresses minimal bare hand contact with not-ready-to-eat foods; however, microbes are efficiently transferred from contaminated products to hands and from hands to food-contact surfaces (4).

3. **Soiled food-contact surfaces may contain residues of fats, proteins, carbohydrates and/or assorted microorganisms.** An inadequately cleaned food contact surface contains food residues, and many foods leave residues of protein that can nourish microorganisms. Food-contact surfaces often have residues that persist after washing and may provide nourishment that allow contaminants to propagate. Residues provide nutrients for contaminating microbes to utilize and multiply (5).
4. **Bioaerosols are created from multiple sources such as high power washes and respiratory/nasal droplets that settle and foul food-contact surfaces** at food service establishments. Microorganisms on food-contact surfaces may be from direct contact with contaminated objects or indirectly via aerosols. Airborne microbes have been determined to be capable of survival on food and food-contact surfaces for at least a short time (6, 7).
5. **The food service environment contains equipment and utensils constructed from different surface materials with varied propensities** to be vehicles for microbial attachment and survival (7). Silva *et al.* (2008) evaluated the adhesion and viability of *Listeria* on eight food-contact surface materials commonly used in kitchens was conducted: stainless steel 304, marble, granite, glass, polypropylene from a bowl and from a cutting board, and two kinds of quartz surfaces. The results indicated that there is a complex relationship between the nature of surface materials and microbial surface properties that impact the propensity of microbial attachment to abiotic surfaces. Although to different extents, all evaluated *L. monocytogenes* strains attached to all surfaces used in the study. *L. monocytogenes* adhered most tightly to marble and granite, followed by quartz surfaces, glass, and stainless steel 304, and finally polypropylene surfaces.
6. **Surfaces are often used for multiple tasks.** Kitchen work surfaces, particularly utensils and chopping boards, are generally used for a variety of tasks during

domestic food preparation. Based on a survey reported by Moore *et al.* (2007), 30 to 71% of consumers reported using the same chopping board or area of work surface to prepare raw meats and other foods. Real-time microbiological analysis suggested that if contaminated surfaces are not adequately cleaned, there is an 81% chance that subsequently prepared food will be significantly contaminated (8).

7. **Difficult to clean surfaces.** Inability to effectively wash, rinse and sanitize the surfaces of food equipment may support development of biofilms through food. Studies regarding the rigor and effort required to remove biofilms from smooth surfaces emphasize the need for use of materials of optimal quality in multiuse equipment (1).
8. **Surfaces may be marked with scratches or crevices** due to wear and tear, as well as polishing with abrasive powders or substances. These crevices or channels may serve to entrap food residues and microorganisms (9).
9. **Biofilm formation has been documented on a wide variety of surfaces** of which the material and microtopography of surfaces can influence biofilm structure and density. There is evidence that the density of biofilm formation varies with substratum. When compared in a study by Corcoran *et al.* (2013), biofilm growth on tile is denser than on the other substrata that were evaluated (glass, steel, and concrete). Transfer of bacteria from tile to food after exposure time of up to 28 h was shown and it was suggested that differences in surface polarity and/or surface roughness of substratum are important in microbial attachment or biofilm density (10).
10. **Biofilm formation is affected by types of food products:** Biofilm formation is greater in meat and poultry broths than in produce broths. Raw materials such as meat and dairy products provide rich substrates for bacterial adhesion, colonization, and biofilm formation on food-contact surfaces (11).
11. **Poorly executed or inadequate cleaning and sanitizing regimes** can induce stress responses making microbes more prone to adhering to solid surfaces. Physical and chemical treatments of food-contact surfaces are used to eliminate and control the presence of microbes in foods. When cleaning and sanitizing regimes are poorly executed or inadequate, microorganisms may remain in the processing

environment in an injured state. Sub-lethal treatments or stresses (i.e., heat, anaerobiosis, oxidation, starvation, cold shock, ethanol) can result in unique adaptive responses by bacteria whereby the organism becomes more resilient (12). For example, starvation stress is often accompanied by an increase in cell number, a decrease in cell size, an increase in cell surface hydrophobicity, and an increase in adhesiveness to solid surfaces where they benefit from an enhanced nutrient status.

**12. Microbial contamination in processed and ready-to-eat (RTE) foods** can occur as they encounter raw contaminated vegetables through cutting boards and stainless steel slicing, cutting, handling or packaging utensils. When there is failure in handwashing, glove changing, and daily sanitation of cutting utensils and other surfaces, the possibility of contamination of processed and RTE foods increases (13).

**13. Residual moisture.** When flatware is stored wet, they are likely to become contaminated. The available moisture on wet-nested food-contact surfaces prevents desiccation of contaminating microbes and facilitates their survival and growth (14). Moisture is retained on surfaces and in pockets when dishes are stacked after removal from the wet, warm dishwasher, or in cases where dishes are hand washed and insufficiently dried before storage. Among the important factors in bacterial transfer from one surface to another are moisture, contact time and pressure which can support higher transfer rates between surfaces (15).

**14. Kitchen items such as towels or mittens may harbor and spread microbes to utensils and flatware.** Handling flatware and utensils with soiled towels allow transfer microbes to food-contact surfaces (16). Cleaning tools such as sponges and cloths harbor large numbers of bacteria and are therefore a potential source of spreading microorganisms throughout food preparation areas during use (17).

### **Measures to control microbial contamination of food contact surfaces**

Survey data identify various factors that repeatedly contribute to microbial contamination of food (1). Among them are: contaminated equipment surfaces, food from unsafe sources, and poor personal hygiene. The *2013 Food Code* addresses controls and establishes interventions to minimize microbial loads on food-contact surfaces. Specifically, these interventions include controlling hands as a vehicle of

contamination as well as time and temperature parameters for controlling microbial survival and growth.

1. **Handwashing:** Recognizing that handwashing is critical to maintaining a clean foodservice environment, the *Food Code* provides a cleaning procedure on how food employees should clean and dry their hands and exposed portions of their arms (1).
2. **Food contact surface materials:** By regulation, materials that are used in the construction of utensils and food-contact surfaces of equipment must be safe, durable, be able withstand repeated ware washing, and finished to have a smooth, easily cleanable surface (1).
3. **Cleaning to remove residues:** Physical and chemical cleaning of food-contact surfaces is a prerequisite for effective sanitization. Cleaning involves use of appropriate detergent chemicals for removal of organic matter from food residues to enable sanitizer to come into physical contact with the surface to be sanitized (18).
4. **Sanitization after cleaning:** Sanitization refers to application of heat or chemicals to food-contact surfaces after thorough cleaning and rinsing to yield a 99.999% reduction of representative pathogenic microorganisms of public health importance (1, 18). Heat and chemicals applications are the two sanitization methods used in retail/foodservice establishments. The *Food Code* describes the application standards for heat and chemicals:

**Heat:** Ware-washing machines are required to be able to maintain water of at least 77°C (171° F) in three-compartment sinks equipped with a rack or basket to allow complete immersion of equipment and utensils into the hot water during washing and rinsing.

**Chemicals.** Chemicals approved for use as sanitizers for food-contact surfaces in retail/foodservice establishments contain chlorine, iodine or quaternary ammonium at specified concentrations and contact times to ensure efficacy.

5. **Moisture removal:** *The Food Code* specifies that all dishes should be air-dried before being stacked and stored. This practice is necessary to inhibit the presence of moisture that could support microbial survival and growth (1).
6. **Limits on what materials can physically contact food surfaces:** Sponges, because of their construction are difficult, if not impossible, to clean once they have

been in contact with food particles and contaminants that are found in the use environment. Therefore, sponges provide harborage for vast numbers and types of microbes. *The Food Code* stipulates that the use of sponges should be limited to applications where they will not contaminate cleaned and sanitized or in-use, food-contact surfaces such as for cleaning equipment and utensils before rinsing and sanitizing (1).

7. **Avoid cross-contamination:** Cross-contamination refers to the transfer of microbes from one area, surface, or medium to another (15). In food preparation areas, it is a primary goal to keep raw meat, poultry, and seafood separated from RTE foods like salads and cooked meat by handling them in separate areas and avoid using the same utensils for both types of foods to prevent transfer of residual microorganisms (13).

### **Why Microban antimicrobial technology?**

Food workers and equipment often perform as expected to keep food-contact surfaces clean. However, there can be lapses that result conditions that support to microbial attachment, survival, and growth. These include:

1. Poor hygiene and handwashing practices by food workers and/or consumers in self-service locations can leave food-contact surfaces with higher than expected microbial loads.
2. Over time, the materials from which food service equipment and utensils are made begin to age and are no longer effective in maintaining the cleanliness of food contact surface.
3. Lapses by food workers can result in RTE foods being contaminated with microbes from raw foods; as well as cleaning and sanitizing procedures not being followed. Inadequate cleaning and sanitization of food-contact surfaces before use have been commonly observed in the food service setting. A 2004 U.S. Food and Drug Administration (FDA) report stated that improper cleaning and sanitization of food-contact surfaces before use were commonly observed. Out of Compliance values for cleaning and sanitization ranged from 25% in elementary schools to 58% in supermarket deli departments (18).

Under these conditions, the presence of another level of clean to support existing regulations, procedures, and protocols is valuable.

**Microban antimicrobial technology** is incorporated into Libbey's Constellation™ line of dinnerware at the point of manufacturing. Microban SilverShield® technology, registered with the Environmental Protection Agency (EPA) for food contact, is incorporated into the glaze of the dinnerware. When fired in a kiln, the glaze hardens and forms the exterior surface of the plate. Microban's technology is permanently incorporated into the plate and thus will not be lost even if the surface is scratched. The antimicrobial effect is certified with a proven industrial antibacterial test method, the ASTM E3031-15 that determines the antibacterial efficacy of ceramics surfaces.

**Microban's antimicrobial technology** in Libbey's dinnerware provides an additional level of safeguard by complementing good hygiene practices with a novel means of protection. It is not meant to be an alternative to or a replacement of proper hygiene practices discussed in the previous sections, but rather provide another tool in a systems-based approach. Professional restaurateurs and food operators can rest assured that they are accessing all possible means to protect customers and clients by pursuing all recommended methods of sound hygiene practices in addition to using Libbey's dinnerware with Microban antimicrobial protection.

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