Is there a risk of bacterial overkill in the kitchen?

Charles Penn & Anthony Hilton

Poor kitchen hygiene can lead to foodborne infections. But do the new antimicrobial products provide the right remedy? And can we ever eliminate human error in the home?

The kitchen as a source of infection

There is little doubt that the domestic kitchen is a significant source of foodborne infection. It has been estimated that in western European societies, 50–80% of foodborne infection outbreaks originate in the home. Most of the risk factors in the kitchen are quite well known and include incorrect storage of foods, particularly with respect to temperature, contamination of raw or cooked foods before consumption, by contact with other foods or utensils carrying pathogens, and inadequate or poorly controlled cooking which may allow persistence of pathogens in food. Other factors are less well understood, for example the potential role of domestic pets which may be considerable but for which firm data is hard to find. It is also unclear to what extent organisms originating from the domestic human food handler are implicated in disease.

The vehicles involved

What then of the routes and vehicles for dissemination of micro-organisms in the kitchen? Again, it is self-evident that direct contact between raw and prepared foods can be avoided by an understanding of the route of infection coupled with appropriate handling. For example, it is quite well known that there are risks in storing raw meat, which may be dripping juices, on high shelves in the fridge where foods stored lower down may be contaminated. It is also obvious that knives, chopping boards and hands should be properly washed between operations with raw and prepared foods. There are adequate data to support the obvious risks from moist, dirty locations such as sink wastes. In other contexts, however, there is still a lack of basic information about the importance of potential routes of infection, and some new approaches to control are now being explored. One aspect of kitchen hygiene where the possibility of infection is clear, but hard data is lacking, is the use of dishcloths for general wiping of surfaces and spills. Despite the introduction of disposable paper products such as kitchen rolls, many domestic kitchens still contain a cloth which is used for general wiping of surfaces and sometimes also chopping boards after use. The cloth may typically be rinsed, more or less thoroughly, under the tap after use and frequently will be washed out in the washing up water or bowl and stored damp. It may seldom be properly washed and dried or disinfected and is a prime microbiological habitat! What is the likelihood that this is a key factor in dissemination of pathogens? Again there is very little hard data from recent investigations – older figures may not be reliable against the background of use of modern detergents and kitchen surfaces. The limited information available suggests that while total microbial populations in these cloths may be high, perhaps in the hundreds of millions per cloth, pathogens are sometimes but not always present. One survey suggests they may include members of the *Enterobacteriaceae* such as *Salmonella*, while another indicates little evidence of pathogens other than staphylococci. This is clearly a topic for further exploration.

Strategies for prevention

There is great scope for intervention to improve the microbiological safety of food preparation in the home, and despite the gaps in knowledge indicated above, we are better informed than ever before about the causes of infectious disease and its transmission. Safety of food, and more so its preservation from spoilage, have for centuries been the main drivers in the development of the science of microbiology outside the medical field. Thus the major foodborne pathogens are known and much is understood of their mechanisms of pathogenicity. Less is known generally about their survival outside their human or animal hosts and their transmission between individuals. It is true that the stress resistance mechanisms and survival in the environment of some of the 'paradigm' species such as *Escherichia coli* and *Salmonella enterica* have been well researched. For others, such as *Campylobacter* species, currently the most prevalent foodborne bacterial pathogen, although not the best known to the general public, there is little understanding of persistence and transmission. One of the tools that is available for interruption of this cycle is the use of antibacterial substances to keep these pathogens in check in our food preparation environments.

Antibacterial agents can be broadly categorized into antibiotics, generally taken to be substances with therapeutic potential in infection and therefore by definition harmless or only marginally harmful to the host human or animal, and antiseptics and disinfectants. The latter are generally toxic not only to micro-organisms but also to other life forms, including our own, although limited topical or local application of some 'antiseptics', for example in mouthwashes or skin treatments, may be tolerated. It is mainly with disinfectants that food handling safety is concerned, but there may be parallels in the history of antibiotic use which we should heed.

Risks of overkill

It is well known that micro-organisms have evolved rapidly during the past half century since antibiotic use became widespread to become widely resistant to many of the most useful agents. Their resistance genes have been disseminated both by well understood mechanisms, such as transfer of conjugative plasmids between species, and by newly discovered mechanisms, such as the movement of genetic cassettes or integrons between different genetic elements capable of their expression. It is also becoming clear that horizontal transfer of genetic information, by means not always understood, can lead to 'quantum leaps' in the biological fitness and

adaptation of bacteria to new lifestyles, such as ability to behave pathogenically. Horizontally acquired DNA of this kind can often be detected as an 'island', distinguishable by its differing G+C content for example, in a 'sea' of chromosomal DNA. Thus mechanisms for rapid evolution of resistance, and its spread as genetic elements to other organisms, are prevalent in the context of antibiotic resistance. Why should these processes not also lead to evolution of microbial resistance to disinfectants or antiseptics? To date there is little evidence that they have done so, but clues are beginning to appear that resistance to these agents may currently be evolving in bacteria. Such evolutionary processes are of course driven by selective forces.

It is therefore alarming to see that antimicrobial agents are being used indiscriminately to counter microbial hazards in the home. Although there has been a long history of use of simple disinfectants such as phenolics and hypochlorite in sporadically used domestic cleaners, new approaches and new philosophies are now increasing dramatically the interaction of more discriminating agents with bacterial populations. Incorporation of agents into plastics and cloths, wide-spread use of disinfectant aerosols and impregnated wipes and greater focus on anti-microbial soaps and personal hygiene products are now generating conditions of continuous low-level exposure of bacteria to the antimicrobial agents, exactly the conditions required for selection of resistance mechanisms. Much of this 'progress' is driven by the potential for commercial profitability, and of course advertising is often used to increase the interest and motivation of potential customers. While there is no doubt that antibacterial agents can reduce populations of organisms on surfaces, is there evidence that this will reduce the incidence of foodborne disease? If so, their use can perhaps be justified, but if not, we should stop their abuse and reserve them for use where they are really needed.

Until we have a better understanding of the routes of transmission of pathogens in the kitchen, it is impossible to answer such questions about the value or otherwise of widespread use of these agents. They cannot prevent direct spread of organisms by contact between raw and prepared foods. If routine and 'traditional' washing procedures with hot water and surfactants are incapable of removing pathogens from utensils and surfaces, there is a case for greater use of disinfectants. We need better information and clear answers.

Human factors

We should not neglect to consider the human side of the equation in our delicate equilibrium with micro-organisms. First, what if we eventually virtually eliminate common pathogens from our daily environment? There does seem to be a risk that natural immunity to them will diminish. For example, it is known that *Campylobacter* diarrhoea is commonly less severe, with a lower incidence of dysentery-like symptoms, in developing parts of the world than in environments such as Western Europe or North America. Julian Ketley of the University of Leicester has suggested that in the developing societies this may be due to background immunity, stimulated probably by relatively frequent exposure to the organisms. There is the suggestion that a bit of 'healthy dirt' is beneficial to the maintenance of an effective immune system. Perhaps we are lessening the natural resistance of our own population by over-emphasis on hygiene. Second, is human behaviour modified by over-use of these agents? It is being suggested that if people are reassured by the presence of antimicrobial agents in their kitchen, they may see them more as a substitute for, rather than an addition to, established domestic hygiene practice. For example, impregnated chopping boards and wiping cloths have in some cases been misinterpreted as 'self-cleaning' therefore increasing the potential risk of cross-contamination. Antimicrobial agents are known to be poorly effective in dirty environments. Clearly, it is necessary that consumers be provided with the necessary information to incorporate these types of products effectively into a domestic cleaning regime.

ABOVE:
Incorrect and correct storage of raw and cooked meat in a refrigerator.
PHOTO SGM

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