Sponges and Sinks and Rags, Oh My!

Where microbes lurk and how to rout them

By JANET RALOFF

Think household germs, and chances are you'll think of the bathroom.

Yet when scientists from the University of Arizona in Tucson sample surfaces from kitchens and bathrooms in the same house, "consistently, kitchens come up dirtier," notes microbiologist Carlos Enriquez. This trend holds even for disease-causing germs spread by fecal contamination, such as the *Escherichia coli* coliform bacteria.

"We have swabbed the toilet rim, for instance, and seldom do we find fecal coliform bacteria there, surprising as that may sound," he observes.

Enter the kitchen, though, and they're everywhere—in the sponges, dish towels, sink, even on countertops. "So my boss usually jokes about it being safer eating dinner in the bathroom," he says.

But kitchen pathogens are no laughing matter. In the United States, the diseases they cause kill an estimated 9,000 persons each year—mostly the very young, the very old, and those with severely weakened immune systems. The cost of treating foodborne infections ranges from $5 billion to $22 billion annually, according to an analysis released in May by the U.S. General Accounting Office.

Though state and federal agencies compile records on widespread or highly publicized cases—like the *E. coli* deaths traced to hamburger served at Jack-in-the-Box restaurants in early 1993—they have little information on cases involving just one or two individuals, especially when the ensuing stomach cramps, vomiting, or diarrhea don't lead to hospitalization. However, when researchers have attempted to tally homespun outbreaks, the numbers have proved staggering, notes food safety expert Elizabeth Scott of Newton, Mass.

In the January JOURNAL OF APPLIED BACTERIOLOGY, she reviewed European data on disease that could be traced to food eaten at home. For 1989 to 1991 in England and Wales, for instance, 86 percent of the 2,766 reported outbreaks of salmonella infection involving one or more persons appeared to stem from household exposure.

Says Enriquez, these data indicate that "even though we usually feel more secure eating at home, it doesn't necessarily mean it's safer." He and researchers in a few other labs around the country are now investigating where kitchen bugs lurk, with an eye toward making home cooking safer.

Sponges provide an ideal way to spread disease, a discovery the Arizona researchers stumbled upon while swabbing kitchen surfaces daily in several homes.

Bacteria tend to be concentrated in

Zottola

Amid a field of microscopic food particles (dyed yellow), pseudomonas bacteria (dyed pink) are attaching via thin filaments to a stainless steel surface.

the sink, its drain, and the sponge, Enriquez and his colleagues found. In one home they examined, however, everything from the countertops to refrigerator handles bore consistently heavy contamination—until the sixth day, when most surfaces suddenly turned up virtually germfree. It turned out the family had simply begun using a new sponge.

That was a few years ago. At the American Society for Microbiology meeting in New Orleans last May, Enriquez and his coworkers reported finding that most of the 75 dishrags and 325 sponges from home kitchens that they have sampled harbor large numbers of virulent bacteria (SN: 5/25/96, p. 326), including *E. coli* and strains of *Salmonella*, *Pseudomonas*, and *Staphylococcus*.

They measure bacteria in colony-forming units—one or more cells that, when cultured, generates a clump of bacteria. In wet areas around the sink, and especially its drain, Enriquez's group has measured up to 10,000 colony-forming units per milliliter of moisture sampled. "And we've found up to 10 million colony-forming units in 1 ml of the liquid wrung from a sponge," he told SCIENCE NEWS.

"Initially, we were surprised," he says. In retrospect, the microbiologists realized that continually moist cellulose sponges provide "a very hospitable environment" for bacteria. Key to their survival is a surface easy to cling to, a steady supply of nutrients—even microscopic scraps of food—and moisture.

If a sponge stays moist, the number of live microbes doesn't decrease for 2 weeks. Bacteria can even survive for at least 2 days, Enriquez finds, in a damp sponge gradually drying in the air.

On dry surfaces, resident bacteria survive no more than a few hours. However, Enriquez points out, that's long enough to infect another source of food, or a person's hands during meal preparation.

Though bacteria may love sponges, they happily colonize even stainless steel, notes Edmund A. Zottola of the University of Minnesota in St. Paul. Metal that appears smooth to the naked eye is, from a microbe's perspective, "full of all kinds of nooks and crannies, canyons, gullies, and hills," he observes. Whenever bacteria find a site harboring moisture and food, he says, "they will set up housekeeping and grow."

His studies have shown that if they aren't sent packing quickly, the microbes produce an organic goo with threadlike tendrils "that literally cements the cells to the surface." This allows them to weather the elements—fast-flowing sprays of water, a little rubbing, or a weak detergent solution. Eventually, unrelated families of microbes move in. The resulting cosmopolitan community forms biofilms that further protect its inhabitants.

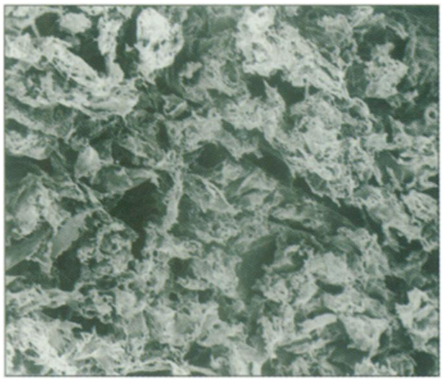
Cutting boards, with their accumulations of scars, also prove hospitable to bacteria. About 4 years ago, Philip H. Kass and his colleagues at the University of California, Davis found that victims of sporadic salmonellosis—infections not linked to large outbreaks—were more likely to use plastic cutting boards than wooden ones.

At about the same time, microbiologist

Dean O. Cliver, then at the University of Wisconsin in Madison, began investigating cutting board hygiene (SN: 2/6/93, p. 84). In the January 1994 JOURNAL OF FOOD PROTECTION, Cliver and his colleagues reported that it is easier to recover live bacteria from a plastic board than a wooden one. In the wood, germs hide out in the millimeter or so below the surface.

More recently, Carl A. Batt of Cornell

Cliver/Park



The surface of a knife-scarred plastic cutting board, magnified 36 times, shows niches where germs can hide.

University and his colleagues discovered that the differences between wooden and plastic boards depend on how moist they are.

"If the wood board is somewhat wet and then you apply bacteria to it, you can pull those bacteria off as easily as you can from plastic," he observes. "But a dry wood board absorbs moisture and draws the bacteria into its pores by capillary action." These findings are slated for publication in FOOD MICROBIOLOGY.

Cliver's group is now investigating whether cutting into the surface of either type of cutting board can retrieve and transport previously hidden bugs to other foods. So far, Cliver told SCIENCE NEWS, knives are "getting more bacteria out of knife-scarred plastic boards than out of knife-scarred wood boards."

The good news is that kitchen germs can usually be removed by some method of cleansing. On metal surfaces, Zottola says, detergent dissolves the food and microbial material. A good rubbing then forcibly evicts most of the squatters. A follow-up, sanitizing rinse—such as a solution of dilute bleach (hypochlorous acid)—will annihilate even the most tenacious hangers-on, he's found. To deter recolonization, the cleansed surfaces must stay dry.

Wood requires a different sterilization regime, Zottola points out, because its organic building blocks will react with bleach, rendering the disinfectant unavailable for killing germs. As a result, cooks have had to be satisfied with just bathing their wooden cutting boards.

In the January 1994 JOURNAL OF FOOD PROTECTION, Cliver and his colleagues showed that it is possible, using soap and water, to hand scrub microbes from the surface of new or used wooden cutting boards and from new plastic ones. Plastic boards that bore the knife scars of use, however, proved resistant to decontamination by hand washing.

Bacteria below the surface of a wooden board are untouched by hand scrubbing and can remain alive at least several hours. Even though at that location they can't contaminate other foods that may contact the board, it remains prudent to kill them, says Cliver, now at UC-Davis.

In a pair of papers to be published in the JOURNAL OF FOOD PROTECTION, Cliver and Paul K. Park report success in annihilating *E. coli* and *Staphylococcus aureus* with microwave heating. They contaminated wooden cutting boards with 1 billion colony-forming units per 25 square centimeters of surface and then cooked the boards on high heat in an 800-watt home microwave oven.

After 10 minutes, a medium-sized board emerged bone dry—and free of live microbes both on and below the surface. Wetting the board speeded the killing, suggesting that the microbes probably boiled to death.

The microwave can also disinfect other kitchen items. Sterilizing dry cellulose sponges took a mere 30 seconds, while wet sponges took 1 minute. Cotton dishrags required 30 seconds when dry but 3 minutes when wet.

No amount of microwaving disinfected plastic boards. That's not surprising, Cliver notes, since their surfaces never achieved cell-killing temperatures. However, studies by others have shown that the normal cycle in a dishwasher can sterilize even well-used plastic boards.

Whether you use wood or plastic cutting boards becomes unimportant at home if you are into cleaning and sanitizing—as all cooks should be, Batt argues.

Many people, however, aren't. A study published last year by scientists at the Food and Drug Administration found that 26 percent of U.S. consumers don't bother to clean cutting boards after using them for raw meat or chicken.

Moreover, many food safety specialists, such as microbiologist Charles E. Benson of the University of Pennsylvania School of Veterinary Medicine in Kennett Square, note that few publications specifically focus on the home kitchen. The few that do, Benson says, generally offer suggestions "based on no concrete evidence."

With a growing incidence of foodborne disease in the United States and limited consumer knowledge, Theodore P. Labuza suspects that the next wave of kitchen safety technologies will be self-disinfecting appliances, packaging, and building materials. A food safety engineer at the University of Minnesota, he sees particular promise in what he has termed "active" surfaces.

Today, he notes, one can buy sponges with bacteria-killing compounds built into the cellulose. There's no reason similar agents couldn't be engineered into countertops, he notes, or the paints used on the inside of refrigerators. Antimicrobial cutting boards are already being sold, and the Japanese are marketing plastic bags that claim to emit germ-killing radiation.

When it comes to food safety, "research paradigm shifts need to occur for the 21st century," he says. Making home kitchens self-disinfecting, he argues, "is certainly one of them." □

Much foodborne disease goes unreported

Occasionally, a single food-poisoning outbreak results in widespread illness. Even in such instances, however, only a fraction of the cases may be officially reported. Nowhere is this better illustrated than by an investigation of the 1994 Schwan's ice cream episode.

Epidemiologists traced this incident, the largest salmonella outbreak ever recorded, to ingredients that had been tainted as they were shipped to the ice cream manufacturer. Government researchers identified how many batches were likely to have been affected and where they had been shipped.

They then meticulously surveyed Schwan consumers in Minnesota (where the ice cream was made) to assess the true incidence of *Salmonella enteritidis* disease and compared their results to the number of cases initially reported in that state. By applying this ratio to the ice cream shipped and eaten elsewhere, the scientists were able to estimate the outbreak's magnitude nationally.

In the May 16 NEW ENGLAND JOURNAL OF MEDICINE, Thomas W. Hennessy of the Centers for Disease Control and Prevention in Atlanta and his colleagues concluded that the toxic ice cream probably caused some 224,000 cases of gastroenteritis—even though fewer than 300 cases of *S. enteritidis* disease had been reported to federal agencies from all causes that year.

If CDC and state agencies missed nearly a quarter of a million cases in this heavily reported incident, imagine how difficult it is for them to detect the occasional gut-wrenching episode caused by microbes from raw poultry that were transferred to salad ingredients chopped on the same countertop 15 minutes later.

In fact, a General Accounting Office review of published studies estimated that as many as 81 million cases of foodborne illness occur each year in the United States—only thousands of which are ever officially reported.