WOOD VS. PLASTIC CUTTING BOARDS

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We began our research comparing plastic and wooden cutting boards after the U.S. Department of Agriculture told us they had no scientific evidence to support their recommendation that plastic, rather than wooden cutting boards be used in home kitchens. Then and since, the U.S. Department of Agriculture's Meat and Poultry Inspection Manual (official regulations) and the U.S. Food and Drug Administration's 1999 Food Code (recommended regulations for restaurants and retail food sales in the various states of the U.S.) permit use of cutting boards made of maple or similar close-grained hardwood. They do not specifically authorize acceptable plastic materials, nor do they specify how plastic surfaces must be maintained.

Our research was first intended to develop means of disinfecting wooden cutting surfaces at home, so that they would be almost as safe as plastics. Our safety concern was that bacteria such as Escherichia Coli O157:H7 and Salmonella, which might contaminate a work surface when raw meat was being prepared, ought not remain on the surface to contaminate other foods that might be eaten without further cooking. We soon found that disease bacteria such as these were not recoverable from wooden surfaces in a short time after they were applied, unless very large numbers were used. New plastic surfaces allowed the bacteria to persist, but were easily cleaned and disinfected. However, wooden boards that had been used and had many knife cuts acted almost the same as new wood, where as plastic surfaces that were knife-scarred were impossible to clean and disinfect manually, especially when food residues such as chicken fat were present. Scanning electron micrographs revealed highly significant damage to plastic surfaces from knife cuts.

Although the bacteria that have disappeared from the wood surfaces are found alive inside the wood for some time after application, they evidently do not multiply, and they gradually die. They can be detected only by splitting or gouging the wood or by forcing water completely through from one surface to the other. If a sharp knife is used to cut into the work surfaces after used plastic, or wood has been contaminated with bacteria and cleaned manually, more bacteria are recovered from a used plastic surface than from a used wood surface.

"Manual cleaning" in our experiments has been done with a sponge, hot tap water, and liquid dish washing detergent. Mechanical cleaning with a dish washing machine can be done successfully with plastic surfaces (even if knife-scarred) and wooden boards especially made for this. Wooden boards , but not plastics, that are small enough to fit into a microwave oven can be disinfected rapidly, but care must be used to prevent overheating. Work surfaces that have been cleaned can be disinfected with bleach (sodium hypochlorite) solutions; this disinfection is reliable only if cleaning has been done successfully.

The experiments described have been conducted with more than 10 species of hardwoods and with 4 plastic polymers, as well as hard rubber. Because we found essentially no differences among the tested wood species, not all combinations of bacteria and wood were tested, nor were all combinations of bacteria and plastics or hard rubber. Bacteria tested, in addition to those named above, include Campylobacter jejuni, Listeria monocytogenes, and Staphylococcus aureus. We believe that the experiments were designed to be properly representative of conditions in a home kitchen. They may or may not be applicable to other plastic and wooden food contact surfaces or to cutting boards in commercial food processing or foodservice operations, but we have no reason to believe that they are not relevant, except that not all plastic surfaces are subject to knife-scarring. Before our first studies had been published, they were criticized incorrectly for not having included used (knife-scarred) cutting surfaces. We had been careful to include used surfaces, and so were surprised that others who did later experiments and claimed to have refuted our findings often had used only new plastic and wood. Although some established scientific laboratories say their results differ from ours, we have received multiple communications form school children who have done science projects that have reached essentially the same conclusions that we did.

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We have no commercial relationship to any company making cutting boards or other food preparation utensils. We have tested boards and cleaning and disinfection products, some of which were supplied to us gratis. We have not tested all of the products that have been sent to us, simply because there is no time. We are aware that there are other food preparation surfaces made of glass or of stainless steel; we have done very little with these because they are quite destructive of the sharp cutting edges of knives, and therefore introduce another class of hazard to the kitchen. **We believe, on the basis of our published and to-be-published research, that food can be prepared safely on wooden cutting surfaces and that plastic cutting surfaces present some disadvantages that had been overlooked until we found them**.

In addition to our laboratory research on this subject, we learned after arriving in California in June of 1995 that a case-control study of sporadic salmonellosis had been done in this region and included cutting boards among many risk factors assessed (Kass, P.H., et al., Disease determinates of sporadic salmonellosis in four northern California counties: a case control study of older children and adults. Ann. Epidemiol. 2:683-696, 1992.). The project had been conducted before our work began. It revealed that those using wooden cutting boards in their home kitchens were less than half as likely as average to contract salmonellosis (odds ratio 0.42, 95% confidence interval 0.22-0.81), those using synthetic (plastic or glass) cutting boards were about twice as likely as average to contract salmonellosis (O.R. 1.99, C.I. 1.03-3.85); and the effect of cleaning the board regularly after preparing meat on it was not statistically significant (O.R. 1.20, C.I. 0.54-2.68). We know of no similar research that has been done anywhere, so we regard it as the best epidemiological evidence available to date that wooden cutting boards are not a hazard to human health, but plastic cutting boards may be.

Publications to date from our work:

Ak, N.O., D. O. Cliver, and C.W. Kaspar; 1994. Cutting boards of plastic and wood contaminated experimentally with bacteria. J. Food Protect. 57: 16-22.

Ak, N. O., D. O. Cliver, and C. W. Kaspar. 1994. Decontamination of plastic and wooden cutting boards for kitchen use. J. Food Protect. 57: 23-30; 36.

Galluzzo, L., and D.O. Cliver. 1996. Cutting boards and bacteria--oak vs. Salmonella. Dairy, Food Environ. Sanit. 16: 290-293.

Park, P. K., and D. O. Cliver. 1996. Disinfection of household cutting boards with a microwave oven. J. Food. Protect. 59: 1049-1054.

Park, P. K., and D. O. Cliver. 1997. Cutting boards up close. Food Quality 3 (Issue 22, June-July): 57-59.

Others are in preparation.

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Research Projects
August 1, 2005
A review of our research on plastic and wooden cutting boards
A review of our protozoan research
Summary of research program at the Food Safety Laboratory: Dean O. Cliver, PhD, Professor of Food Safety, and Maha N. Hajmeer, PhD, Lecturer and Researcher in Food Safety; with guidance from Hans P. Riemann, Professor Emeritus

- We study infectious diseases that are transmitted via food and water. Some are zoonoses, and others are human-specific. In some instances, we use animal agents as surrogates for human pathogens. our laboratory is the World Health Organization's Collaborating Center for Food Virology.

- Animal feeds are sometimes ammoniated to enhance their nutritional value or to reduce levels of mycotoxins. We are studying the ammoniation process from the standpoint of what it may do to reduce on-farm levels of potentially foodborne bacteria, especially Salmonella.

- Sprouts made from alfalfa and other seeds have been vehicles in outbreaks of foodborne disease. We are studying ammoniation as a means to kill bacterial pathogens (e.g., Escherichia coli 0157:H7 and Salmonella) on the seeds before sprouting, hopefully without interfering with sprouting efficiency.

- Some of the most important foodborne viruses are detectable only by the reverse transcription-polymerase chain reaction (RT-PCR), which cannot distinguish between infectious and inactivated virus. We have devised a way to eliminated positive RT-PCR results with inactivated virus. We are trying to expand this while adapting it to detection of virus extracted from foods.

- We are in process of publishing results of work on the persistence of Listeria monocytogenes, Salmonella spp., and Escherichia coil O157:H7 during production and storage of chrizos, a Mexican-style sausage that is often produced and sold in California without inspection. We are seeking funding to expand this work and to include other ethnic products.

- We have bacteria from bovine and swine manure that attack human viruses. With the help of off-campus collaborators, we plan to determine whether these bacteria are also effective against prions, foot-and-mouth disease virus, and other pathogens. We are doing similar screening of thermophilic bacteria from composted turkey manure and of fluids from anaerobic sewage sludge digestion, both mesophilic and thermophilic. These results are intended to lead to composting carcasses of food animals infected with exotic disease agents.

- We are beginning a comparative study, with three other universities, of the incidence of L. monocytogenes in ready-to-eat meat products at retail.

- We are expecting to receive support for collaborative work with the East Bay Municipal Utilities District on pathogen destruction in modified sewage treatment procedures. We are also supposed to be collaborators in an inter-university project to prevent transmission of animal diseases by terrorists. Various other studies are pending.

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Recent publications:

198. Cotruvo, J. A., A. Dufour, G. Rees, J. Bartram, R. Carr, D.O. Cliver, G.F. Craun, R. Fayer and V.P.J. Gannon, eds. 2004. Waterborne Zoonoses: Identification, Causes and Control. IWA (International Water Association) Publishing, London. xvii + 506 pp., including:

    a. Cliver, D. O., and R. Fayer. SECTION V: CATEGORIES OF WATERBORNE DISEASE ORGANISMS, pp. 209-212
    b. Cliver, D. O., and C. L. Moe. Chapter 15: Prospects of waterborne viral zoonoses, pp. 242-254.

199. Committee on Transmissible Spongiform Encephalopathies: Assessment of Relevant Science (incl. D. O. Cliver, member), National Academies Institute of Medicine. Erdtmann, R., and L. B. Sivitz, eds. 2004. Advancing Prion Science: Guidance for the National Prion Research Program. National Academies Press, Washington, DC. xxiv + 258 pp.

200. Hew, C. M., M. N. Hajmeer, T. B. Farver, J. M. Glover, and D. O. Cliver. 2005. Survival of Listeria monocytogenes in experimental chorizos. J. Food Prot. 68:324B330.

201. Hew, C. M., M. N. Hajmeer, T. B. Farver, J. M. Glover, and D. O. Cliver. 2005. Survival of Salmonella spp. and Escherichia coli O157:H7 in chorizos. J. Food Prot. 68:2039-2046.

202. Hajmeer, M. N., I. Basheer, and D. O. Cliver. 2005. Mathematical model for the survival of Listeria monocytogenes in Mexican-style sausage. J. Food Safety 25:226-240.

203. Hajmeer, M. N., I., Basheer, and D. O. Cliver. 2005. Modeling survival curves of Salmonella spp. in chorizos using artificial neural networks and regression. Journal of Rapid Methods and Automation in Microbiology. 13:283-306.

204. Riemann, H. P., and D. O. Cliver, eds. 2006. Foodborne Infections and Intoxications, 3d ed. Academic Press (Elsevier), London, Amsterdam. xvii + 903 pp., including:
    a. Cliver, D. O., S. M. Matsui, and M. Casteel. Ch. 11. Infections with viruses and prions, pp. 367-448.

205. Hajmeer, M. N., D. O. Cliver, and J. L. Marsden. 2006. Central nervous system tissue detection in meat from advanced meat recovery systems. Meat Science 72(4): 656B659.

206. Hajmeer, M. N., I. Basheer, D. O. Cliver, and C. Hew. 2006. Modeling the survival of Salmonella spp. in chorizo. Int. J. Food Microbiol. 107(1):59-67.

207. Hajmeer, M. N., I. Basheer, and D. O. Cliver. 2006. Survival curves of Listeria monocytogenes in chorizos modeled with artificial neural networks. Food Microbiology 23(6): 561-570.

208. Cliver, D. O. 2006. Cutting boards: possible role in Salmonella cross contamination. J. AOAC International 89(2):538-542.

209. Hew, C. M., M. N. Hajmeer, T. B. Farver, H. P. Riemann, J. M. Glover, and D. O. Cliver. 2006. Pathogen survival in chorizos-ecological factors. J. Food Prot. 69(5):1087-1095.

210. Hajmeer, M. N., I. Basheer, and D. O. Cliver. 2006. Reliability-based estimation of survival of Listeria monocytogenes in chorizos. J. Sci. Food Agric. 86:2337B2344.

211. Tajkarimi, M., H. P. Riemann, M. N. Hajmeer, E. L. Gomez, V. Razavilar, and D. O. Cliver. 2008. Ammonia disinfection of animal feeds — laboratory study. Int. J. Food Microbiol. 122(1-2):23-28.

212. Cliver, D. O. 2008. Ch. 3. Viruses and protozoan parasites in food, p. 55–63. In C. L. Wilson, ed. Microbial Food Contamination, 2d ed. CRC Press, Atlanta, GA.

213. Koopmans, M. P. G., D. O. Cliver, and A. Bosch (eds.). 2008. Food-Borne Viruses: Progress and Challenges. ASM (American Society for Microbiology) Press, Washington, DC, xii + 245 pp., including:
    a. Cliver, D.O. Chapter 1. Historic overview of food virology, pp. 1–28.

214. Cliver, D.O. 2008. Review of: L. Fallaice, 2006. Mad Sheep: The True Story Behind the USDA's War on a Family Farm. Chelsea Green Publishing Company, White River Junction, VT (ISBN 1-933392-09-6). Agr. History 82(3):402–403.

215. Cliver, D.O. 2008. Viral foodborne diseases. Proceedings of the FAVA-OIE Joint Symposium on Emerging Diseases, Thai Veterinary Association under the Royal Patronage, Bangkok. pp. S35–S40.

216. Cliver, D.O. 2008. Shedding light on virus replication [invited commentary]. Proc. Natl. Acad. Sci. USA 105:17213-17214.

217. Cliver, D.O. 2009. Control of viral contamination of food and the environment. Food Environ. Virol., in press.