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THE EVALUATION OF WOODEN vs. POLYETHYLENE CUTTING BOARDS USING FLUORESCENT POWDER by O. Peter Snyder, Jr., Ph.D.

Introduction

Traditional surfaces on which food has been prepared for centuries have been wood. These surfaces were commonly cleaned and sanitized by putting salt on the wood at the close of business, scraping it in with a metal brush, which also removed food residue, and then, sanitizing it by putting vinegar or lemon juice on the wood surface. In the last few years, various polymers have become available as cutting boards. Since the introduction of polymer cutting boards, particularly polypropylene and high-density polyethylene, retail food operations inspectors, without research data, arbitrarily decided that plastic must be a safer food contact surface on which to prepare food. They have mandated the replacement of wood cutting surfaces with plastic cutting surfaces. This is in spite of the fact that FDA Food Codes have permitted the use of hard wood cutting boards in food preparation, although the FDA provides no research data to back its position.

Ak *et al.* (1994a; 1994b) showed that wooden cutting boards and plastic cutting boards were comparable and, perhaps, that wood was better in terms of the number of contaminating microorganisms that could be recovered from the surface after cleaning. They used conventional cleaning methods and conventional microbiological surface recovery methods, and showed that both surfaces could be contaminated if not cleaned correctly or could be cleaned virtually free of recoverable microorganisms. It is important to say, "recoverable," because both wood and plastic surfaces are porous, and microorganisms can be absorbed into the material where they may be viable for a time before they die.

Abrisham *et al.* in 1994, using hard maple cutting boards and clear acrylic cutting boards, compared the cleanability of these two food contact surfaces. In their study, however, they biased their results by not cleaning the cutting boards by standard foodservice and FDA code procedures with hot water and detergents, and by using an acrylic cutting board rather than a standard NSF-approved polymer cutting board. In addition, while they did extensive scanning electron microscopy to look for bacteria absorbed in the wood, they did not repeat the study on the acrylic cutting board, apparently assuming that it was non-porous. The conclusion of their study was that acrylic cutting boards were more easily cleaned than wooden cutting boards. The real desired outcome is recoverable microorganisms

on the surface reduced to a safe level. In fact, there never has been a scientific microbiological standard by FDA as to what is a safe level of microorganisms on a clean, sanitized food contact surface.

The only government standards for cutting boards relate to cleaning procedure, which Abrisham *et al.* (1994) did not follow. Actually, any study on cutting boards will be indeterminate until the FDA can identify what a safe level of recoverable microorganisms is on a cutting board after it is cleaned and sanitized. There is a standard for milk bottles.

In cutting board studies, the assumption has been that the polymer cutting board does not absorb microorganisms. In fact, this is a flawed assumption, as shown by the results of this study. In this study, Glo Germ® fluorescent powder in mineral oil was applied to the cutting boards (1 wooden; 1 high density polyethylene; 1 acrylic) to perform a simple visual cleaning test to determine how much residual fluorescent powder remained on the cutting boards after cleaning with common warewashing detergent and procedures.

Procedures

A hard maple cutting board 9" x 9" x 3/4" thick was purchased from Target Stores, division of Dayton-Hudson Corporation, Minneapolis, Minnesota. A 6" x 6" piece of Ziplite®, 800 thermal plastic polyethylene cutting board was provided by C & K Manufacturing, Bay Village, Ohio. The acrylic cutting board was 8" x 10 1/2" x 1/4" from Decorator House, Dallas, Texas. The cutting boards were scarred with typical knife cuts. The wooden and acrylic cutting boards would not groove as deeply as the polyethylene cutting board.

About 3 ml of a mineral oil-suspended fluorescent powder that shows blaze orange under a long wave length (366 nanometers) ultraviolet light was applied to each surface and rubbed in, using a paper towel. The powder particle size is about 5 microns in diameter, about the same size as bacteria. A model UVL-56 Blak-Ray® lamp (UVP Corporation, Upland, California) was used to reveal the fluorescent powder.

After the powder was wiped into the cutting boards, the cutting boards were taken to a sink, rinsed with water at 100°F, and then washed and scrubbed twice with Dawn® (Procter & Gamble, Cincinnati, Ohio) detergent and a Viking brush (Sparta Brush Company, Sparta, Wisconsin) in flowing hot water at 100°F.

After cleaning and drying the cutting boards, they were exposed to the ultraviolet light, and photographs were taken as a simple measurement of cleaning effectiveness.

Results

The results of the experiment are shown in *Figures 1, 2, and 3*. *Figure 1* is a picture of the wooden board and the polyethylene cutting board under typical room fluorescent light. Note the accumulation of the pink fluorescent powder in the grooves and in the surface of the polyethylene cutting board.

Figure 2 shows the same cutting boards under ultraviolet stimulation. It is evident that a small amount of the fluorescent powder has worked its way into the wooden cutting board and has become trapped in the fibers of the cutting board. This occurrence was reported by Ak *et al.* (1994a and 1994b) and Abrisham *et al.* (1994). Note the much greater intensity of fluorescent light from the polyethylene cutting board, indicating a much greater absorption, even after repeated scrubblings using detergent, a scrub brush, and a lot of hot flowing water.

The acrylic cutting board (*Figure 3*) is much harder and does not show general absorption, but still shows unremovable accumulation in the cuts and scratches.

Discussion

It is apparent from this simple experiment using finely ground fluorescent powder that it is a critical flaw to assume that a polymer surface will not absorb bacteria, which are about the same size as the fluorescent powder. The porosity of NSF-approved polymer surfaces is further evidenced by simple observations of polymer cutting boards in food operations where they become stained from food and black mold growth. If polymer cutting boards are not soaked in a bleach solution almost nightly, they tend to become very dirty looking. This extreme procedure would probably make the polymer even more porous. Polymer has the additional problem that there are no rules as to when to change them for new boards. This results in very old polymer cutting boards being used in food operations. Their porosity should be much greater than the new high-density

polyethylene board tested. Sometimes it is suggested that old polymer cutting boards be sanded to remove deep knife cuts. This is a very poor suggestion, because the sanding will leave deep scratches in the polymer.

The non-NSF acrylic cutting board that Abrisham *et al.* (1994) used in their study is not approved for retail operations. While it only absorbed fluorescent material in the cracks, it is hard and brittle, dulls knives, and will chip and get physical objects in the food.

Conclusions

It is evident from this simple experiment that any test of cutting boards to determine their cleanability must be done with great care and must precisely simulate actual foodservice operations and age of cutting boards in order to reach valid conclusions. Residual microbiological levels that are removable must be determined. The general government standard for safety is that there is no recoverable *Salmonella* in a 25-gram sample of a food. Since there are probably less than 100 salmonellae per cm² of food surface, the studies of Ak *et al.* (1994a and 1994b) and Abrisham *et al.* (1994) both indicate that a simple water rinse of a cutting board, followed by washing with detergent, a scrub brush and hot water at >110°F, and rinsing will reduce 100 salmonellae per cm² of food contact surface to an unrecoverable level.

Some of the best sanitizing solutions as approved in 21 CFR 178.1010 (FDA, 2007) are those aqueous solutions containing peroxide and acetic acid that may be absorbed by wooden cutting boards, thus providing residual destruction of microorganisms.

Salt and vinegar worked well for our ancestors and could be used to complement the cleaning process of wooden cutting boards to make them far safer than polymer cutting boards. Further research will show the effectiveness of this salt / vinegar sanitizing process.

References:

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