Bacterial Biofilms Less Likely on Electropolished Steel

When the news came out that stainless steel can harbor bacterial biofilms, a Dallas, Georgia, company decided to test its metal against other materials. The results were good news for anyone wanting to reduce bacterial cross-contamination in poultry.

Cross-contamination occurs as poultry is processed and bacteria from carcasses attach to wet steel surfaces on processing equipment. When the bacteria accumulate, they develop an increasingly complex matrix by attaching to each other and forming a bacterial film that stubbornly resists normal washing.

Wayne Austin is vice president of Simmons Engineering Company. The firm specializes in poultry processing machines. Austin knew that ARS' Judy W. Arnold was testing various kinds of steel for resistance to bacterial attachment. So he asked her to include his company's electropolished steel as part of her research protocol.

Test results showed that the process developed by Simmons to give their machine steel a shiny, chromelike appearance also kept bacteria at bay.

Arnold, a microbiologist in the ARS Poultry Processing and Meat Quality Research Unit at Athens, Georgia, found surface finishing treatments such as polishing, sandblasting, and grinding all reduced buildup of bacterial biofilms. But eletropolishing seemed to work the best.

Electropolishing involves placing steel in an acid bath, then running an electric current through the solution. Arnold has a theory about why this prevents bacterial biofilms: The process may change the electrical charge on the metal. Bacteria are negatively charged, and the charge on a given surface can affect how well they attach to it.

Arnold's findings are important. One reason is that the federal HACCP (Hazard Analysis Critical Control Points) inspection policy requires all meat producers to identify potential contamination areas and take preventive measures. The findings are especially important to the poultry industry because of the fast-paced production.

"Some of our evisceration machines can process 90 to 140 birds a minute," says Austin.

"If eletropolishing can prevent the cross-contamination of bacteria between birds and the buildup of bacteria over time—that's an important quality control."

But it's not just equipment manufacturers who worry about cross-contamination. ARS sponsored a special forum on poultry research at which Arnold presented findings that caught the attention of Michael Robach, vice president of food safety at Continental Grain.

Headquartered in Gainesville, Georgia, Continental Grain is the sixth largest broiler producer in the United States. The company distributes 1.2 billion pounds of ready-to-cook meat and 100 million pounds of ready-to-eat chicken each year.

Robach says he plans to use Arnold's slides of bacterial biofilms on steel to make a point when training plant managers on sanitation and safety.

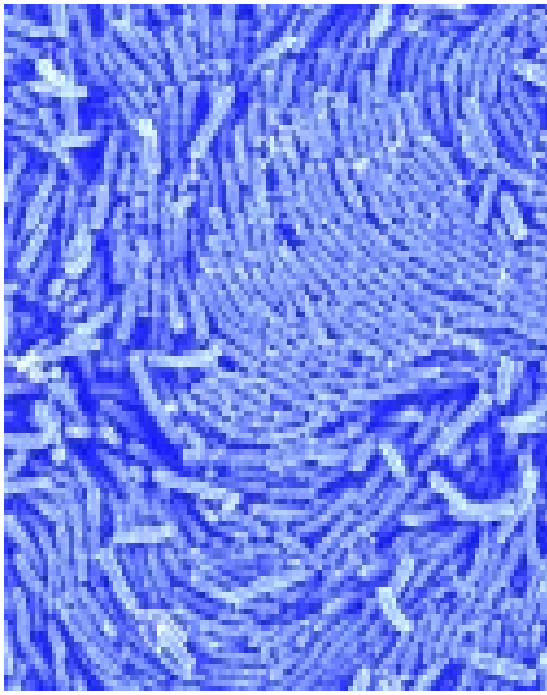
"We want to show them that just because a steel surface looks clean doesn't mean it's bacteria-free," he says. "Our safety protocol includes using chlorine dioxide to disinfect, and we replace our processing equipment regularly."

Arnold says the surface treatments, scouring and others, could be more effective than some cleansers and may also reduce the amount of chemicals required to keep plants sanitary.

"I think industry executives get tired of people throwing chemicals at them as the only solution to *Salmonella*," says Arnold. "What I have to offer will be an effective part of contamination prevention—perhaps with reduced environmental impact."

Arnold says she now plans to explore how and where various bacterial species develop biofilms in processing plants. She will also explore new chemical pre-treatments to prevent biofilms.—By **Jill Lee,** ARS.

SANDRA SILVERS (K7970-4)



As bacteria accumulate on surfaces, they exude a complex matrix of fibrils that connect cells, and many bacteria align side to side. Magnified about 2,500x.

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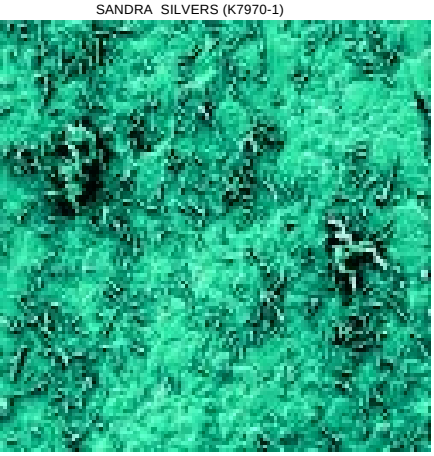
SANDRA SILVERS (K7970-1)



Most of the surfaces in a food processing plant are made of stainless steel that is susceptible to bacterial attachment, as seen here. Magnified about 500x.

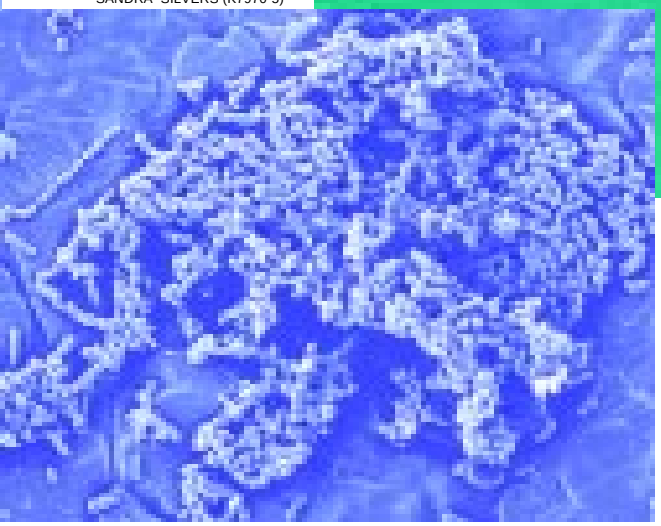
When bacteria attach to a surface, they produce extracellular polymers that anchor the cells and provide a favorable site for attachment and growth of more bacteria, other microbes, and debris. Magnified about 10,000x.

SANDRA SILVERS (K7970-3)

SANDRA SILVERS (K7970-2)

Stainless steel that has been electropolished shows significantly fewer bacterial cells and beginning biofilm formations. Magnified about 700x.

SANDRA SILVERS (K7970-5)



The bacterial composite forms a biofilm that is resistant to cleaners and sanitizers. Magnified about 1,500x.