



Food production: hygiene can be tricky

**Disinfectants help to keep infectious agents in check along the food chain.
However, using them does not come without risks.**

Cleaning and disinfection are just as much a part of the hygiene concept in animal husbandry as well as food production and processing as they are in healthcare. Antimicrobial agents are used in disinfectants and antiseptics – and this also harbours risks. These biocides can select less sensitive microorganisms if they are exposed to only low concentrations of these substances. Furthermore, bacteria could develop antibiotic resistance through non-lethal concentrations of disinfectants (see box on page 27). Certain antibiotics are then no longer effective against these bacteria, and infectious diseases can only be medically treated with great difficulty.

Disinfectants can promote antibiotic resistance

BfR scientists, in cooperation with Jena University Hospital and Freie Universität Berlin, are conducting research on how disinfectants can be used without health risks. The research project (BioZAR – “Impact of biocides on the dissemination of antibiotic resistance

in *Escherichia coli*”) is funded by the German National Research Platform for Zoonoses and the Federal Ministry of Education and Research (BMBF). The experts analyse three possible “adverse effects” of disinfectants (see box).

***E. coli* as an indicator**

The main focus lies on the risk of the spread of antibiotic resistance, using the example of the indicator germ *E. coli*. The research team examines the pathogen, which has been isolated from livestock for meat production, from food, from sick people during and after being admitted to hospital as well as from healthy individuals. It is specifically about its sensitivity to disinfectants, antiseptics and antibiotics.

Preliminary studies put BfR researchers on the right track: together with cooperation partners at Jena University Hospital, they had isolated *Klebsiella pneumoniae* from samples from a hospital outbreak, which



How disinfectants promote antibiotic resistance

Cross-resistance

Cross-resistance occurs when a resistance mechanism makes microorganisms insensitive to several antimicrobial agents at once. So called "efflux pumps", among others things, can be responsible for this: they transport biocides and antibiotics out of the bacterial cells.

Co-selection

Several resistance genes are frequently found together in bacteria on mobile genetic elements, such as plasmids. Different resistances can then be transmitted to a bacterium at the same time and co-selected, or enriched, by biocides.

Stimulating transmission

Low, non-lethal concentrations of biocides can increase the transmission rate of plasmids and, in doing so, possibly directly encourage the spread of resistance genes.

not only showed reduced sensitivity to the antiseptic chlorhexidine, but also cross-resistance to the antibiotic colistin. In another research project, some of the *Listeria monocytogenes* isolates from food production tested demonstrated tolerance to the biocide benzalkonium chloride used in disinfectants. However, cross-resistance to clinically relevant antibiotics was not found.

Within the BiozAR project, the BfR team now uses modern molecular biological techniques, such as whole genome sequencing, advanced statistical methods and machine learning applications. The analyses should provide information for new and improved hygiene guidelines and create more safety for consumers. ■

More information:

Stein, C. et al. 2019. Carbapenem-resistant *Klebsiella pneumoniae* with low chlorhexidine susceptibility. *The Lancet Infectious Diseases*, Volume 19, Issue 9, 932–933. DOI 10.1016/S1473-3099(19)30427-X0

Rödel, A. et al. 2019. Biocide-tolerant *Listeria monocytogenes* isolates from German food production plants do not show cross-resistance to clinically relevant antibiotics. *Appl Environ Microbiol* 85: e01253–19. DOI 10.1128/AEM.01253-19



Bacteria can develop antibiotic resistance due to underdosed disinfectants.