Characterization and quantification of antibiotic resistance genes and mobile genetic elements on fresh produce

Eva Fornefeld, Sven Jechalke, Katja Reimann and Kornelia Smalla
Julius Kühn-Institut, Institute for Epidemiology and Pathogen Diagnostics, Braunschweig
Email of corresponding author: eva.fornefeld@jki.bund.de

Enterobacteria, especially human pathogens consumed with raw fresh produce can cause human illnesses. As foodborne outbreaks associated with fruits and vegetables are a growing concern, there is a need to further investigate the dissemination of human pathogens to plants and understand the factors influencing their survival on the surface and inside of plants. Especially the aspect of internalization into plant tissues is not entirely understood. Putative factors influencing the colonization of plants by human pathogens may be the presence of resistance genes and mobile genetic elements like plasmids.

Fresh produce from supermarkets was screened for occurrence of enterobacteria, antibiotic resistance genes and mobile genetic elements. The bacterial communities of lettuce, corn salad, cilantro and fresh-cut salad were compared using culture-dependent and -independent methods.
Antibiotic resistant bacteria, mobile genetic elements and resistance genes were found to be widespread on fresh produce. The incidence of Enterobacteria and resistant bacteria differed between plant species with the highest numbers found on cilantro. *E. coli* were detected in a few samples and no *Salmonella.* Among the resistance genes detected were *sul1* and *sul2*. These genes confer resistance to sulfonamides, which are widely used in veterinary medicine. Furthermore the *qacE* gene was detected, which encodes for resistance against quaternary ammonium compounds that are used as disinfectants in food producing and clinical environments. Q*acE* genes are often found on integrons, clinically important genetic elements which are able to integrate and exchange gene cassettes. Among the mobile genetic elements on fresh produce classI integrons were found in high prevalence. Also plasmids of the IncP-1 incompatibility group were detected in some of the samples. These plasmids have a broad host spectrum and are able to transfer resistance genes among almost all Gram-negative bacteria including human pathogens. Mobile genetic elements often carry more than one resistance gene which can lead to co-selection and therefore spreading of different resistances.

In summary, resistance genes and mobile genetic elements were detected on fresh produce which might serve also as reservoir for human pathogens. The influence they might have on survival and spread of human pathogens needs to be investigated in further experiments to avoid produce-related illnesses.