Farzana Chowdhury

Abstract of Doctoral Thesis:

"Studies on the uptake of antibiotics in red cabbage and carrots - distribution paths and potential consumer risks"

Worldwide a drastic increase of pathogenic, antibiotic-resistant bacteria is being observed, also due to the extensive use of antibiotics in the animal husbandry. In Germany 30 million tons of animal excrements are excreted every year, which are used as manure on farm fields. Manure can include pathogenic bacteria as well as antibiotic residues and their transformation products or metabolites, respectively. These can be taken up by the roots of agricultural plants and can also be transported to the edible plant organs.
In view of the obvious research gap and the legal loopholes, the objective of this work was to contribute to the study of antibiotic uptake in widely consumed vegetables. For this purpose the potential antibiotic uptake of red cabbage and carrots was investigated in hydroponic culture, as well as under field conditions (red cabbage) and further in red cabbage from conventional agriculture.
First, an antibiotic residue analysis method was developed on the basis of sequential extractions and by means of LC-MS/MS. The applied veterinary antibiotics belong to the drug classes of tetracyclines, sulfonamides, macrolides, fluoroquinolones and beta-lactams. The developed and validated analytical method was successfully applied, except for the case of beta-lactams, which could not be sufficiently extracted from the plants.
For the determination of antibiotic uptake, experiments in hydroponic culture were carried out. The nutrient solutions were spiked with antibiotics. In these experiments, red cabbage and carrots showed an enormous potential for the uptake and transport of chlortetracycline (CTC) and enrofloxacin (ENR). The leaves of red cabbage contained 0.21 mg/kg fresh weight (fw) CTC and 14.6 mg/kg fw ENR. The roots even contained up to 60 mg/kg fw CTC and 72.8 mg/kg fw ENR. The amounts in the edible parts of carrots were 6.0 mg/kg fw CTC and 4.1 mg/kg fw ENR. The roots respectively, contained 70.5 mg/kg fw CTC and 72.8 mg/kg fw ENR. Components of other drug classes (sulfadiazine, monensin) were detected only in small quantities and were partially converted into metabolites.
Furthermore, a field experiment was conducted to obtain additional information on factors influencing the bioavailability of soil-bound antibiotics. Red cabbage was grown on experimental plots that were fertilized with manure, to which antibiotics (CTC and ENR in combination) were added. The residue analyzes of various plant organs (roots, edible parts) regarding the uptake of ENR have shown levels of 9.2 to 16.9 µg/kg fw, whereas CTC could not be extracted. This is probably due to its strong sorption to soil matrix. Analyzes of the soil from the experimental plots have revealed, however, the presence of ENR, CTC and CIP, a metabolite of ENR.
In addition, red cabbage from fields of common agriculture was assayed for antibiotics. The assays started with the fresh harvested red cabbage through various stages of production up to a sellable product (canned red cabbage). And indeed, positive results of tetracycline (from 16.4 to 19.2 µg/kg fw) were detected in freshly harvested cabbage.
The results of this study provide further insights into the possible antibiotic exposure of consumers in the intake of vegetable food. Systematic screening studies of exposure to antibiotics of agricultural plants will provide a starting point for assessing consumer risks. These screening studies can be conducted through conventional and organic farming in combination with microbiological studies.