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Abstract of Thesis:

„Investigation on the uptake und transport of antibiotic active substances into cereal and vegetables"

In Germany, approximately 30 million tons of liquid manure are used as farm fertiliser for the cultivation of grain and vegetables. The broad spectrum of veterinary antibiotics such as tetracyclines, sulfonamides, fluoroquinolones and coccidiostats originating from veterinary application are discharged with liquid manure onto agricultural fields. In a former study transfer of antibiotics from slurry fertilised soil into the grain of winter wheat was discovered. It cannot be excluded to date that the observed antibiotic concentrations in the wheat, although low in grains, can contribute to the risk of developing bacterial antibiotic resistance. Unclear remained, however, whether such a transfer also occurs in commercial agriculture as antibiotic concentrations are usually lower in those slurries than in the one used in the study mentioned above.

In the first part of the work here, through a screening study cereal was sampled in areas with high livestock concentration in Northrhine Westphalia and Lower Saxony and analysed. In the second part the potential of leek and cabbage for uptake of highly prescribed veterinary antibiotics was tested in hydroponically grown plants. A further aim was to gain data on the situation of vegetables grown in agricultural practise with regard to antibiotic residues.

For the analysis of grain and vegetable LC-MS methods were developed, validated and applied. The sample preparation of these methods, include the solid/liquid extraction of the ground corn as well as homogenized vegetable with citrate buffer, followed by clean-up and preconcentration with solid phase extraction (SPE). Identification of antibiotics findings with low resolution mass spectrometry (ESI-ion trap detector) have been confirmed by high resolution FTICR-MS.

Analyses of grain from Northrhine Westphalia harvested 2005 led to verified positive findings of tetracyclines and their metabolites in the range of ~30-95 µg/kg fresh weight (FW). In grain sampled 2006 in Lower Saxony doxycycline was detected (30 µg/kg FW). Commercial grain samples contained traces of enrofloxacin (max. 32.7 µg/kg FW) and oxytetracycline (below the limit of determination). The results of experiments in hydroponic cultures, using defined concentrations of antibiotics in the nutrient solution, evidently demonstrate that cabbage and leek have a very high potential for uptake of a number of veterinary antibiotics, especially for tetracyclines and enrofloxacin. Some vegetable samples from agricultural practice resulted positive findings of tetracycline and ciprofloxacin.

The results of this work and the studies mentioned above revealed a novel way of human exposure to veterinary antibiotics by plant derived food. A risk assessment for consumers is not yet possible, because the number of systematic investigations is too low and the data base too small. As a consequence, further investigations are urgent.