

Report for 2003IA36B: Veterinary antibiotics: Transport to and degradation in surface water

There are no reported publications resulting from this project.

Report Follows

Veterinary Antibiotics: Transport to and Degradation in Surface Water

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Summary

Tylosin: mobility in a manure-soil matrix and dissipation in surface water. Tylosin is a veterinary antibiotic commonly used as a livestock feed additive for growth promotion and disease prevention. Tylosin enters the environment via application of manure to soil and has recently been detected in many surface water bodies. Little is known about the fate of tylosin in a manure-soil matrix. In this study, the mobility of tylosin was investigated using intact soil columns treated with swine manure spiked to 5 mg/kg tylosin. Following a single rain event, leachate was examined for tylosin. Using ELISA and LC/MS/MS, 0.8 ng/mL total tylosin was detected in leachate, with tylosin isomers A and D comprising 22% and 65%. Over 80% of total tylosin applied to soil columns was tylosin A, thus indicating differential mobility and/or persistence of tylosin D. Our data indicate that tylosin can move in an agronomic soil. Our second objective was to determine the fate of tylosin in surface water and the potential for phytoremediation by an aquatic plant (*Ceratophyllum demersum*). Dilute pond water fortified to 10 ng/mL tylosin received treatments including 0.1% manure solution and vegetation, alone and in combination. Dissipation of tylosin was monitored over 24 days. Solutions receiving manure treatments had a significant decrease in tylosin concentration compared to manure-free treatments beginning at day 4; this decrease could be due to increased microbial degradation or binding of tylosin to organic matter. Vegetation did not have a significant effect on dissipation during the 24-day test; however, trends indicate a possible effect beyond day 24. This study provides data and methods that may be useful in risk assessment of antibiotics and manure management in the environment.

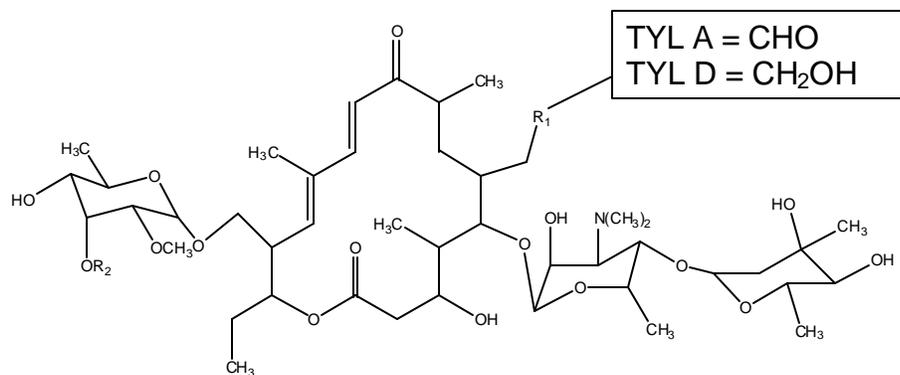
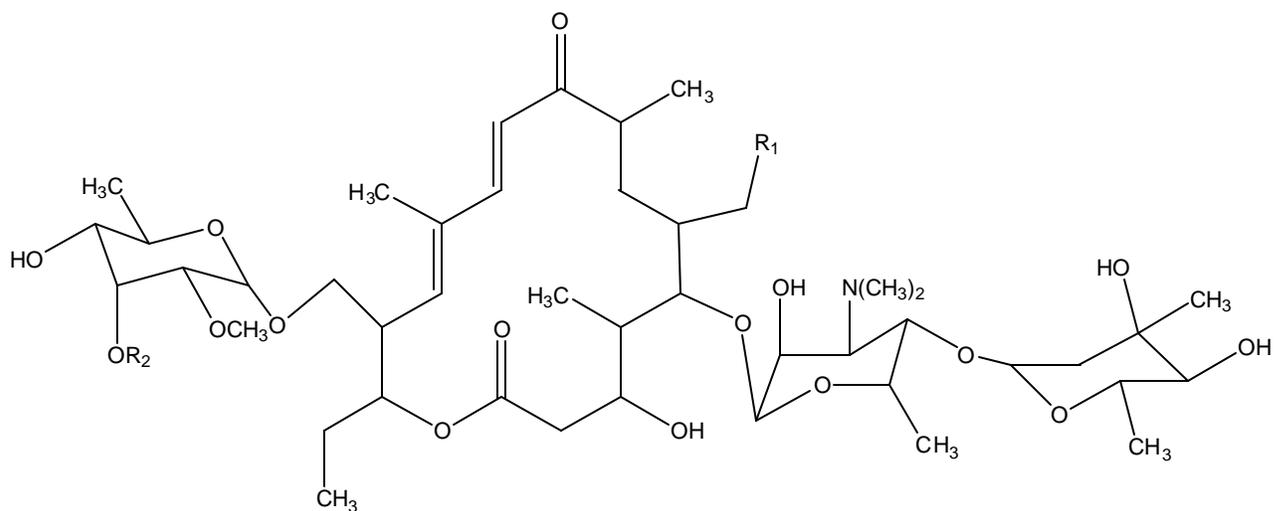
Introduction

Tylosin

- Macrolide class, related to erythromycin.
- Used only in veterinary medicine.
- Mostly active against gram-positive, but also some gram-negative bacteria.
- Mode of action: Inhibition of transcription at 50S ribosomal subunit.

(FAO/WHO, 1991)

Tylosin



- Tylosin A (TYL A) is most prevalent in formulation at >80%.
- Tylosin D (TYL D) is 2nd at ~10%.
- Tylosins B & C are less prevalent forms.
- Koc = 500 to 8000, pKa = 7.1, water solubility = 5 g/L.

- Tylosin is ranked first among antibiotics used in swine production (31.3% of sites surveyed) (Bush & Biehl, 2001).
- It has been well documented that antibiotics, including tylosin, are excreted in urine and feces and may be converted from metabolized forms back into parent compound.

Purpose

Need for investigation of environmental fate of veterinary antibiotics because of high usage rates and concern over microbial resistance.

Objectives

- To evaluate the mobility of tylosin and *E. coli* in a manure-soil matrix.
- To determine the fate of tylosin in surface water and the potential for phytoremediation by a submerged aquatic plant species.

Results

Manure treatment appears to have an effect:

- Possible binding to organic matter.
 - Extraction
- Possible microbial degradation related to manure.
 - LC/MS/MS at end of study to determine metabolites.

Immunoassay

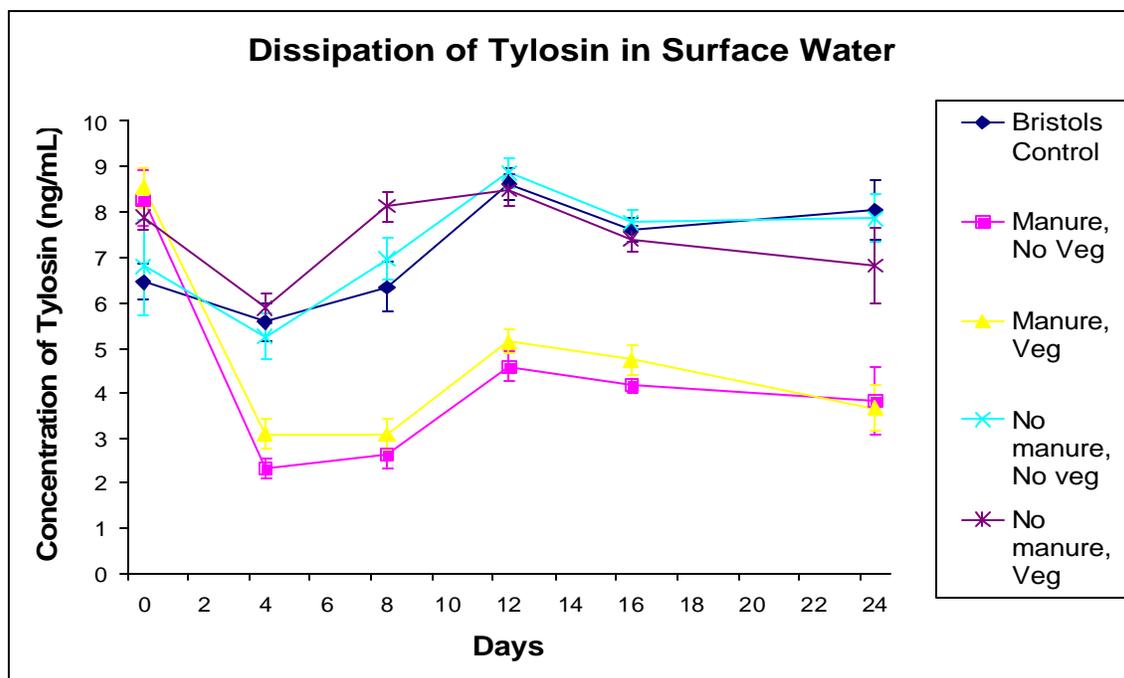
- Treatment leachate mean value of tylosin 0.60 ng/mL (se=0.08).
- Background interaction of control leachate.
- Mean=0.35 ng/mL; se=0.07.
- Detection limit = 0.5 ng/mL.

No significant difference between treatment and control values (two-sided p-value = 0.0577).

Methods—Dissipation in Surface Water

- No significant differences at initial time point.
- Significant differences at days 4, 8, 12, 16, and 24 between treatments with manure and those without manure (0.05 level; p-value <0.001).
- Coontail did not appear to have an effect on tylosin dissipation (two-sided p-value = 0.0809).
- Manure treatment appears to have an effect.
- Possible binding to organic matter.
- Possible microbial degradation related to manure.

Results



Conclusions

- Tylosin D vs. Tylosin A
 - D may be more stable or more mobile.
 - TYL A may be more easily degraded or less mobile.
- Interaction with immunoassay needs to be explored.
 - Actual background tylosin highly unlikely, possible cross reactivity with native microorganisms producing very low levels of tylosin.
- Preliminary results indicate that tylosin can move in an agronomic soil.
- Previous work by Rabølle & Spliid (2000) in sandy soil indicated no tylosin in leachate.
 - Limit of detection 7 µg/L.

Future Directions

- HPLC-UV and LC/MS/MS methods correlated with enzyme immunoassay.
- Repeat study with varied manure application rates and tylosin rates.
- Additional leaching events.
- Increased efficiency of extraction of tylosin from soil.

Acknowledgements

Dr. Todd Phillips

Dr. Tom Carson

Iowa State Water Resources Research
Institute

Dr. Tom Moorman

Beth Douglass &

Kenwood Scoggin, USDA-ARS, NSTL

The Ronald Deppe family