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IMPACT OF PHOTOLYSIS AND MANURE-BORNE BACTERIA ON THE FATE OF STEROID HORMONES

Thomas Borch*, Jessica G. Davis, Catherine R. Simpson, R. B. Jones, Jennifer M. Jones, Lu Hai

ABSTRACT: The estrogen, androgen, and progestogen excretion rates of farm animals in the US have been estimated to 49, 4.4, and 270 t/yr. Animal waste (manure) are often being used as fertilizer on agricultural soils. Land application of manure thus has the potential for steroid hormone leakage or runoff into the aquatic environment. Steroid hormones can cause endocrine disruption in humans and wildlife. Consequently, it is important to determine the fate of steroid hormones to enable predictions of their long-term effects in the environment. However, the fate of hormones in manures, soils, and waters is poorly understood.The objectives of this study were thus to determine the impact of direct and indirect photolysis by UVA light and (bio)degradation by manure-borne bacteria such as Escherichia coli on the fate of 17beta-estradiol, testosterone, and progesterone.Samples containing 17beta-estradiol (estrogen), testosterone (androgen), or progesterone for the photolysis study were placed in a photochemical reactor, followed by irradiation with UV-light in the range of 305-410 nm. Experiments were conducted in 10 mM phosphate buffer (pH 5.5) in the absence and presence of photosensitizers (i.e. 10 mg/L KNO3, 5 mg/L humic acid (HA), or a mixture of KNO3 and HA). The impact of manures from cattle, poultry, and swine on the degradation of testosterone was studied in aerobic batch experiments by adding testosterone to the manures and one pure E. coli culture in flasks that were shaken over a period of 7 days. Samples were taken out periodically in both studies and analyzed for parent-compound and potential degradation products using HPLC-DAD and mass spectrometry.Photolysis of 17beta-estradiol, testosterone, and progesterone was observed. Interestingly, 17beta-estradiol was only photolyzed in the presence of HA. Testosterone and progesterone were both directly photolyzed, however, increased photolysis was observed for testosterone in the presence of HA. The half-lives for the photolytic reactions ranged from 3 to 6 hours. Ongoing work involves the manure related studies and characterization of (photo)degradation products formed in these experiments.This study indicates so far that photolysis of hormones might be an important removal mechanism in aqueous environments and that humic acid can influence the photodegradation potential.

***** Assistant Professor, Colorado State University, Department of Soil and Crop Sciences, 1170 Campus Delivery, Fort Collins, CO 80523-1170, USA, Phone: 970-491-6235, Fax: 970-491-0564, Email: borch@colostate.edu