Fact Sheet: Tough Questions about Beef Sustainability

Project Title: Are Residues of the Growth Hormones Used in Cattle in our Drinking Water?

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Hormones are naturally produced by the endocrine system of humans and other animals, and regulate growth, development, and reproductive processes. Plants also produce hormones, or plant regulators, which are chemical substances that influence growth and specify cell function. Hormones and their metabolites are excreted out of the body of humans and other animals in the feces and urine, which may be used to supply nutrients as fertilizer, but often end up in the environment through manure disposal or manure runoff. Endogenous hormones are naturally produced in the body, whereas exogenous hormones are produced outside of the body. Exogenous hormones are derived from either natural or synthetic sources, and are incorporated into products such as birth control pills or hormone implants used in livestock. Cattle producers have been using hormone implants in cattle for more than 50 years in order to increase growth rates and feed efficiency.

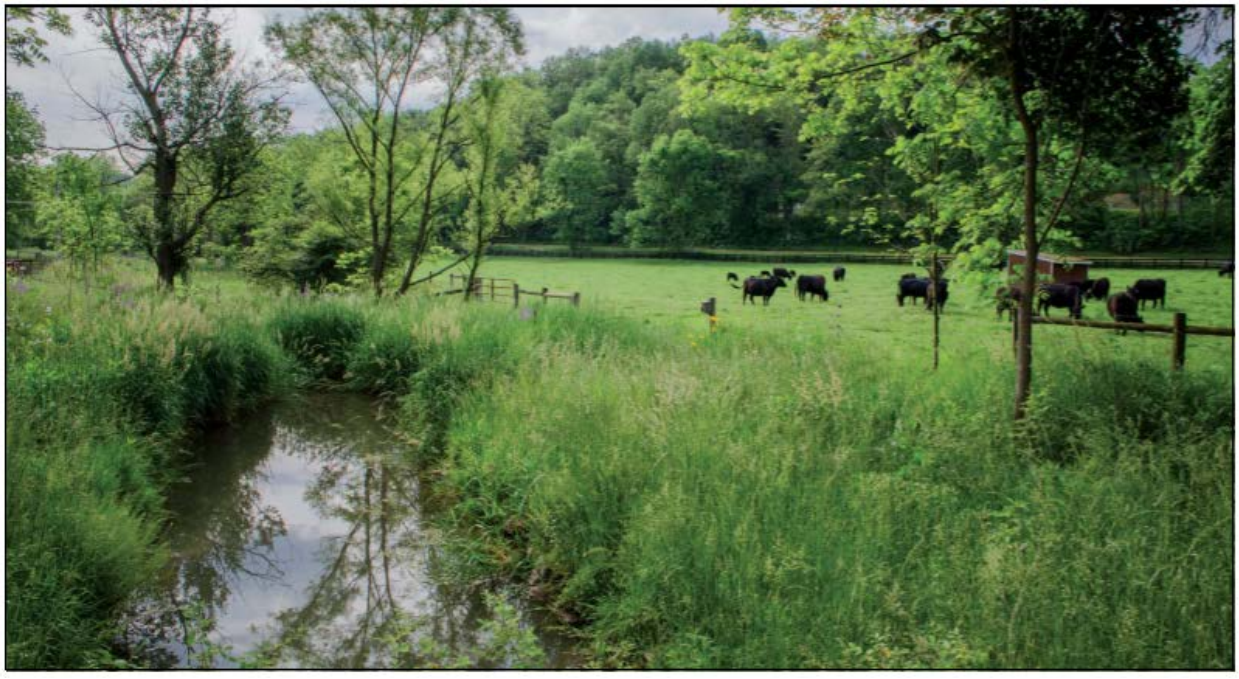

Figure 1. A stream that has been fenced off to prevent cattle access. This management practice by farmers and ranchers can minimize the risk of hormones excreted by cattle from entering water supplies.

Currently, six hormones are approved for use in cattle: three natural (estradiol, testosterone, and progesterone) and three synthetic (melengestrol acetate [MGA], trenbolone acetate [TBA], and zeranol). The synthetic hormones are chemically similar to and mimic the actions of natural hormones. Some of these hormones are feed additives utilized over a short time span to regulate the estrus cycle and synchronize breeding in females such as with MGA. Others are small inserts placed under the skin of the ear to enhance growth of lean tissue and increase feed efficiency. The implants

cattle receive contain low doses of hormones, which translates into little difference in the concentrations of hormones in the beef consumers eat.

Cattle are typically implanted upon arrival at the feedlot and the hormones can be detected in the manure the day after implantation.[1,2] While both exogenous and endogenous hormones can quickly make their way through the body and be detected in the manure, the hormones also degrade relatively quickly when they enter the environment.[3] For example, TBA and estradiol are the two most common hormones used in beef production.[3] Their presence in manure can quickly be detected after implantation, but degradation of TBA and estradiol occurs within 5.1 days and 12.4 days, respectively, in feces and 9.5 days and 8.6 days, respectively, in urine.[3] The rate of degradation for these hormones increases when urine and feces are mixed with soil, as happens on the surface of feedlot pens.[3] Soil contains natural microorganisms that can break down the carbon-rich backbone of steroids to use as an energy source.[4]

The quick breakdown of hormones in the environment is advantageous and limits their environmental impact, but producers are implementing additional manure management practices to minimize the impact potential. Mechanical separation is a promising technique to remove the hormones that are not degraded naturally from the environment.[5] The process is completed by placing the manure into a tank and using mechanical or chemical means to separate urine from feces.[5] The hormones remain with the solid material, allowing the liquid portion to still be used as agricultural fertilizer without risk of adding excess hormones to the environment or water supply.[5] Composting and utilizing microorganisms have been successful in dramatically reducing the concentration of hormones in manure by allowing time for the natural process of degradation to further break down hormones. The microorganisms can be used to speed up the breakdown process by either hydrolyzing or oxidizing hormones which renders them inactive.[4, 6] Other beneficial management practices include maintaining grass buffers between sites of manure application and waterways (Figure 1) and increasing aeration in manure-holding lagoons.

While some research has found steroid hormones in very small concentrations downstream from feedlots, none have been found in tap water supplies meant for human drinking water.[7] Water treatment in the United States is highly effective in removing steroid hormones from drinking water, and though our detection methods are extremely sensitive, steroid hormones have not been detected in drinking water in concentrations at which a physiological effect could be expected. Regardless, reducing the amount of hormones from beef production in surface waters is vital to the health and welfare of aquatic and avian species[1-5] and the quality of the water supply. However, it is important to consider our own contribution to hormone contamination in water sources.[6] Human wastewater facilities and septic systems are common contributors of hormones into freshwater sources. In fact, solids from wastewater treatment plants are land-applied. Therefore, implementing better management practices for humans discarding hormone supplements or other pharmaceuticals is essential in maintaining water quality.[6]

Bottom line: Cattle production does contribute to the amount of natural and synthetic hormones found in the environment. However, the short lifespan of these hormones as well as natural degradation and manure management practices reduce the impact of these compounds on the environment. There is no evidence that growth hormones used in cattle are in tap water supplies meant for human drinking water use.

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