

Contamination of the Chemical Commons

Many thousands of chemicals are known or suspected to interfere with the endocrine system in mammals. Such endocrine disrupting chemicals (EDCs) can produce adverse health effects by blocking or mimicking naturally occurring hormones. EDCs most frequently exhibit agonist or antagonist estrogenic (EA or AEA = EA**) or androgenic (AnA or AAnA = AnA**) activity that has been linked to a variety of adverse health effects in mammals (including humans), including reproductive problems (reduced sperm counts, ovarian and uterine dysfunctions), obesity, increased fetus mortality, various cancers, type II diabetes, learning disabilities, behavioral abnormalities, and increased rates of sexual maturation in females. Fetal, infant, and juvenile mammals are potentially especially sensitive to very low dosages (ppb to < ppt levels) of chemicals having EA** or AnA**.

The “tragedy of the commons” is a metaphor used by Garrett Hardin for economic problems where it is hard to coordinate and pay for public goods. It is a problem long-recognized by game theorists and economists (including Adam Smith and David Ricardo) and biologists. It is often modeled as the fate of a common pasture shared among rational, utility-maximizing herdsmen: As the population of sheep increases, the pasture is destroyed because no individual has meaningful property rights that prevent placing many sheep on the commons that destroy the utility of the commons. However, no one herdsman, or his sheep, is responsible for the tragedy. In today’s world, the tragedy of the chemical commons means that many commercially-available products release chemicals having EA**/AnA** in small quantities whose additive effects have significant adverse effects on our “commons environment”, especially on fetuses, newborns, and juveniles. But, like sheep, no one product or manufacturer is responsible. The “chemical commons tragedy” of combined effects of many products releasing chemicals having EA**/AnA** is perhaps the most serious chronic health problem not yet fully recognized by companies, consumers, and governments -- and is a problem we try to solve at several levels.

We have developed, robotized, and validated with ICCVAM/NICEATM/OECD (or undergoing validation) a battery of *in vitro* assays using MCF-7 cells or BG1-Luc cells to detect EA** and MDA-Kb2-cells to detect AnA** that are the most accurate and sensitive currently available, in part due to our developing Confirmation Assays. Using these assays, we have demonstrated that the great majority of plastic, silicone and personal care products release a variety of chemicals having EA**/AnA**. Using these assays, we have created a knowledge base of commonly-used chemicals and materials having EA**/AnA** or EA/AnA**-free used to make plastics and personal care products. Using this knowledge base and a knowledge of polymer chemistry, we have identified or developed formulations for products that leach *no* chemicals having detectable EA**/AnA** after extraction with hydrophilic or hydrophobic solvents or after common-use stresses of heating, boiling microwaving, UV radiation. This approach differs from that used at present by various commercial, academic, regulatory or government entities that address problematic ingredients having EA**/AnA** (e.g., BPA) one-at-a time without considering that many other ingredients also have significant hormonal activity, more than one solvent is often needed and products may be exposed to common use stresses that create new chemicals. Furthermore, replacing chemicals one-by-one is much more costly than reformulating to eliminate all ingredients having EA**/AnA**.

We believe that when a large variety of EA**/AnA**-free** products become available to the public, this will reduce the potential health problems associated with EDCs of which EA**/AnA** are the most frequent hormonal effects in the “chemical commons”. We believe we are the leading laboratory in this area of hazard analysis, public awareness and genuine health-related product solutions to a problem now being recognized by government agencies and consumer groups.