Chemical Mixtures: Parabens and Triclosan
Shakila Balkhi, Simrun Bhullar & Kierah Leverton
Department of Environmental and Occupational Health
California State University, Northridge

ABSTRACT
Triclosan and parabens are endocrine-disrupting chemicals that are used in personal care products to reduce or prevent bacterial contamination as well as to preserve the product. These chemicals have been introduced into the cosmetic industry to lengthen the shelf life of most products.

These chemicals have not been in use long enough to determine long term health effects and have created an experimental generation within our society. However, animal studies have predicted the chemicals to affect the endocrine system via hormone disruption. Comparison of Triclosan and parabens will examine related mechanisms of actions and similarities among the chemicals. Scientific literature was reviewed to determine possible health effects, bioaccumulation, mechanisms of action, and regulations of the chemicals. Further review of studies determined Triclosan and parabens may have synergistic effects when interacting.

INTRODUCTION
Triclosan is a common chemical found in toothpaste, mouthwash, deodorants, soaps, textiles, toys, food coating, and plastic kitchenware. It is known for its antiseptic properties and is detected as a persistent environmental contaminant in food sources (12). The routes of exposure for parabens are from ingestion, dermal absorption, and inhalation from contaminated air and dust. Parabens are readily metabolized in the liver which results in the distribution of free parabens and adducts of PABA, glucurone, sulfate, and glycosides (14).

PARABENS
Parabens are chemicals used as preservatives in pharmaceuticals, cosmetics, lotions, skin cleansers, and perfumes (9). They are used to prevent bacteria growth and have been commonly used since the 1950s. Parabens are found in 85% of cosmetic products (1). The routes of exposure for parabens are from ingestion, dermal absorption, and inhalation from contaminated air and dust. Parabens are readily metabolized in the liver which results in the distribution of free parabens and adducts of PABA, glucurone, sulfate, and glycosides (14).

According to a study done on parabens in surface water and fish from the greater Pittsburgh area, methyl paraben and butyl paraben were found in surface waters at concentrations ranging from 2.2 to 17.3 and 9.2 to 120 ppb, respectively (3).

ENDOCRINE SYSTEM
The endocrine system is a collection of glands that secrete and produce hormones in the body that regulate the activity of cells and organs. The hormones are released into the bloodstream and are carried to the target cells, where they interact with receptors on the cell membrane or inside the cell. The hormones then influence various physiological processes, such as growth, development, and metabolism. The endocrine system is involved in the regulation of blood pressure, body temperature, electrolyte balance, appetite and body weight, glycerol and ketone body production, production of substances that influence the release of thyroid hormones and sleep cycles.

MECHANISMS OF ACTION
The mechanisms of EDC’s include chemicals binding to hormone receptors and exerting direct agonist or antagonist actions, exerting indirect agonist or antagonist actions, or binding to allosteric sites and yielding unexpected results at low concentrations (5).

Triclosan and parabens are known endocrine disrupters and create estrogen in the body by binding to estrogen receptor sites (1). According to the Journal of Applied Toxicology, Triclosan also exerts estrogenic activities by inducing sulfotransferase activity in an ER reporter gene assay (7).

This schematic represents the different mechanisms of estrogen-signaling:

- Direct genomic signaling pathway: binds to the E2 (17-Beta-estradiol) estrogen receptor and activates the estrogen responsive elements.
- Indirect genomic signaling pathway: E2 activated ESR's bind DNA through protein-protein interactions with transcription factors as their respective response elements.
- Non-genomic signaling pathway: binds to ER at the plasma membrane, which activates various protein-kinase cascades and can lead to changes in gene expression due to phosphorylation of transcription factors.
- Ligand independent signaling pathway: CA activation and target gene transcription through phosphorylation of ESR.

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EFFECTS ON ENDOCRINE SYSTEM

- Methyl- and Butyl-paraben: Increase in Thyroid Hormone production
- Methyl-, ethyl-, n-propyl-, and n-butyl-paraben: Inhibited estrogen receptor binding
- Butyl paraben: Bind to estrogen receptors
- Triclosan: Displaced estradiol from estrogen receptors

REGULATIONS
Regulations for parabens and triclosans are minimal and are currently under review within several governments. The European Union and Canada currently have regulations for parabens. However, within the United States the Cosmetic Ingredient Review concluded that they were safe in cosmetic products up to 25%. Triclosan is currently not regulated within the US and is under further review.

REFERENCES