

Parabens are a group homologous series of hydroxybenzoic acid that are esterified (including methyl-, ethyl-, propyl-, butyl-, heptyl-, and benzyl- parabens) and are used individually or in combination to possess antimicrobial properties. Parabens are considered very effective antimicrobial agents and are widely used in a variety of pharmaceutical products, food additives, and makeup products. Antimicrobial activity increases within parabens as the chain length of the ester group increases, likewise water solubility decreases. (1). Parabens are an essential part of many products. They are generally considered safe to use, stable over the pH range, and are sufficiently soluble in water to produce the effective concentration in aqueous phase. (1). Once in the blood stream, they can be conjugated in the liver with sugars or sulfates for excretion in the urine.

Parabens also pose a variety of health concerns despite their advantageous effects and low toxicity. They are lipophilic and can be absorbed through the skin (i.e. use in makeup products) and are found intact in tissue. Parabens have been found in breast cancer tissue in levels ranging from 20 ng/g tissue to 100 ng/g tissue. (2). This recently surfacing information does not however determine a cause and effect relationship between parabens and breast cancer. Both phenols and parabens are categorized as endocrine disrupting compounds that are widely used in a variety of consumer products. Not all phenols can activate estrogen receptors but studies show that parabens can weakly bind and activate estrogen receptors. (4). They also have been noted to induce the growth of MCF-7 human breast cancer cells *in vitro*, leading some researchers to indicate their potential as initiators or promoters of breast cancer. (3). One study found that competitive inhibition of [3H]oestradiol binding to MCF7 cell oestrogen receptors could be detected at 1,000,000-fold molar excess of n-butylparaben (86%), n-propylparaben (77%), ethyl-paraben (54%) and methylparaben (21%) respectively. (4). It was also noted that

the interaction energies were negative values, because the total energy decreases as the bonds made were stronger than steric interactions. Others indicate that the estrogenic effects of parabens are too weak to cause issues. The xenoestrogenic properties of parabens is an ongoing research debate, the current consensus among the scientific community is that paraben's effect on human health, including cancer risk, is attributed to more than estrogenic mimicry. Paraben's properties pose a risk to public health for these reasons, including the possession of properties that inhibit gene regulation and increased cell production. One study compared paraben binding to an estrogen receptor induced in yeast and estrogen receptors within mammalian cells. Notably they reported relative binding of parabens to the receptors. It was additionally determined that halogenating parabens weakens binding activity if two halogens were present. (5).

This study will analyze the antimicrobial activity of modified parabens to determine if they can still kill bacteria. This data will indicate evidence to support or contradict the idea that they are "safer" in this regard. Antimicrobial properties of various paraben derivatives were analyzed in a micro dilution assay to determine minimum inhibitory concentrations (MIC). The esters on parabens will be modified in order to make multiple parabens by altering the final step. Only the wells containing the compound will be diluted in the MIC assay. The focus is on determining if the compounds still have antimicrobial properties following dilution.

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