

# Cornell University

## Program on Breast Cancer and Environmental Risk Factors (BCERF)

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Research Commentary

## Five Types of Parabens Detected Intact in Human Breast Tumors

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### Background

Parabens have been used as preservatives since the 1920s. Chemically, parabens have a simple structure. They consist of a 6-member carbon ring with a hydroxyl group on one side (-OH) of the ring and a side chain called an alkyl ester on the opposite side of the ring. The side chains can be of varying lengths. Parabens are used to prevent the growth of bacteria in a wide range of consumer products, including a variety of foods and pharmaceutical drugs. The most prevalent use has been as a preservative in cosmetics, including facial and body cosmetics, skin care products, shampoos and conditioners, sunscreens, underarm products (antiperspirants and deodorants), colognes and perfumes, and soaps, including liquid hand soap. One of the most widely quoted sources of information on use, exposure and safety of the four most commonly used parabens was published in 1984 in a report authored by Elder (1). This report estimated that parabens were used in over 13,200 different cosmetic products.

Parabens have been widely accepted and used because of past reports of their effectiveness as preservatives, low cost, and rapid excretion from the body (both human and animal testing). However, recently some scientists have raised concerns that further assessment of parabens may be needed. This is based on recent evidence from over a dozen scientific studies indicating that several types of parabens can bind to the estrogen receptor and can cause estrogen-like responses when tested in laboratory animals or in a variety of tissue culture assays (see <http://envirocancer.cornell.edu/Bibliography/Bibliography.cfm> under Endocrine Disruption Bibliographies). In whole-animal studies, the estrogenic effects of parabens were not seen when fed to the animals, but only when applied to or injected under the skin. But, these were short-term, high-dose studies. Little to no information exists on whether use of products with low levels of parabens over many years results in accumulation of parabens in body tissues and whether there are or are not any health effects associated with use of paraben-containing consumer products.

### Overview

The study by P. Darbre and colleagues (2) was conducted to assess whether any of the six parabens commonly used in consumer products in Europe could be detected in human breast tumors. The names of the parabens studied were: methylparaben, ethylparaben, propylparaben, isobutylparaben, butylparaben and benzylparaben. The prefix (e.g. "methyl") indicates the name of the side-chain structure of each paraben. In this study, 20 samples of human breast tissue were obtained from patients undergoing surgery at the Edinburgh Breast Unit in Scotland, UK. The samples were frozen, and then tumors were minced and homogenized to help break

up the tissue. Solvents were used to extract the parabens from the tumor sample, followed by the use of thin-layer chromatography to isolate any of the parabens present in the samples. Another method called high-pressure liquid chromatography with mass spectrometry was used to identify the type and the concentration of each paraben. For each batch of samples, a blank was included that had no tumor tissue, which was run through the same extraction and detection procedure. The authors were surprised that the blank was not zero, but had some parabens. The authors thought parabens in the hand soap used by technicians or in the detergent used to clean the glassware may have contaminated the laboratory equipment. Blank values were subtracted from sample paraben values to correct for this problem. At least one type of paraben was detected in 19 out of 20 tumors. Methylparaben was the most commonly observed paraben (18/20) and was detected at the highest average level.

### **Commentary**

This study is the first report of the detection of parabens in human breast tumors. The authors are careful to point out that the results of this study do not show that any of the parabens caused breast cancer in these women. This study is not evidence of cause and effect. The study did show that five of the six parabens widely used in consumer products can be detected intact (not changed or metabolized) in human tissues. This is an important initial finding, but more research is needed to see if exposure to parabens does or does not affect breast cancer risk.

For instance, this study did not show if levels of the parabens in breast tumors were any different from nearby normal breast tissue in these women. Also, this study did not include any women without breast cancer. To evaluate breast cancer risk, a study would need to compare levels of parabens in women with breast cancer (cases) to women of similar age without breast cancer (controls). This study was very small, with only 20 tumor samples. A larger, case-controlled study would be needed to more fully evaluate whether parabens do or do not affect breast cancer risk. This study did have some other problems, such as the contamination of the blank samples mentioned above. Another problem reported was in the analytical method. An important way to measure the ability to accurately detect the chemical includes adding (spiking) a known amount of paraben to a sample to see how much of the known amount can be recovered from the sample. For instance, if you add 100 units, you would like to have a high recovery of over 90%. In this study, the recoveries of added paraben averaged just under 50%. Hence, the method used to extract the parabens from the sample needs to be improved.

This study has received attention in the popular press because the authors are interested in exploring the hypothesis of whether estrogenic parabens used in underarm products (like deodorants and antiperspirants) increase breast cancer risk. This study did not test this hypothesis. The results did show that intact parabens can be detected in human tissue. It did not however, make any attempt to find out the source of the parabens. The women who donated the tumor samples were not interviewed. In fact, no reports of their age or tumor status were included in this study. No information on other factors that may have influenced their breast cancer risk, or information on past use or patterns of use of products with parabens was obtained. It is not known if the major exposure was due to the parabens from food or via topical application of a certain type or a variety of personal care products.

Better studies are needed of whether or not long term use of paraben-containing consumer products affect human tissue levels. Given the ubiquitous nature of paraben use in consumer products and recent evidence of the estrogenicity of

parabens, I would agree with other scientists who have called for a reassessment of the safety of parabens. Most of the risk assessments conducted on the safety of parabens were done before it was known that parabens can act as an environmental estrogen and before it was known that levels are detectable in human tissue. A recent study on the safety of propylparaben does acknowledge the estrogenicity of this chemical, but does not fully explore possible human health risks (3). More recent data is needed to update the 1984 study by Elder, which is one of the few reports estimating exposure to parabens from food, drug and cosmetic products. While use of parabens is widespread, product-to-product use is variable. In a survey of products in my own bathroom and kitchen, I found a type of paraben listed as an ingredient in liquid hand soap, two hand lotions, one out of three shampoos (the "natural" brand was the one with the paraben), one out of two hair conditioners, and three out of five sunscreens (including two made for use by children), but in none of the three antiperspirants that my family uses.

At this point in time we do not have information on whether or not paraben-containing products are used at a level that affects human health. But, research indicating that several parabens can act as weak environmental estrogens and the preliminary results of this study do support the need for more vigorous research in this area. Unlike other environmental contaminants, use of personal care products represents a choice made by the consumer and a choice by the manufacturer who determine the ingredients of the product.

- 1) Elder, RL. Final report on the safety assessment of methylparaben, ethylparaben, propylparaben and butylparaben, *Journal of the American College of Toxicology*, vol. 3, pp. 147-209, 1984.
- 2) Darbre, PD, A Aljarrah, WR Miller, NG Coldham, MJ Sauer and GS Pope, Concentrations of parabens in human breast tumors, *Journal of Applied Toxicology*, vol. 24, pp. 5-13, 2004.
- 3) Soni, MG, GA Burdock, SL Taylor, NA Greenberg, Safety assessment of propyl paraben: a review of the published literature (Review), *Food and Chemical Toxicology*, vol. 39, pp. 513-532, 2001.