

# THE TEMPORAL RELATIONSHIP BETWEEN APPLICATION OF PERSONAL CARE PRODUCTS AND BLOOD SERUM CONCENTRATIONS OF 1,3,4,7,8-HEXAHYDRO-4,6,6,7,8,8-HEXAMETHYL-CYCLOPENTA[G]BENZOPYRAN (HHCB)

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## Abstract

People intentionally apply personal care products with fragrances to their skin, yet our understanding of the extent of absorption into the human body is woefully incomplete. Most personal care product fragrances contain polycyclic musks, of which the most common is 1,3,4,7,8-hexahydro-4,6,6,7,8,8-hexamethyl-cyclopenta[g]benzopyran, HHCB. It is lipophilic, bioaccumulative and a suspected selective estrogen receptor modifier. HHCB has been detected in the blood of people of all ages. There have been previous studies that show the positive association between HHCB levels and use of personal care products. Yet, in order to gain a better understanding of the temporal relationship between HHCB exposure and serum levels, this study would recruit 96 individuals, 72 to be exposed to HHCB, and 24 for a control. The 96 individuals would have their blood serum concentrations analyzed before exposure, to any personal care products containing HHCB, and then again at intervals of 24, 48 and 120 hours after application of a lotion with HHCB. With the baseline of HHCB concentration in the lotion established, and the concentrations of HHCB in serum collected from the 24 person sample group, a 2 sample t-test would be performed to compare the mean levels of HHCB across individuals and across the three sample groups, all in comparison with the control group. This study and the statistical analysis would provide a better understanding of the metabolism of HHCB in the human body.

## Are you exposing yourself to dangerous chemicals everyday?



<https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=0ahUKEwj667-U2NPQAhVB7yYKHf1hAwgQjxwIAw&url=http%3A%2F%2Fwww.eaumg.net%2Fa-white-musk-fragrance-guide%2F&bvm=bv.139782543,d.amc&psig=AFQjCNEYp93thAz9HWcLko5BVXGhVwA8PA&ust=1480705546640495>

## What are synthetic Musks?

- Synthetic musks are a class of compounds that were developed to mimic the scent of naturally occurring fragrances secreted by the musk deer (Walters, et al. 2005).
- There are four categories of synthetic musks: nitro musks, polycyclic musks, macrocyclic musks, and alicyclic musks (Walters et al. 2005).
- Nitro musks were the first commercially produced synthetic musks (de Carvalho Cunha 2012). They gained popularity in 1979 when the musk deer became a protected species. Yet, in the 1990s, concerns arose over the safety of the use of nitro musks in personal care products as they were found to be fat-soluble and bio-accumulative (Rimkus, et al, 2003).
- As the public concern regarding these products grew, cosmetic companies replaced nitro musks with polycyclic musks in most of their products without sufficient testing (Correia et al, 2015). Today, most personal care products contain polycyclic musks, most specifically HHCB. (Correia et al, 2013).

## HHCB Facts

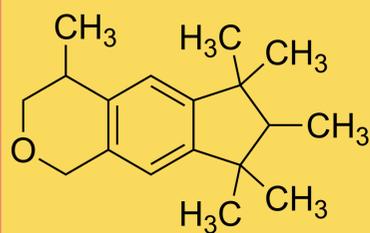
HHCB is found in the greatest concentration in scented products, like perfumes, lotions, and deodorants. It is also found in shampoos, body wash, hair gel, and baby wipes (Correia, et. al, 2015).

HHCB is lipid based, and it is composed of three fused hydrocarbon rings and has the chemical formula C<sub>18</sub>H<sub>26</sub>O (Pubchem).

HHCB is lipophilic and bio-accumulative and can enter the body through skin absorption and inhalation (Campaign For Safe Cosmetics).

HHCB has also shown some evidence of acting as an Endocrine Disruptor in certain situations. For example, it was observed that HHCB is a dose-dependent estradiol inhibitor in a yeast estrogenicity screening assay when the rainbow trout estrogen receptor-alpha was studied (Simmons, et. al, 2010).

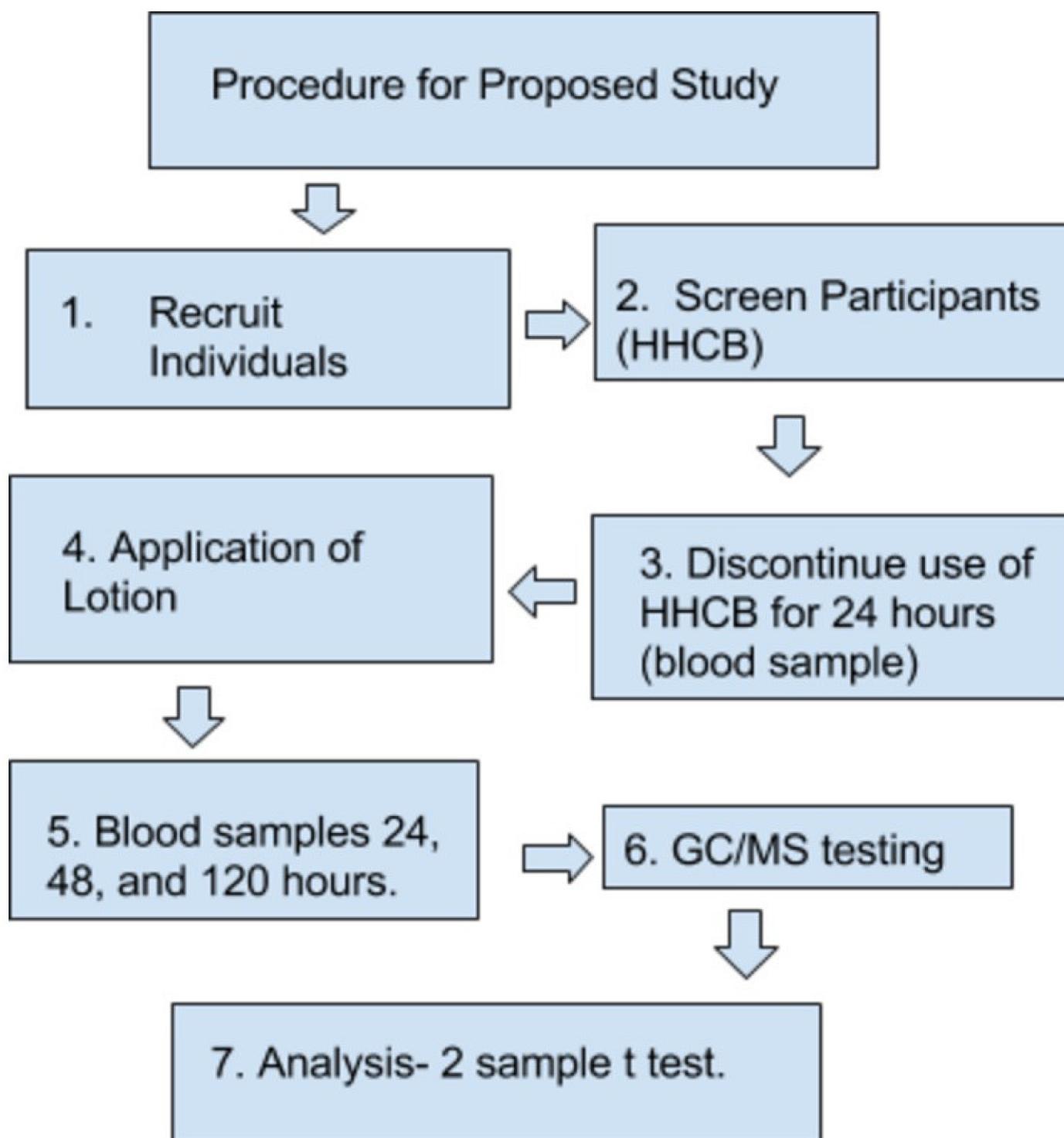
# Proposed Case Study



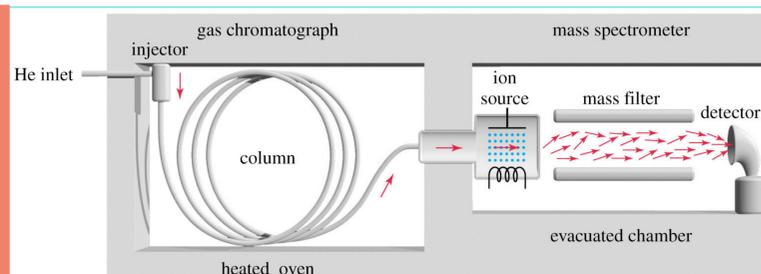
<https://en.wikipedia.org/wiki/Galaxolide>

**Question:** How does exposure to common personal care products affect serum HHCB concentrations?

**Hypothesis:** Those exposed will have higher serum HHCB levels than those not exposed, and samples collected 24 hours after application will have a higher level of HHCB than samples collected five days after application.



## Gas Chromatography Mass Spectrometry Test



<https://orgspectroscopyint.blogspot.com/2014/11/gas-chromatography-mass-spectrometry-gc.html>

## Data Collection and Analysis:

- Blood samples analyzed and concentrations of HHCB in microgram/L determined and exposure rates to HHCB with short-term effects of HHCB to the bodies.
- After the HHCB serum concentrations have been determined for all groups we will conduct a 2 sample t-test comparing the mean levels of serum HHCB in each of the three time intervals with the mean levels in the control group. A sample size of 24 individuals will provide 80% power,  $\alpha=0.05$ , assuming levels in the exposed groups are at least 0.905 micrograms/Liter, and levels in the controls are no more than 0.546 micrograms/Liter. These numbers reflect the 75th and 25th percentiles, respectively, from the Flemish Environment and Health Study from the years 2007 through 2011 (Hond et. al, 2013). This analysis will give us a better understanding of the relationship between dermal contact with HHCB and concentrations of HHCB in the human body. This project may also be useful in determining the half-life of HHCB in blood.

## Expected Result:

Through this study, we hope to find a direct link between the concentration of HHCB in the blood to the use of lotion containing HHCB. We also hope to find how HHCB concentrations fluctuate over time in order to determine a possible half-life or determine when the concentration of HHCB is highest in the blood after application of the lotion. This will provide a better understanding of epidemiologic and toxicologic risks associated with the metabolism of HHCB.

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