Are Structural Analogues to Bisphenol A Safe Alternatives?

Background: Bisphenol A (BPA) is a chemical with widespread human exposure suspected of causing low-dose effects. Thus, a need for developing alternatives to BPA exists. Structural analogues of BPA have already been detected in foods and humans. Due to the structural analogy of the alternatives, there is a risk of effects similar to BPA.

Objectives: The aim was to elucidate and compare the hazards of bisphenol B (BPB), bisphenol E (BPE), bisphenol F (BPF), bisphenol S (BPS) and 4-cumylphenol (HPP) to BPA.

Methods: In vitro studies on steroidogenesis, receptor activity, and biomarkers of effect, as well as Quantitative Structure-Activity Relationship (QSAR) modeling.

Results: All test compounds caused the same qualitative effects on estrogen receptor and androgen receptor activities, and most of the alternatives exhibited potencies within the same range as BPA. Hormone profiles for the compounds indicated a specific mechanism of action on steroidogenesis which generally lead to decreased androgen, and increased estrogen and progestagen levels. Differential effects on corticosteroid synthesis were observed suggesting a compound-specific mechanism. Overall, BPS was less estrogenic and antiandrogenic than BPA, but BPS showed the largest efficacy on 17α-hydroxyprogesterone (17α-OH progesterone). Finally, there were indications of DNA damage, carcinogenicity, oxidative stress, effects on metabolism, and skin sensitization of one or more of the test compounds.

Conclusions: Interference with the endocrine system was the predominant effect of the test compounds. A substitution of BPA with these structural analogues should be carried out with caution.