



Phthalates &
Parabens

PHTHALATES & PARABENS PROFILE INTERPRETIVE GUIDE



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ENDOCRINE DISRUPTING CHEMICALS (EDCs)

There is growing interest in studying the possible health effects of the increasing number of chemicals used in industry, food, and consumer products. Anecdotal and scientific observations have come to suggest that these chemicals in our environment may be exerting harmful effects on the environment and the health of wildlife and man. Phthalates and parabens are included among the many chemicals now being studied for their endocrine disrupting potentials. Other types of EDCs include industrial solvents and lubricants such as polychlorinated biphenyls (PCBs), polybrominated biphenyls (PBBs), dioxins, plastics like bisphenol A, pesticides, fungicides, and pharmaceutical agents. The Endocrine Society released a scientific statement discussing the impact of endocrine disruptors on our health.¹ They describe EDCs as “substances in our environment, food, and consumer products that interfere with hormone biosynthesis, metabolism, or action resulting in deviation from normal homeostatic control or reproduction.” EDCs often have a phenolic moiety that mimics natural steroid hormones. EDCs have low water solubility and high lipid solubility making way for bioaccumulation in adipose tissue.

Conditions associated with endocrine disruption include infertility, decreased sperm count, breast cancer, endometriosis, prostate cancer, ovarian cancer, asthma, allergies, and obesity.

Because the endocrine disrupting properties are still being investigated, using the Precautionary Principle is wise to maintain public endocrine and reproductive health. This principle states that, in the absence of a scientific consensus

that harm would not ensue, chemicals thought to cause harm to the public or environment should be avoided or decreased and the burden of proof of safety falls on those producing and selling the chemical.²

WHY MEASURE PHTHALATE AND PARABEN LEVELS?

There is ongoing controversy about the health threats from current levels of exposure to phthalates and parabens. The Center for Disease Control has been measuring phthalate metabolite levels in the National Health and Nutrition Examination Study to observe the levels found in the North American population.³ Other government-sponsored web sites such as www.phthalates.com attempt to inform the public about safety of usual exposures. It is clear that there are real health and reproductive threats at some level of exposure, but that level is difficult to establish for an individual because of variable capacities for detoxification. Also, these chemicals are often studied in singularity, and the combination of multiple exposures over a lifetime may have real health disrupting outcomes.⁴ A laboratory test for urinary phthalate and paraben concentrations shows whether an individual has higher than normal body burden. Measurements of phthalates in human urine displayed good day-to-day reliability, and the wide concentration range found indicates that they are appropriate biomarkers for use in epidemiologic studies of environmental exposures in relation to health outcomes in adults and children.⁵ If high levels are found, then the risks of adverse impact on health may warrant actions to reduce exposures.

Table 1. Phthalates and Their Metabolites

Phthalates Name (CAS number)	Abbreviation	Urinary Metabolite (CAS number)	Abbreviation
Diethyl phthalate (84-66-2)	DBP	Mono-ethyl phthalate (2306-33-4)	MEtP
Di-2-ethylhexyl phthalates (117-81-7)	DEHP	Mono-2-ethylhexyl phthalate (4376-20-9)	MEHP
Di-2-ethylhexyl phthalates (117-81-7)	DEHP	Mono-(2-ethyl-5-oxohexyl) phthalate	MEOHP
Di-2-ethylhexyl phthalates (117-81-7)	DEHP	Mono-(2-ethyl-5-hydroxyhexyl) phthalate	MEHHP



PHTHALATES AND PARABENS MEASURED ON THE METAMETRIX PROFILE

The phthalates that are measured in the urine are metabolites of common phthalates found in consumer products.

PHTHALATES

- Mono-ethyl phthalate (MEtP)
- Mono-2-ethylhexyl phthalate (MEHP)
- Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)
- Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)

Phthalates are compounds used in the production of plastics. They are esters of 1,2-benzenedicarboxylic acid, where the alcohols that form the ester bonds have chain lengths from 4 to 15 carbon atoms long. Phthalates are so widely used in the production of plastics, cosmetics, and other convenience items that exposure to phthalates is universal for all but the most primitive and remote cultures. Numerous other uses in consumer products constitute the worldwide production of, roughly, a billion pounds of phthalates per year.⁶

Phthalates are used in cosmetics, perfumes and fixatives, aerosols, paints, lotions, air fresheners, shampoos, conditioners, lubricants, medications, medical bags and tubing, antifoaming agents, skin emollients, nail polish, and false fingernails. They are not required to be listed in the ingredient list, and can often be disguised under the term “fragrance”. In one study of 27 female and 23 male healthy subjects, food was the main source for DEHP.⁷ For some phthalates, the most significant exposure may be via inhalation of aerosols that can deliver highly absorbable phthalates. Skin exposure from lotions and creams can easily reach nearly 1000 mg/day.⁸ Seven of the most commonly encountered phthalates in consumer products were detectable in 81% of infants, which demonstrated widespread exposure from lotions, powders, and shampoos.⁹

HEALTH EFFECTS

Phthalates have been shown to have numerous physiological effects, mainly related to steroid hormone disruptions. Although studies on individual phthalates have found them to be of low estrogenic potency, when multiple compounds are present at their no-observed-effect concentrations (NOEC), dramatic enhancement of estrogen receptor response to estradiol was found.¹⁰ Such results demonstrate the additive and synergistic effects of multiple exposures.

Phthalates have also been linked to the obesity epidemic. In one study, obese, insulin-resistant adult males excrete higher amounts of MEHHP, MEOHP, and MEtP than controls.¹¹ DEHP was found to interact with peroxisome proliferator-activated receptors (PPARs), which are a family of nuclear receptors that control many cellular and metabolic processes in the body.¹² For example, PPAR- γ is crucial for fat tissue production, or adipogenesis. Therefore binding of phthalates to this receptor might contribute to fat accumulation in adipose tissues.

Anti-androgenic effects in female infants, as measured by the andro-genital index, were significantly correlated with urinary and amniotic fluid MBP levels.¹³ Testicular function effects of phthalates have also been studied. Both liver enlargement and testicular atrophy were observed in male rats exposed to increasing doses of DEHP, and the protection against the gonadotoxicity was

afforded by supplemental doses of vitamin C.¹⁴ Prenatal phthalate exposure can cause impaired male reproductive development¹⁵ or female endometriosis.¹⁶ In female mice, DEHP exposure induced functional zinc deficiency and teratogenesis, or damage to the developing embryo.^{17, 18}

Other adverse effects from phthalate exposure can be related to direct enhancement of oxidative stress and depletion of antioxidant protection. DEHP-exposed rat hepatocytes show increased levels of lipid oxidation markers and lowered levels of glutathione and vitamin E.¹⁹⁻²¹

PARABENS

Parabens are widely used as preservatives in cosmetic, pharmaceutical, and food products because of their bactericidal and fungicidal properties. Their name comes from the chemical name, para-hydroxybenzoic acid, which encompasses a family of esters that differ at the para position of the benzene ring. The most common parabens used in production are methylparaben, ethylparaben, propylparaben, butylparaben and benzylparaben. While parabens used in commercial products are chemically synthesized, they also occur naturally in foods such as blueberries, strawberries, blackberries, and currants.²² Methyl- and propylparaben are the most commonly used preservatives in cosmetics, and are allowed in concentrations up to 1%.

Parabens are found in shampoos and conditioners, moisturizers, hair care products, shave gels, cosmetics, personal lubricants, sunscreen and tanning lotions, deodorants and antiperspirants, toothpastes, food additives, and topical and parenteral pharmaceuticals.

The common parabens measured are:

- Butylparaben
- Ethylparaben
- Methylparaben
- Propylparaben

HEALTH EFFECTS

There is far less research on the negative health effects of parabens compared to phthalates, with most of the research reported in animal models. But because paraben application is often daily and continuous over a duration of years, many researchers are paying closer attention to the possible health effects of these chemicals. Much

of what is discussed about parabens is allergic contact dermatitis. However, parabens have been shown to have weak estrogenic activity.^{23,24} They can induce oxidative stress and lipid peroxidation leading to cell hemolysis and biochemical changes in mice liver and kidney.²⁵ Rodent exposure to butyl- and propylparaben decreased male reproductive function and testosterone synthesis.²⁶ Adverse reproductive development was seen in male progeny of maternal rats exposed to butylparaben during gestation and lactation of the pups.²⁷ Recently, a study came out discussing the mitochondrial connection between paraben exposure and male infertility.²⁸ The study suggests that the mitochondrial respiration chain and phosphorylation system is a target for paraben toxicity.



STEPS FOR REDUCING ELEVATED LEVELS OF PHTHALATES AND PARABENS

1. Avoid ingested, topical, and airborne phthalate and paraben sources to reduce elevated levels. Exposure to plastics, paints, and cosmetics that are not labeled as “phthalate-free and paraben-free” should be reduced in the home, at work, and in personal grooming. Read labels and avoid anything that mentions “fragrance” on the ingredient list.
2. Increase excretion and metabolism to enhance the rate of removal from the body. Increasing phthalate-free fluid intake can improve rates of excretion, leading to lowering of tissue levels.²⁹ Exercise stimulates hepatic detoxification enzymes and promotes excretion via the kidneys and skin³⁰, and use of saunas can further enhance removal of phthalates in sweat.³¹
3. Eat foods and take nutritional supplements that stimulate detoxification or improve intestinal binding to lower absorption also benefits toxin removal. Oligonantigenic diets containing whole, organic foods, including dark colored vegetables, nuts, seeds, and whole grains along with the detoxification-stimulating components from such foods are usually recommended for the patient with elevated levels of urinary phthalates.³²
4. Assess detoxification ability with organic acid analysis, amino acid analysis, and genetic predisposition testing. Genetic testing can determine predisposed risk factors such as detoxification capacity.³³ All of the tests mentioned can aid in designing appropriate detoxification protocols for patients.



Visit toxins.metamatrix.com for more information on additional toxicity testing options.

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