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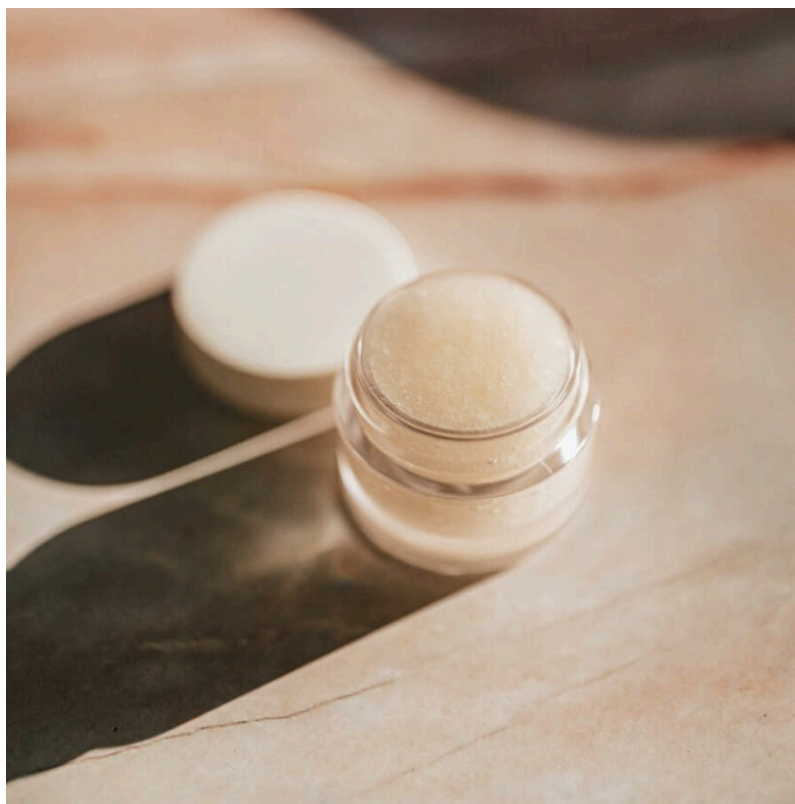
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Benzophenone & Related Compounds

Benzophenone is used in personal care products such as lip balm and nail polish to protect the products from UV light. Derivatives of benzophenone, such as benzophenone-2 (BP2) and oxybenzone (benzophenone-3 or BP3) are common ingredients in sunscreen. Benzophenone is persistent, bioaccumulative and toxic (PBT).^{[1][2]} These chemicals are linked to cancer, endocrine disruption, and organ system toxicity.



WHAT IS BENZOPHENONE?

Benzophenone is widely used in household products, such as sunglasses, food packaging, laundry and cleaning products to protect from UV light.^[5]

It can contaminate drinking water and migrate from food packaging into food.^[6] Benzophenone is used in some food packaging inks and may migrate into foods.^[7] Benzophenone occurs naturally in some foods (such as wine grapes and muscat grapes) and is added to other foods as a flavoring.

In personal care products, benzophenone is used as a fragrance enhancer or to prevent products such as soaps from losing scents and colors in the presence of UV light.^[8] Derivatives of benzophenones such as BP2 and oxybenzone (BP3) are used in sunscreens. Oxybenzone is used as an ultraviolet light absorber and stabilizer especially in plastics and sunscreen agents.^[9] Benzophenone and oxybenzone are also used in nail polish, and lip balm.^{[10][11]}

Found In

- Lip balm

- Nail polish
- Foundations
- Baby sunscreens
- Fragrance
- Shampoo
- Conditioner
- Hair spray
- Moisturizers
- Foundation

What to look for on the label

- Benzophenone
- Ingredients containing the word benzophenone (for example benzophenone-2)
- BP# (for example BP2)
- Oxybenzone
- Sulisobenzene
- Sulisobenzene sodium

Health Concerns

Cancer: The California EPA's Proposition 65 list identifies benzophenone as a possible human carcinogen.^[12] Experimental studies suggest benzophenone may lead to several kinds of tumors.^[13]

Endocrine disruption: Benzophenone and its derived chemicals may influence the endocrine system.^[14] It can affect the endocrine system indirectly by changing gene expression.^[15]

The evidence linking benzophenone and different derivatives to endocrine disruption is complex, and research suggests that different benzophenones have different endocrine effects. Some studies indicate that benzophenone has little estrogenic activity.^[16] However, studies of benzophenone in juvenile female rats conclude that benzophenone is not estrogenic itself, but may become estrogenic when it is metabolized by the body into other chemicals (for instance, the benzophenone metabolite p-hydroxybenzophenone is estrogenic).^[17] Studies in adult rats show that benzophenones that are metabolized can exhibit estrogenic activities.^[18] The European Commission on Endocrine Disruption has determined that there is not yet sufficient evidence that benzophenone itself is a human endocrine disruptor.^[19]

Some studies indicate that the benzophenone derivative, oxybenzone, can elicit strong anti-androgenic activities in a human breast carcinoma cell line MDA-kb2.^[20] Other research suggests oxybenzone has estrogenic activity, as indicated by studies of estrogen-sensitive MCF-7 breast cancer cell lines,^[21] but other studies found less estrogenic activity.^[22] Studies of estrogenic activity and reproductive effects of oxybenzone found that oxybenzone can alter reproductive endpoints in fish species.^[23] Studies in adult rats found that oxybenzones do not have effects on the uterus.^[24] Although the evidence is mixed with regard to oxybenzone's capacity to mimic estrogen, it can be converted into other forms that exhibit estrogenic potencies such as BP8 and 2,4,4'-trihydroxy-benzophenone (THB).^[25] BP2, BP8 and THB stimulate the proliferation (growth and multiplication) of MCF-7 cells, which are used to test for estrogenic activity.^[26]

Benzophenone 4 (BP4) has low levels of estrogenic activity in studies of cells, but this activity did not lead to changes in body weight and length in fish, which is a sensitive measure of estrogen exposure.^[27] In addition, BP4 interferes with the expression of genes that control sex hormones in zebrafish, a species widely used to measure endocrine activity of substances.^[28]

Organ System Toxicity: The European Food Safety Authority (EFSA) classifies benzophenone as a known toxicant because benzophenone can cause liver hypertrophy in the rat at lower doses.^[29] Oxybenzone can permeate across the skin and accumulate in blood, the kidneys and the liver, and may be toxic to liver cells.^[30]
^[31]

Developmental and reproductive toxicity: Studies have found that exposure to high doses of BP2 may affect reproduction in fish. BP2 affects ovaries of female fish and testes of male fish, and also reduces production of eggs and sperm.^[32]

Irritation: Studies show that sunscreen products formulated with concentrations of up to 6 percent of oxybenzone rarely led to allergic reactions—in fact, only about 7/10,000 people had an allergic reaction in one study.^[33] Other studies suggest that use can lead photoallergy, allergic contact dermatitis and facial erythema.^[34] The Cosmetic Ingredient Review does not consider benzophenones used in cosmetics and personal care products to be an irritant.^[35]

Ecotoxicity: Benzophenone is toxic to aquatic organisms.^[36] Oxybenzone is persistent and can collect in fat.^[37] Oxybenzone concentrations vary considerably by season, and may be especially high in areas where sunscreens are heavily used in specific months. In most cases, concentrations present low hazards to aquatic systems. However, in some of the hotspots (for example, San Diego County) concentrations may be high enough to raise concerns.^[38]

Vulnerable Populations

[Babies & Children \(https://www.safecosmetics.org/population/babies-children/\)](https://www.safecosmetics.org/population/babies-children/),
[Pregnant Women \(https://www.safecosmetics.org/population/pregnant-women/\)](https://www.safecosmetics.org/population/pregnant-women/),
[Teenagers \(https://www.safecosmetics.org/population/teenagers/\)](https://www.safecosmetics.org/population/teenagers/), [Women of Color \(https://www.safecosmetics.org/population/women-of-color/\)](https://www.safecosmetics.org/population/women-of-color/).

Regulations

Benzophenone, benzophenone-2, benzophenone-3, benzophenone-4, and benzophenone-5 restricted in cosmetics in United States^[3] and oxybenzone is restricted in cosmetics at up to 10% maximum concentration in the EU.^[4]

How to Avoid?

Read labels and avoid products containing these chemicals. Choose sunscreens that rely on non-nanoized zinc oxide or titanium dioxide.

Explore other Chemicals

[Resorcinol \(https://www.safecosmetics.org/chemicals/resorcinol/\)](https://www.safecosmetics.org/chemicals/resorcinol/)

[Homosalate \(https://www.safecosmetics.org/chemicals/homosalate/\)](https://www.safecosmetics.org/chemicals/homosalate/)

[Ethoxylated Ingredients \(https://www.safecosmetics.org/chemicals/ethoxylated-ingredients/\)](https://www.safecosmetics.org/chemicals/ethoxylated-ingredients/)

[P-Phenylenediamine \(https://www.safecosmetics.org/chemicals/p-phenylenediamine/\)](https://www.safecosmetics.org/chemicals/p-phenylenediamine/)

[Nitrosamines \(https://www.safecosmetics.org/chemicals/nitrosamines/\)](https://www.safecosmetics.org/chemicals/nitrosamines/)

[1,4-DIOXANE \(https://www.safecosmetics.org/chemicals/14-dioxane/\)](https://www.safecosmetics.org/chemicals/14-dioxane/)

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References

- [1] Brooks AC., et al. (2009). Importance of prey and predator feeding behaviors for trophic transfer and secondary poisoning. *Environ Sci Technol*, vol. 43, no. 20, pp 7916–7923, 2009.
- [2] Kim S. & Choi K., Occurrences, toxicities, and ecological risks of benzophenone-3, a common component of organic sunscreen products: A mini-review. *Environment International*, vol. 70, pp 143–57, 2014.
- [3] Cosmetics Info. Benzophenone-1. Available online: <http://cosmeticsinfo.org/ingredient/benzophenone-1>
<https://www.cosmeticsinfo.org/ingredients/benzophenone-1/>

(<https://www.cosmeticsinfo.org/ingredients/benzophenone-1/>). Accessed April 18, 2022.

[4] European Commission. Available online: http://ec.europa.eu/consumers/cosmetics/cosing/index.cfm?fuseaction=search.details_v2&id=28809 (http://ec.europa.eu/consumers/cosmetics/cosing/index.cfm?fuseaction=search.details_v2&id=28809). Accessed April 18, 2022.

[5] IARC (2012). Benzophenone. Available online: <http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf> (<http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf>). Accessed April 18, 2022.

[6] IARC (2012). Benzophenone. Available online: <http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf> (<http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf>). Accessed April 18, 2022.

[7] IARC (2012). Benzophenone. Available online: <http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf> (<http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf>). Accessed April 18, 2022.

[8] IARC (2012). Benzophenone. Available online: <http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf> (<http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf>). Accessed April 18, 2022.

[9] Toxicity Effects, National Toxicology Program. Available online: https://ntp.niehs.nih.gov/ntp/htdocs/lt_rpts/tr533.pdf (https://ntp.niehs.nih.gov/ntp/htdocs/lt_rpts/tr533.pdf). Accessed April 18, 2022.

[10] Skin Deep. Benzophenone. Available online: <http://www.ewg.org/skindeep/ingredient/700684/BENZOPHENONE/> (<http://www.ewg.org/skindeep/ingredient/700684/BENZOPHENONE/>). Accessed April 18, 2022.

[11] Skin Deep. Oxybenzone. Available online: <http://www.ewg.org/skindeep/ingredient/704372/OXYBENZONE/> (<http://www.ewg.org/skindeep/ingredient/704372/OXYBENZONE/>). Accessed April 18, 2022.

[12] Chemicals Known to the State to Cause Cancer or Reproductive Toxicity. Available online: <https://oehha.ca.gov/proposition-65/cnr/chemicals-listed-known-state-cause-cancer-or-reproductive-toxicity> (<https://oehha.ca.gov/proposition-65/cnr/chemicals-listed-known-state-cause-cancer-or-reproductive-toxicity>). Accessed April 18, 2022.

[13] Rhodes MC., et al. Carcinogenesis studies of benzophenone in rats and mice. Food Chem Toxicol, vol. 45, no. 5, pp 843-851, 2007.

[14] IARC (2012). Benzophenone. Available online: <http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf> (<http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf>). Accessed April 18, 2022.

[15] Mikamo E., et al. Endocrine disruptors induce cytochrome P450 by affecting transcriptional regulation via pregame X receptor. Toxicology and Applied Pharmacology, vol. 193, no. 1, pp 66-72, 2003.

[16] Kerdivel G., et al. Estrogenic potency of benzophenone UV filters in breast cancer cells: proliferative and transcriptional activity substantiated by docking analysis. PLoS One, vol. 8, no. 4, pp e60567, 2013.

[17] Nakagawa Y. & Tayama K., Estrogenic potency of benzophenone and its metabolites in juvenile female rats. Molecular Toxicology, vol. 75, pp 74-79, 2001.

[18] Schlecht C., et al., Effects of estradiol, benzophenone-2 and benzophenone-3 on the expression pattern of the estrogen receptors (ER) alpha and beta. The estrogen receptor-related receptor 1 (ERR1) and the aryl hydrocarbon receptor (AhR) in adult ovariectomized rats. Toxicology, vol 205, pp 123-130, 2004.

[19] European Commission. List of 146 substance with endocrine disruption classifications prepared in the expert meeting. Available online: http://ec.europa.eu/environment/archives/docum/pdf/bkh_annex_13.pdf (http://ec.europa.eu/environment/archives/docum/pdf/bkh_annex_13.pdf). Accessed April 18, 2022.

[20] Kim S. & Choi K., Occurrences, toxicities, and ecological risks of benzophenone-3, a common component of organic sunscreen products: A mini-review. Environment International, vol. 70, pp 143-57, 2014.

[21] Nakagawa Y. & Suzuki T. Metabolism of 2-hydroxy-4-methoxybenzophenone in isolated rat hepatocytes and xenoestrogenic effects of its metabolites in MCF-7 human breast cancer cells. Chemico-Biological Interactions, vol. 139, no. 2, pp 115-128, 2002.

[22] Kerdivel G., et al. Estrogenic potency of benzophenone UV filters in breast cancer cells: proliferative and transcriptional activity substantiated by docking analysis. PLoS One, vol. 8, no. 4, pp e60567, 2013.

[23] Coronado M., et al. Estrogenic activity and reproductive effects of the UV-filter oxybenzone (2-hydroxy-4-methoxyphenylmethanone) in fish. Aquatic Toxicology, vol. 90, no. 3, pp 182-6, 2008.

[24] Schlecht C., et al., Effects of estradiol, benzophenone-2 and benzophenone-3 on the expression pattern of the estrogen receptors (ER) alpha and beta. The estrogen receptor-related receptor 1 (ERR1) and the aryl hydrocarbon receptor (AhR) in adult ovariectomized rats. Toxicology, vol 205, pp 123-130, 2004.

[25] Kerdivel G., et al. Estrogenic potency of benzophenone UV filters in breast cancer cells: proliferative and transcriptional activity substantiated by docking analysis. PLoS One, vol. 8, no. 4, pp e60567, 2013.

[26] Kerdivel G., et al. Estrogenic potency of benzophenone UV filters in breast cancer cells: proliferative and transcriptional activity substantiated by docking analysis. PLoS One, vol. 8, no. 4, pp e60567, 2013.

- [27] Kunz, P. Y., Galicia, H. F., & Fent, K. (2006). Comparison of in vitro and in vivo estrogenic activity of UV filters in fish. *Toxicological Sciences*, 90(2), 349–361.
- [28] Zucchi, S., Blüthgen, N., Ieronimo, A., & Fent, K. (2011). The UV-absorber benzophenone-4 alters transcripts of genes involved in hormonal pathways in zebrafish (*Danio rerio*) embryos and adult males. *Toxicology and applied pharmacology*, 250(2), 137–146.
- [29] European Food Safety Authority. EFSA Panel on food contact materials, enzymes, flavoring and processing aids (CEF). The EFSA Journal. Available online: <http://www.efsa.europa.eu/en/efsajournal/pub/1104> (<http://www.efsa.europa.eu/en/efsajournal/pub/1104>). Accessed April 18, 2022.
- [30] Fediuk DJ., Tissue disposition of the insect repellent DEET and the sunscreen oxybenzone following intravenous and topical administration in rats. *Biopharm Drug Dispos*, vol. 32, no. 7, pp 369–79, 2011.
- [31] European Food Safety Authority. Available online: <http://www.efsa.europa.eu/en/efsajournal/pub/1104> (<http://www.efsa.europa.eu/en/efsajournal/pub/1104>). Accessed April 18, 2022.
- [32] Weisbrod CJ., et al. Effects of the UV Filter Benzophenone-2 on Reproduction in Fish. *Toxicology and applied pharmacology*, vol. 225, no. 3, pp 255–66, 2007.
- [33] Agin PP., et al. Rates of allergic sensitization and irritation to oxybenzone-containing sunscreen products: a quantitative meta-analysis of 64 exaggerated use studies. *Photodermatology, Photoimmunology & Photomedicine*, vol. 24, no. 4, pp 211–7, 2008.
- [34] Nedorost S., Facial erythema as a result of benzophenone allergy. *Journal of the American Academy of Dermatology*, vol. 49, no. 5, pp259–261, 2003.
- [35] Cosmetics Info. Benzophenone-1. Available online: <http://cosmeticsinfo.org/ingredient/benzophenone-1> (<https://www.cosmeticsinfo.org/ingredients/benzophenone-1/>). Accessed April 18, 2022.
- [36] IARC (2012). Benzophenone. Available online: <http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf> (<http://monographs.iarc.fr/ENG/Monographs/vol101/mono101-007.pdf>). Accessed April 18, 2022.
- [37] Kim S. & Choi K., Occurrences, toxicities, and ecological risks of benzophenone-3, a common component of organic sunscreen products: A mini-review. *Environment International*, vol. 70, pp 143–57, 2014.
- [38] Kim S. & Choi K., Occurrences, toxicities, and ecological risks of benzophenone-3, a common component of organic sunscreen products: A mini-review. *Environment International*, vol. 70, pp 143–57, 2014.

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