

EASTMAN

UV Light Effects

on Food, Beverage, and
Personal Care Product Ingredients



Crystal-Clear
Packaging Solutions
From Eastman

Bottles courtesy of Altira, Inc.

UV Light Effects

PET packaging provides food, beverage, and personal care brand owners with the shelf appeal, clarity, shatter-resistance, convenience, and portability consumers demand. To deliver a premium brand, however, packagers must also ensure that the container protects the delicate ingredients of their high-quality food, beverage, and personal care products.

Research shows that ultraviolet (UV) light can have an adverse effect on many food, beverage, and personal care product ingredients, including natural and synthetic colors, vitamins, and flavors. Some products are damaged by visible light as well, but this information is directed to the multitude of products that are affected by UV light but essentially unaffected by visible light.

Ultraviolet A light, characterized as wavelengths of light in the range of 320 to 400 nanometers, is typically transmitted through clear or translucent packaging materials. For the purposes of this brochure, UV light refers to the "A" portion of the spectrum.

Many food and beverage packaging professionals are becoming aware of the effect UV light has on their products' delicate colors, flavors, and nutrients. Products impacted by UV light include salsas, jams, fruit juices, ready-to-drink teas, and nutraceuticals. A similar awareness is being developed within the personal care industry of the effect of UV light on lotions, shampoos, liquid soaps, and body washes.



on Food, Beverage, and Personal Care Product Ingredients

Effects of UV Light on Synthetic and Natural Colors

UV light can degrade both synthetic and natural colors in foods and beverages. For example, our research shows that dyes such as FD&C blue #1 and FD&C red #40, often found in popular fruit juices, are susceptible to UV light. External D&C violet #2 and D&C red #33, often found in shampoos or other personal care products, are also susceptible to UV light.

Fruit Punch
14-Day Exposure

Eastman's
Heatwave™ Polymer



Standard PET
(No UV Protection)



Body Wash
3-Day Exposure



Vitiva™
PET

Standard
PET

Schnapps
2-Day Exposure



Vitiva™
PET

Standard
PET

Dish Detergent
11-Day Exposure



Vitiva™
PET

Standard
PET

Effects of UV Light on Natural Colors

Natural colors can be found in fruits, vegetables, flowers, and other plant tissues. Red, yellow, and orange pigments (carotenoids) such as those in citrus fruits, carrots, and tomatoes, and blue and red pigments (anthocyanins) such as those in grapes, cherries, berries, and flowers, can be unstable to UV light. Carotenoids, such as beta-carotene and lutein, degrade when exposed to UV light. Light also accelerates the degradation of some anthocyanins, having an effect on natural bright colors such as the purple in grape juice.

Effects of UV Light on Flavors

UV light exposure to foods and beverages can also degrade flavors. For example, citrus flavors such as citral and limonene are susceptible to UV light degradation. UV light exposure increases p-cymene concentration in some lemon-containing beverages. The increase in p-cymene can cause an “off” taste in food and beverage products. Research also shows that UV light can affect a solution of aspartame (an intense sweetener). The degradation of this compound can result in loss of sweetness when exposed to UV light.

Additionally, UV light is known to greatly accelerate the oxidation of unsaturated fatty acids. This reaction not only degrades the fatty acid, but also produces compounds that impart “off” odors and flavors to foods at extremely low concentrations. Even low-fat foods containing trace amounts of polyunsaturated fatty acids can become rancid.

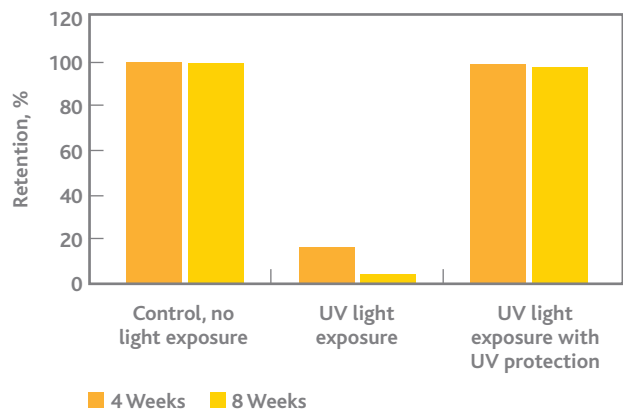
Effects of UV Light on Vitamins

UV light has an adverse effect on several vitamins such as vitamins A and D, folic acid, vitamin B₆, vitamin C, and riboflavin. Packaging material such as PET should have the proper UV barrier to protect foods and

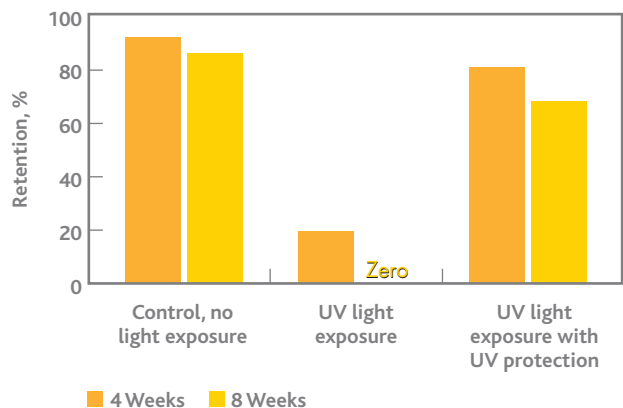
beverages and maximize the retention of these vitamins. Vitamin A and beta-carotene (pro vitamin A) are especially sensitive to UV light. Vitamin B₂, riboflavin, is degraded by both UV and visible light at wavelengths from 350–520 nm.

The graphs below show the results of some of the work done at Eastman to demonstrate the adverse effect of UV light on vitamins. A beverage containing vitamins B₆ and C was exposed to UV light. Both of these vitamins degraded when exposed to UV light, even to the extent of vitamin C being nondetectable at the eight-week test point. A shield of Heatwave™ polymer CF746, a resin containing a UV absorber, was placed over additional beverage bottles, protecting both vitamins from UV light damage.

Retention of Vitamin B₆ After UV Light Exposure



Retention of Vitamin C After UV Light Exposure



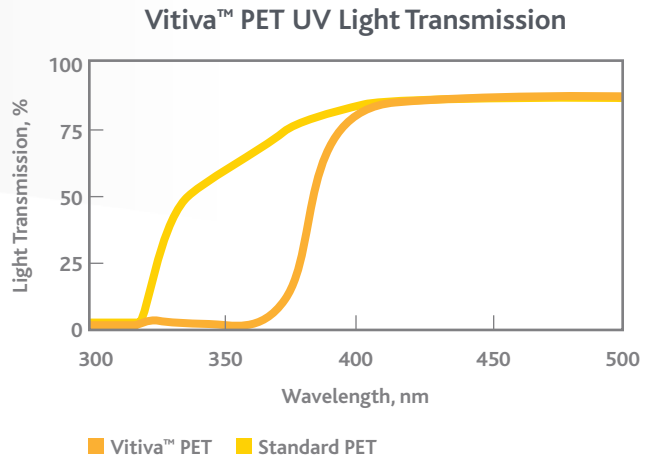
Packaging Materials With UV Light Barrier

There are many packaging materials available with properties specifically designed for food, beverage, and personal care product containers. However, only advanced packaging materials such as PET resins that contain essential UV light absorbers can help protect such products from damaging UV exposure and ultimately preserve colors, flavors, and nutrients. For example, resins such as Eastman's UV light-protected polymers, Heatwave™ polymer CF746 and Vitiva™ PET PC715, are formulated with UV light-absorbing dyes that absorb damaging wavelengths of light and keep them from penetrating through the container and into the food, beverage, or personal care product inside.

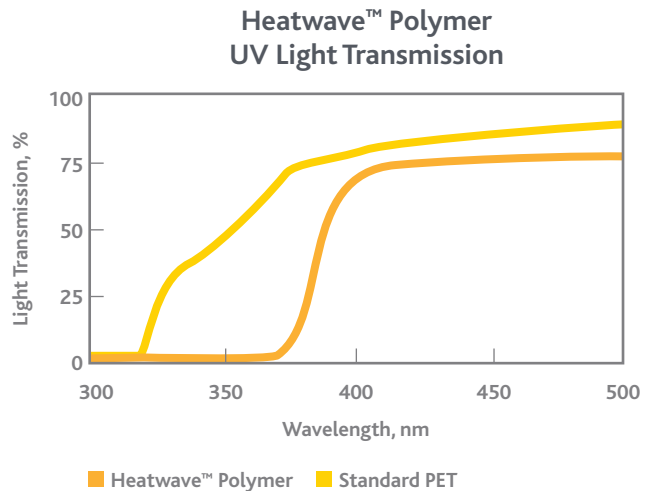
UV Light Protection in a Crystal-Clear Container

Eastman, with a wide array of PET polymers to select from, can ensure customers the best blend of attributes in which UV light protection is an important element. Vitiva™ PET PC715 and Heatwave™ polymer CF746 were engineered to enable high-speed production of bottles with excellent moldability and crystal clarity. Eastman's UV light-protected PET resins offer the crystal clarity that consumers expect, and allow brand owners to show off their products and get outstanding UV light barrier.

Vitiva™ PET PC715 has excellent color, clarity, and high gloss. It transmits less than 7% light at 370 nm through a 9-mil oriented bottle sidewall. Its transmission spectrum, shown at right, is compared to the spectrum of standard PET (no UV absorber), which transmits light at greater than 320 nm.



Heatwave™ polymer CF746 has improved hot-fill stability. It transmits less than 10% light at 370 nm on a 12-mil oriented bottle sidewall. Its transmission spectrum, shown below, is compared to the spectrum of standard PET (no UV absorber), which transmits light at greater than 320 nm.



The UV light protection provided by Heatwave™ polymer CF746 and Vitiva™ PET PC715 resins are of tremendous value to the brand owner. By protecting sensitive products from UV light damage, these resins can enable the use of a more-desirable ingredient or a less-expensive ingredient that was previously avoided because of its UV sensitivity. These resins can enable the commercialization of products that previously were unable to be commercialized because of too-short shelf lives caused by UV light-sensitive components.

Eastman™ UV-protected PETs are the same kind of plastic used worldwide for soft drink bottles, water bottles, and food containers, with the addition of a UV light protectant that automatically blocks most UV light. There is never a doubt with Eastman™ UV light-protected PET of any additives “leaching” or escaping from the container into the product. The UV component is locked into the plastic “backbone” and cannot escape into the product. These Eastman™ PET resins comply with FDA food-contact regulations at 21 CFR 177.1315(b)(3) and may be used for the conditions of use described in 21 CFR 177.1630 (f), (g), or (j).

Eastman™ light-protected PETs are economical for your container producer, too. These PET resins are a “drop-in” replacement for standard (no UV protection) PET, and they require no special tooling or capital investment for container manufacturers already using PET.

Recycling and UV Efficacy

Eastman™ UV light-protected PET resins are completely recyclable. Both Heatwave™ polymer CF746 and Vitiva™ PET PC715 accommodate the incorporation of postconsumer recycled content (PCR) while maintaining the ability to protect products from UV light. In a study done at Eastman, Heatwave™ bottles containing 10% and 25% PCR were filled with a juice drink and exposed to UV light. Even at the 25% level, the PCR did not affect the ability of Heatwave™ polymer to protect the product from color change when exposed to UV light.

Heatwave™ Polymer With Varying Levels of Postconsumer Recycled Content vs. Standard PET



Heatwave™ Polymer
Unexposed

Heatwave™ Polymer
3-Day Exposure

Heatwave™ Polymer
10% PCR
3-Day Exposure

Heatwave™ Polymer
25% PCR
3-Day Exposure

Consumers rank taste as the number one criterion for selecting a specific food and beverage brand. Brand owners retain customer loyalty by delivering consistent, high-quality products that deliver the brand promise. Consumer purchasing decisions can be influenced by any alterations in product color and/or flavor caused by UV light.

Eastman™ UV light-protected polymers aid food, beverage, and personal care product packagers in maintaining their competitive cost position by incorporating the UV light protection into the polymer, thereby providing a great alternative to UV light-barrier additives. Vitiva™ PET PC715 and Heatwave™ polymer CF746 provide the protection needed by countless branded products. Further information related to these or other products is available online at:

www.eastman.com

or e-mail:

vitiva@eastman.com or
heatwave@eastman.com



Standard PET
(No UV Protection)
3-Day Exposure





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