QUICKSILVER SCIENTIFIC®

TPGS SAFETY AND USE IN QUICKSILVER FORMULATIONS

As leaders in the nutraceutical industry, Quicksilver Scientific combines premium ingredients with the most innovative nanoparticle delivery technology available to offer highly bioavailable formulations to its end users. Our formulas are comprised primarily of botanicals, nutraceuticals, and vitamins. However, our advanced liposomal delivery format — the same format used by leading pharmaceutical companies — also necessitates the use of stabilizing and surfactant agents to ensure product stability and bioavailability.*

One common yet controversial ingredient used in nanoparticle manufacturing is called TPGS or tocofersolan. This water-soluble version of vitamin E is quite misunderstood, prompting this paper. We'll shed some much-needed light on this supportive ingredient and explain the critical reasons why TPGS is safe and effective when added to liposomal formulations.

What is TPGS?

D-α-Tocopherol polyethylene glycol 1000 succinate, also known as TPGS or tocofersolan, is a synthetic water-soluble version of vitamin E. While natural forms of vitamin E are fat-soluble and immiscible with water, the water-soluble nature of TPGS renders it an extraordinarily useful tool in the supplement industry, capable of stabilizing solutions and improving the bioavailability of numerous ingredients.[1,2,3]

TPGS is prepared through the esterification of α-tocopherol succinate and polyethylene glycol (PEG). PEG is a petroleum-based compound with many applications in medicine. It is used as an osmotic laxative in formulas such as Miralax due to its effects on water retention in the stool, which aids bowel movements. PEG demonstrates no toxic effects when taken in controlled quantities.[4]

Currently, TPGS is listed under the name "Tocofersolan" and is designated as an inactive ingredient by the FDA. It has been conferred "generally recognized as safe" (GRAS) status, a statement that has never been challenged by the FDA.

The History of TPGS

TPGS was first developed over 60 years ago as a solubilizing agent for fat-soluble vitamins. In the late 1980s and early 1990s, it was discovered that TPGS could improve fat-soluble vitamin absorption in children with chronic cholestasis, a condition characterized by defective bile acid transport from the liver to the intestine that damages the biliary epithelium and precipitates nutritional deficiencies.[1,2]

To the medical community's dismay, high doses of naturally occurring fat-soluble nutrients could not correct the nutrient deficiencies induced by chronic cholestasis.[1] The hydrophobic nature of these compounds renders them nearly impossible to absorb in individuals with the low bile acid levels characteristic of chronic cholestasis. TPGS quite literally became a lifesaver when it was discovered that it could improve fat-soluble nutrient absorption across the intestinal epithelium of children with chronic cholestasis. TPGS not only replenished low vitamin E levels, but facilitated the absorption of other fat-soluble nutrients, such as vitamin D.[3]

Today, TPGS is approved by the U.S. FDA as a safe adjuvant and is currently used as an absorption-enhancing, stabilizing ingredient in a wide array of pharmaceutical and nutraceutical delivery systems. It is nontoxic to normal cells and tissues in the body.[5]

The Difference Between PEG and Ethylene Glycol

A pervasive misconception about TPGS is that it is harmful because it contains "antifreeze." This concern results from a misunderstanding about the differences between the chemical structures and properties of polyethylene glycol, from which TPGS is derived, and a highly toxic but completely different compound called ethylene glycol.

PEG is a FDA approved substance, on the other hand, ethylene glycol is a very toxic compound best known for its use in antifreeze and deicer solutions. Despite their similar names, these compounds are not equivalent; there is no ethylene glycol present in TPGS. Polyethylene glycol is not harmful if ingested, hence its use in laxatives.

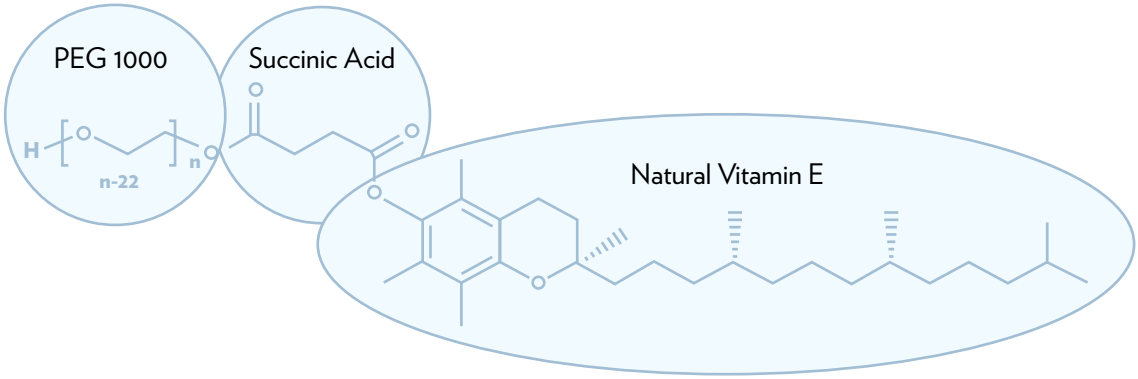
Why Use TPGS?

The hydrophilic properties of TPGS make it a highly desirable solubilizing agent in the pharmaceutical and nutraceutical industries. But what exactly are "solubilizing" properties?

A solubilizing agent is a substance that increases the solubility or the property of a solid, liquid, or gaseous chemical called solute to dissolve in a solid, liquid, or gaseous solvent. In the pharmaceutical and nutraceutical industries, a crucial goal is to improve therapeutic compounds' solubility in the water-rich state of the gastrointestinal tract.

We want to increase the solubility of poorly water-soluble compounds by adding surfactant ingredients, compounds that decrease surface tension, allowing hydrophobic compounds to disperse in water more readily. The addition of PEG and succinic acid onto the natural vitamin E chemical structure confers hydrophilic properties to a previously hydrophobic molecule.

In addition to its surfactant properties, TPGS also improves drug permeation, or the ability of a drug to move across biological membranes such as cell membranes.[5,8,9] The enhancement of permeation facilitated by TPGS also increases its bioavailability, as well as the bioavailability of other ingredients with which it is "packaged." TPGS may improve the efficiency of drug and nutrient delivery at the cellular level.*



The pharmaceutical industry makes frequent use of TPGS to optimize drug delivery. The first drug to utilize TPGS, Amprenavir, was approved by the U.S. FDA in 1999.[7] In 2009, the European Medicines Agency approved tocofersolan under the trade name Vedrop as a treatment for vitamin E deficiency due to malabsorption in pediatric patients suffering from chronic cholestasis.[6] The HIV antiviral Tripanavir and a form of ibuprofen produced by Banner Pharmacaps also contain TPGS.[7] Today, TPGS is used as an adjuvant in vaccines and nutritional supplements.[10] Additional pharmaceutical and nutraceutical uses for TPGS continue to be investigated.

TPGS technology synergizes beautifully with liposomal technology because it stabilizes the delicate membranes of liposomes and improves the absorption of hydrophobic nutraceuticals, such as fat-soluble vitamins. Quicksilver Delivery Systems® uses the power of liposomes to rapidly deliver health-promoting ingredients directly to cells, bypassing absorption constraints posed by the gastrointestinal system and optimizing the bioavailability of these encapsulated compounds.

Liposomes are also readily cleared by the reticuloendothelial system (RES), a system of monocytic and phagocytic cells in the spleen and lymph nodes and Kupffer cells in the liver that remove particulates from circulation.[6] The delicate nature and rapid clearance of liposomes necessitate incorporating ingredients that can stabilize the liposomal membrane, allowing intact functional liposomes to remain in circulation for a longer period of time. High-grade TPGS helps pharmaceutical and nutraceutical manufacturers overcome biological barriers and efficiently deliver health-transforming ingredients directly to cells.[11]

Quicksilver Scientific's products use only high-grade TPGS as a PEG source. The cost of the TPGS we use is 5-10 times higher than other commercial PEG types.

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