

STAY-C® 50 - more than just stable Vitamin C in your formulation

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Abstract

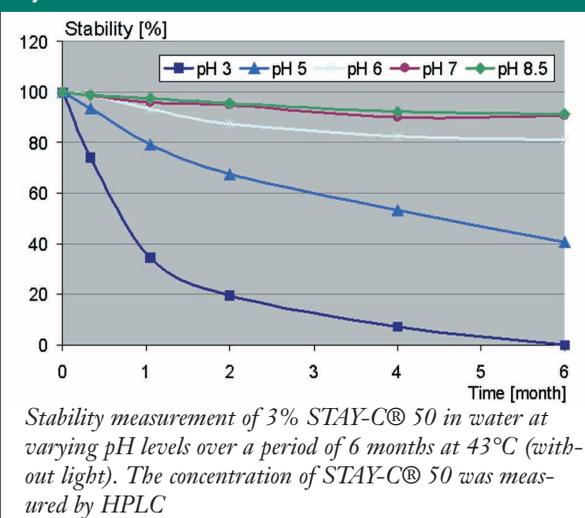
Vitamin C (ascorbic acid) is one of the most widely used antioxidants for protecting the skin. Unfortunately, it is easily depleted when the skin is exposed to the sun, and by external stresses such as pollution and smoking. Maintaining adequate levels of Vitamin C is, therefore, important to help protect the skin against UV-induced free radical damage that is related to skin aging. To provide the maximum benefit from Vitamin C, it is recommended that a stable form of Vitamin C be used in personal care preparations. One such stable form of Vitamin C, known as Sodium Ascorbyl Phosphate or STAY-C® 50, maximizes the protective properties of Vitamin C by retaining its effectiveness over time.

STAY-C® 50, alone or together with Vitamin E, can provide an effective antioxidant combination that reduces the formation of free radicals and stimulates collagen synthesis (which slows down with aging). Additionally, STAY-C® 50 can help to improve the appearance of skin as it can lessen the appearance of photo-damage and age spots as well as protect hair color from UV degradation.

STAY-C® 50 - overcoming Vitamin C's stability issue

Although Vitamin C is a popular 'active' ingredient on skin, stability has always been the main reason why this vitamin was not used at adequate levels in cosmetic formulations. The personal care industry was in need of a Vitamin C form that would be stable in aqueous systems and yet be available as the ascorbic acid form after application. STAY-C® 50 was, therefore, developed to address this requirement. Figure 1 shows that the phosphorylated Vitamin C derivative STAY-C® 50 is highly stable at 43°C at a pH of 7 and higher.

Figure 1



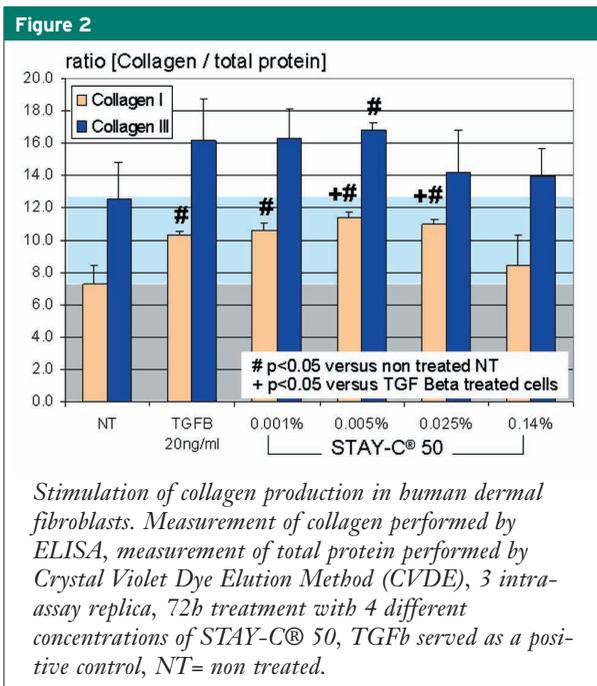
STAY-C® 50 for anti-aging

As an antioxidant, STAY-C® 50 is an ideal ingredient for anti-aging personal care products since it prevents accelerated skin aging induced by the presence of free radicals. Furthermore, STAY-C® 50 has regenerative functions (described below) making it a universal active ingredient in skin care.

Stimulation of collagen production

It has been reported that Vitamin C enhances the production of collagen in fibroblasts^(1,2). In this study, STAY-C® 50 was shown to promote the synthesis of Collagen I and Collagen III in human dermal fibroblasts.

Figure 2 shows that STAY-C® 50 significantly stimulated Collagen I and Collagen III production. The increase compared to no treatment was 57.4% for Collagen I at 0.005% active.



Reduction of skin roughness

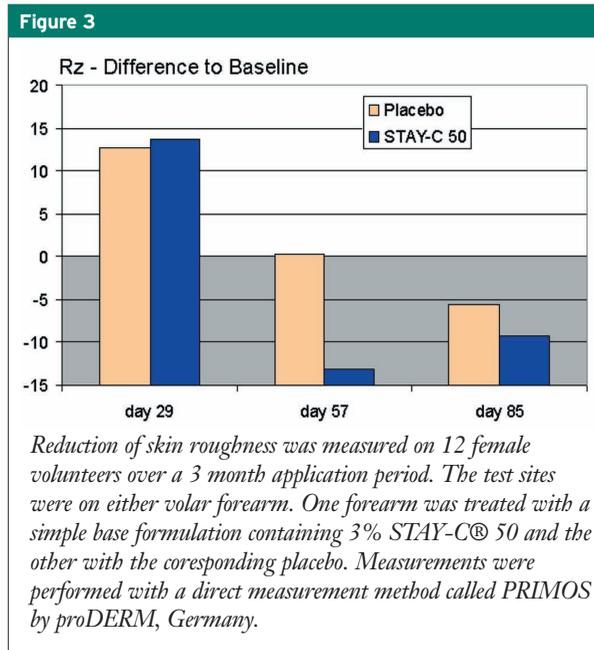
A significant increase in collagen production should result in the improved overall appearance of the skin. In the following *in vivo* study on 12 female volunteers, STAY-C® 50 had a positive effect on skin roughness. Volunteers applied a base formulation containing 3% STAY-C® 50 and its correspondent placebo for 3 months to either volar forearm. Figure 3 shows that STAY-C® 50 reduced the appearance of fine wrinkles after 2 months of application.

STAY-C® 50 in sun care

There is a heightened awareness by both researchers and consumers alike for the increased use of antioxidants in sun care⁽³⁾. It is well known that sun rays can trigger hundreds of reactions in the skin including the formation of free radical species. Exposure to UV light over a lifetime may lead to accelerated skin aging. This is largely due to the formation of free radicals which are able to oxidize the natural components in the skin. Antioxidants such as Vitamin C are able to combat such harmful reactions. The following two studies show the protective effect of Stay-C® 50 in sun care products.

Reduction of lipid peroxide formation after UV irradiation

When skin is irradiated by UV-light oxidation reactions



occur and affect oxygen-sensitive substances in the skin such as unsaturated fatty acids, enzymes, proteoglycans and others. An indicator for oxidative stress in the skin is squalene peroxide, which is formed by the reaction of oxygen with squalene via free radical reactions.

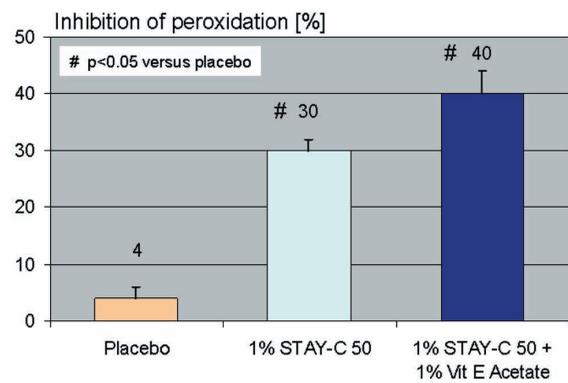
Figure 4 shows a 30% reduction of the formation of squalene peroxide when the skin is pre-treated with 1% STAY-C® 50. The addition of 1% Vitamin E Acetate enhances this protection even more, due to the synergistic effect of Vitamin E and Vitamin C in combating oxidative stress⁽⁴⁾.

Quenching of Reactive Oxygen Species (ROS) formed after UV irradiation

Recent research shows that photodamage to skin is partially caused by reactive oxygen species (ROS) (ROS = singlet oxygen, hydrogen peroxide, superoxide and nitric oxide, etc). ROS may react and destroy lipid membranes, induce inflammatory cytokines and trigger apoptosis. Many of the visible signs of aging are attributed to ROS-induced photodamage that accumulates as a person ages.

The research conducted by Kerry Hanson, Visiting Research Assistant Professor at the University of Illinois, Urbana-Champaign, and her associates showed that sunscreens alone do not protect the skin from the generation of ROS. Using her two-photon fluorescence imaging method, she and

Figure 4



In vivo study on 20 subjects where selected sites on the volar forearm were pretreated by topical application of three different formulations containing 1% STAY-C® 50, 1% STAY-C® 50 plus 1% Vitamin E Acetate or the corresponding placebo. After 7 days of application (twice per day), the skin was irradiated with a UVA dose of 10J/cm² and squalene peroxide found on the upper layers of the treated skin was identified by HPLC measurements.

her team were able to quantify and visually capture the appearance of highly destructive ROS⁽⁵⁾. They were able to show the benefit of using the antioxidants Vitamin E Acetate and STAY-C® 50 in combination with sun filters to reduce ROS formation in human breast tissue. Figure 5 shows the additional quenching effect of ROS of almost 50% when 2.5% STAY-C® 50 and 2.5% Vitamin E Acetate were added to a standard sun filter formulation of SPF 8.

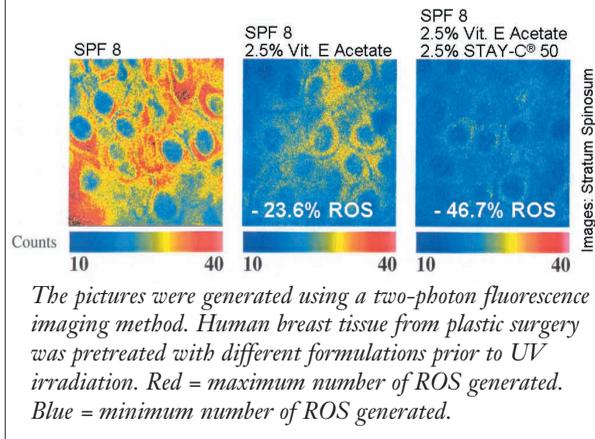
STAY-C® 50 in oral care

Vitamins are used in a variety of different applications including food, topical skin care and technical applications. A special field of application is oral care. Different vitamins such as Vitamin A, Panthenol or Vitamin E have been successfully used in oral care for many years. The stability issue of Vitamin C was the biggest hindrance for toothpaste applications. With the introduction of STAY-C® 50, more stable Vitamin C oral care formulations were developed and have become more popular.

Inactivation of caries bacteria

In the formation of cavities (caries), several bacteria are involved whereas one of the most predominant found in the saliva is *Streptococcus mutans*. Figure 6 shows that STAY-C® 50 at 0.1% and 0.5% effectively inactivates *Streptococcus*

Figure 5



The pictures were generated using a two-photon fluorescence imaging method. Human breast tissue from plastic surgery was pretreated with different formulations prior to UV irradiation. Red = maximum number of ROS generated. Blue = minimum number of ROS generated.

mutans in vitro and, therefore, helps to prevent caries when added to oral care products.

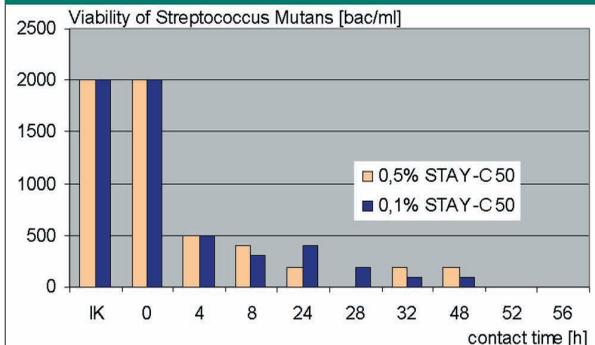
STAY-C® 50 in skin brightening and against age-spots

Vitamin C and Vitamin C derivatives similar to STAY-C® 50 are well known for their ability to inhibit the synthesis of melanin *in vitro* and in the skin⁽⁵⁾. The following tests confirm STAY-C® 50 is also effective as a skin brightening agent and may be used for the treatment of age spots. The benefits include a translucent, lustrous complexion, as well as even skin tone and minimal appearance of dark spots and freckles.

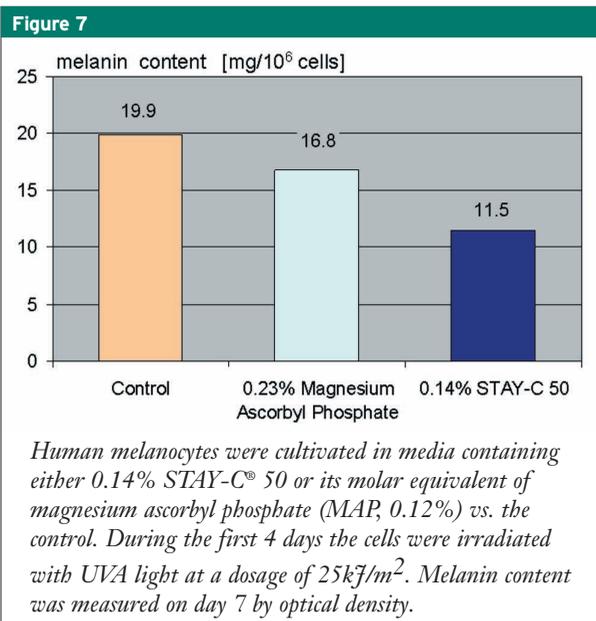
Reduction of melanin formation in human melanocytes

A sure way to measure the inhibition of melanogenesis is to cultivate human melanocytes *in vitro* and then measure the

Figure 6



In vitro test where different concentrations of STAY-C® 50 were added to colonies of Streptococcus mutans and the viability of those bacteria was observed over time



amount of melanin produced^(6,7). Figure 7 shows STAY-C® 50 reduces the melanin content by more than 40% in human melanocytes after stimulation with UV-A light. Compared to magnesium ascorbyl phosphate, it demonstrates slightly better activity.

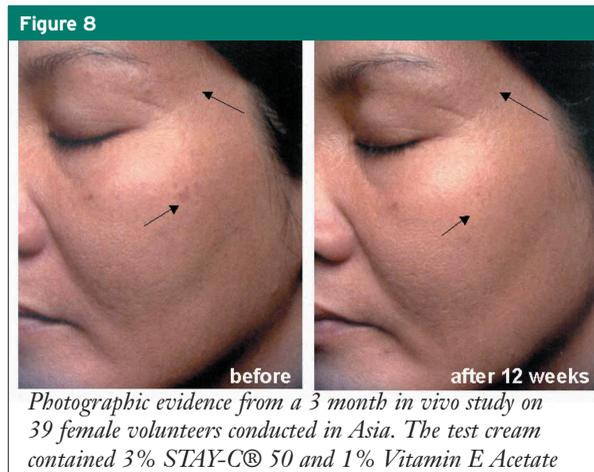
Reduction of age spots

Age spots are noticeable due to an overproduction of melanin in the skin. They are one of the visible signs of skin aging. Age spots can be measured by colorimetry, by the diameter of an age spot before and after treatment or by visual assessment (a qualitative measurement). The photos shown in Figure 8 demonstrate the results of a 3-month *in vivo* study on Asian skin where STAY-C® 50 reduced the color intensity of age spots by 25% (by visual assessment). (Note: STAY-C® 50 has quasi-drug status in Japan as a skin whitening ingredient.)

STAY-C® 50 for acne treatment

Acne vulgaris is one of the most common inflammation reactions that occurs on skin. One way that acne develops is by the skin's reaction to the presence of certain micro-organisms. These micro-organisms can trigger inflammation reactions.

Propionibacterium acnes is one of the major bacteria involved in *acne vulgaris*. As we have already seen in oral care application, STAY-C® 50 is able to inactivate different bacteria types. Figure 9 shows STAY-C® 50 inactivated *Propionibacterium acnes* after 8 hours nearly completely.



Therefore STAY-C® 50 can be used as a mild and natural anti-acne ingredient.

STAY-C® 50 in deodorants

Bacteria cause malodor, especially in the axillary area as they digest certain components from sweat gland secretions. The following underarm sniff test was conducted to assess whether STAY-C® 50 has deodorant activity.

Figure 10 shows that a formulation containing 0.2% STAY-C® 50 reduces malodor by more than 40% 8 hours post-application.

STAY-C® 50 in hair care

UV irradiation can damage the hair in different ways⁽⁸⁾. Although UV filters are used to protect the hair against color change and integrity loss, antioxidants may provide even more protection. As an antioxidant, STAY-C® 50 has the potential to

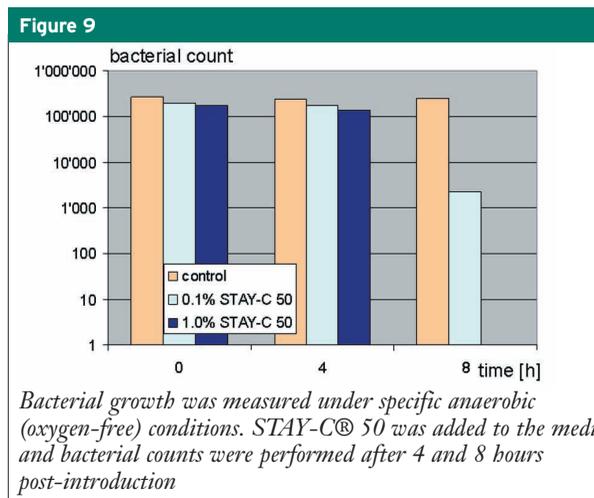


Figure 10

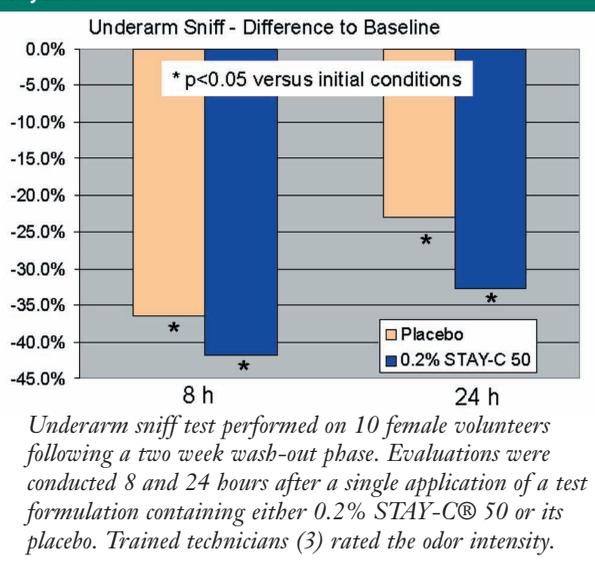
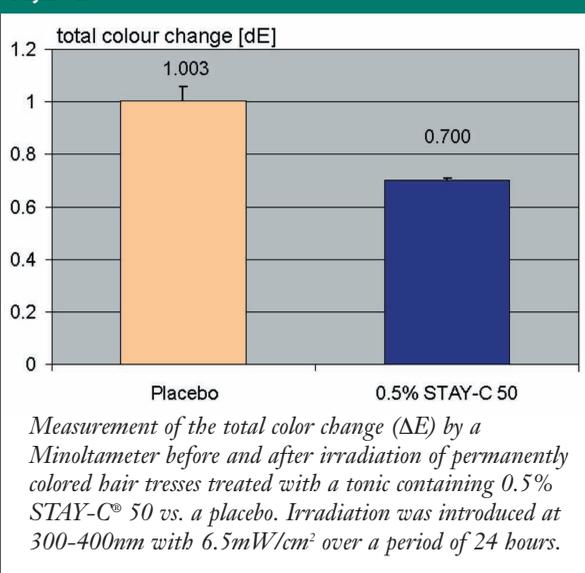


Figure 11



protect hair against the damaging effects of UV light. Figure 11 shows 0.5% STAY-C® 50 in a simple hair tonic protects the hair from color loss upon exposure to UV irradiation.

Conclusion

STAY-C® 50 is a stable form of Vitamin C (ascorbic acid). It is a sodium salt of the monophosphate ester of ascorbic acid (Sodium Ascorbyl Phosphate) and is supplied as a white powder. The most important attributes of STAY-C® 50 are:

- Stable provitamin C of which bioconverts to Vitamin C in the skin
- *In vivo* antioxidant that is applicable to skin care, sun care and hair care products (not approved for oral care use in the US)
- Stimulates collagen production and is, therefore, an ideal active in anti-aging and skin firming products
- Reduces melanin formation that is applicable in skin brightening and anti age-spot treatments (approved as a quasi-drug skin whitener in Japan at 3%)
- Has mild anti-bacterial activity and is, therefore, an ideal active in oral care, anti-acne and deodorant products

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