After 30 years ... the future of hydroxyacids

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Alpha-hydroxyacids (AHAs) have transformed skin care and enjoyed huge commercial success since their introduction by dermatologist Dr Eugene J. Van Scott and dermatopharmacologist Dr Ruey J. Yu in the early 1970s. Thirty years have passed since the published introduction of AHAs, demonstrating their significant "normalizing" or corrective effects on severely dry skin and ichthyosis.[1] It was not until the mid-1990s, just 10 years ago, that the antiaging effects of AHAs became a prominent message in cosmetic dermatology, leading to a proliferation of AHA-containing antiaging products and skin care systems. Today, AHAs and related compounds, including the polyhydroxy acids (PHAs) and polyhydroxy bionic acids (bionic acids), are used manifold in dermatology – cosmetically to achieve smoother skin, adjunctively with topical and systemic medications, and as a complement or enhancing agent with cosmetic procedures.

Many companies have marketed AHA-containing skin care products and, accordingly, consumer recognition of their beneficial effects is high. However, many of the important skin benefits of AHAs are not well understood by many consumers and other users of AHAs. Still viewed by many as simple exfoliants, the more significant effects of AHAs, including normalization of epidermal keratinization[1,2] and dermal remodeling,[2] are frequently overlooked.

Moreover, the newer AHAs (such as benzilic and mandelic acids), polyhydroxy acids (PHAs, such as gluconolactone), and bionic acid compounds (such as lactobionic and maltobionic acids) are even less well understood. The polyhydroxy ingredients are not simply another AHA. They provide similar antiaging and skin smoothing effects of AHAs with the addition of other important benefits too, including gentleness and antioxidant effects – significant advantages over traditional AHAs. The newer, more lipophilic AHAs offer targeted treatment of oily and acne-prone skin, and appear to be less stinging than glycolic acid.

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Accepted for publication January 26, 2005

Mandelic acid and benzilic acid – targeted skin benefits

AHAs that are traditionally used in dermatology (e.g., glycolic and lactic acid) are highly polar, water-soluble materials. Less commonly used AHAs that offer increased hydrophobic properties and lipophilicity include mandelic acid (phenyl glycolic acid) and benzilic acid (diphenyl glycolic acid). These ingredients offer benefits on oily and acne prone skin because they can absorb into oily sebaceous glands.

The addition of mandelic acid and benzilic acid to 0.5% salicylic acid has been shown to provide significant oil-reducing properties and a favorable tolerability profile while offering a concentration of salicylic acid that can be used nearly worldwide.[3]

Polyhydroxy acids (PHAs) – advanced hydroxyacids

After the discovery of the AHAs, continued research led to the use of polyhydroxy acids (PHAs), including gluconolactone and glucoheptonolactone. Considered the "next generation" of AHAs, these compounds provide some unique benefits that other traditional AHAs do not offer. For example, many of the PHAs are antioxidants, functioning as chelators, which trap metals that can have a pro-oxidative effect. Testing models have demonstrated gluconolactone's ability to prevent the oxidation of easily oxidized test substances (hydroquinone and anthralin) with antioxidant results similar to ascorbic acid (vitamin C) and citric acid. Recently, gluconolactone was shown to inhibit the activation of the solar elastosis gene following ultraviolet (UV) exposure. This effect is reportedly caused by antioxidants, and again demonstrates gluconolactone's comparable antioxidant activity to vitamins C and E.[4] Moreover, in contrast to glycolic acid, PHAs (gluconolactone and glucoheptonolactone) have been shown not to increase the formation of sunburn cells in skin following UVB exposure.[4] Perhaps this is in part due to the ability of PHAs to strengthen skin barrier function.[5]

Some of the favorable cosmetic benefits of PHAs result from the multiple hydroxyl groups found on the PHA molecular structure. Due to their polyhydroxy nature, these compounds function as humectants that attract and bind water. In this regard, their effect is similar to other known humectants, such as glycerol and propylene glycol. Perhaps one of the most important benefits of the PHAs is their gentleness. When compared to glycolic acid and lactic acid, PHAs are nonirritating and nonstinging. Product use studies have demonstrated compatibility with sensitive skin, even on rosacea and atopic dermatitis.[6,7] While gentle to the skin, PHAs provide significant antiaging benefits. A recent study demonstrated comparable antiaging effects of PHA products to similar AHA products over a 12-week testing period, with improved mildness characteristics in the PHA treatment group.

Lactobionic acid – bionic hydroxyacids

Another prominent introduction in the AHA class of ingredients offers strong advantages over traditional AHAs. Lactobionic acid, a polyhydroxy bionic acid, is derived from milk sugar. A similar compound, maltobionic acid, is derived from maltose. Both are hygroscopic and moisturizing due to the polyhydroxy structure, producing a gel-like film under conditions of dehydration. Lactobionic acid is a potent antioxidant because of its iron chelating properties and is currently being used as an antioxidant preservative for organs during transplantation procedures. Aside from antioxidant protective effects for skin, lactobionic acid has also been shown to inhibit matrix metallo-proteinase (MMP) enzymes. Activation of these enzymes is largely responsible for the degradation of collagen in skin after sun exposure. Therefore, inhibition of MMP enzymes in combination with antioxidant effects represents a novel, "prevention of photoaging" approach to skin care with this compound. Furthermore, products containing lactobionic acid have been shown to reverse some signs of photoaging, helping to smooth skin and minimize the appearance of fine lines and wrinkles, as well as markedly improve skin clarity, and increase skin thickness and firmness.[8]

Because of their gentleness, lactobionic acid and the PHA, gluconolactone, are ideal for use postprocedurally. They are nonirritating, hydrating, and provide antioxidant protection. Their strong antiaging effects can be used to help extend the benefits of cosmetic procedures, which often diminish barrier function during the process. Topical application of a nonirritating, antiaging product enhances the skin benefits of procedures, such as glycolic acid peels and microdermabrasion by delivering AHA effects to the skin.

Summary

AHAs continue to be used extensively in the fight against photoaging and for adjunctive therapeutic effects in clinician's offices. New, more lipophilic AHAs will be utilized more in the future, especially when targeting oily and acne-prone skin. The polyhydroxy acids are a tremendous advantage in skin care. Offering all of the antiaging benefits of AHAs, these hydrating compounds are also antioxidants, barrier conditioning, gentle, and safe. Lactobionic acid, one of the bionic PHAs, is a unique compound with strong water binding effects, antioxidant properties, and skin smoothing benefits. While all of these compounds provide exfoliation effects, they offer a plethora of other important benefits to skin making them ideal candidates for use in both photoaging and therapeutic treatment regimens.

References

1 Van Scott EJ, Yu RJ. Control of keratinization with alpha hydroxyacids and related compounds. *Arch Dermatol* 1974; **110**: 586–90.

2 Ditre CM, Griffin TD, Murphy GF, Sueki H, Telegan B, Johnson WC, Yu RJ, Van Scott EJ. Effects of alpha hydroxyacids on photoaged skin: a pilot clinical, histologic and ultrastructural study. *J Am Acad Dermatol* 1996; **34**: 187–95.

3 Green BA, Edison BL, Wildnauer RH, Hwu R. Cosmetic uses of benzilic acid – a lipophilic alpha-hydroxyacid (AHA). *European Academy of Dermatology and Venereology Poster Exhibit: Barcelona, Spain* October 15–18, 2003.

4 Bernstein EF, Brown DB, Schwartz MD, Kaidbey K, Ksenzenko SM. The polyhydroxy acid gluconolactone protects against ultraviolet radiation in an in vitro model of cutaneous photoaging. *Dermatologic Surg, Inc* 2004; **30**: 1–8.

5 Berardesca E, Distante F, Vignoli GP, Oresajo C, Green B. Alpha hydroxyacids modulate stratum corneum barrier function. *Br J Dermatol* 1997; **137**: 934–8.

6 Rizer RL, Turcotte AL, Edison B *et al.* An evaluation of the tolerance profile of a complete line of gluconolactone-containing skin care formulations in atopic individuals. *Skin & Aging Suppl.* 2001; **9** (9): 18–21.

7 Rizer RL, Turcotte AL, Edison B *et al.* An evaluation of the tolerance profile of gluconolactone-containing skin care formulations in individuals with rosacea. *Skin & Aging Suppl.* 2001; **9** (9): 22–25.

8 Green BA, Edison BL, Wildnauer RH, Sigler ML. Lactobionic acid and gluconolactone: PHAs for photoaged skin. *Cosmetic Dermatology* 2001: **14** (9): 24–8.