

A Polyhydroxy Acid (PHA) Skin Care Regimen Provides Comparable Anti-Aging Effects to an Alpha-Hydroxyacid (AHA) Regimen

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Introduction

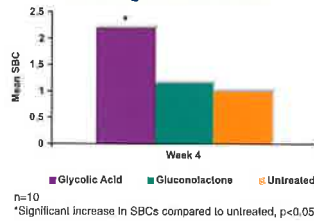
The alpha-hydroxyacids (AHAs) are one of few ingredient technologies that have advanced the science of cosmetic dermatology. Their benefits on skin are varied and impressive, having been documented in numerous clinical publications demonstrating both cosmetic and therapeutic effects.¹⁻⁶ Glycolic acid, the most commonly used AHA, has been shown to smooth skin, promote even skin tone, and enhance skin firmness, elasticity and luminosity/clarity.⁶⁻⁸

The beneficial effects of AHAs are mediated through several biological processes in skin. These include: 1) diminishing the bonding properties between corneocytes at the base of the stratum corneum leading to exfoliation - particularly of abnormally thick skin⁹; 2) normalization of epidermal structure and cell morphology as evidenced by improved differentiation, increased epidermal thickness, and more uniform melanin disbursement¹⁰; which promotes improved skin clarity; and 3) at higher concentrations, AHAs have been shown to provide dermal effects including increased glycosaminoglycan (GAG) deposition (and a resultant skin plumping), collagen gene induction, and diminished solar elastosis as a result of the increased density of striated elastic fibers in place of globular, non-functioning fibers.¹¹ Taken together, all of these effects provide profound anti-aging and skin normalization effects.

Many new ingredients have been introduced as potential competitors to AHAs including copper peptides, vitamin C, and other imaginative hydroxyacid creations such as amino fruit acids, and glycolates. Little human-use clinical data is provided to support the use of these compounds for anti-aging, especially in comparison to the published findings with AHAs.

The polyhydroxy acids (PHAs) are a newer ingredient technology that extend the class of AHAs. Moreover, the PHAs have been studied in many human clinical studies to evaluate their cosmetic benefits. They provide similar anti-aging effects as AHAs, while being more gentle to skin, compatible with atopic and rosacea skin types, and enhance skin barrier efficiency.¹²⁻²⁰ These molecules also function as humectants/moisturizers and antioxidants as a result of their polyhydroxy structure.^{21,22} **Importantly, gluconolactone and glucoheptonolactone (both PHAs) have been shown not to increase the potential for sun sensitivity as measured in the sunburn cell model (see graph below), which has been a source of concern with topical use of glycolic acid without sunscreen.^{23,24} While significant evidence exists to support the use of polyhydroxy acids (PHAs) for anti-aging skin care, a direct comparison of the anti-aging effects of AHAs and PHAs in skin care products has not been available.**

Mean Sunburn Cell Count SBC/High Power Field



Objective

The purpose of this poster is to summarize the results of a human clinical study demonstrating:

- Relative equivalence in anti-aging activity between the tested AHA and PHA regimens.
- Enhanced mildness characteristics with the PHA regimen compared with the AHA regimen.

Method

This was a twelve-week, controlled-usage study to assess the comparative ability of an AHA-containing regimen and a PHA-containing regimen to reduce the signs of photoaging on the face. The study was conducted during the months October through January.

- Population:**
 - Caucasian females with mild to moderate periorcular fine lines, periorcular coarse wrinkles, and mottled hyperpigmentation on the face.
 - Females, 31-58 years.
 - AHA treatment group: n=27.
 - PHA treatment group: n=30.

- Conditioning Phase:**
 - Subjects discontinued use of all products on the face except cleansers and glamour products 3-5 days in advance of baseline.

- Test Products:**
 - Currently marketed products were selected for use in this study for claim support purposes. Products were provided in blinded packaging.

	AHA Regimen	PHA Regimen
Daytime Moisturizer SPF 15	8% glycolic acid, pH: 3.8	4% gluconolactone, pH: 3.8
Nighttime Moisturizer	8% glycolic acid, pH: 3.7	10% gluconolactone, pH: 3.6
Total Daily Usage	16% glycolic acid	14% gluconolactone

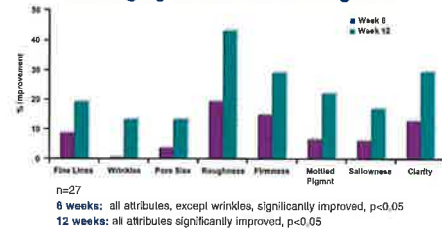
- Regimen Usage:**
 - Each participant used a PHA-containing, wash-off cleanser twice daily followed by application of the daytime moisturizer with SPF 15 sunscreens during the day and the nighttime moisturizer in the evening.
 - Products were applied everyday for 12 weeks.
- Clinical Evaluations (Baseline, Week 6, Week 12):**
 - Performance parameters:** the left side of the face was evaluated by a trained visual grader using a 10-cm analog scale with 0.25cm increments (where 0 = none and 10 = severe) for the parameters: fine lines, coarse wrinkles, pore size, roughness, firmness, mottled pigmentation, sallowness (dullness), and clarity.
 - Irritation parameters:** facial irritation was graded *objectively* for the parameters: erythema, edema and dryness, and *subjectively* for the parameters: burning, stinging, itching, tightness, and tingling, using a 0-3 scale.
 - Pinch recoil:** measurements were taken of the left under eye area to assess skin elasticity by pinching the skin and recording time with a stopwatch (in seconds) to full recovery of the skin. The measurements were performed in triplicate, and the average score was reported. Pinch recoil is a recognized indicator of skin resiliency and firmness.²⁵
 - Silicone replicas:** negative impressions of skin topography on the left periorcular (crow's feet) area were taken to assess changes in fine lines, coarse wrinkles and skin texture at baseline and after 12 weeks.
 - Self-assessment:** questionnaires were completed by the panelists at each study visit.
- Data Analysis:**
 - Mean scores of clinical grading parameters and pinch recoil measurements *within a treatment* were statistically analyzed compared to baseline scores using a paired t-test at the p<0.05 significance level.
 - Mean percent changes from baseline were calculated. Comparisons were made *between treatments* using ANOVA with pairwise comparisons using Fisher's LSD.
 - Silicone replicas were analyzed using image analysis by bioNet, Inc.

Results

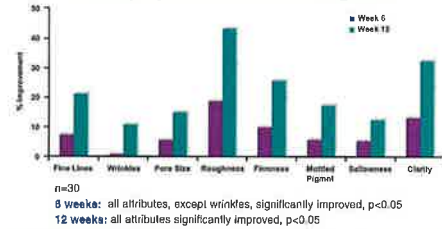
CLINICAL GRADING: ANTI-AGING

- The AHA and PHA regimens significantly improved the quality of photoaged skin at 6 and 12 weeks.
 - The AHA regimen scored significantly better than the PHA regimen for sallowness at 12 weeks. All other visually graded efficacy parameters were statistically equivalent.
- Skin resiliency was significantly improved at both 6 and 12 weeks for the AHA and PHA regimens.
 - The AHA treatment regimen improved skin elasticity more strongly than the PHA regimen at week 12, p<0.05. (13.5% vs. 10.2%)

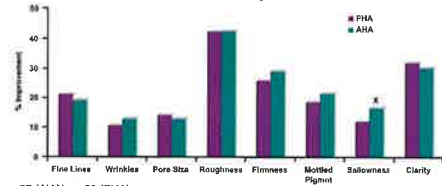
Anti-Aging Effects of AHA Regimen



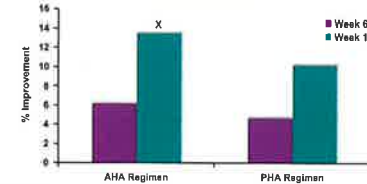
Anti-Aging Effects of PHA Regimen



Comparative Anti-Aging Effects of AHA and PHA Regimen Week 12 Comparison



Pinch Recoil

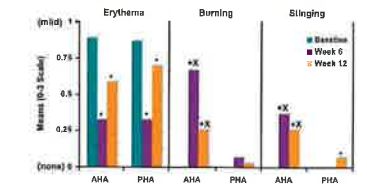


- Silicone Replicas (Week 12):**
 - AHA regimen: A significant improvement of wrinkles was measured by: Ra, Rz, spacing, shadows and number of wrinkles. There was an increase in the roughness parameter of fine lines corresponding to diminished coarse wrinkling. (As wrinkles diminish, fine lines increase in their place.)
 - PHA regimen: Significant improvement in the number of fine lines.

CLINICAL GRADING: IRRITATION

- The AHA and PHA regimens were well tolerated.
- Minimal but statistically significant differences were observed for the parameters: erythema, burning and stinging. All other objective and subjective irritation parameters were not notable.

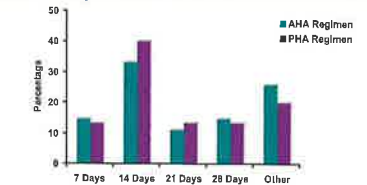
Irritation Assessment



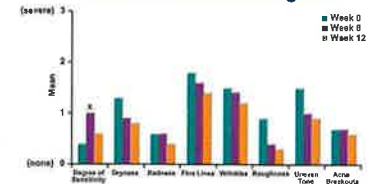
CLINICAL GRADING: SELF-ASSESSMENT

- The AHA and PHA regimens were rated favorably for providing anti-aging effects.
- The PHA regimen was better tolerated at the 6 week timepoint based on self-assessed 'degree of sensitivity', p<0.05.

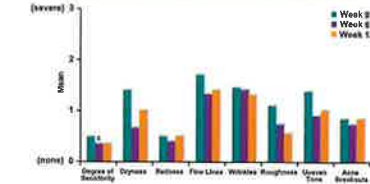
Number of Days Until Skin Looked and Felt Younger



Self-Assessment: AHA Regimen



Self-Assessment: PHA Regimen



Conclusions

- The AHA regimen and PHA regimen provided significant anti-aging benefits to photoaged skin as measured by silicone replicas, clinical grading and pinch recoil for firmness.
- The anti-aging benefits of the AHA regimen and PHA regimen are equivalent with only a couple of statistically significant differences being noted:
 - Sallowness was more improved with AHA use at the 12-week time point only: 17.1% vs. 12.4%
 - Pinch recoil was more improved with AHA use at the 12-week time point only: 13.5% vs. 10.2%
- Use of the PHA regimen was better tolerated than the AHA regimen as evidenced by lower stinging and burning, as well as self-assessed 'degree of sensitivity'.

Summary

There are many reasons to select polyhydroxy acids (PHAs), such as gluconolactone, to use in anti-aging skin care. They are suitable for use on all skin types, including sensitive skin, rosacea and atopic dermatitis.^{18,19} Gluconolactone has been shown to provide anti-acne effects at higher concentrations²⁰, and it does not increase sun sensitivity^{21,22}. PHA regimens have demonstrated compatibility with concomitant retinoid use²³, and offer gentle hydrating and light exfoliating effects^{18,19}. PHAs are also anti-oxidants that have been shown to prevent the oxidative degradation of readily oxidized drugs, which may be in part due to their ability to chelate oxidation-promoting metals.^{21,22} The present study demonstrates their equivalence in providing anti-aging benefits when compared to an AHA regimen, while being more gentle.

References

- Van Scott EJ, Yu RJ. Hydroxy acids: past, present, future. In: Moy R, Luttman D, Kalka L, eds. *Glycolic acid peels*. New York, NY: Marcel Dekker; 2002; pp 1-14.
- Yu RJ, Van Scott EJ. Alpha-hydroxy acids: science and therapeutic use. *Cosmetic Dermatology Supplement* 1994;(suppl)1-6.
- Van Scott EJ, Yu RJ. Hyperkeratinization, corneocyte cohesion and alpha hydroxy acids. *J Am Acad Dermatol* 1984;11:857-879.
- Van Scott EJ, Yu RJ. Alpha hydroxy acids: therapeutic potentials. *Canad J Dermatol* 1982;1(8):108-112.
- Van Scott EJ, Yu RJ. Alpha Hydroxyacids: procedures for use in clinical practice. *Cutis* 1989;43:222-226.
- Bergfeld W, Iung R, Vilmos A, Vellanki L, Remol B, Stanton-Hicks U. Improving the cosmetic appearance of photoaged skin with glycolic acid. *J Am Acad Dermatol* 1997;38:101-3.
- Leyden JJ, Lawler RM, Grove G, Kaidbey K. Alpha hydroxy acids are more than moisturizers. *J Geniatr Dermatol* 1995;3 Suppl A (3):35A-37A.
- Hendon MI and Okan G. The use of alpha hydroxy acids in xerosis and photoaging. In: Moy R, Luttman D, Kalka L, eds. *Glycolic acid peels*. New York, NY: Marcel Dekker; 2002; pp 115-139.
- Dire CM, Griffin TD, Murphy GF, Siskel H, Telegan B, Johnson WC, Yu RJ, Van Scott EJ. Effects of alpha-hydroxy acids on photoaged skin: A pilot clinical, histologic, and ultrastructural study. *J Am Acad Dermatol* 1996;34:187-95.
- Bernstein EF, Underhill CB, Lakkakorpi J, Dire CM, Uitto J, Yu RJ, Van Scott EJ. Citric Acid increases viable epidermal thickness & glycosaminoglycan content of sun-damaged skin. *Dermatol Surg* 1997;23:889-94.
- Bernstein EF. Dermal effects of alpha hydroxy acids. In: Moy R, Luttman D, Kalka L, eds. *Glycolic acid peels*. New York, NY: Marcel Dekker; 2002; pp 71-114.
- Bernstein EF, Uitto J. Connective tissue alterations in photoaged skin and the effects of alpha hydroxy acids. *J Geniatr Dermatol* 1995;3 Suppl A(3):7A-18A.
- Griffin TD, Murphy GF, Siskel H, Telegan B, Johnson WC, Dire CM, Yu RJ, Van Scott EJ. Increased factor XIII immunoreactivity expression in dermal dendrocytes after treatment with alpha-hydroxy acids: potential physiologic significance. *J Am Acad Dermatol* 1996;34:196-203.
- Kim S, Park J, Kim D, Won Y, Malbach HL. Increased *in vivo* collagen synthesis and *in vitro* cell proliferative effect of glycolic acid. *Amer Soc for Derm Surgery*. Inc. Published by Elsevier Science Inc. 1996;24:1054-1058.
- Bernstein EF, Lee J, Brown DB, Yu RJ, Van Scott EJ. Glycolic acid treatment increases type I Collagen mRNA and hyaluronic acid content of human skin. *Dermatol Surg* 2001;27(5):51-5.
- Bernstein EF, Brown BA, Edison BL, Wildnauer RH. Poly hydroxy acids (PHAs): clinical uses for the next generation of green acids. *Skin & Aging* 2001; Suppl 5.
- Green BA, Edison BL, Wildnauer RH and Sigler ML. Lactobionic acid and gluconolactone: PHAs for photoaged skin. *Cos Dermatol* 2001; 9:24-26.
- Ortinas F, Edison BL, Green BA and Wildnauer RH. Evaluation of inherent differences in ethnic skin types and response to topical polyhydroxy acid (PHA) use. *Amer Acad of Derm Postgr Exhibit*. Washington DC, March 2001.
- Bergfeld WF, Remzi BK, Green B, Patel P, Ravas R. An evaluation of the gluconolactone sensitive skin care products. *Amer Acad of Derm Postgr Exhibit*. Orlando, February 1998.
- Bernardesa E, Blakmore F, Vignot CP, Orsajo C, Green B. Alpha hydroxyacids modulate stratum corneum barrier function. *British J Dermatol* 1997;137:938-939.
- Butavari S, ed. *The Marck Index*. 12th ed. Whitehouse Station, NJ: Marck & Co.; 1996;757-758.
- Yu RJ, Van Scott EJ. Hydroxycarboxylic acids, N-acetylamino sugars, and N-acetylamino acids. *SKINnews* 2002;2:117-122.
- Green BA, Edison BL, Wildnauer RH. Polyhydroxy acids (PHAs) provide conditioning effects to skin without increasing sensitivity to UV light. *Amer Acad of Derm Postgr Exhibit*. New Orleans, March 2002.
- Bernstein EF, Brown DB, Schwartz MG, Kiskibey K, Ksenzko SM. The polyhydroxy acid gluconolactone protects against ultraviolet radiation in an *in vitro* model of cutaneous photoaging. *Submitted for publication*, 2003.
- Appa Y, Aswinton BS, Stephens TJ, River RL, Miller DL, Herndon JH. A six month clinical study to evaluate the long term efficacy and safety of an alpha hydroxy acid lotion. *Amer Acad Derm Postgr Exhibit* Washington DC, February 1996.
- Hurt MJ, Bernelson R SIC. A comparative study of gluconolactone versus benzoyl peroxide in the treatment of acne. *Australas J Dermatol* 1992;33:131-134.

This study was conducted by Stephens & Associates, Carrollton, TX by Dr. Monya Sigler with Board Certified Dermatologist, James H. Herndon, Jr., M.D.
American Academy of Dermatology Poster Exhibit: San Francisco, CA; March 22-24, 2003.