



# INTERNATIONAL JOURNAL OF CLINICAL PHARMACOKINETICS AND MEDICAL SCIENCES

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## Hydroxy Acids: The Booming OTC Skincare Trend

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### Article History:

Received on: 01 May 2021  
Revised on: 14 May 2021  
Accepted on: 15 May 2021

### Keywords:

Hydroxy Acids,  
Salicylic Acid,  
AHA

### ABSTRACT

The following article emphasizes on the basics of hydroxy acids as a concept. Acid is often thought of as a substance as to which is not seen anywhere near the skin, but Hydroxy acids have been used in the skincare industry for a long time now, but the year 2020 had them come into the picture as a miraculous skincare product for all the traditionally occurring skin conditions like acne, hyperpigmentation, blackheads, etc., that being said it has quite a few side effects. In the due course of the article, we see what are hydroxy acids, their classification, side effects, indication, and significance.

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eISSN: 2583-0953

DOI: <https://doi.org/10.26452/ijcpms.v1i2.195>



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### INTRODUCTION

The hydroxy acids constitute a greater level of substance use in the skincare industry. Their major use as seen in many years is that they act as chemical exfoliators and have been used in concentrations varying from 2% to 70%. The given concentrations depend on the skin condition, pH, and time of administration. The higher the concentration of the product, the greater the exfoliative, epidermolytic, and even toxic and corrosive action. The most well know and widely used hydroxy acids are glycolic acid, mandelic acid, salicylic acid, and its derivatives. In recent times, newer derivatives like PHA's like gluconolactone have been developed that have lesser side effects and increased efficacy. The major pharmacological action of these hydroxy acids towards the skin is providing hydration, anti-aging action, collagen synthesis acceleration, exfoliation and modulation matrix degradation, free radical neutralization. The use of hydroxy acids can be

in varied dermatological scenarios like acne, blackheads, rosacea, sebum production control, hyperpigmentation, wrinkles, and dealing with sensitive skin all with high efficacy and good safety profile index [1].

### Classification/Type

#### AHA's

AHAs are carboxylic acids with one hydroxyl group attached to the  $\alpha$ -position of the carboxyl group [2]. The uncomplicated representation of an alpha hydroxy acid is through glycolic acid, which was the first of this class of compounds to be introduced into skincare products. Alpha hydroxy acids are a group of acids based on their origin, like lactic acid (derived from milk, cane sugar), etc. from the smallest to the largest they range as Glycolic acid, Lactic acid, mandelic acids. They are water-soluble and make the skin sensitive to sunscreen Lactic acid, which is derived from milk, cane sugar, or beet sugar is a great alternative having optimal biological activity, and is used in various topical dosage formulations for its exfoliative action [3].

#### PHA's

A new lineage of acids called PHAs and polyhydroxy bionic acids (PHBAs), are a family of alpha-hydroxy acids, provide effects similar to that of  $\alpha$ HAs but with fewer hypersensitive reactions. At least one hydroxyl group must be attached to the  $\alpha$ -position. Attaching a sugar molecule to the PHA-structure forms a polysaccharide known as bionic acid. PHA's make ideal ingredients for use in derma-

tologic and cosmetic procedures. Ultraviolet radiation damages the skin through a variety of mechanisms, including the generation of free radicals [3]. Gluconolactone is a polyhydroxy acid (PHA) that is capable of chelating metal ions and may also function by scavenging free radicals, thereby protecting the skin from some of the damaging effects of Ultraviolet radiation. These acids won't make the skin photosensitive; they also act as nutrients; they offer antioxidant properties. Protects against the breakdown of collagen, as these are slow-release acids, they work great for sensitive skin people.

### BHA's

Beta Hydroxy acids (BHAs) are carboxylic acids having 1 hydroxyl group attached to the beta-position of the carboxyl group. Few beta hydroxy acids also come under alpha hydroxy acids because they contain a hydroxyl group in the alpha position and to the carboxyl group there is a hydroxyl group attached. Citric acid and Malic acid are the well-known prototypes in this division of beta hydroxy acids. Citric acid which is a beta hydroxy acid is derived from citrus fruits and is most widely used as a topical preparation due to its antioxidant property and its use as an anti-aging agent. These are oil-soluble; they go deep into the pores and help with severe acne. These acids won't make the skin sensitive to the sunlight, however, it is best to use sunscreen regardless [2].

### Hyaluronic Acid

Hyaluronic acid is best known for its humectant action. Hyaluronic acid is also called Hyaluronan. Hyaluronic acid is a non-sulfated glycosaminoglycan and is anionic. The mechanism of action of HA is by two mechanisms, Hyaluronan which is a product of the physicochemical basis of HA forms a film over the surface of the skin and this film is acting as a humectant by acting as an epidermal barrier and preventing the loss of moisture from the skin. The second action is that the HA absorbs moisture from the atmosphere and adds it back to the skin surface, this is still under study. Due to the above reasons, hyaluronic acts as a great moisturizer for people living in a colder climate and people with dry skin.

### Mechanism of Action

The precise mechanism of action of Hydroxy acids on the skin is not fully known. Hydroxy acids are mainly widely used for their action on acne and various skin condition and aging. Hydroxy acids act on inducing desquamation {skin peeling}, skin plasticization {increase in elasticity of skin}, skin softening, also cause normalization of epidermal differentiation which thereby causes a reduction in corneocyte cohesion which induces keratolysis [2]. The use

of Hydroxy acids for conditions like acne or its use on acne-prone skin in form of peeling and topical treatments is recommended. The higher the concentration of the acid and the lower the pH of the formulation, there is seen faster keratolysis & differentiation [1]. Sometimes the increased concentration of the acid causes excessive hypersensitivity reaction. A patch test is recommended before use. The mechanism of action is mentioned in the Chart 1 below [4].

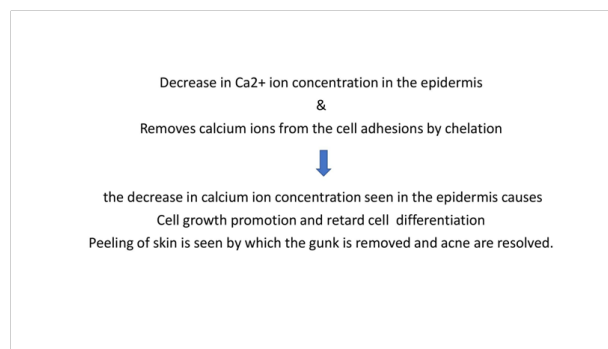


Chart 1: Mechanism of action

### Salicylic Acid

Salicylic acid is one of the most popular hydroxy acids. Salicylic acid is a phenolic derivative that is seen distributed in a wide range of plants. It is a natural plant product and is a phenolic derivative, i.e., it is obtained as a product of phenylpropanoid metabolism, decarboxylation of trans-cinnamic acid to benzoic acid, and its subsequent 2- hydroxylation thus leading to the formation of salicylic acid. SA is one of the major ingredients in a variety of skincare products. It is widely used for the treatment of dermatitis, acne, psoriasis, calluses, corns, keratosis nigricans, ichthyosis, and warts. In SA, both the hydroxyl and therefore the carboxyl groups are directly attached to an aromatic benzene formula, and both exhibit acidic properties. In contrast, the hydroxy groups in  $\alpha$ HAs,  $\beta$ HAs, and PHAs are neutral under the conditions utilized in clinical and cosmetic settings supported knowledge so far, SA doesn't function physiologically or therapeutically as a  $\beta$ HA [2]. SA is employed in cosmetic formulations for a spread of applications, more specifically, it's fat-soluble, which makes it useful in subjects with oily skin.

### Indications

#### AHA's

The use of AHAs in cosmetic and dermatologic scenarios depends on various factors i.e., the use for the treatment with AHA and their derivatives, depends mainly on concentration, pH, formulation, and appli-

**Table 1: Hydroxy acid and its uses**

Hydroxy acid	Dosage forms available	Indication / Use
<b>Alpha hydroxy acid</b>		
1. Glycolic acid (Figure 1)	1. Serums	1. Warts
2. Lactic acid (Figure 1)	2. Toners	2. Seborrheic keratoses
3. Mandelic acid (Figure 1)	3. Gels	3. Photo aged skin
	4. Soaps	4. Fibromyalgia
	5. Shampoos etc.	5. Melasma
<b>Beta hydroxy acid</b>		
1. Salicylic acid (Figure 1)	1. Gels	1. Keratolytic
2. Citric acid (Figure 1)	2. Toner	2. Calluses
	3. Ointment	3. Acne
	4. Serum	4. Aging
<b>Polyhydroxy acids</b>		
1. Gluconolactone (Figure 1)	1. Toner	1. Anti-aging
	2. Serum	2. Humectant
		3. Anti-oxidant
		4. Skin smoothening
<b>Hyaluronic acid (Figure 1)</b>		
	1. Moisturizer	1. Humectant
	2. Lotions	
	3. Cream	
	4. Serum	

cation time [1]. The lower the pH of the product the higher is its concentration in that particular formulation, the more is its efficacy and toxicity. The formulations such as creams and gels have a concentration in the range of 5% up to 20% for their use in chemical peeling and topical therapy. The formulations containing free AHA's in a concentration of 20% to 70% are partially neutralized and handling if these formulations are done by professional dermatologists. They are classified as chemical exfoliants/peels. The physicochemical effects of these formulations as mentioned above prevail and their applications result in more intense reactions. The most commonly used AHA is glycolic acid. Indications of AHA's include: to remove epidermal skin alterations like seborrheic or actinic keratoses as well as senile lentiginos and verrucae vulgares [2].

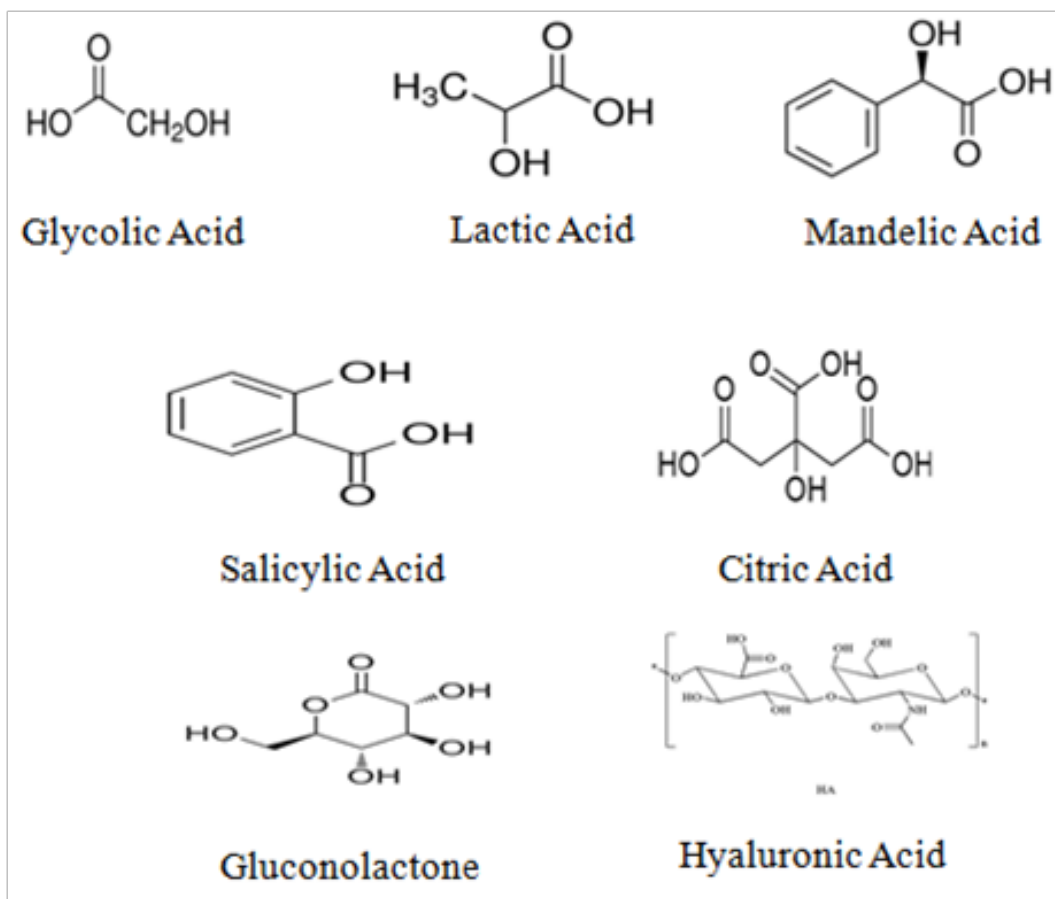
**Salicylic Acid**

Salicylic acid is widely used in cosmetic formulations used in concentrations of 2%–4% and also has been used therapeutically as a keratolytic (peel-

ing)agent to treat skin conditions, such as calluses, keratoses, acne, and photoaging. An alternative, Beta lipo hydroxy acids have an 8-carbon fatty acid chain that is linked to a benzene ring, which makes it more lipophilic than salicylic acid and preferred. This is responsible for its slow penetration. Salicylic acid is used for calluses, acne vulgaris, blackheads, seborrheic dermatitis, and also as a keratolytic.

**PHAs**

Polyhydroxy acids constitute the next generation of alpha-hydroxy acids for their use in the skincare and cosmetic industry. PHA's are alpha-hydroxy acids that contain several hydroxyl groups. A newer addition to PHA's is polyhydroxy benzoic acids, which have an additional sugar molecule attached to the PHA structure. PHAs and PHBAs are known for their clinically proven anti-aging and skin smoothening actions that are comparable to that of AHAs but with less toxic side effects. Apart from that, these PHAs and PHBAs have additional roles as humectants and antioxidants which make them even more promis-



**Figure 1: Different Types of Hydroxy Acid**

ing.

**Side Effects**

Side effects depend upon the used concentration and therefore the pH of the respective preparation. The lower the concentration of hydroxy acid {active ingredient} in a particular formulation, the lower are the chances for side effects. Usually, a product when used daily, and which is applied by the patient, the concentration of the product should be in a tolerable range say 2% to 15%, and causes only mild side effects. The patient has to be informed of the potential side effects ranging from milder symptoms like itching, redness, irritation, erythema, and more superior symptoms like burning, purging, bleeding, etc. Sometimes, purging which is often seen as a concern is however not as it is a sign that the acid is working its way. Side effects are mostly seen when the skin is sensitive and the severity depends on the concentration and pH the hydroxy acid is used, when used in higher concentrations side effects are seen more frequently [2]. The side effects usually observed are:

1. Pain
2. Blistering

3. Purpura or crusting

Potential side effects such as:

1. Erythema
2. Hypopigmentation
3. Hyperpigmentation
4. Atrophy
5. Ulceration
6. Scarring; 7. Hypertrophic scarring or keloid formation, as well as the risk of infection.

However, the most commonly observed effect following the use of a hydroxy acid is Persistent Erythema [5].

**CONCLUSION**

The use of hydroxy acids has transformed skincare on a wider ratio. Coming to the year 2020 especially, with the lockdown imposed a large number of people (in the age group 19-29) have been using hydroxy acids, specifically in the form of serums

with a percentage of about alpha hydroxy acid being 30 % and Beta hydroxy acid being 2%. These have led to a significant rise in the usage of conveniently available OTC formulations in the form of toners, serums, and few as moisturizers. However, having said the pros, these products have a major con being photosensitivity. Using an acid on to the skin particularly sensitive skin, a doctor's recommendation is appreciated. The use of sunscreen with an SPF of at least 50 is a must. This helps prevent harmful photo-aging. Hydroxy acids have transformed the skincare arena to a maximum. The concentrations and ph of the active ingredients should be considered while usage. The timing of application of certain acids is very important, for example; the use of salicylic acid or any active acid should be at night time as it is the best time for skin recovery and also have minimal or no exposure to sunlight. The combination of actives also plays a major role, for example when using two actives like niacinamide and salicylic or glycolic acid, niacinamide being an excellent source of a water-soluble form of vitamin b3 and salicylic acid being a beta hydroxy acid work very well in combination. But having said that, the timing and interval gap between usage of these actives is very keen. Keeping in mind the Ph balance of the skin, i.e., the Ph of the skin ranges from about 5.4 to 5.9 i.e., weakly acidic. When layering actives, one always wants to be moving in the order of lowest to highest Ph. This means that in this example, first apply the hydroxy acid and then incorporate a 30-minute time window which gives time for the skin to return to its natural ph. Then the niacinamide can be applied. After which we can proceed with the moisturizers and sunscreen (day time/ while in front of bright light). However, chronic use is not recommended.

#### Funding Support

The authors declare that they have no funding support for this study.

#### Conflict of Interest

The authors declare that there is no conflict of inter-

est.

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**Cite this article:** Varagani Tejaswini. Hydroxy Acids: The Booming OTC Skincare Trend. *Int. J. of Clin. Pharm. Med. Sci.* 2021; 1(2): 30-34.



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