



THE FIRST EFFECTIVE SKIN-FRIENDLY,
LONG-ACTING, NON-IRRITANT,
SWEAT-CONTROLLING DEODORANT

APPEARANCE: SOLID VISCOUS SUSPENSION
RECOMMENDED DOSAGE: 5-40%

A “smart” deodorant able to understand when it’s time to work more? Now it’s possible with Kalichem **DEOAP**, the first sweat-controlling and deodorizing active ingredient able to “self-regulate” its activity. The special “AP delivery system” allows the functional components of **DEOAP** to act in a controlled way, optimizing its performance and ensuring a long-lasting effect. The more the amount of sweat and odor produced, the greater its sweat-limiting and deodorizing power. **DEOAP** efficacy has been extensively proven by *in vitro* and *in vivo* studies. It is produced according to a totally green and sustainable process and has been designed to ensure maximum skin tolerability and to improve skin texture, elasticity and appearance. Moreover **DEOAP** carefully respects skin microbiota, especially in delicate areas like the armpits. **DEOAP** is a new generation deluxe ingredient that guarantees both safety and functionality, finally allowing to replace the obsolete and poorly tolerated classic deodorants.

• FORMULATION STRATEGY

The starting point was to maintain, enhance and control the sweat-controlling activity of aluminum, avoiding the irritant effects of the chlorohydrates (the aluminum salts more commonly used to reduce sweat), minimizing at the same time the aluminum impact. Functional substances with synergistic actions were therefore combined: aluminum exerts sweat-controlling activity, reducing the amount of sweat produced; zinc possess an adsorbent, bacteriostatic, deodorizing activity; hydroxyapatite and PCA act on skin improving its elasticity, hydrolipidic film, texture and appearance. All these benefits have been conveyed into a single active ingredient: **Aluminum Zinc Hydroxyapatite & Zinc PCA**.

By solubilizing in sweat, aluminum chlorohydrate and sesquichlorohydrate, produce hydrochloric acid (HCl) which is aggressive on the skin. Due to HCl, chlorohydrates are indeed associated with the impair of skin microbiota, the onset of irritative dermatitis and the damage to the sweat gland (**Fig. 1**).

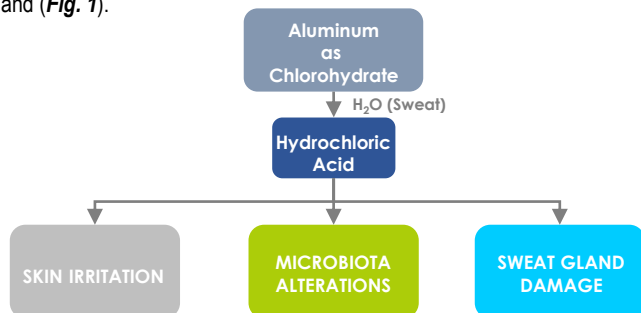


Figure 1. Problems associated with HCl release from aluminum chlorohydrates.

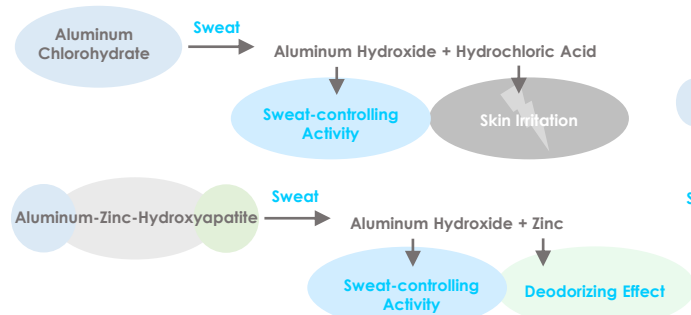


Figure 2a. Comparison between sweat-controlling activity of aluminum chlorohydrate and Al-HA-Zn.

Zinc possess also astringent properties but it mainly exhibits adsorbing properties, it blocks volatile molecules (e.g. Volatile Fatty Acids, VFA) produced by bacterial metabolism of sweat and sebum, which are responsible for unpleasant odor (**Fig. 3a**). Moreover zinc exerts bacteriostatic properties, it reduces bacterial activity and proliferation, thus decreasing the production of volatile compounds. Finally it has a high skin tolerability. Release of zinc from Al-HA-Zn is also self-regulating. Indeed zinc reacts with fatty acids produced by bacteria to form non-volatile compounds. Therefore the more the production of fatty acids acidifying the sweat, the greater the amount of zinc released from Al-HA-Zn (**Fig. 3b**). This means that the more the odor produced, the greater the deodorizing effect of Al-HA-Zn.

Compared to aluminum chlorohydrates, Aluminum-Zinc-Hydroxyapatite (Al-HA-Zn) does not generate HCl, therefore does not cause skin irritation (**Fig. 2a**). Moreover, due to the sweat acidic pH (4-6), it gradually solubilizes, thus determining a controlled release and a lower subsequent systemic absorption of aluminum and thus, a long-lasting sweat-controlling effect. Unlike chlorohydrates Al-HA-Zn does not produce any irritant side-product on skin. When more sweat is produced and pH becomes acidic again, Al-HA-Zn solubility increases (**Fig. 2b**). Therefore the more the sweat produced, the greater the sweat-controlling effect of Al-HA-Zn. This self-regulating system allows to decrease product applications, to generate a long-lasting sweat-controlling effect and to reduce aluminum systemic absorption.

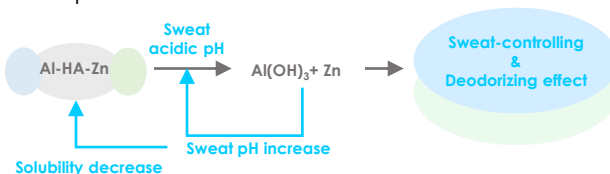
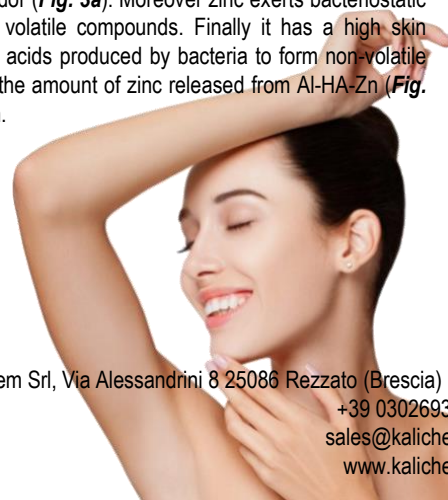


Figure 2b. Aluminum self-regulating release from Al-HA-Zn.





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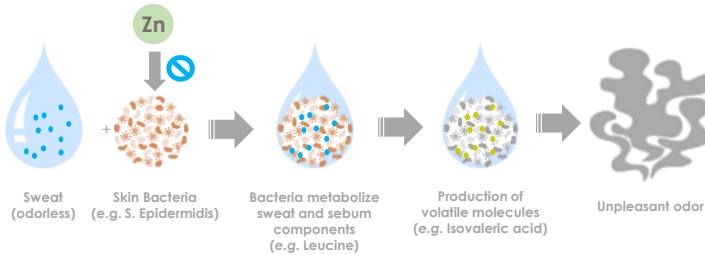


Figure 3a. Zinc deodorizing activity.

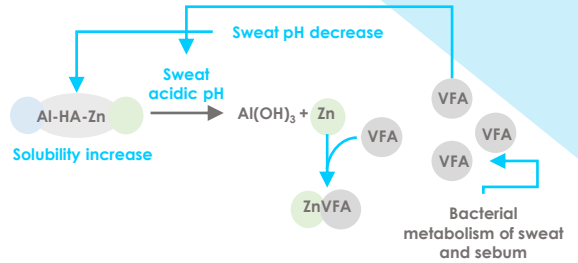


Figure 3b. Zinc self-regulating release from Al-HA-Zn.

In order to give to **DEOAP** a rapid deodorizing activity, Zinc PCA (zinc salt of pyrrolidone carboxylic acid) was added. Moreover Zinc PCA significantly improves skin quality. Since it contains zinc, it forms non-volatile compounds by reacting with short-chain fatty acids responsible for unpleasant odors, exerts bacteriostatic activity on skin microorganisms producing volatile molecules and reduces the secretion of sebum (the main source of volatile fatty acids); moreover PCA not only increases the bioavailability of zinc, but it also represents a natural moisturizing factor. Indeed PCA participates to skin hydro-lipidic film formation. Zinc possesses bacteriostatic but not bactericidal properties; it reduces bacterial activity and proliferation without erasing bacteria, thus respecting skin microbiota. For aluminum chlorohydrate instead, more than bacteriostatic activity, "In vitro assays demonstrated highly bactericidal activity on microorganisms comprising the resident axillary skin flora" (Hölzle et al.). Hydroxyapatite is not only a carrier and a delivery system for aluminum and zinc, but also a physiological mineral ingredient (main component of bones and teeth), biomimetic and safe (it does not cause allergies and irritations). It considerably improves skin appearance and elasticity and moreover contributes to odors reduction due to its adsorbent surface.

• **GRAVIMETRIC TEST**

A gravimetric *in vivo* test was carried out on 16 volunteers and performed with 1 application/day for 4 days of a test formulation containing Al-HA-Zn. Half of the test subjects applied the test formulation under the left axilla and the placebo control formulation under the right axilla, leaving the remaining test subjects to be assigned oppositely. The amount of sweat produced at 40°C was collected on pre-weighed adsorbent pads.

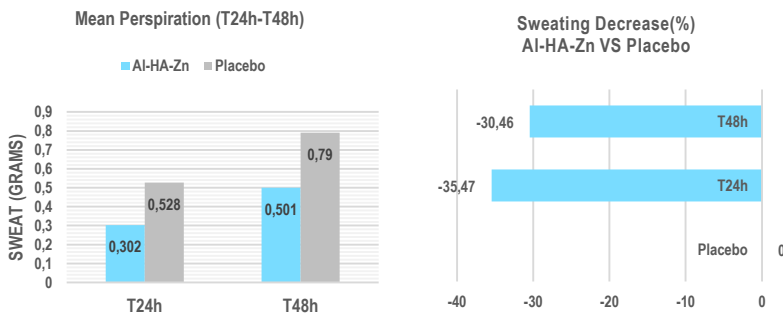


Figure 4. In vivo sweat-limiting efficacy of a cosmetic formulation containing Al-HA-Zn VS a placebo formulation, evaluated at 24 and 48 hours.

Statistical analysis demonstrated the sweat-limiting efficacy (both at 24 and 48 hours) of Al-HA-Zn: the reduction in sweating exceeded 20% in at least 50% of the target population.

• **OTHER TESTS**

In vivo and *in vitro* tests showed that Zinc PCA is able to reduce sebum production (the main source of volatile molecules) and to inhibit bacterial proliferation of different microorganisms causing unpleasant odors.

Tests on volunteers showed that hydroxyapatite not only acts as a delivery system to allow a controlled release of aluminum and zinc, but it also improves skin texture and elasticity (in 4 weeks, Fig. 5).

DEOAP is more effective and performing compared to a classic sweat-controlling ingredient. It guarantees high sweat-limiting efficacy without skin irritation, aluminum and zinc controlled release with low systemic absorption, bacteriostatic, adsorbent and sebum regulating activity (reducing odors production), skin improvement, due to its biocompatible functional substances, and definitely, high skin tolerability. Moreover it is produced through a green and sustainable process (Ecoscale Score>90%).

DEOAP represents the first effective skin-friendly, long-acting, non-irritant, sweat-controlling deodorant.

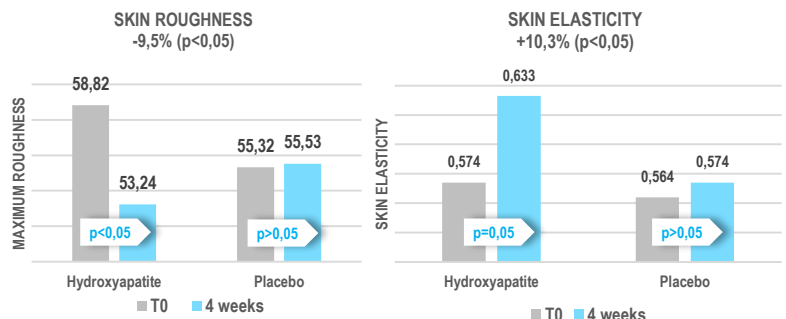
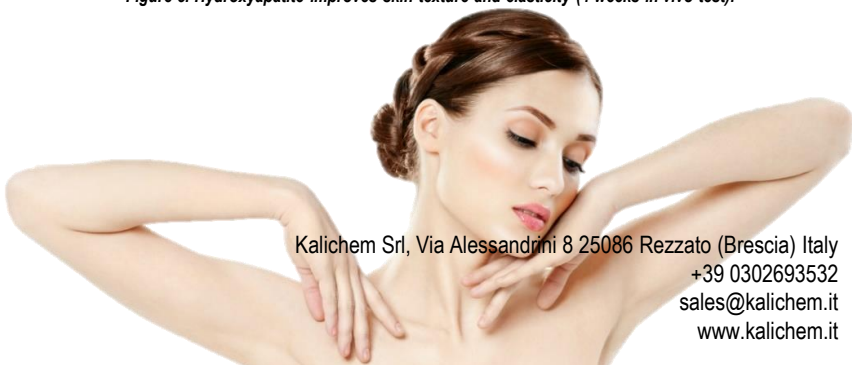


Figure 5. Hydroxyapatite improves skin texture and elasticity (4 weeks in vivo test).



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