

# PGA ( $\gamma$ -polyglutamic acid) and hyaluronic acid – comparative study of natural moisturizers

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## Introduction

Proper hydration is essential to maintain various skin functions including protection, elasticity and plasticity. For years, the most popular among hydrating substances was the well-known hyaluronic acid due to its hygroscopic properties. Today we find that a similar action is demonstrated by the  $\gamma$ -PGA, perhaps even surpassing hyaluronic acid properties.  $\gamma$ -PGA is a polypeptide in which glutamate is polymerized via  $\gamma$ -amide linkages. It occurs naturally in aquatic organisms living in a highly saline environment, such as jellyfish, protecting them against water loss.

$\gamma$ -PGA is biotechnologically obtained through the bio-synthesis of L-glutamic acid, using probiotic organisms. It is soluble in water, biodegradable and biocompatible with the skin.  $\gamma$ -PGA was placed in a physiological carrier system made of mesoporous calcium phosphate. When applied on the skin,  $\gamma$ -PGA increases the amount of two main components of Natural Moisture Factor-pyrolidonecarboxylic acid and lactic acid. Thus, it acts as a natural moisturizer with hygroscopic and moisturizing effects comparable with Hyaluronic acid (HA).

The aim of this work was to evaluate moisturizing potential of PGA *in vitro* as well as its efficacy after skin application in volunteers with dry skin. We also compared differences in water capacity between PGA and HA samples.

## Methods

Water binding capacity was assessed by weighing the raw materials (PGA and two forms of HA) and controlling their weight over time. Samples were incubated in 70% RH and 32°C. Wilcoxon test  $p < 0,05$ .

Comparison of moisturizing properties between PGA and HA was evaluated after one application of 3% PGA and 3% HA creams,  $n=5$ .

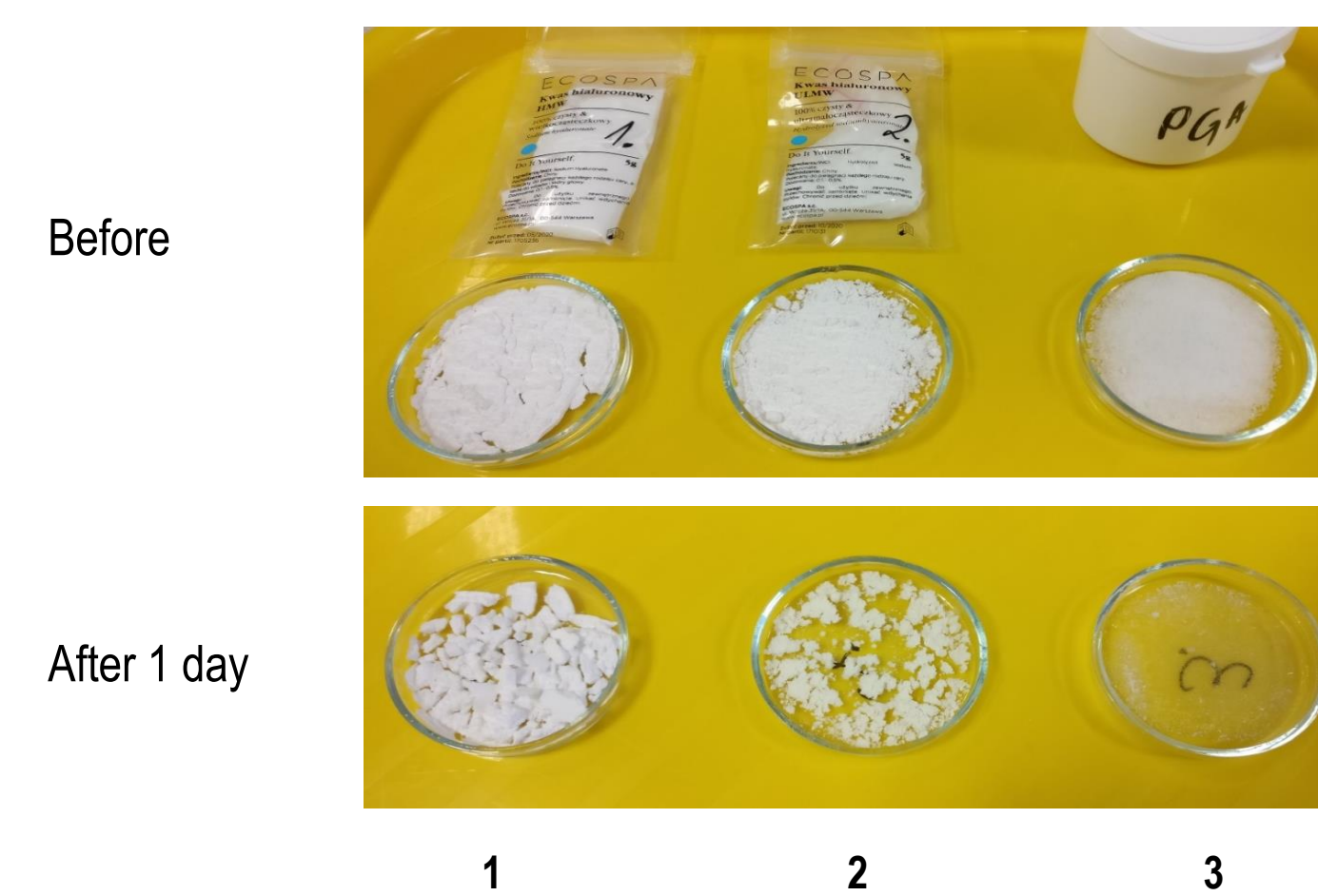
For *in vivo* study 30 female volunteers with dry skin aged 32 to 62 years were included. All volunteers applied the 3% PGA cream on face area, twice a day for 3 weeks. Measurements were taken before and after the treatment. Changes in hydration (Corneometer, MoistureMap MM100), elasticity (Cutometer), skin smoothness (Visioscan) and the number and size of wrinkles (Visia) were evaluated. In addition, a subjective analysis was performed based on survey data.

## Conclusion

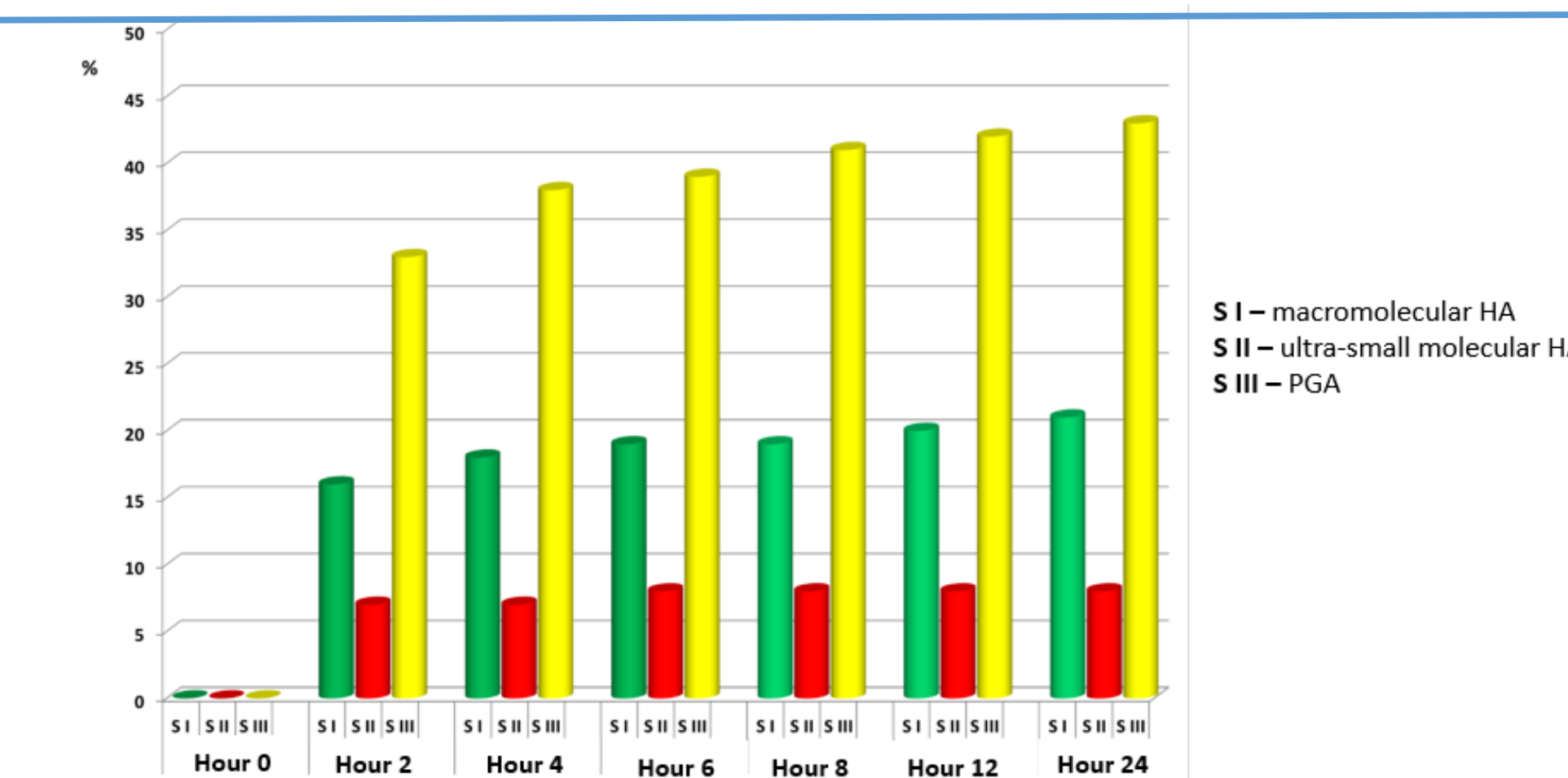
According to the results  $\gamma$ -polyglutamic acid is a new promising moisturizing component. It stimulates production of natural NMF building substances, as well as intercellular cement lipids. It moisturizes for a long time, improves skin firmness and elasticity by retaining water in the deeper layers of the skin.  $\gamma$ -PGA is effective, safe and may in the future become a substitute for hyaluronic acid.

## Results

### In Vitro – PGA vs HA

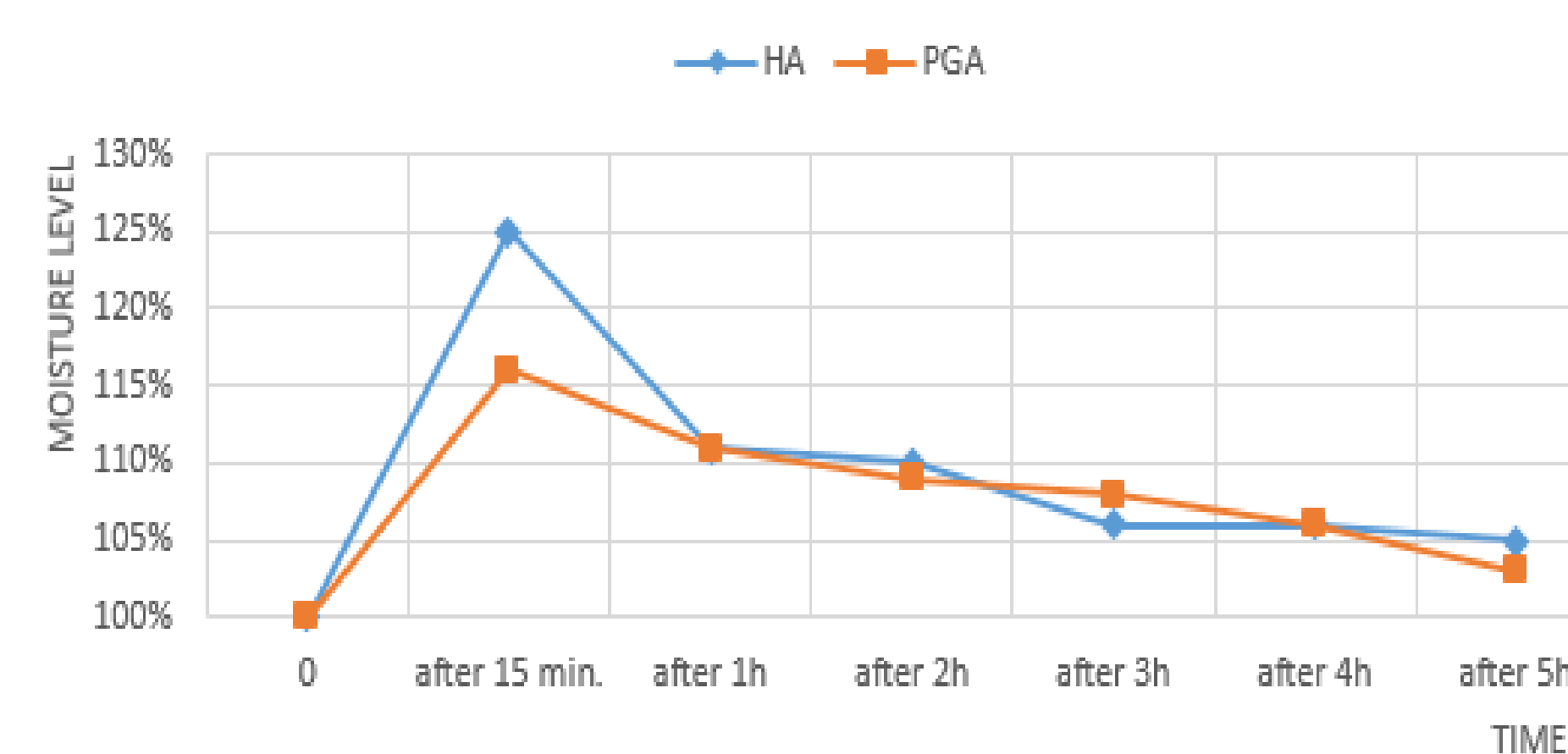


**Figure 1.** The appearance of raw materials before and after 24 hours in 32°C, 70% RH. 1- macromolecular hyaluronic acid, 2- ultra-small molecular hyaluronic acid, 3- polyglutamic acid. The picture shows that PGA had higher water binding capacity than HA.

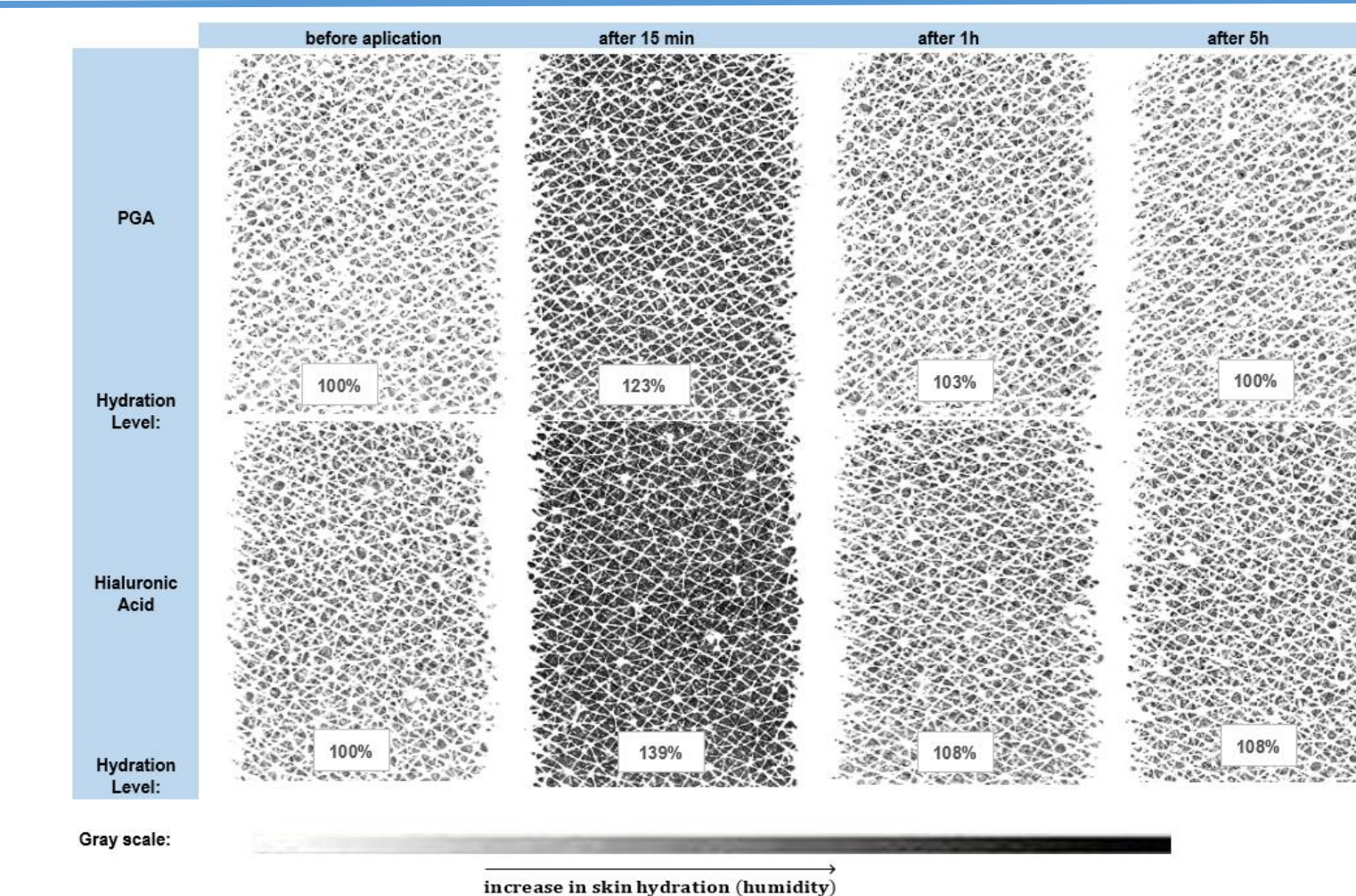


**Figure 2.** Graph of change in the mass of raw materials. An *in vitro* study showed more than 5 times higher water-binding capacity of PGA compared to ultra-small molecular HA and more than 2 times compared to macromolecular HA after 4 hours.

### In Vivo – PGA vs HA efficacy

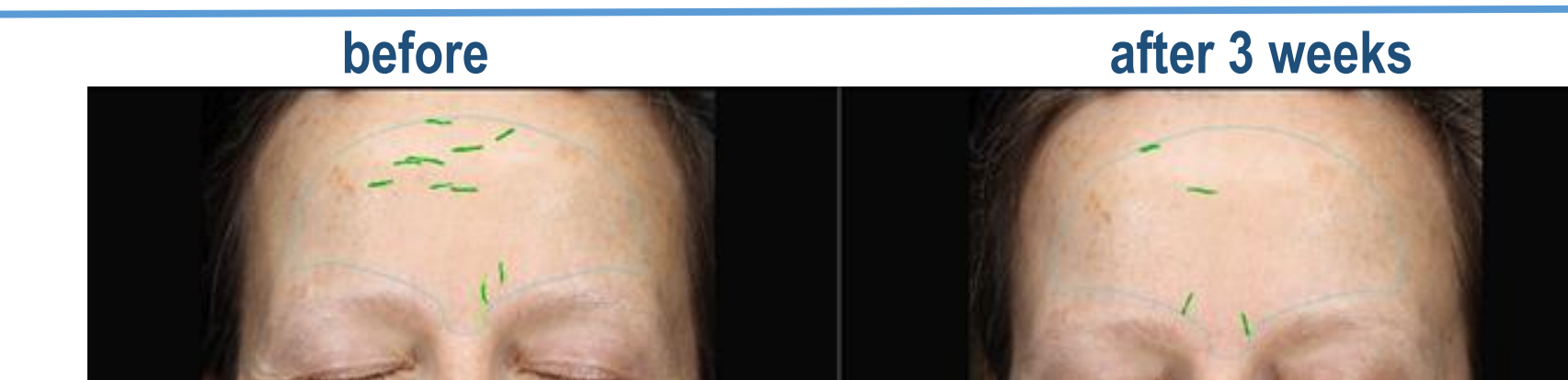


**Figure 3.** Graph of moisture changes over time after HA and PGA cream usage. After a single creams application ( $n=5$ ) we proved comparable moisturizing properties of PGA and HA. We also confirmed long-lasting skin moisturizing effect of PGA similar to hyaluronic acid.

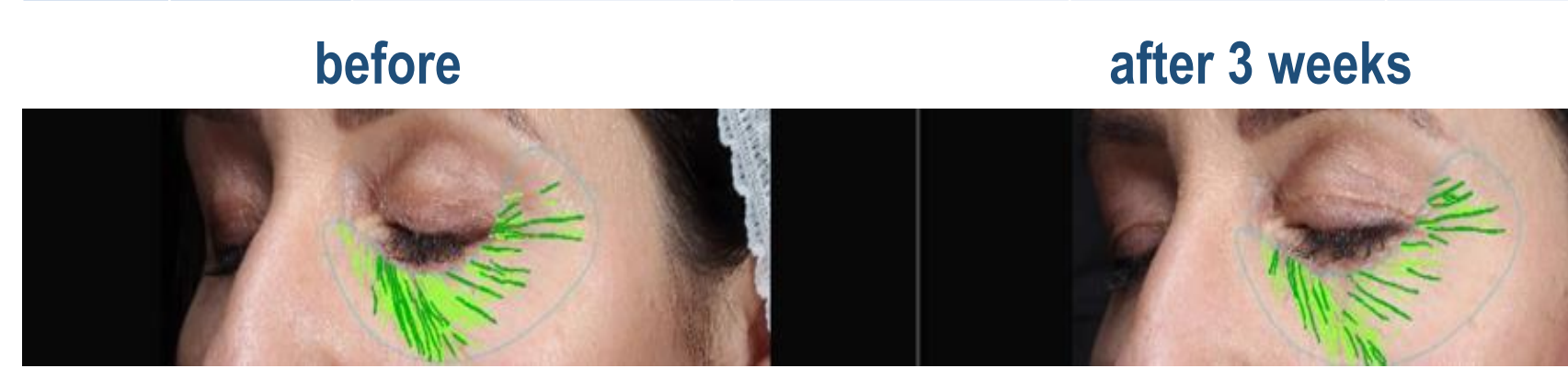


**Figure 5.** Skin hydration level after a single application of cream with 3% HA and 3% PGA. Darker coloration indicates higher skin hydration. The study proved that hyaluronic acid hydrates the stratum corneum slightly more than polyglutamic acid (15 min. after usage) due to its skin surface water binding activity.

### In Vivo – PGA efficacy

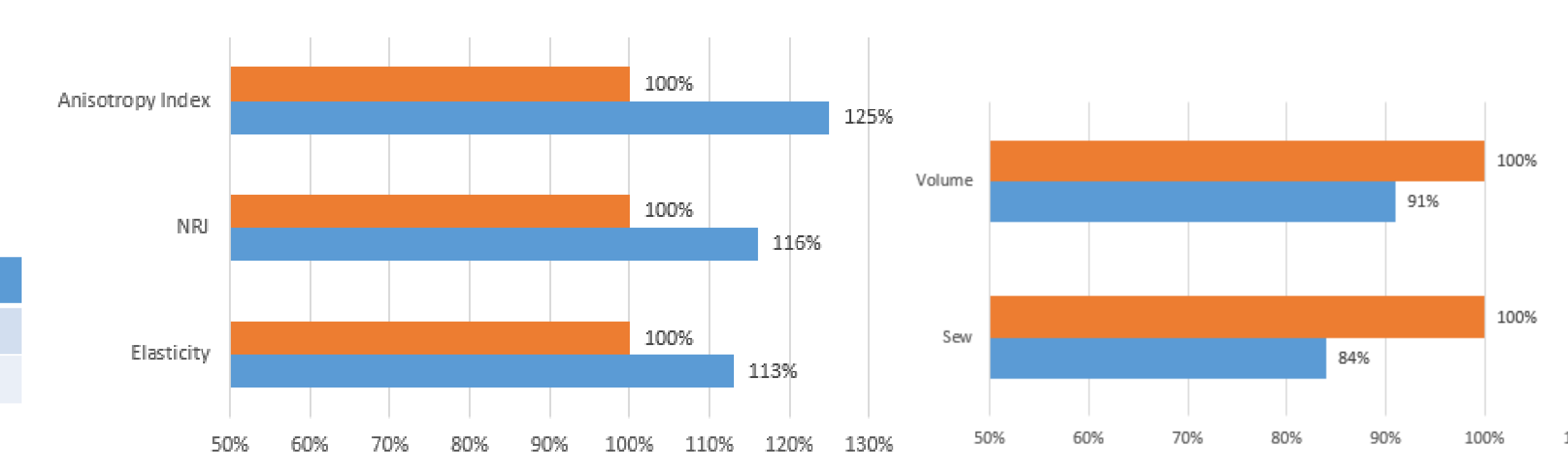


ID	age	wrinkles	before	after	reduction
kc	50	Number	47,0	35,0	-26%
		Size	22,71	15,20	-33%



ID	age	wrinkles	before	after	reduction
aw	46	Number	57,5	44,0	-23%
		Size	24,239	16,683	-31%

**Figure 4.** Best cases report of wrinkles reduction evaluated by Visia System after 3 weeks of 3% PGA cream application. Reduction in the number of wrinkles by up to 26% and their size by up to 33% were noticed. In addition, the average reduction in visibility of wrinkles by 21% in 55% of respondents was observed.



**Figure 6.** Results of instrumental analysis after 3 weeks of 3% PGA cream usage. Orange colour - before, blue colour - after 3 weeks of test. Improvement in Anisotropy Index (appearance of the skin structure in difference planes), NRJ (general skin condition) and elasticity was noticed by 25%, 16% and 13%, respectively. Reduction in Volume (size and number of cavities and wrinkles) and Sew parameter number of wrinkles) was observed by 9% and 16%, respectively.

Self-evaluation revealed that 80% of respondents felt their skin was intensively moisturized (increase in skin hydration by 71% in a 5-point analogue scale) and 83% of volunteers observed reduction of skin tightening. 93% testers noticed skin comfort restoration, 87% - improvement of skin elasticity and 73% - reduction of fine lines and wrinkles.