Gamma Poly Glutamic Acid
PGA

Baby-skin start from PGA

Shandong Freda Biotechnology Co., Ltd.
Add: No. 888 Xinluo Street, High-tech Development Zone,
Jinan, China
P.C.: 250101
Tel: +86-531-81213308
Fax: +86-531-81213113
E-mail: mfreda@fredabiotech.com
http://www.fredabiotech.com

Overseas Sales:
Tel: 86-531-81213307
Fax: 86-531-81213113
E-mail: sales@fredabiotech.com

Domestic Sales:
Tel: 86-531-81213070
Fax: 86-531-81213113
E-mail: marketing@fredabiotech.com
http://www.fredabiotech.com

SHANDONG FREDA BIOTECHNOLOGY CO., LTD.
About us

Shandong Freda Biotechnology Co., Ltd is a high-tech biotechnological joint venture co-founded by Shandong Freda Pharmaceutical Group Corporation, Shandong Business Group and Shandong High-tech Investment Co., Ltd. With R & D platform of Shandong Pharmaceutical Academy, Freda is committed to research, manufacture and sales of the biological raw materials and bio-engineering products for food, cosmetics, medicine and agriculture industries.

Freda has a modern production base that covers an area of over 36 acres in Linyi, China. At this base, production is carried out with up-to-date equipment for fermentation, biochemical extraction and purification in GMP workshops. Cutting-edge detecting equipment as well as strict QC system ensure that all the products produced meet the international standards.

As the largest manufacturer of Gamma-poly-glutamic-acid in China, Freda has developed the PGA production technique by microbial fermentation. Up till now, Freda can provide cosmetics, food, pharmaceutical and agricultural grades of gamma-poly-glutamic acid for various applications and customers from different industries.

Gamma-poly-glutamic Acid

First recognized in Japanese food “Natto” (Fig.1), gamma-poly-glutamic acid (γ-PGA) is a natural multifunctional biopolymer produced with Bacillus Subtilis by fermentation. Gamma PGA is a water soluble homo-polyamide. It consists of D-and L-glutamic acid monomers which are connected by amide linkages between α-amino and γ-carboxyl groups (Fig.2). Freda has two series of cosmetics grade PGA products - the high molecule (HM) PGA (700-1000 k Da) and the low molecule (LM) PGA (70-100 k Da).

The large number of carboxyl groups along the molecule chain of gamma PGA can form hydrogen bonding in a molecule or between different molecules. Thus it has high water absorbability and moisture-retaining capability. Thanks to its unique properties, Gamma PGA can be used as thickener, filmogen, humectant, retarder, cosolvent, binder and anti-freezer, therefore the application prospect of gamma PGA is promising.

Efficacy of Gamma PGA in Cosmetics

- Long-lasting moisturization
  - Possessing high moisturizing capability, much better than Hyaluronic acid and Collagen
  - Keeping moisture of skin for longer time
  - Restoring skin elasticity and smoothing wrinkles

- Synergy effect
  - Stabilizing and increasing HA of skin
  - Increasing NMF of skin
  - Increasing nutrients absorption of skin

- Inhibiting melanin biosynthesis

Multi-functional skin-care ingredient.
Long-lasting Moisturization

With strong moisturizing ability, the side chain of gamma PGA can enhance the moisturizing capability of skin without breaking moisture balance of skin. When integrated into skin-care products, gamma PGA can strengthen the moisturizing ability of skin and prevent skin from drying.

The compound of gamma PGA (HM) and gamma PGA (LM) has better moisturizing efficacy. Gamma PGA (HM) can form a protective film on the surface of skin to prevent loss of moisture. Meanwhile, gamma PGA (LM) can nourish skin to deep layer by locking more moisture and nutrients. As shown in Fig. 4, adding 3% of compound gamma PGA HM and LM at a ratio of 1:1 can enhance the the moisturizing effect and synergistically improve the effect of active ingredients in facial cream. Fig. 5 shows gamma PGA (HM) can effectively improve skin humidity and elasticity.

Synergy Effect

Moisture is a key factor to keep the skin healthy. Gamma PGA can not only efficiently increase the moisture of skin but participate in the metabolic activity of skin to improve the health condition of skin.

Increasing and Maintaining HA of Skin

As a basic component of skin, Hyaluronic Acid (HA) can lock the moisture of the skin and maintain its elasticity, but HA can hydrolyzed very quickly by hyaluronidase (HAase) of skin as well. Gamma PGA can increase and maintain the content of HA. Fig. 6 illustrates how gamma PGA inhibits the activity of HAase and increases and maintains HA in skin. Especially, gamma PGA (LM) can effectively inhibit the HAase in skin. The HA content is remarkably increased for the higher concentration of gamma PGA (LM). It shows that gamma PGA (LM) and HA can improve skin moisture, elasticity and skin appearance in a synergistic manner.
Effectively Increasing NMF in Inner Skin

As a hygroscopic material produced by skin, Natural Moisturizing Factor (NMF) provides moisture for skin in cuticle. The NMF including amino acids which are hydrolyzed from skin matrix protein (e.g. Filament aggregating protein), pyrrolidone carboxylic acid (PCA), lactic acid and urocanic acid (UCA) can retain moisture of skin. Fig. 8 illustrates how PGA (LM) increases the production of NMF which further enhances the internal moisturizing ability of skin.

![Fig. 8 PGA increase the N.M.F and enhances the skin internal moisturizing ability](image)

Gamma PGA is the only effective ingredient that is known till now to induce the production of NMF to 130% of the normal level. Gamma PGA can lock the moisture in inner skin by promoting the growth of fibroblast and increasing the content of NMF in horn cells. Fig. 9 shows how gamma PGA

![Fig. 9 Comparison of PGA, HA and Collagen in effect on N.M.F](image)

Improving Nutrient Supply

Thanks to its controlled release property, gamma PGA can control the release of nutrients and moisture in a continuous manner. Each gamma PGA monomer has ionized groups like α-COOR, -CO and -NH, which can absorb electropositive nutrients (see Fig. 10). Hence a good embedding delivery system is created and active ingredients in cosmetics can possibly maximize their efficacy.

Gamma PGA can also whiten skin by controlling melanin synthesis to prevent and reduce freckles. Ultraviolet irradiation is the main incentive of tyrosinase, which in turn induces the formation of Melanin. Table 1 illustrates the inhibition effect of gamma PGA, Kojic acid and Vc on tyrosinase. As it shows, gamma PGA, either HM gamma PGA (0.5%) or LM gamma PGA (0.5%) can effectively inhibit the formation of melanin. Meanwhile, gamma PGA can form a film upon surface of skin which fences out ultraviolet.

![Table1 Effect of PGA on the Inhibition on Melanin Biosynthesis](image)
Comparison of the effectiveness of PGA, HA and Collagen in cosmetics

<table>
<thead>
<tr>
<th></th>
<th>PGA</th>
<th>HA</th>
<th>Collagen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>Bio-fermentation (G+)</td>
<td>Bio-fermentation (G-)</td>
<td>animal</td>
</tr>
<tr>
<td>Accessory</td>
<td>no endotoxin</td>
<td>with endotoxin</td>
<td>animal allergen</td>
</tr>
<tr>
<td>pH, Thermo-stability</td>
<td>most stable</td>
<td>stable</td>
<td>fair</td>
</tr>
<tr>
<td>Touching feeling</td>
<td>Smooth, soft not oily</td>
<td>slightly stick</td>
<td>slightly stick</td>
</tr>
<tr>
<td>TEWL</td>
<td>→</td>
<td>→</td>
<td>→</td>
</tr>
<tr>
<td>Elasticity</td>
<td>+++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Inducing the skin's (N.M.F)</td>
<td>+++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Long-Lasting Moisturize</td>
<td>+++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>Conclusion</td>
<td>Best moisturizer Synergistic effects</td>
<td>Good</td>
<td>Common</td>
</tr>
</tbody>
</table>

As a multifunctional skin-care ingredient, gamma PGA can moisturize and whiten skin and improve skin health. It builds gentle and tender skin and restore skin cells, facilitates exfoliation of old keratin, clears stagnant melanin and gives birth to white and translucent skin.

Safety Concern

Freda cosmetics grade gamma PGA meets USP/NF standards, with TPC ≤100cfu/g, Staphylococcus aureus tested negative and yeast and mold ≤100cfu/g. It is suitable for all kinds of cosmetics and personal care applications with no safety concern.

Applications of Gamma PGA in Skin-care Products

Gamma PGA has excellent compatibility in non-ionic, anionic and amphoteric surfactants. It is a perfect ingredient for cream, essence, astringent, face mask, eye gel, sun cream, shampoo, body wash, lotion, hairstyle formula and so on.

Table 2 Evaluation of cosmetics and personal care formula containing PGA

<table>
<thead>
<tr>
<th>Item</th>
<th>Essence with 0.5% PGA</th>
<th>Lotion with 1% PGA</th>
<th>Body Wash with 0.8% PGA</th>
<th>Soap with 1% PGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing Smoothness</td>
<td>13/15</td>
<td>5/15</td>
<td>10/10</td>
<td>2/10</td>
</tr>
<tr>
<td>Increasing Elasticity</td>
<td>10/15</td>
<td>5/15</td>
<td>7/10</td>
<td>2/10</td>
</tr>
<tr>
<td>Whitening Effect</td>
<td>5/15</td>
<td>1/15</td>
<td>4/10</td>
<td>0/10</td>
</tr>
<tr>
<td>Irritative</td>
<td>0/15</td>
<td>3/15</td>
<td>0/10</td>
<td>0/10</td>
</tr>
</tbody>
</table>

Notes: 13/15 is number of person positively reacted/number of person tested

Flexibility in Formula

Gamma PGA is an ideal moisturizer with high compatibility with other cosmetics materials. Dosage of the material depends on the function of the skin-care products. Generally suggested dosage of gamma PGA (HM) is 5%. Gamma PGA (HM) is more suitable for anti-wrinkle, UV-preventing and moisturizing strengthening products, suggested dosage is 1%-1%. Gamma PGA (LM) is better for facial masks and whitening products thanks to its nutrition transdermal absorption and melanin inhibition effect, and the suggested dosage is 3%.
Leading the Trend of the Future

Sales of skin-care products are expected to steadily grow throughout the rest of the decade. Meanwhile skin-care products are being produced with more sophisticated techniques and more customized ingredients. Today’s market is shaped by two important trends: the one of natural products and the one of products with increasingly sophisticated formulation. So the products satisfying both trends will take the vantage point in the future.

Gamma PGA is not only a moisturizing agent but an ideal skin filler for anti-wrinkle application. It will also be a promising ingredient for plastic surgeries for its safe and reliable effects.

As a polyelectrolyte of Na+ and Ca2+ and each building unit of the polyelectrolyte containing a negative charge, gamma PGA is not only a perfect material for beauty industry but a healthy and natural ingredient for health-care industry.

Freda has been certified by ISO9001, ISO22000, Kosher and HALAL. Freda products have been exported to South Korea, Turkey, South Africa, Brazil, USA, EU etc.

In the spirit of “Innovative Technology, Health Pilot”, Freda will actively rise to challenges ahead in the market, provide differentiated technical solutions and establish long-term and win-win partnership with clients from across the world.

Marketing of Freda Gamma PGA around the World